

**PRELIMINARY STUDIES ON THE PHYTOCHEMISTRY AND  
BIOLOGICAL ACTIVITY OF  
*ACANTHOPHORA SPICIFERA* (M. Vahl) Borgesen**

**Dissertation submitted in partial fulfilment of the requirements  
for the award of the degree of Master of Science in Botany**

**By**

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**ERNAKULAM**

**2022**

# CERTIFICATE

This is to certify that the dissertation entitled "**Preliminary Studies on the Phytochemistry and Biological Activity of *Acanthophora spicifera* (M. Vahl) Borgesen**" is an authentic record of work carried out by Miss Anjana Ajayan K (AM20BOT004) under the supervision and guidance of Smt. I. K. Nishitha Assistant Professor, The Department of Botany and Centre for Research, St. Teresa's College (Autonomous), Ernakulam, in the partial fulfilment of the requirement of the M.Sc. Degree of Mahatma Gandhi University, Kottayam. I, further certify that no part of the work embodied in this dissertation work has been submitted for the award of any other degree or diploma.



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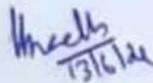
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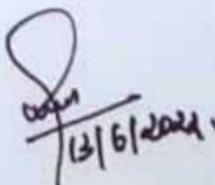


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## DECLARATION

I hereby declare that the project entitled "**Preliminary Studies on the Phytochemistry and Biological Activity of *Acanthophora spicifera* (M. Vahl) Borgesen**" submitted to Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirement for the Degree of Master of Science in Botany is an original project done by me under the supervision and guidance of Ms. I. K. Nishitha, The Department of Botany and Centre for Research, St. Teresa's college (Autonomous), Ernakulam.

PLACE: ERNAKULAM

DATE: 24/05/2022

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## ACKNOWLEDGEMENT

I extend my sincere gratitude and indebtedness to Smt. I. K. Nishitha, Assistant Professor, The Department of Botany, St. Teresa's College (Autonomous), Ernakulam for her valuable guidance and inspiration throughout the period of this work.

I also acknowledge my sincere thanks to all my beloved teachers of the Botany Department for their encouragement and support.

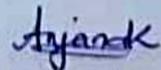
My sincere thanks to the non-Teaching staff for their assistance throughout the course of my work.

I am extremely grateful to my beloved parents and friends for their kindness, support and whole hearted encouragement which was guiding light for me throughout my project.

Above all, I thank God Almighty for his Blessing which Enlightened me throughout the course of the dissertation.

Place: Ernakulam

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## CONTENT

<b>Sl. No</b>	<b>CHAPTER</b>	<b>PAGE NO.</b>
1.	<b>INTRODUCTION</b>	1-9
2.	<b>REVIEW OF LITERATURE</b>	10-14
3.	<b>MATERIALS AND METHODS</b>	14-18
4.	<b>OBSERVATION AND RESULT</b>	19-31
5.	<b>DISCUSSION</b>	32-34
6.	<b>SUMMARY AND CONCLUSION</b>	35-36
7.	<b>REFERENCES</b>	37-41

## INTRODUCTION

Algae are diverse group of relatively simple, chlorophyll containing, photo-autotrophic and oxygen evolving aquatic thalloid (without differentiation into True roots, stems, leaves or leaf like organs) organisms. The word “algae” has its origin from Latin, where ‘alga’ means seaweed. The term algae was first used by Carolous Linnaeus in 1753.

Pond scums, seaweeds, freshwater and marine phytoplankton etc are different algal forms. They are principal photo synthesizers in the globe and control our atmosphere in several ways. Their role in environment is enormous (Barsanti & Gualtieri, 2006; Graham *et al.*, 2009). Marine algae from Indian coasts amounting to 844 species are distributed among 217 genera. They grow in the intertidal, shallow and deep-sea areas up to 180meter depth and also in estuaries, backwaters and lagoons on solid substrates such as rocks, dead corals, pebbles, shells, mangroves and other plant materials (Anatharaman *et al.*, 2007; Sakthivel, 2007). Although seaweeds have been utilized in traditional and folk medicine for a long time their use in modern medicine has been realized only after 1950 (Lincoln *et al.*, 1991).

The term "seaweed" refers to a variety of marine plants and algae that can be found in the ocean, rivers, lakes, and other bodies of water. Some seaweeds, such as phytoplankton, are small and remain floating in the water column, providing the foundation for most aquatic food chains. Some are massive, such as the giant kelp that grow in dense forests. The large percentage are medium-sized, with red, green, brown, and black colours, and sometimes may wash up on beaches and shorelines. (Guiry, Michael D, 2014). Mostly seen seaweeds are macro algae. Seaweeds are classified as Green algae (Chlorophyta), Brown algae (Phaeophyta), Red algae (Rhodophyta) and some filamentous Blue-green algae (Cyanobacteria). Most of the seaweeds are red (6000 species) and the rest known are brown (2000 species) or green (1200 species). They differ significantly in many ultrastructural and biochemical functions, including photosynthetic pigments, storage molecules, cell wall composition, presence/absence of flagella, mitosis ultrastructure, linkage between cells, and structure of the chloroplasts, in addition to pigmentation.

Algae are found in both marine and freshwater habitats. Algae are relatively undifferentiated organisms which, unlike plants, have no true roots, leaves, flowers or seeds. As these organisms have a short doubling time, they are considered among fastest growing creatures. They have

different pathways to fix atmospheric carbon dioxide and to efficiently utilize the nutrients to convert it into biomass. In recent years, focus towards these organisms has increased due to their food and fuel production capability. In fuel industry algae biofuels have emerged as a clean, nature friendly, cost-effective solution to other fuels. More recently algae have been identified and developed as renewable fuel sources, and the cultivation of algal biomass for various products is transitioning to commercial-scale systems. Large-scale cultivation of algae merges the fundamental aspects of traditional agricultural farming and aquaculture (Emily M Trentacoste *et al.*, 2014). Algae fuels are categorized into bio-ethanol, biogas, bio-hydrogen, biodiesel and bio-oil. Algae can be used in the preparation of Biodiesel, Bioethanol, Biobutanol and Hydrogen gas (Raja *et al.*, 2013).

Algae have been in use as human food for centuries in various parts of the world. Algae are taken in several ways according to the choice and taste of the people. Their nutritional value is quite high, as they contain a good amount of proteins, carbohydrates, fats and vitamins, especially A, B, C and E. Not only are algae considered worldwide to be a low-cost source of protein, but it also contains a number of important minerals such as iron, potassium, magnesium, calcium, manganese, and zinc. Commonly used species are -Chlorophyta–Chlorella, Ulva lactuca (Sea lettuce). The large Brown and Red algae are used as organic fertilizers, especially on land close to the sea. Many forms of marine algae, Phaeophyta and Rhodophyta, are highly valuable for certain commercial products, chiefly agar-agar, algin or alginic acid and carrageenin. The important use of agar is in microbiology and tissue culture (in the preparation of culture media for growing algae, fungi and bacteria in the laboratories). Other uses are in the cosmetics, paper and silk industries, etc. *Digenia simplex*, a red alga, provides an antihelminthic drug. Agar-agar, for its absorptive and lubricating action, is used medicinally in the prevention of constipation. The antibacterial product chlorellin, obtained from *Chlorella* is well known and is used against coliforms and other related intestinal bacteria. Algae are important sources of vitamins, minerals, proteins, fatty acids etc (Pulz & Gross, 2004).

Rhodophyta is a phylum of macroalgae that includes the classes Phaeophyceae and Chlorophyta, which are brown and green seaweeds, respectively. The Red algae are one of the oldest groups of eukaryotic algae, and also one of the largest, with about 5,000–6,000 species of mostly multicellular, marine algae, including many notable seaweeds.

Within Archaeplastida, Rhodophyta, or red algae, is a monophyletic lineage that contains glaucophyte algae, green algae, and terrestrial plants. Bangia-like species have been found in 1.2-billion-year-old strata, indicating that Rhodophyta has a lengthy fossil history. The morphology of red algae ranges from unicellular filamentous to multicellular thalloid forms, with certain species producing economically important products like agar and carrageenan. These species can be found in a variety of marine settings, ranging from the intertidal zone to deep oceans. There are also freshwater (e.g., *Batrachospermum*) and terrestrial lineages. A triphasic life cycle with one haploid and two diploid phases, with the carposporophyte borne on female gametophytes, is one of the Rhodophyta's significant advances.

Freshwater Rhodophyta has 66 species and 27 genera in North America, although these numbers will change as molecular investigations uncover more diversity. Freshwater red algae have a limited size range than marine species, with the majority (80%) of them measuring 1-10 cm in length. Gelatinous filaments, free filaments, and pseudoparenchymatous forms are the most prevalent types (Yoon, Hwan Su, *et al.*, 2017).

*Acanthophora* is a genus of marine red algae. There are 26 species (and infraspecific) names in the Algae Base database at present, of which 7 have been flagged as currently accepted taxonomically. It can be found in almost all tropical and subtropical oceans. Because of its changeable form, it can adapt to a wide range of environmental circumstances and hence invade a wide range of ecosystems. *Acanthophora* is an erect macroalgae that may reach a height of 40cm. It has solid cylindrical branches that are 2-3mm diameter and are rarely or repeatedly branched. Short, determinate branches, irregularly shaped and spinose, with spines numerous and radially oriented, make up the major branches. The major axes have no spines. A big, oddly shaped holdfast gives rise to the plant. It has short (4 - 10cm), compact, and dense thalli in intertidal high-motion water areas. It comes in a wide range of colours, including red, purple, yellow, orange, and brown. Thalli are typically quite black in intertidal, high-motion locations, and lighter in shallow areas with low water motion and reflective sandy or silty bottoms.

*Acanthophora spicifera* is seaweed that grows in upright clumps of spiny branches, 1-2 mm in diameter. It can be pale yellow, brownish, dark green, or reddish (often dark green in intertidal areas and high wave motion areas). This species grows on the reef in intertidal, lagoon and reef flat habitats, or it can be free-floating. In intertidal high-motion water areas, *Acanthophora spicifera*

has short (4 - 10 cm), compact and very dense thalli. In moderate or low water motion areas, the thalli are tall (10 - 25 cm), more openly branched and occur in scattered clumps. *Acanthophora spicifera* is abundant on calm, shallow reef flats, tidepools, and on rocky intertidal benches. This alga usually attaches to hard substrates, such as rocks, basalt ledges, or dead coral heads. It may also be found free-floating, due to its brittle, easily-broken nature. Colour is highly variable, can be shades of red, purple, yellow, orange, or brown. Are often very dark in colour in intertidal, high motion areas. Usually, lighter colour in shallow areas with low water motion and reflective sandy or silty bottoms. This alga's plastic morphology has allowed it to adapt to different conditions and invade a diversity of habitats. The brittle nature of the branches often results in fragmentation, which contributes to frequent, large free-floating populations and widespread distribution.

*Acanthophora spicifera*, native to Florida and the Caribbean, is a cultivated human food source high in nutrients (Kaliaperumal, 1986, Lin & Fong 2008, Russel 1992). It is however, one of the most invasive algal species and poses threats to native species in the reef (Weijerman et al., 2008, Williams 2007). *Acanthophora spicifera* has a nearly continuous distribution in all the tropical and subtropical seas of the world (Doty, M, 1961).

It possesses antitumor, antioxidant activity, and the beneficial effect due to the presence of bioactive components such as flavonoids, terpenoids, and tannins (Yamamoto I, Maruyama H, 1985). Abundant halogenated compounds are the most frequently reported metabolites from the red algae (Faulkner, DJ., 2001). The findings revealed that an ethanol extract of *Acanthophora* has antitumor and anti-oxidant activity, which may be due to the presence of bioactive components such as flavonoids, terpenoids, and tannins (Lavakumar, K. F. H. Ahamed, and V. Ravichandran, 2012).

Infectious diseases are one of the main causes of high morbidity and mortality in human beings around the world, especially in developing countries (Waldvogel, 2004). Antibiotic resistance in bacteria and fungi is one of the major emerging health care related problems in the world, it became a greater problem of giving treatment against resistant pathogenic bacteria. Decreased efficiency and resistance of pathogen to antibiotics has necessitated the development of new alternatives (Smith et al., 1994; Ireland, 1988). Aquatic organisms are a rich source of structurally novel and biologically active compounds (Ely et al., 2004). Secondary or primary metabolites produced by these organisms may be potential bioactive compounds of interest in the pharmaceutical industry

(Febles et al., 1995). Algae have wide span of ecosystems contributes to the innumerable chemical compounds that they are able to synthesize. A number of antimicrobial compounds have been identified in microalgae as well as macroalgae (De Marsac and Houmard, 1993). A large number of microalgal extracts and or extracellular products have been proven antibacterial, antifungal, antiprotozoal and antiplasmodial activity (Mayer and Hamann, 2005; Cardozo et al., 2007). Harder (1917) was the first to note seaweed's antimicrobial properties. Bactericidal compounds have been discovered in a variety of algal organisms (Glombitza, 1980; Banerjee *et al.*, 2009).

Marine algae were reported to produce a wide variety of bioactive secondary metabolites as antimicrobial, antifeedant, antihelmintic and cytotoxic agents and the bioactive substances included alkaloids, polyketides, cyclic peptide, polysaccharide, phlorotannins, diterpenoids, sterols, quinones, lipids and glycerols (Cabrita et al., 2010) and marine macro-algae are considered as the actual producers of some bioactive compounds with high activity (Shimizu, 1996). Seaweeds are a powerful group of secondary metabolites with a wide range of structures. These bioactive compounds provide resistance to herbivores, fouling species, and pathogens as well as reproduction, UV defence and allopathic agent resistance (Hay, 1996). The marine habitat of India has diverse seaweeds, spread through inter-tidal and deep-water regions of the Indian coast. Marine algae (Seaweeds) are a group of marine multicellular algae, plentiful in minerals, vitamins, and polysaccharides. They are considered as a potential source of bioactive substances such as proteins, lipids, and polyphenols possessing potent antibacterial, anticancer, antioxidant, antifungal, and antiviral properties (Sundaramurthy A *et al.*, 2016).

Decreasing efficiency and resistance of pathogens to antimicrobial drugs made the search of a new antimicrobial agent an important strategy for the establishment of alternative therapies in difficult handling infections, eg: *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* that causes diseases like diarrhoea, mastitis and upper respiratory complications. In recent years, multiple resistance has developed in human pathogenic microorganisms due to the indiscriminate use of antibiotic drugs for the treatment of common infectious diseases. The undesirable side effects of certain antibiotics and the emergence of previously uncommon infections have forced scientists into looking for new antibiotic substances from various sources like marine macroalgae. Macroalgae serve as an important source of bioactive natural substances (Smit, 2004). Many

metabolites isolated from macroalgae have been shown to possess bioactive effects (Faulkner, 2002).

Natural products from marine algae have attracted the attention of biologists and chemists the world over for the last five decades. Many of these compounds are used to treat diseases like cancer, acquired immune-deficiency syndrome, inflammation, pain, arthritis, as well as viral, bacterial, and fungal infections. The marine red alga showed the phytochemical constituents like phenols, alkaloids, saponins, flavonoids and steroids. Red algae and their extracts have been studied as novel sources of variety of compounds and reported for their biological activity for potential medicinal use. Red algae are the source of amino acids, terpenoids, phlorotannins, steroids, phenolic compounds, halogenated ketones and alkanes, cyclic polysulphides, fatty acids, acrylic acid. These compounds probably have diverse simultaneous functions for the seaweeds and can act as allelopathic, antimicrobial, antifouling, and herbivore deterrents, or as ultraviolet-screening agents. They are also used by the pharmaceutical industry in drug development to treat diseases like cancer, acquired immune-deficiency syndrome (AIDS), inflammation, pain, arthritis, infection for virus, bacteria and fungus (Deig E F *et al.*, 1974).

Phenolic compounds are commonly found in brown, green, red seaweeds, whose antioxidant properties have been correlated to their phenolic contents. Recently, a number of studies have been reported on the phytochemistry of plants across the world. Saponins are considered as a key ingredient in traditional Chinese medicine and are responsible for most of the observed biological effects. Saponins are known to produce inhibitory effect on inflammation. Flavonoids in human diet may reduce the risk of various cancers, as well as preventing menopausal symptoms. Its potent water-soluble antioxidants and free radical scavengers prevent oxidative cell damage and have strong anti-cancer activity. They show anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activity (Cushnie and Lamb, 2005). Flavonoids are largest group of polyphenolic compounds and are known to contain a broad spectrum of chemicals and biological activities including antioxidant and free radical scavenging properties. They are remarkable group of plant metabolites. Flavonoids are perhaps best known to enhance the effects of ascorbic acid. The secondary metabolites of seaweeds have always attracted the interest of biochemists because of their diversity as compared with those present in the leaves of higher plants. Isoprenoids (terpenes, carotenoids, steroids), polyketides (Phlorotannins), amino-acid-derived natural products

(alkaloids), and shikimates (flavonoids) are the major groups of secondary metabolites found in algae.

Antioxidant compounds play an important role in various fields such as medical field (to treat cancers, cardiovascular disorders, and chronic inflammations), cosmetics (anti- ageing process), food industries (food preservative) and others (Kohen R; Nyska A, 2002). Over the years, the search for new antioxidant compounds from natural products has mounted. This is due to health concerns regarding the potential toxic and side effects generated from synthetic antioxidants, as well as changes in consumer preferences for natural products. As algae are photosynthetic organisms, they produced free radicals and other oxidative reagents when they are exposed to high oxygen concentrations and light. It is considered because of absence of structural damage that these organisms are able to generate the necessary compounds to protect themselves against oxidation. Hence, algae are a potent antioxidant compounds that could also be suitable for protecting our bodies against the damaging effect of reactive oxygen species produced as a result of normal metabolism of the body.

Many commercialized synthetic antioxidants, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are used under strict regulation in certain countries because of their potential health hazards. Thus, the search for alternative antioxidants from natural products has increased and among them, aquatic plants have gained the focus. Seaweeds or marine macroalgae have been known as rich sources of various natural antioxidants. Compounds such as polyphenols, catechin, flavonols, flavonol glycosides, and phlorotannins have been discovered from methanol extract of red and brown algae. The uniqueness of their molecular skeleton and structures has contributed to the strong antioxidant activity. Polyphenols for instant uses its phenol rings as electron traps for free radicals.

Much previous research has studied the biological effects of natural marine products, including their antioxidant, antibacterial, anti-malarial, antiviral, anti-inflammatory and cytotoxic activities (Skropeta D, 2008). However, only a few studies have examined the biological potential of the marine algae (seaweeds). Diverse antioxidants found in seaweeds such as polysaccharides, dietary fibres, minerals, proteins, amino acids, vitamins, polyphenols, and carotenoids have been recorded by several scientists. Seaweeds contain a remarkable range of potential novel antioxidants that help in counteracting the environmental pressures.

Natural antioxidants are superior to synthetic antioxidants since they are free of environmental contaminants and perform a wide range of beneficial functions. Such additives are secure to be used in medicines, nutritional supplements, nutraceuticals, including cosmetics to enhance consumer wellbeing, lessen the impact of infectious diseases, besides other wider forms of immune system function. Natural antioxidants are superior to synthetic antioxidants because they do never include chemical pollutants and have a wide range of benefits. These are safe for use as ingredients in medicine, dietary supplements, nutraceuticals, and cosmetics with the objective of improving customer health, reducing the effects of harmful diseases, and other broader aspects of immune system function (Shahidi, 2009). Many marine organisms develop biochemical pathways in relation to environmental stresses such as space competition, maintaining unfolded surfaces, avoiding predation, and the ability to reproduce successfully. Seaweeds contain powerful group of secondary metabolites with a wide range of structures. These bioactive compounds provide resistance to herbivores, fouling species, and pathogens as well as reproduction, UV defence and allopathic agent resistance (Hay, 1996). The most powerful water-soluble antioxidants found in algae are polyphenols, phycobiliproteins and vitamins (Plaza M *et al.*, 2008). Oxidative processes promote carcinogenesis. The antioxidants may be able to cause the regression of premalignant lesions and inhibit their development into cancer. It is found that, several algal species have prevented oxidative damage by scavenging free radicals and active oxygen and hence able to prevent cancer cell formation (Richardson JS,1993). These antioxidants are considered key compounds to fight against various diseases (e.g.cancer, chronic inflammation, atherosclerosis and cardiovascular disorder) and ageing processes (Kohen R and Nyska A, 2002).

The current project aimed at studying the phytochemical and pharmacological potentials of the red alga *Acanthophora spicifera* available in the Kerala coast.

**Objectives of the study:**

- Taxonomic description of the algae *Acanthophora spicifera*.
- Qualitative phytochemical evaluation of the algae.
- Assessment of anti-bacterial potential of *A. spicifera* in its dried form extracted in two different solvents, ethanol and chloroform against gram-positive *Staphylococcus* and gram-negative *E. coli*.
- Assessment of anti-oxidant potential of *A. spicifera* in its dried form extracted in ethanol and chloroform, using the ferric reducing power assay.
- Estimate the extractive value of the alga in ethanol and chloroform.

## REVIEW OF LITERATURE

Marine macroalgae are an important renewable resource of bioactive compounds useful for healthy food and alternative medications capable of regulator diseases or multi-resistant strains of pathogenic microorganisms (Perez *et al.*, 2016).

Nurul Aili Zakaria *et al.*, (2011) adopted Soxhlet extraction method for the extraction of *Acanthophora spicifera* for the assessment of antioxidant activity, total phenolic content and in-vitro toxicity. 20 g of powdered algal sample contained in a Whatman No.1 filter paper thimble was placed into an extraction chamber. The extraction chamber was then connected to a flask containing 200 ml organic solvent with increasing polarity; hexane, ethyl acetate, chloroform and methanol, subsequently (1:10, w/v). Constant heat source was supplied for this procedure (40-50°C). All the extracts were concentrated under reduced pressure using a rotary evaporator and left air dried in a fume cupboard to obtain paste extract. The dried paste extracts were then stored at 4 °C for further bioassay (Nurul Aili Zakaria *et al.*, 2011).

Phytochemicals are chemicals produced by plants through secondary metabolism. They generally have biological activities in the plant host and play a role in plant growth or defense against predators, pathogens or competitors. They are commonly found in fruits, vegetables, nuts, legumes, and grains. Phytochemicals include all plant compounds both plant chemicals that are beneficial and those that are toxic. Some phytochemicals possess incredible health benefits while others are toxic to health (Leitzmann K, 2016). Secondary constituents are the remaining plant chemicals such as alkaloids, terpenes, flavonoids, lignins, plant steroids, curcumines, saponins, phenolics, flavonoids and glucosides. Phenolics have been reported to be the most abundant and structurally diverse plant phytochemicals. Marine algae are a rich source of bioactive secondary metabolites, including phenols and polyphenols (Andrade *et al.*, 2016). Flavonoids are perhaps best known to enhance the effects of ascorbic acid (Yasantha A *et al.*, 2007).

Isaiah Nirmal Kumar *et al.*, (2014) determined total phenolic assay by using Folin Ciocalteu assay. Zhishen J *et al.*, (1999) and Isaiah Nirmal Kumar *et al.*, (2014) used aluminum chloride calorimetric assay for measuring total flavonoid content of selected seaweeds from Okha coast.

Harder (1917) was the first to note seaweed's antimicrobial properties. Bactericidal compounds have been discovered in a variety of algal organisms (Glombitza, 1979; Banerjee *et al.*, 2009). The antibacterial activity of extracts or components from various algae has been demonstrated in vitro against both gram-positive and gram-negative bacteria. The antibacterial susceptibility test was performed using the agar disc diffusion method, with 6 mm discs impregnated with 20 µl of extracts and placed in infected agar. The antimicrobial activity of seaweeds, including *Gracilaria corticata*, *Acanthophora spicifera* extracts was studied by ethanolic solvents against antimicrobial activity of *Staphylococcus aureus*, *Bacillus thuringiensis*, *Pseudomonas* and *Klebsiella* human pathogens (Ahilya Vitthal Waghmode *et al.*, 2021). Antimicrobial activity was measured using ELISA microplate reader.

A number of antimicrobial compounds have been identified in microalgae as well as macroalgae (De Marsac and Houmard, 1993). Antimicrobial activity was evaluated using the disc diffusion technique in petri dishes (NCCLS, 1993). Briefly, sterile filter paper discs, 6 mm in diameter were loaded with 25  $\mu$ L of the different antibacterial compound extracts and were air dried. Discs containing standard concentration of ciprofloxacin for bacteria and amphotericin B for fungi were used as control. The discs were placed on Muller Hinton agar plates (Chowdhury *et al.*, 2015). Ethanolic and methanolic extracts of *Acanthophora spicifera* performed a good antimicrobial activity but chloroform extract was not good enough (Chowdhury *et al.*, 2015).

Krishnapriya *et al.*, (2013) conducted an antibacterial activity on the seaweed extracts, carried out by agar disc diffusion assay. The Muller Hinton agar (MHA) medium was used for this study using bacterial pathogens. Among the solvent extracts, methanol extract showed best results for both positive and negative strains. Chloroform extract of *G. verrucosa* gave the highest zone of inhibition measuring  $21 \pm 1.0$  mm. Ethanol extract of *G. acerosa* also showed a zone of inhibition of  $12 \pm 1.0$  mm. Ethanol and chloroform extracts of *G. verrucosa* gave clearly distinct zone of inhibition measuring  $8 \pm 1.0$  and  $9 \pm 1.0$  mm, with respect to control ( $25 \pm 1.0$  mm) against *Staphylococcus* (Varier, Krishnapriya Madhu, *et al.*, 2013).

The antibacterial properties of eight crude extracts of local *Acanthophora spicifera* obtained by two distinct extraction methods were investigated by Zakaria (2010) using soxhlet extraction and solvent partitioning. By using the Disc diffusion method, these extracts were evaluated in vitro against 18 bacteria, 3 yeasts, and 6 fungal strains. The results demonstrated that the solvent partitioning extracts of methanol and ethyl acetate had a greater spectrum of action against the tested bacterial strains. *Bacillus cereus* ATCC 10876, *Bacillus licheniformis* ATCC 12759, Methicilin Resistance *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* ATCC 27853, *Yersinia* sp., and *Citrobacter freundii* displayed inhibitory zones against these two extracts. While methanol extracts from Soxhlet extraction and butanol from solvent partitioning had no antibacterial activity against *P. aeruginosa* ATCC 27853, the other six extracts did (Zakaria 2010).

The antibacterial activity of five *gracilaria* species was determined in both gram positive and gram-negative bacteria. In the preliminary assay ten different organic solvents like Acetone, Butanol, Ethanol, Ethyl acetate, Isoamyl alcohol, Methanol and Propanol (polar) and Benzene, Chloroform and Hexane (non-polar) were evaluated (Prasad M. P., Shekhar Sushant, Rindhe Ganesh, 2012).

In a study done by Ibraheem et al. (2017), simplex extracts of *Acanthophora* showed potent inhibitory growth activities against three Gram positive bacteria [*Streptococcus agalactiae*, *pyogenes* and *Streptococcus sanguis* of inhibition ranging from [23.1±0.58 to 20.6±0.63 mm] and showed moderate activities with [*Corynebacterium diphtheriae*, *Bacillus subtilis* and *Staphylococcus aureus*] with inhibition zones ranging from [20.1±1.5 to 16.3±2.1 mm]. (Ibraheem et al.; 2017)

Also, the crude extracts were found to be more active than the positive control Ampicillin, (22.3±1.5 mm), against *Streptococcus agalactiae* which showing inhibition zone. The hydro alcoholic extracts of the selected species were investigated for their antimicrobial activities using Agar well diffusion and Muller Henton against gram positive and gram-negative bacteria.

In a study by Nurul Aili Zakaria et al. (2010), the antimicrobial activities of the hexane extract were evaluated using disc diffusion method against 8 Gram-negative and 10 Gram-positive bacterial strains. Out of all bacterial tested, only a Gram-positive bacterium and a Gram-negative bacterium were susceptible to the extracts. The hexane extract showed antibacterial activity against both Gram-positive bacterium and Gram-negative bacterium (*P. aeruginosa* ATCC 27853). While, chloroform and ethyl acetate extract only showed inhibitory effect on *P. aeruginosa* ATCC 27853 with inhibition zone of 9.0 mm. No inhibitory effect was showed by methanol extract on bacteria tested (Nurul Aili Zakaria et al.; 2010).

Antioxidants are compounds that protect human, animal and plant cells against the damaging effects of free radicals. Free radicals can be defined as any species containing one or more unpaired electrons in atomic or molecular orbitals and capable of independent existence (Halliwell, 2011). In recent times, marine algae have been gaining importance as sources of pharmacologically active constituents possessing antioxidant, antiproliferative, antimutagenic, antidiabetic, anticoagulant, antibacterial and antitumor activities (Smit AJ, 2004; Folmer F *et al.*, 2010). Exploration for bioactive compounds led to the screening of selected marine algae from the Tamil Nadu coast for antiproliferative and antioxidant activities (Murugan K & Iyer VV, 2013).

Ahilya Vitthal Waghmode *et al.*, (2021) determined antioxidant potential of various seaweed extracts using the DPPH and FRAP assay. The FRAP assay showed a highest antioxidant activity in methanolic extract of the green seaweed *Ulva*. The most FRAP activity was observed in U.

In a study done by Ibraheem et al. (2017), simplex extracts of *Acanthophora* showed potent inhibitory growth activities against three Gram positive bacteria [*Streptococcus agalactiae*, *pyogenes* and *Streptococcus sanguis* of inhibition ranging from [23.1±0.58 to 20.6±0.63 mm] and showed moderate activities with [*Corynebacterium diphtheriae*, *Bacillus subtilis* and *Staphylococcus aureus*] with inhibition zones ranging from [20.1±1.5 to 16.3±2.1 mm]. (Ibraheem et al.; 2017)

Also, the crude extracts were found to be more active than the positive control Ampicillin, (22.3±1.5 mm), against *Streptococcus agalactiae* which showing inhibition zone. The hydro alcoholic extracts of the selected species were investigated for their antimicrobial activities using Agar well diffusion and Muller Henton against gram positive and gram-negative bacteria.

In a study by Nurul Aili Zakaria et al. (2010), the antimicrobial activities of the hexane extract were evaluated using disc diffusion method against 8 Gram-negative and 10 Gram-positive bacterial strains. Out of all bacterial tested, only a Gram-positive bacterium and a Gram-negative bacterium were susceptible to the extracts. The hexane extract showed antibacterial activity against both Gram-positive bacterium and Gram-negative bacterium (*P. aeruginosa* ATCC 27853). While, chloroform and ethyl acetate extract only showed inhibitory effect on *P. aeruginosa* ATCC 27853 with inhibition zone of 9.0 mm. No inhibitory effect was showed by methanol extract on bacteria tested (Nurul Aili Zakaria et al.; 2010).

Antioxidants are compounds that protect human, animal and plant cells against the damaging effects of free radicals. Free radicals can be defined as any species containing one or more unpaired electrons in atomic or molecular orbitals and capable of independent existence (Halliwell, 2011). In recent times, marine algae have been gaining importance as sources of pharmacologically active constituents possessing antioxidant, antiproliferative, antimutagenic, antidiabetic, anticoagulant, antibacterial and antitumor activities (Smit AJ, 2004; Folmer F *et al.*, 2010). Exploration for bioactive compounds led to the screening of selected marine algae from the Tamil Nadu coast for antiproliferative and antioxidant activities (Murugan K & Iyer VV, 2013).

Ahilya Vitthal Waghmode *et al.*, (2021) determined antioxidant potential of various seaweed extracts using the DPPH and FRAP assay. The FRAP assay showed a highest antioxidant activity in methanolic extract of the green seaweed *Ulva*. The most FRAP activity was observed in U.

*lactuca* (81.80%) followed by *C. peltata* and *Batrachospermum*, while less activity was detected in *S. ilicifolium* (48.70%). The antioxidant activity pattern of methanolic solvents varied due to the presence of various compounds with different species. A high value of astaxanthin has been recorded in green alga, *Ulva intestinalis* (Banerjee *et al.*, 2009).

Dovi Kelman *et al.*, (2012) determined the total antioxidant activity of organic extracts of 37 algal samples, comprising of 30 species of Hawaiian algae from 27 different genera. The activity was determined by employing the FRAP (Ferric Reducing Antioxidant Power) assays. Different Hawaiian algae had widely varying antioxidant activities, ranging from  $0.13 \pm 0.07 \mu\text{M}/\mu\text{g}$  extract for *Ulva* sp., from Penguin Bank, off Molokai Island, to  $10.27 \pm 0.40 \mu\text{M}/\mu\text{g}$  extract for *Turbinaria ornata* from Waikoloa, Hawaii Island. Of the red algae tested, *Polysiphonia howei* exhibited the highest antioxidant activity. Other studies on *P. urceolata* and *P. morrowii* have shown their extracts to have antioxidant activity. In the current study, *P. howei* showed higher antioxidant activity than all tested species of *Laurencia* from the same order, Ceramiales. This observation is in accordance with previous studies, in which *Laurencia* spp., although a good source of biologically active secondary metabolites, do not exhibit high antioxidant activity.

## **MATERIALS AND METHODS**

### **SAMPLE COLLECTION**

The specimen was collected by hand picking from Thikkodi beach, Calicut. The collected samples were washed immediately in seawater and then washed with fresh water and transported to the laboratory. It was again washed thoroughly to remove impurities and sand and rinsed with distilled water. The sample was identified taxonomically as *Acanthophora spicifera*. Collected sample was taxonomically evaluated using the standard literature.

### **SAMPLE PREPARATION**

The cleaned samples were shade dried, cut into small pieces and powdered in a mixer grinder. The organic solvents chloroform and ethanol were used for the extraction process due to its higher efficiency using Soxhlet extraction method. 20g of samples were packed in a thimble and placed in the extractor. 200ml of the solvent was added into the flask and heated. The temperature was maintained at 800°C to 850°C throughout the extraction. The soluble active constituents of the extract remained in the flask and the process was repeated until the compounds were completely extracted. The liquid extract was then cooled and concentrated by using an evaporator.

The beaker with dried extract was weighed and noted. DMSO was used to dissolve the extracts from the beaker. Later the weight of the beaker alone was noted. Hence, the actual weight of the dried extract was obtained. Similarly, the weight of dried extract of *Acanthophora*, in Ethanol and Chloroform was 1.62g and 0.15g respectively. From this the extractive value was calculated using the formula

$$\text{Extractive value (\%)} = (\text{Weight of dried extract} / \text{Weight of plant material}) \times 100$$

### **PREPARATION OF EXTRACT IN VARIOUS CONCENTRATIONS**

From the stock extract, concentrations of 10%, 20%, 40%, 60% (v/v) was made. The stock concentration of *Gracilaria* in ethanol and chloroform was 10mg/ml and 10mg/ml respectively.

From the stock the appropriate amount was pipetted out and made up to the required concentrations using DMSO.

## **PHYTOCHEMICAL ANALYSIS**

### **Qualitative Analysis**

#### **Extract Preparation**

2g of shade dried plant material is taken in clean dry conical flask to it 20ml of the extracting solvent, ethanol, methanol and water was added and kept in the mechanical shaker for 24 hours. Then it was filtered using Whatman No 1 filter paper and made up to 50ml.

The following standard protocols were used for qualitative analysis of samples to check for the presence of Alkaloids, Cardiac glycosides, Flavonoids, Phenols, Saponins, Tannins and Terpenoids.

#### **Test for Flavonoids:**

2 ml of each extract was added with few drops of 20% sodium hydroxide, formation of intense yellow colour is observed. To this, few drops of 70% dilute hydrochloric acid were added and yellow colour was disappeared. Formation and disappearance of yellow colour indicates the presence of flavonoids in the sample extract.

#### **Test for Alkaloids:**

To 1ml of the extract 1ml of any one of the below reagent is added.

##### **Mayer's reagent:**

1.36g of  $\text{HgCl}_2$  was dissolved in 60ml distilled water (solution A ) and 5g of potassium iodide was dissolved in 10ml distilled water (solution B ) .Both solutions A and B were mixed and made upto 100ml.

##### **Dragendroff's reagent:**

8g Bismuth Sub Nitrite was dissolved in 20ml con.  $\text{HNO}_3$  to form solution A. 27g of potassium iodide was dissolved in 50ml of distilled water to form solution B. Both solution A and B were

mixed and allowed to stand when  $\text{KNO}_3$  precipitates out, supernatant was discarded and made up to 100ml with distilled water.

**Wagner's reagent:**

1027g of iodine and 2g potassium iodide were dissolved in 5ml distilled water. It was then made up to 100ml with distilled water.

Presence of precipitate in all three reagents confirms the presence of alkaloids

**Test for Saponins:**

To 2 ml of each extract, 6 ml of distilled water were added and shaken vigorously; formation of bubbles or persistent foam indicates the presence of saponins.

**Test for Tannins:**

To 2 ml of each extract, 10% of alcoholic ferric chloride was added; formation of brownish blue or black colour indicates the presence of tannins.

**Test for Phenols:**

To 2 ml of each extract, 2 ml of 5% aqueous ferric chloride were added; formation of blue colour indicates the presence of phenols in the sample extract.

**Test for Cardiac Glycosides:**

To 1 ml of each extract, 0.5ml of glacial acetic acid and 3 drops of 1% aqueous ferric chloride solution were added, formation of brown ring at the interface indicates the presence of cardiac glycosides in the sample extract.

**Test for Terpenoids:**

Take 1 ml of extract of each solvent and add 0.5 ml of chloroform followed by a few drops of concentrated sulphuric acid, formation of reddish-brown precipitate indicates the presence of terpenoids in the extract.

## **ANTIBACTERIAL ACTIVITY IN ACANTHOPHORA**

### **PREPARATION OF BACTERIAL CULTURE**

In the present study, the extracts were evaluated for antimicrobial activity against *Staphylococcus* strain and *E. Coli*, a Gram-positive and a Gram-negative bacterium respectively. 3g of nutrient broth was dissolved in 100ml of distilled water in a conical flask. The broth is sterilized by autoclaving for 15 minutes. Both of the obtained bacterial stains were inoculated in the nutrient broth in laminar air flow and incubated in appropriate conditions for 24hrs.

### **PREPARATION OF PETRI PLATES**

The selected species of seaweed were analysed for the antimicrobial activity for gram negative *Escherichia coli* and gram-positive *Staphylococcus* by disc diffusion methods. Agar medium was prepared by dissolving 4g agar and 2.6g of nutrient broth in 200ml distilled water. The mixture is sterilized in an autoclave for 15 minutes. Just after sterilization the mixture was poured into petri plates in laminar air flow. The petri plates were allowed to solidify under aseptic conditions.

### **ANTIMICROBIAL TEST BY DISC DIFFUSION METHOD**

Bacteria were inoculated onto the prepared agar petri plates using sterilized cotton swabs. Sterilized 6mm discs were taken from filter paper and autoclaved and is used for the method. The disc was then dipped in different concentrations of stock (10, 20, 40, 60) and placed on the agar plate using sterile forceps. Tetracycline was used as positive control and DMSO was used as negative control. This was done for both extracts of *Acanthophora* against the two strains of bacteria. The petri plates were incubated at 37°C for 24 hours and results were recorded.

### **ANTIOXIDANT ASSAY**

#### **Ferric reducing power assay**

The total antioxidant activity can be measured by the ferric reducing antioxidant power assay (FRAP). The flavonoids and phenolic acids present in the medicinal plant exhibit strong

antioxidant activity which is depending on their potential to form the complex with metal atoms, particularly iron and copper. This method is based on the principle of, increase in the absorbance of the reaction mixture, indicates an increase in antioxidant activity.

The antioxidant compound present in the samples forms a coloured complex with potassium ferricyanide, trichloroacetic acid and ferric chloride, which is measured at 700nm by UV-Spectrophotometer.

### **Reagent preparation**

0.2M Phosphate buffer: Dissolve 27.218g of  $\text{KH}_2\text{PO}_4$  in 1000ml distilled  $\text{H}_2\text{O}$

Potassium ferricyanide (1%): 1g of  $\text{K}_3\text{Fe}(\text{CN})_6$  was dissolved in 100ml distilled  $\text{H}_2\text{O}$

Trichloroacetic acid (10%): Dissolve 10ml of TCA was dissolved in 90ml distilled  $\text{H}_2\text{O}$

Ferric chloride (0.1%): 0.1g of  $\text{FeCl}_3$  was dissolved in 100ml distilled  $\text{H}_2\text{O}$

Ascorbic acid (0.1%): 1mg of Ascorbic acid was dissolved in 1ml of distilled  $\text{H}_2\text{O}$

### **Working procedure**

0.02g of the algal residue was dissolved in 30ml ethanol and used as the stock. Various concentrations of the extract were prepared by taking 2ml, 4ml, 6 ml, 8ml and 10ml of the stock and making up to 10ml using distilled  $\text{H}_2\text{O}$ . Then 1 ml from each dilution was pipetted out into separate test tubes. To this 2.5 ml of 0.2M sodium phosphate buffer and 2.5ml of 1%  $\text{K}_3\text{Fe}(\text{CN})_6$  solutions were added and the reaction mixture was incubated in a boiling water bath at 50o C for 20 minutes. Following this 2.5 ml of 10% trichloroacetic acid was added to the mixture and mixed. Then 2.5ml of solution was pipetted out from each reaction mix into separate test tubes, to which 2.5 ml of distilled water and 0.5ml of 0.1%  $\text{FeCl}_3$  were added. Solvent solution along with the above stated reagents, was used as control. The coloured solutions including control were read at 700nm with reference to standard using UV-Spectrophotometer to find the absorbance. Here, Ascorbic acid was used as a reference standard, the reducing power of the samples were comparable with the reference standard.

## OBSERVATION AND RESULT

The current work was undertaken as a preliminary study of the red seaweed *Acanthophora spicifera*. The scope of the study included the estimation of extractive value in two solvents, ethanol and chloroform and the anti-microbial and anti-oxidant potential of these extracts. The anti-microbial potential activity was studied against Gram positive *Staphylococcus* and Gram-negative *E. coli*, two non-pathogenic bacteria. The anti-oxidant activity was studied in various concentrations of the extract by carrying out the FRAP assay with ascorbic acid as the standard. The results obtained are described below.

### TAXONOMIC DESCRIPTION

Division: Rhodophyta

Class: Florideophyceae

Order: Ceramiales

Family: Rhodomelaceae

Genus: *Acanthophora*

Species: *spicifera*

*Acanthophora spicifera* (M. Vahl) Borgesen

Erect plants, 40 cm tall, with solid cylindrical branches, 2 - 3 mm wide, branched either sparingly to repeatedly, grows in upright clumps of spiny branches, 1-2 mm in diameter. The plant grows from a large, irregularly shaped holdfast. It can be pale yellow, brownish, dark green, or reddish. In intertidal high-motion water areas, *Acanthophora spicifera* has short (4 - 10 cm), compact and very dense thalli. In moderate or low water motion areas, the thalli are tall (10 - 25 cm), more openly branched and occur in scattered clumps.



*Acanthophora spicifera* (M.Vahl) Borgesen

## EXTRACTIVE VALUE

Extractive values of plant materials are used to evaluate extracts of the sample, in order to get an idea about the nature of chemical constituents present in it. It can also be used to assess quality, purity and detect adulteration of the extract.

In the present study, polar and non-polar solvents were used for eluting the valuable Phyto-compounds present in the sample. Extractive values of Ethanol and Chloroform extracts of *Acanthophora spicifera* used in the anti-bacterial study, are estimated in the table 1 given below;

**Table 1: Extractive value of solvents administered for *Acanthophora spicifera***

Solvent	Extractive value of the sample (%)
Ethanol	12.2
Chloroform	0.9

The extractive value was greater for the Ethanol extract than for Chloroform suggesting that polar solvent was more efficient in extracting the phytochemicals from the algae.

**Fig 1: Experimental setup for extraction:**



Soxhlet Apparatus

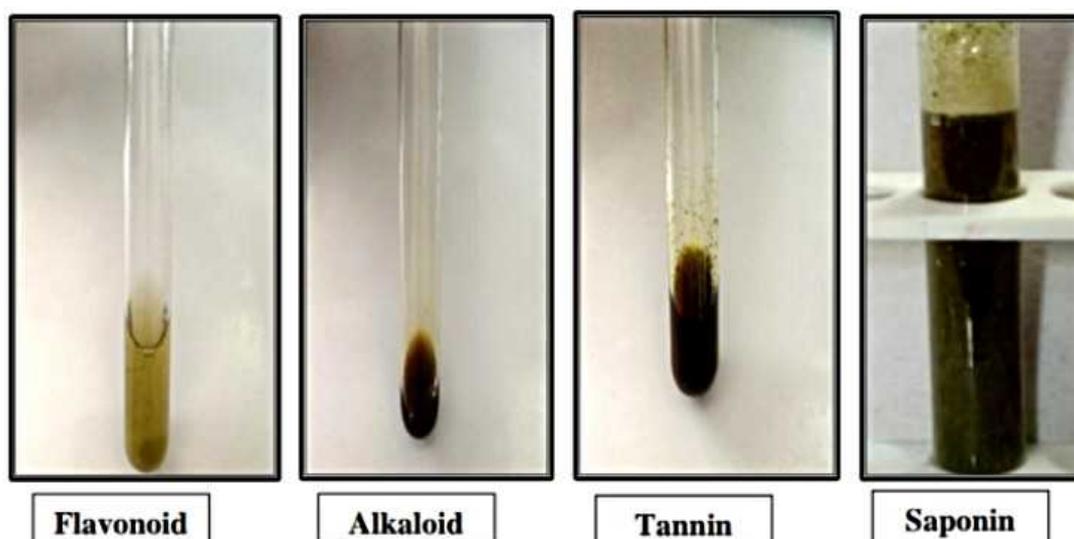
## PHYTOCHEMICAL ANALYSIS

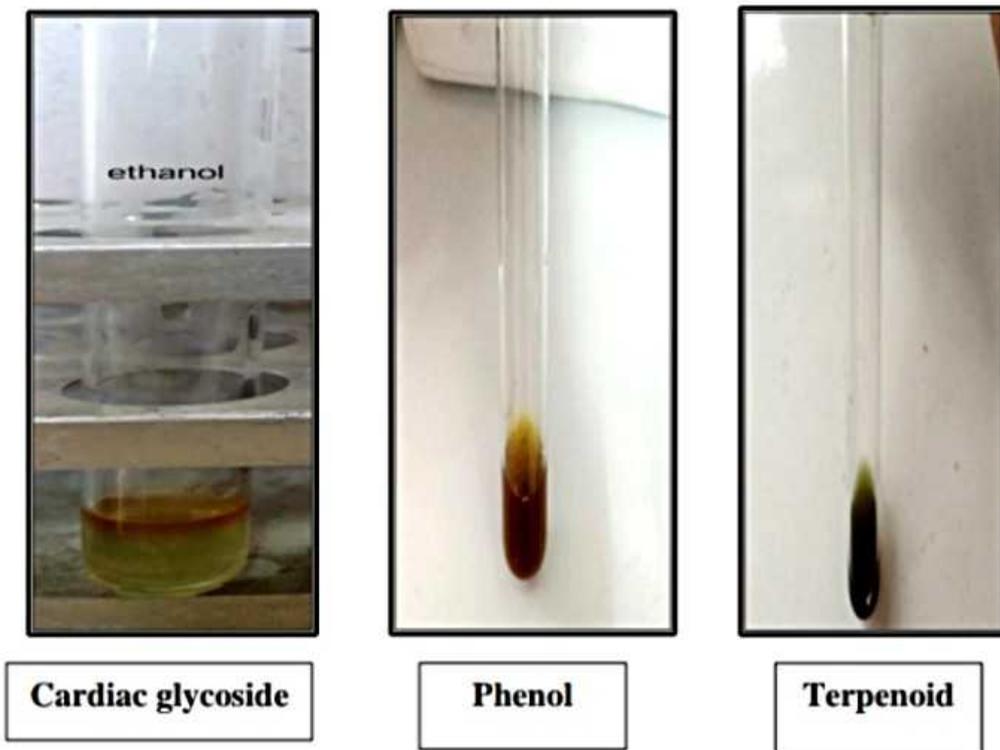
Preliminary qualitative tests clearly revealed the presence of Flavonoids, Alkaloids, Tannins, Saponins, Cardiac glycosides and Phenolic compounds. There was no presence of Terpenoid in the test algae. The test algae were proved to be a good source of bioactive components i.e. flavonoids, alkaloids, tannins, saponins, cardiac glycosides and phenolic compounds.

**Table No 2: Phytochemical constituents of *Acanthophora spicifera***

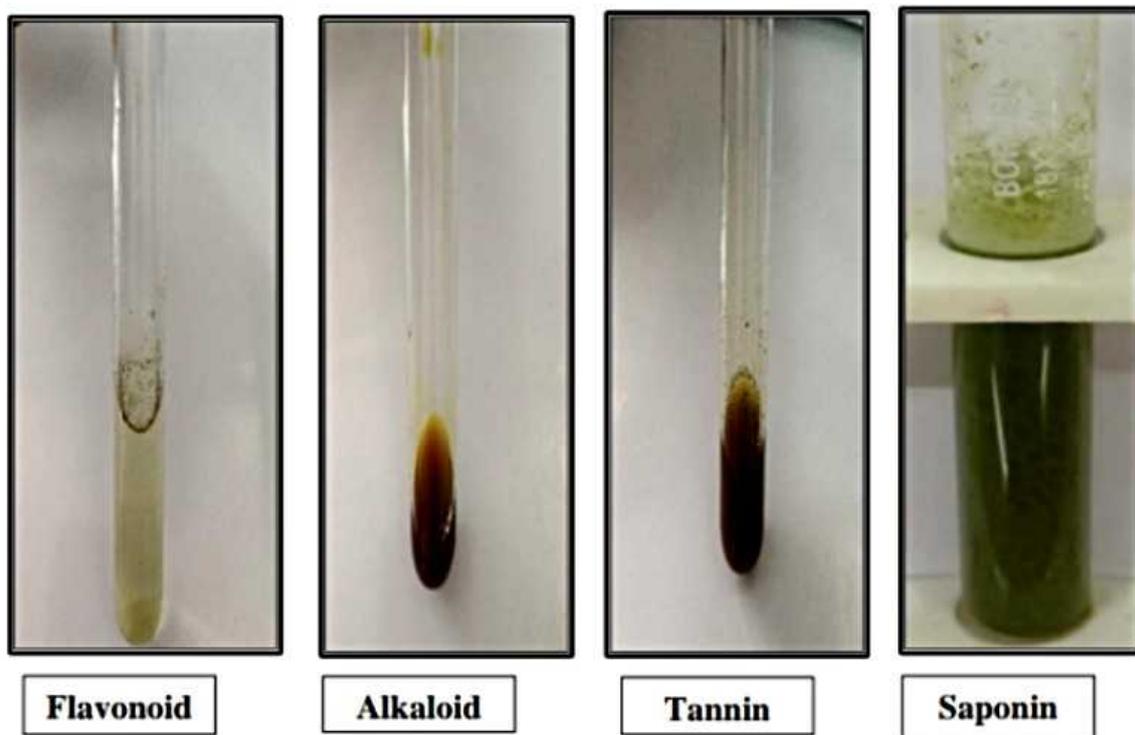
Content	Ethanol extract	Chloroform extract
Flavonoid	++	++
Alkaloid	++	++
Tannin	++	++
Saponin	++	++
Cardiac glycosides	++	++
Phenol	--	--
Terpenoid	--	--

**Figure 2: showing phytochemical activity of *Acanthophora* in Ethanol extract:**





**Figure 3: showing Phytochemical activity of *Acanthophora* in Chloroform extract:**

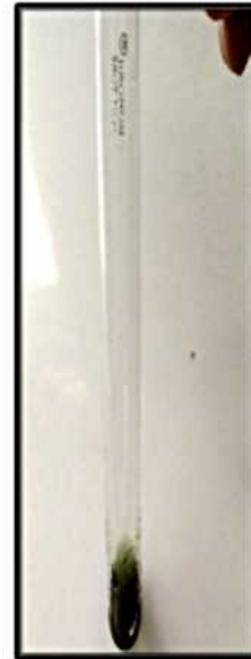




**Cardiac glycoside**



**Phenol**



**Terpenoid**

## **ANTIBACTERIAL ACTIVITY**

The anti-bacterial activity of *Acanthophora* was determined both in gram-positive and gram-negative bacteria. The extracts of the algae exhibited anti-bacterial activity against the two microorganisms. The activity observed can be described as bacteriostatic that is mild action for concentration in 20 and 40 and more bacteriostatic in concentration of 60. The ethanol extract of the algae showed more antibacterial activity against *E. coli* alone. The activity is shown only at high concentration against gram negative bacteria. Chloroform extract seems to be bacteriostatic for both test organisms at higher concentrations studied.

**Table 3: Antibacterial activity of Ethanol extract of *A. spicifera* against *E. coli* and *Staphylococcus* bacteria:**

Concentration %	<i>E. coli</i>	Zone of Inhibition	<i>Staphylococcus</i>	Zone of Inhibition
20	No action	Nil	Bacteriostatic	0.7mm
40	Bacteriostatic	0.7mm	Bacteriostatic	0.8mm
60	Bactericidal	1.5mm	Bactericidal	1.2mm

The ethanol extract of *Acanthophora* has more effect on the growth of *E. coli*. In higher extract concentration *E. coli* shows more effect than *Staphylococcus*. Potential activity observed is observed on the growth of *E. coli* as well as *Staphylococcus* higher concentrations used for the current study. (Table 3)

**Table 4: Antibacterial activity of Chloroform extract of *A. spicifera* against *E. Coli* and *Staphylococcus* bacteria:**

Concentration %	<i>E. coli</i>	Zone of inhibition	<i>Staphylococcus</i>	Zone of inhibition
20	No action	Nil	No action	Nil
40	No action	Nil	No action	Nil
60	Bacteriostatic	0.7mm	Bactericidal	1.2mm

The chloroform extract of *Acanthophora* has mild effect on the growth of *E. coli* only at higher concentration. Bactericidal activity was observed only at higher extract concentration on *Staphylococcus*. No potential activity could be observed on the growth of *E. coli* in any of the concentrations used for the current study. (Table 4)

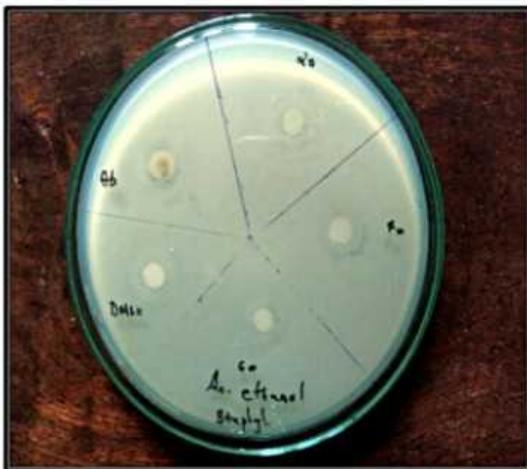


Replica 1



Replica 2

**Fig 4: Anti-microbial activity of Ethanol extract of *Acanthophora spicifera* against *E. coli***

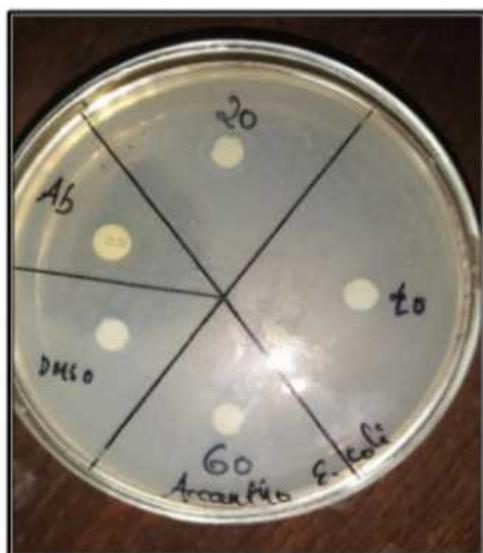


Replica 1

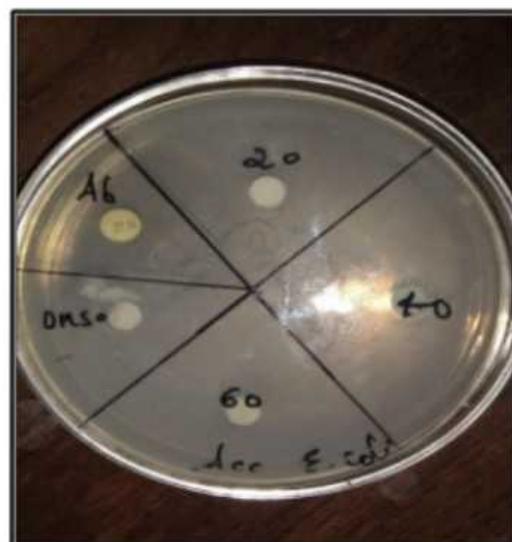


Replica 2

**Fig 5: Anti-microbial activity of Ethanol extract of *Acanthophora spicifera* against *Staphylococcus***



Replica 1

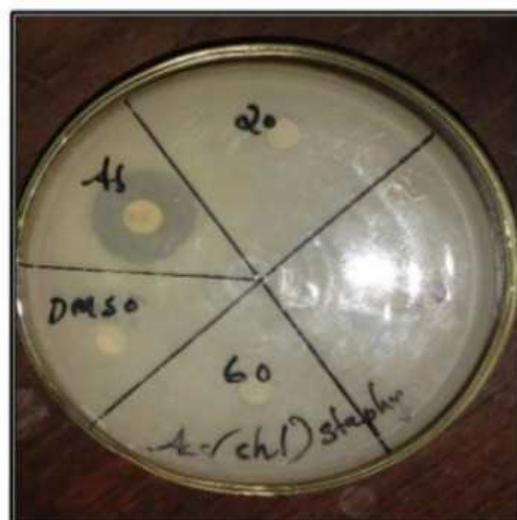


Replica 2

**Fig 6: Antimicrobial activity of Chloroform extract of *Acanthophora spicifera* against *E. coli***



Replica 1



Replica 2

**Fig 7: Antimicrobial activity of Chloroform extract of *Acanthophora spicifera* against *Staphylococcus***

## ANTI-OXIDANT ASSAY

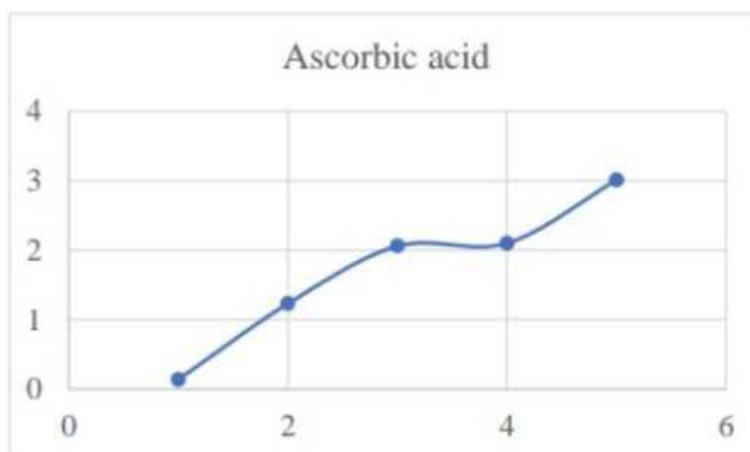
### Ferric Reducing Antioxidant Power (FRAP) Assay

Total anti-oxidant activity was measured by Ferric Reducing Anti-oxidant Power (FRAP) assay. The method is based on the principle that, an increase in the absorbance of the reaction mixture, indicates an increase in anti-oxidant activity. The anti-oxidant compound present in the sample forms a coloured complex with Potassium ferricyanide, Trichloroacetic acid and Ferric chloride, which is measured at 700nm by UV-Spectroscopy.

**Table 5: Absorbance of various concentrations of the standard, ascorbic acid in FRAP assay.**

Solvents/Std/Concentration	Absorbance of Ascorbic acid
2ml	0.14
4ml	1.23
6ml	2.06
8ml	2.10
10ml	3.01

**Fig 8: Graphical representation of absorbance of the standard, ascorbic acid in FRAP assay.**

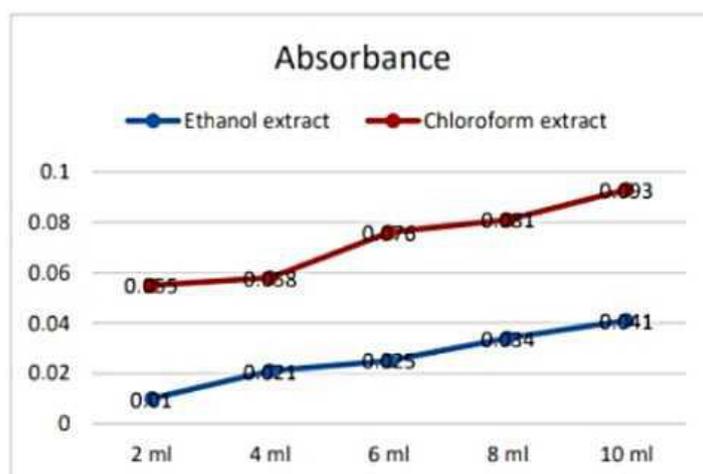


The inhibition of ferric radicals by ascorbic acid was in a concentration dependent manner (Table 5, Fig 8).

**Table 6: Absorbance of various concentrations of ethanol and chloroform extract of *Acanthophora spicifera* in FRAP assay.**

Sample Concentration	Absorbance of Ethanol extract	Absorbance of Chloroform extract
2ml	0.010	0.055
4ml	0.021	0.058
6ml	0.025	0.076
8ml	0.034	0.081
10ml	0.041	0.093

**Fig 9: Graphical representation of absorbance of ethanol and chloroform extract of *Acanthophora spicifera* in FRAP assay.**



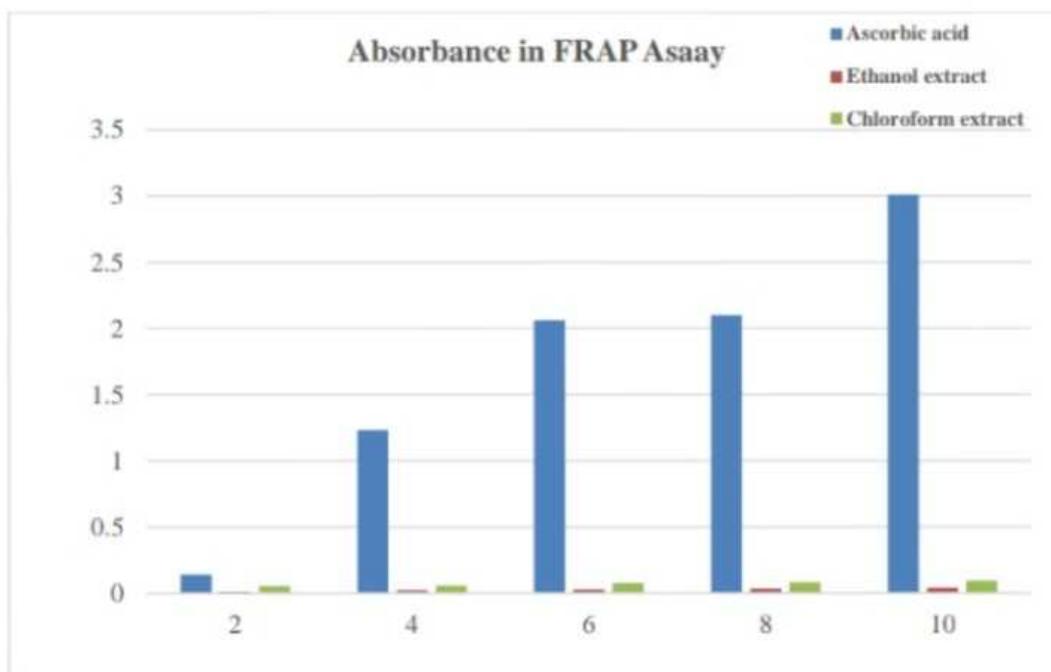
The inhibition of ferric radicals by ethanol extract and chloroform extract of *Acanthophora spicifera* was in a concentration dependent manner (Table 6, Fig 9).

The FRAP assay showed a highest antioxidant activity in chloroform extract than in ethanol extract of *Acanthophora spicifera*.

**Table 7: Absorbance of ethanol and chloroform extracts of *Acanthophora spicifera* and the standard, ascorbic acid, in FRAP assay.**

Sample Conc	Absorbance		
	Ascorbic acid	Ethanol extract	Chloroform extract
2ml	0.14	0.010	0.055
4ml	1.23	0.021	0.058
6ml	2.06	0.025	0.076
8ml	2.10	0.034	0.081
10ml	3.01	0.041	0.093

**Fig 10: Graphical representation of FRAP assay conducted on ethanol and chloroform extracts of *Acanthophora spicifera* and the standard, ascorbic acid.**



In Ferric Reducing Power Assay, the reducing power of the ethanol extracts, chloroform extracts and the standard, increases with increase in the amount of sample and standard concentrations (Table 7, Fig 10). The chloroform extract showed better anti-oxidant activity for the plant extract than the ethanol extract.

Both the extracts administered in the Ferric Reducing Antioxidant Power Assay, were found to possess good anti-oxidant effect depending on the concentration of anti-oxidants in the samples. They react with potassium ferricyanide ( $Fe^{3+}$ ) to form potassium ferrocyanide ( $Fe^{2+}$ ), which then reacts with ferric chloride to form ferric–ferrous complex. *A. spicifera* is an anti-oxidant plant both in ethanol and chloroform extracts. However, the chloroform extract of *A. spicifera* has significantly higher anti-oxidant activity than the ethanol extract.

## DISCUSSION

Seaweeds are the macroscopic algae which are important components of marine living systems. Marine algae contain more than 60 trace elements in a concentration higher than in terrestrial plants. They also possess protein, bromine, vitamins, iodine and substances of stimulatory and antibiotic nature. The phytochemicals from marine algae are extensively used in various industries such as food, pharmaceutical, dairy and mostly as gelling, stabilizing and thickening agents (Seenivasan R *et al.*, 2012). Seaweeds or marine macroalgae are the renewable living resources which are also used as food, feed and fertilizer in many parts of the world. The seaweeds offer greatest wealth in terms of biomass. Rhodophytes shows the largest representation among the seaweeds. *Acanthophora spicifera* is a red seaweed, with about 26 species distributed world-wide.

Seenivasan R *et al.*, (2012) investigated the phytochemical constituents like alkaloids, flavonoids, phenols, proteins and free amino acids, saponins, sterols, terpenoids and sugars in all samples and coumarin and glycosides, quinones and tannin. Among the minerals analysed most of them were highest in the red algae *A. spicifera*. The study shows that the phenol, alkaloid and flavonoid are present in *A. spicifera*.

The phytochemical screening in the current study it has been observed that *A. spicifera* contains a good source of bioactive compounds. The results of current study shows that *A. spicifera* contains flavonoid, alkaloids, tannins, saponin and cardiac glycosides but terpenoid and phenolic compounds are seen to be absent.

Shankhadarwar S D (2015) analyzed the presence of a variety of chemical constituents, such as saponins, phenols, flavonoids, alkaloids and steroids in *Acanthophora spicifera*. They used thin layer chromatographic technique for the separation of active components like flavonoids, alkaloids, steroids, saponins and phenols from various solvents combinations which were observed under U.V. light (Wagner R., Bladt S 1996; Harborne J B 1998). In their study they analysed flavonoid, alkaloid, phenol, saponin and steroid were present in the red seaweed *A. spicifera*.

Antibacterial activity refers to the process of killing or inhibiting the disease-causing bacteria. Several plants have been traditionally used for their antibacterial activity. Like plants some algae also exhibit antibacterial properties due to the presence of terpenoids, steroids, saponins, tannins,

and flavonoids. There are numerous reports regarding the inhibitory activities of macroalgae against human pathogens, fungi and yeasts.

The use of algae as an alternative for prevention and treatment of infectious diseases has been suggested by Abirami and Kowsalya (2012). In the present study ethanolic and chloroform extract were evaluated for activity against Gram positive *Staphylococcus* and Gram-negative *E. coli*. It was found that ethanolic extract had more bacteriostatic activity against *E. coli* and bacteriostatic against *Staphylococcus*. The chloroform extract had bacteriostatic activity against *E. coli* and bacteriostatic activity against *Staphylococcus* in higher concentration alone.

Different solvent systems were used to extract bioactive principles from macroalgae with concomitant changes in the antibacterial activities (Thirupurasundari *et al.*, 2008). The solvents such as acetone, benzene, butanol (Vanitha *et al.*, 2003; Prakash *et al.*, 2005), ethanol (Selvi *et al.*, 2001) were used to extract antimicrobial compounds from macroalgae. The aqueous extracts prepared from seven macroalgal samples showed varying degrees of activity against tested pathogens, including the Gram-positive and Gram-negative bacteria. Padmakumar (2002) is of the opinion that these differences are due to the different solubility behaviour of secondary metabolites which could be influenced by seasonal and geographical distribution of the species.

Antibacterial potential of *A. spicifera* ethanol extracts were evaluated by Meenakshi *et al.*, (2014), against six bacterial specimens. They reported high antimicrobial activity against *E. coli*. In the present study, ethanolic extract showed more activity at higher concentration (60%) and mild activity at zones of 20% and 40%. In their work, Meenakshi *et al* have also reported significant cytotoxic potential against Ehrlich Ascites carcinoma cell lines for ethanolic extract of the algae.

In living systems, free radicals are constantly generated which interacts with other molecules within the cells. This can cause oxidative stress and damage to tissues and biomolecules leading to various diseases, especially degenerative diseases and extensive lyses. Many commercially available antioxidant drugs possess significant side effects. Traditionally, medicinal plants are used to treat various diseases, but in the middle of the 20th century, the use of medicinal plants was reduced to one fourth due to the overuse of synthetic chemicals to treat diseases. Now the situation is reversed, the researchers have considerable interest and are keen in finding natural sources to replace the synthetic ones (Devika Sivakumar *et al.*, 2018).

Ahilya Vitthal Waghmode *et al.*, (2021) evaluated the antioxidative potential and antimicrobial activity of *Acanthophora spicifera*. The antioxidant potential of various seaweed extracts was determined using the DPPH and FRAP.

Marine algal extracts have been demonstrated to possess strong antioxidant properties (Fernando *et al.*, 2016). The present study indicates that the seaweed possesses strong antioxidant activity. The antioxidant activity was analyzed by FRAP assay. The antioxidant activity was measured using UV spectrometer at 700nm. The current study also evaluated the difference in antioxidant potential shown by the algae in two different solvents; ethanol and chloroform. The results obtained revealed the reductive ability of *Acanthophora spicifera* and it was found to increase with rise in concentration. The study reveals that the seaweed has a remarkable antioxidant potential as compared to the standard ascorbic acid.

## SUMMARY AND CONCLUSION

The plant selected for the study, *Acanthophora spicifera* is a marine red seaweed. It has shown antibacterial, antioxidant and antifungal activity in many studies conducted before. Marine macroalgae are considered as a promising source of chemical compounds with a broad array of biological activities. Seaweeds are the macroalgae found in marine ecosystems where they play a multitude of roles as primary producers providing nutrients and energy to other living organisms, provide shelter and home to these life forms.

Red algae possess antibacterial, antioxidant, antifungal properties. They can be used as food and are a storehouse of bioactive components like vitamins, phenolics, terpenoids and other secondary metabolites. The present study was done to estimate the difference in extractive yield, phytochemical screening, antimicrobial and antioxidant activity of the dried form of, *Acanthophora spicifera* in polar and non-polar solvents, ethanol and chloroform respectively.

The whole plant body was taken for the study. The cleaned, dried and powdered sample and it was extracted using the Soxhlet apparatus. Extractive values of plant materials are often used to evaluate extracts of the sample, to get an idea about the nature of chemical constituents present in it. It can also be used to assess quality, purity and detect adulteration of the extract. *A. spicifera* showed a better elution for polar solvent than non-polar solvent. The extractive yield obtained was more for ethanolic extract (12.2%) as compared to chloroform extract (0.9%).

The extract obtained in two different solvents were taken for qualitative analysis to check for the presence of alkaloids, cardiac glycosides, flavonoids, phenols, saponins, tannins and terpenoids. Preliminary qualitative tests clearly revealed the presence of flavonoids, alkaloids, tannins, saponins, cardiac glycosides and phenolic compounds. There was no presence of terpenoid in the test alga. The alga proved to be a good source of bioactive components i.e. flavonoids, alkaloids, tannins, saponins, cardiac glycosides and phenolic compounds.

In the current study, antibacterial potential of *Acanthophora spicifera* was tested against two non-pathogenic bacteria, the Gram-negative *E. coli* and the Gram-positive *Staphylococcus* by the disc-diffusion method. It is concluded that the organic solvent extraction by ethanol and chloroform was suitable to verify the antimicrobial properties of *A. spicifera* and they were supported by many investigations.

The current study also reveals that *A. spicifera* has antimicrobial potential. The ethanol extract has better antimicrobial activity when compared to chloroform extracts. Ethanol extract was bactericidal for both gram-negative, *E. coli* and gram-positive, *Staphylococcus* bacteria at all highest concentration studied. Whereas the extract in chloroform showed no significant activity except in the higher concentration (60%) for both gram-negative and gram-positive bacteria.

Algae possess potent antioxidant compounds that are suitable for protecting human bodies against damaging effects of reactive oxygen species produced as a result of normal metabolism of the body. Thus, it reduces the risk of various cancers, as well as prevents menopausal symptoms. The total antioxidant activity of ethanol and chloroform extracts of *A. spicifera* was measured using Ferric Reducing Antioxidant Power (FRAP) Assay. The assay measures the antioxidant potential in the sample through the reduction of ferric ion ( $\text{Fe}^{3+}$ ) to ferrous ion ( $\text{Fe}^{2+}$ ). Following the reduction of ferric ion, a colored complex develops which is read using UV spectrophotometer at 700nm. Thus, the colored complex formed by ethanol and chloroform extract of *A. spicifera* signifies its antioxidant potential. The result signifies that absorbance of chloroform extract was found to be greater than ethanol extract.

The present study justifies the claimed uses of *A. spicifera* in the traditional system of medicine to treat various infectious diseases caused by the microbes. These results suggest the possibility of using marine algae extracts in therapy as natural alternatives to antibiotics currently in the market, and clearly show that seaweeds are a valuable source of biologically active compounds. Both the extracts used in the Ferric Reducing Antioxidant Power Assay, were found to possess good antioxidant effect which was concentration dependent and it may reduce the risk of various cancers. Hence, this potential can be further utilized and can be studied further.

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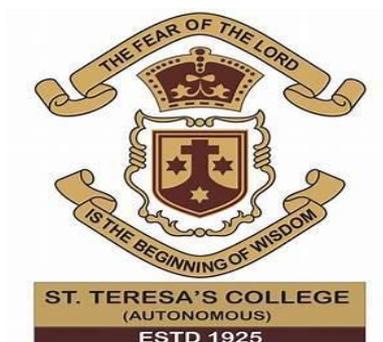
**PHYTOCHEMICAL SCREENING AND STUDIES ON THE  
ANTIBACTERIAL AND ANTIOXIDANT POTENTIAL OF  
GRACILARIA CORTICATA (J. Agardh) J. Agardh**

**DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN  
BOTANY**

**By**

**NEETHU ROBERT**

**AM20BOT014**



**DEPARTMENT OF BOTANY  
ST.TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM**

**2022**

## CERTIFICATE

This is to certify that the dissertation entitled "Phytochemical screening and studies on the antibacterial and antioxidant potential of *Gracilaria corticata* (J. Agardh) J. Agardh " is an authentic record of research work carried out by Miss NEETHU ROBERT (AM20BOT014) under the supervision and guidance of Smt. I. K. Nishitha Assistant Professor, Department of Botany and Centre for Research, St. Teresa's College (Autonomous), Ernakulam, in partial fulfilment of the requirements for the award of the degree of Bachelor of Science in Botany. I further certify that no part of this work embodied in this project has been submitted for the award of any degree or diploma.

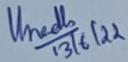


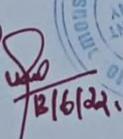
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## **DECLARATION**

I hereby declare that the project entitled “Phytochemical screening and studies on the antibacterial and antioxidant potential of *Gracilaria corticata* (J. Agardh) J. Agardh ” submitted to Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirement for the Degree of Master of Science in Botany is an original project done by under the supervision and guidance of Smt. I.K Nishitha Department of Botany and Centre for Research, St. Teresa’s college (Autonomous), Ernakulam.

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## **ACKNOWLEDGEMENT**

I extend my sincere gratitude and indebtedness to Smt.I.K.Nishitha, Assistant Professor, Department of Botany, St. Teresa's College (Autonomous), Ernakulam for her valuable guidance and inspiration throughout the period of this work.

I also acknowledge my sincere thanks to all my beloved teachers of the Botany Department for their encouragement and support.

My sincere thanks to the Non-Teaching staff for their assistance throughout the course of my work.

I am extremely grateful to my beloved parents and friends for their kindness, support and whole hearted encouragement which was guiding light for me throughout my project.

Above all, I thank God Almighty for his Blessing which Enlightened me throughout the course of the dissertation.

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## **CONTENT**

<b>SI. No</b>	<b>CHAPTER</b>	<b>PAGE NO.</b>
<b>1.</b>	<b>INTRODUCTION</b>	<b>5-12</b>
<b>2.</b>	<b>REVIEW OF LITERATURE</b>	<b>13-16</b>
<b>3.</b>	<b>MATERIALS AND METHODS</b>	<b>17-21</b>
<b>4.</b>	<b>OBSERVATION AND RESULT</b>	<b>22-29</b>
<b>5.</b>	<b>DISCUSSION</b>	<b>30-32</b>
<b>6.</b>	<b>SUMMARY AND CONCLUSION</b>	<b>33-34</b>
<b>7.</b>	<b>REFERENCES</b>	<b>35-39</b>

## INTRODUCTION

Algae are diverse group of relatively simple, chlorophyll containing, photo-autotrophic and oxygen evolving aquatic thalloid (without differentiation into True roots, stems, leaves or leaf like organs) organisms. The word “algae” has its origin from Latin, where ‘alga’ means seaweed. The term algae was first used by Carl Linnaeus in 1753.

Pond scums, seaweeds, freshwater and marine phytoplankton etc are different algal forms. They are principal photo synthesizers in the globe and control our atmosphere in several ways. Their role in environment is enormous (Barsanti & Gualtieri, 2006; Graham et al., 2009). Marine algae from Indian coasts amounting to 844 species are distributed among 217 genera. They grow in the intertidal, shallow and deep-sea areas up to 180meter depth and also in estuaries, backwaters and lagoons on solid substrates such as rocks, dead corals, pebbles, shells, mangroves and other plant materials (Anatharaman et al., 2007; Sakthivel, 2007). Although seaweeds have been utilized in traditional and folk medicine for a long time their use in modern medicine has been realized only after 1950 (Lincoln et al., 1991).

The term "seaweed" refers to a variety of marine plants and algae that can be found in the ocean, rivers, lakes, and other bodies of water. Some seaweeds, such as phytoplankton, are small and remain floating in the water column, providing the foundation for most aquatic food chains. Some are massive, such as the giant kelp that grow in dense forests. The large percentage are medium-sized, with red, green, brown, and black colours, and sometimes may wash up on beaches and shorelines. (Guiry, Michael D, 2014). Mostly seen seaweeds are macro algae. Seaweeds are classified as Green algae (Chlorophyta), Brown algae (Phaeophyta), Red algae (Rhodophyta) and some filamentous Blue-green algae (Cyanobacteria). Most of the seaweeds are red (6000 species) and the rest known are brown (2000 species) or green (1200 species) (Richard et al., 1998). They differ significantly in many ultrastructural and biochemical functions, including photosynthetic pigments, storage molecules, cell wall composition, presence/absence of flagella, mitosis ultrastructure, linkage between cells, and structure of the chloroplasts, in addition to pigmentation.

Algae are found in both marine and freshwater habitats. Algae are relatively undifferentiated organisms which, unlike plants, have no true roots, leaves, flowers or seeds. As these organisms have a short doubling time, they are considered among fastest growing creatures. They have different pathways to fix atmospheric carbon dioxide and to efficiently utilize the nutrients to convert it into biomass. In recent years, focus towards these organisms has increased due to

their food and fuel production capability. In fuel industry algae biofuels have emerged as a clean, nature friendly, cost-effective solution to other fuels. More recently algae have been identified and developed as renewable fuel sources, and the cultivation of algal biomass for various products is transitioning to commercial-scale systems. Large-scale cultivation of algae merges the fundamental aspects of traditional agricultural farming and aquaculture (Emily M Trentacoste et al., 2015). Algae fuels are categorized into bio-ethanol, biogas, bio-hydrogen, biodiesel and bio-oil. Algae can be used in the preparation of Biodiesel, Bioethanol, Biobutanol and Hydrogen gas (Raja et al., 2013).

Algae have been in use as human food for centuries in various parts of the world. Algae are taken in several ways according to the choice and taste of the people. Their nutritional value is quite high, as they contain a good amount of proteins, carbohydrates, fats and vitamins, especially A, B, C and E. Not only is algae considered worldwide to be a low cost source of protein, but it also contains a number of important minerals such as iron, potassium, magnesium, calcium, manganese, and zinc. Commonly used species are -Chlorophyta–Chlorella, *Ulva lactuca* (Sea lettuce). The large Brown and Red algae are used as organic fertilizers, especially on land close to the sea. Many forms of marine algae, Phaeophyta and Rhodophyta, are highly valuable for certain commercial products, chiefly agar-agar, algin or alginic acid and carrageenin. The important use of agar is in microbiology and tissue culture (in the preparation of culture media for growing algae, fungi and bacteria in the laboratories). Other uses are in the cosmetics, paper and silk industries, etc. *Digenia simplex*, a red alga, provides an antihelmintic drug. Agar-agar, for its absorptive and lubricating action, is used medicinally in the prevention of constipation. The antibacterial product chlorellin, obtained from *Chlorella* is well known and is used against coliforms and other related intestinal bacteria. Algae are important sources of vitamins, minerals, proteins, fatty acids etc (Pulz & Gross, 2004).

Rhodophyta is a phylum of macroalgae that includes the classes Phaeophyceae and Chlorophyta, which are brown and green seaweeds, respectively. The Red algae are one of the oldest groups of eukaryotic algae, and also one of the largest, with about 5,000–6,000 species of mostly multicellular, marine algae, including many notable seaweeds.

Within Archaeplastida, Rhodophyta, or red algae, is a monophyletic lineage that contains glaucophyte algae, green algae, and terrestrial plants. *Bangia*-like species have been found in 1.2 billion-year-old strata, indicating that Rhodophyta has a lengthy fossil history. The

morphology of red algae ranges from unicellular filamentous to multicellular thalloid forms, with certain species producing economically important products like agar and carrageenan. These species can be found in a variety of marine settings, ranging from the intertidal zone to deep oceans. There are also freshwater (e.g., *Batrachospermum*) and terrestrial lineages. A triphasic life cycle with one haploid and two diploid phases, with the carposporophyte borne on female gametophytes, is one of the Rhodophyta's significant advances.

Freshwater Rhodophyta has 66 species and 27 genera in North America, although these numbers will change as molecular investigations uncover more diversity. Freshwater red algae have a limited size range than marine species, with the majority (80%) of them measuring 1-10 cm in length. Gelatinous filaments, free filaments, and pseudoparenchymatous forms are the most prevalent types (Yoon, Hwan Su, et al., 2017).

In terms of the number of species, the genus *Gracilaria* is one of the largest genera of red algae. It's also a wide spread genus, with species found in all oceans except the Arctic. Nearly 28 species of *Gracilaria* have been reported from the Indian coast (Sahoo *et al.*, 2001). Because of its size and extensive range, it's suitable for biogeographic investigation. The greatest number of *Gracilaria* species can be found in tropical waters. Large beds of *Gracilaria* usually grow in the eulittoral zone, or just below it in the beginning of the sublittoral, on sandy or muddy sediments that are protected from waves. Sometimes it can be found free-floating in tidal lakes of salt or brackish water. It can adapt to large variations in growing conditions such as freshwater dilution, increase in fertilizer concentration from runoff, and raised temperatures. Large biomasses can grow when there is little competition from other species, and vegetative propagation may be a normal method of reproduction (McLachlan, J., et al., 1984). In tropical and subtropical oceans, these are frequently red, green, or greenish brown.

*Gracilaria* are found as branched thalli, terete to flattened, branching sub-dichotomous to irregular. It has holdfast a disc or crust giving rise to one to many erect axes. The thalli are red, olive, green to purple, Spermatangia are seen in pits or shallow depressions. Sporophytes with tetrasporangia are scattered in the outer cortex, cruciately divide (R Iyer, et al., 2004)

Because they have phycocolloids, the major source of agar- (1, 4)-3, 6-anhydro-1-galactose and -(1,3)-d-galactose with low esterification in the cell wall, *Gracilaria* species are essential for industrial and biotechnological uses. Agar and other polysaccharides are found in *G. confervoides*, *G. dura*, *G. chilensi*, and *G. secundata* among the carbohydrates.

Infectious diseases are one of the main causes of high morbidity and mortality in human beings around the world, especially in developing countries (Waldvogel, 2004). Antibiotic resistance in bacteria and fungi is one of the major emerging health care related problems in the world, it became a greater problem of giving treatment against resistant pathogenic bacteria (Sieradzki et al., 1999). Decreased efficiency and resistance of pathogen to antibiotics has necessitated the development of new alternatives (Smith et al., 1994; Ireland, 1988). Aquatic organisms are a rich source of structurally novel and biologically active compounds (Ely et al., 2004). Secondary or primary metabolites produced by these organisms may be potential bioactive compounds of interest in the pharmaceutical industry (Febles et al., 1995). Algae have wide span of ecosystems contributes to the innumerable chemical compounds that they are able to synthesize. A number of antimicrobial compounds have been identified in microalgae as well as macroalgae (De Marsac and Houmard, 1993). A large number of microalgal extracts and or extracellular products have been proven antibacterial, antifungal, antiprotozoal and antiplasmodial activity (Mayer and Hamann, 2005; Cardozo et al., 2007). Harder (1917) was the first to note seaweed's antimicrobial properties. Bactericidal compounds have been discovered in a variety of algal organisms (Glombitza, 1979; Banerjee et al., 2009).

Marine algae were reported to produce a wide variety of bioactive secondary metabolites as antimicrobial, antifeedant, antihelmintic and cytotoxic agents and the bioactive substances included alkaloids, polyketides, cyclic peptide, polysaccharide, phlorotannins, diterpenoids, sterols, quinones, lipids and glycerols (Cabrita et al., 2010) and marine macro-algae are considered as the actual producers of some bioactive compounds with high activity (Shimizu, 1996). Seaweeds are a powerful group of secondary metabolites with a wide range of structures. These bioactive compounds provide resistance to herbivores, fouling species, and pathogens as well as reproduction, UV defence and allopathic agent resistance (Hay, 1996). The marine habitat of India has diverse seaweeds, spread through inter-tidal and deep-water regions of the Indian coast. Marine algae (Seaweeds) are a group of marine multicellular algae, plentiful in minerals, vitamins, and polysaccharides. They are considered as a potential source of bioactive substances such as proteins, lipids, and polyphenols possessing potent antibacterial, anticancer, antioxidant, antifungal, and antiviral properties (Sundaramurthy A et al., 2016).

Decreasing efficiency and resistant of pathogens to antimicrobial drugs made the search of a new antimicrobial agent an important strategy for the establishment of alternative therapies in difficult handling infections, eg: *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas*

aeruginosa that causes diseases like diarrhea, mastitis and upper respiratory complications (Levine, 1987; Jawetz et al., 1995). In recent years, multiple resistances in human pathogenic microorganism have developed due to the indiscriminate use of antibiotic drugs commonly employed in the treatment of infectious diseases. The undesirable side effects of certain antibiotics and the emergence of previously uncommon infections have forced scientists into looking for new antibiotic substances from various sources like marine macroalgae. Macroalgae serve as an important source of bioactive natural substances (Smit, 2004). Many metabolites isolated from macroalgae have been shown to possess bioactive effects (Faulkner, 2002).

Natural products from marine algae have attracted the attention of biologists and chemists the world over for the last five decades. Many of these compounds are used to treat diseases like cancer, acquired immune-deficiency syndrome, inflammation, pain, arthritis, as well as viral, bacterial, and fungal infections. The marine red alga showed the phytochemical constituents like phenols, alkaloids, saponins, flavonoids and steroids. Red algae and their extracts have been studied as novel sources of variety of compounds and reported for their biological activity for potential medicinal use. Red algae are the source of amino acids, terpenoids, phlorotannins, steroids, phenolic compounds, halogenated ketones and alkanes, cyclic polysulphides, fatty acids, acrylic acid (Taskin E et al., 2007). These compounds probably have diverse simultaneous functions for the seaweeds and can act as allelopathic, antimicrobial, antifouling, and herbivore deterrents, or as ultraviolet-screening agents. They are also used by the pharmaceutical industry in drug development to treat diseases like cancer, acquired immune-deficiency syndrome (AIDS), inflammation, pain, arthritis, infection for virus, bacteria and fungus (Deig E F et al., 1974).

Phenolic compounds are commonly found in brown, green, red seaweeds, whose antioxidant properties have been correlated to their phenolic contents. Recently, a number of studies have been reported on the phytochemistry of plants across the world. Saponins are considered as a key ingredient in traditional Chinese medicine and are responsible for most of the observed biological effects. Saponins are known to produce inhibitory effect on inflammation. Flavonoids in human diet may reduce the risk of various cancers, as well as preventing menopausal symptoms. Its potent water-soluble antioxidants and free radical scavengers prevent oxidative cell damage and have strong anti-cancer activity. They show anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activity (Cushnie and lamp, 2005; De Sousa et al., 2007; Yadhav et al., 2011). Flavonoids are largest group of polyphenolic compounds and

are known to contain a broad spectrum of chemicals and biological activities including antioxidant and free radical scavenging properties. They are remarkable group of plant metabolites. Flavonoids are perhaps best known to enhance the effects of ascorbic acid (Yasantha A et al., 2007). The secondary metabolites of seaweeds have always attracted the interest of biochemists because of their diversity as compared with those present in the leaves of higher plants. Isoprenoids (terpenes, carotenoids, steroids), polyketides (Phlorotannins), amino-acid-derived natural products (alkaloids), and shikimates (flavonoids) are the major groups of secondary metabolites found in algae (Mendis and Kim, 2011).

Antioxidant compounds play an important role in various fields such as medical field (to treat cancers, cardiovascular disorders, and chronic inflammations), cosmetics (anti- ageing process), food industries (food preservative) and others (Kohen R; Nyska A 2002). Over the years, the search for new antioxidant compounds from natural products has mounted. This is due to health concerns regarding the potential toxic and side effects generated from synthetic antioxidants, as well as changes in consumer preferences for natural products (Safer AM, 1999). As algae are photosynthetic organisms, they produced free radicals and other oxidative reagents when they are exposed to high oxygen concentrations and light. It is considered because of absence of structural damage that these organisms are able to generate the necessary compounds to protect themselves against oxidation. Hence, algae is a potent antioxidant compounds that could also be suitable for protecting our bodies against the damaging effect of reactive oxygen species produced as a result of normal metabolism of the body.

Many commercialized synthetic antioxidants, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are used under strict regulation in certain countries because of their potential health hazards. Thus, the search for alternative antioxidants from natural products has increased and among them, aquatic plants have gained the focus. Seaweeds or marine macroalgae have been known as rich sources of various natural antioxidants. Compounds such as polyphenols, catechin, flavonols, flavonol glycosides, and phlorotannins have been discovered from methanol extract of red and brown algae. The uniqueness of their molecular skeleton and structures has contributed to the strong antioxidant activity. Polyphenols for instant uses its phenol rings as electron traps for free radicals.

Much previous research has studied the biological effects of natural marine products, including their antioxidant, antibacterial, anti-malarial, antiviral, anti-inflammatory and cytotoxic activities (Skropeta D, 2008). However, only a few studies have examined the biological

potential of the marine algae (seaweeds) (Jung W.K. et al., 2009). Diverse antioxidants found in seaweeds such as polysaccharides, dietary fibres, minerals, proteins, amino acids, vitamins, polyphenols, and carotenoids have been recorded by several scientists (Burtin, 2003). Seaweeds contain a remarkable range of potential novel antioxidants that help in counteracting the environmental pressures (Lesser, 2006). Natural antioxidants are superior to synthetic antioxidants since they are free of environmental contaminants and perform a wide range of beneficial functions. Such additives are secure to be used in medicines, nutritional supplements, nutraceuticals, including cosmetics to enhance consumer wellbeing, lessen the impact of infectious diseases, besides other wider forms of immune system function.

Natural antioxidants are superior to synthetic antioxidants because they do never include chemical pollutants and have a wide range of benefits. These are safe for use as ingredients in medicine, dietary supplements, nutraceuticals, and cosmetics with the objective of improving customer health, reducing the effects of harmful diseases, and other broader aspects of immune system function (Shahidi, 2009). Several countries have reported the antioxidant result of input seaweeds such Matsukava, 1997), Indonesia (Santos' et al., 2004), Korea (Heo et al., 2005), India (Chandini et al., 2008) and Malaysia (Matanjun et al., 2008). Notably, there is a great deal of interest in monitoring the potential targeted therapies through natural products, with a particular focus on marine entities. Thus, many marine organisms develop biochemical pathways in relation to environmental stresses such as space competition, maintaining unfolded surfaces, avoiding predation, and the ability to reproduce successfully (Konig et al., 1994). Seaweeds are a powerful group of secondary metabolites with a wide range of structures. These bioactive compounds provide resistance to herbivores, fouling species, and pathogens as well as reproduction, UV defence and allopathic agent resistance (Hay, 1996). Antioxidants play prominent role in the later stages of cancer development. The most powerful water-soluble antioxidants found in algae are polyphenols, phycobiliproteins and vitamins (Plaza M et al., 2008). Oxidative processes promote carcinogenesis. The antioxidants may be able to cause the regression of premalignant lesions and inhibit their development into cancer. It is found that, several algal species have prevented oxidative damage by scavenging free radicals and active oxygen and hence able to prevent the occurrence of cancer cell formation (Richardson JS,1993), these antioxidants are considered key compounds to fight against various diseases (e.g. Cancer, chronic inflammation, atherosclerosis and cardiovascular disorder) and ageing processes (Kohen R and Nyska A, 2002).

**Objectives of the study:**

- To give a taxonomic description of *Gracilaria corticata*.
- Preliminary phytochemical assessment of the alga.
- Assessment of anti-bacterial potential of the alga in its dried form extracted in two different solvents – ethanol and chloroform.
- Evaluate the difference in anti-bacterial potential shown by the alga in the two different solvents against gram-positive *Staphylococcus* and gram-negative *E. coli*.
- Assessment of anti-oxidant potential of *G. corticata* extracted in ethanol and chloroform using the Ferric Reducing Antioxidant Power assay.
- Estimate the extractive value of the plant, in both Ethanol and Chloroform Solvents.

## REVIEW OF LITERATURE

In a study conducted by Inci Tuney (2006), antibacterial activity of extracts or components from various algae has been demonstrated in vitro against both gram-positive and gram-negative bacteria. The antibacterial susceptibility test was performed using the agar disc diffusion method, with 6 mm discs impregnated with 20  $\mu$ l of extracts and placed in infected agar. *Gracilaria* chloroform extract was tested for antibacterial properties against *Staphylococcus aureus* bacterial strains. *Gracilaria* extract showed action in *S. aureus* extract. Ethanol extracts from *G. domigensis* and *G. sjoestedii* showed antibacterial activity against *E. coli* and *S. aureus*. (TÜney, İnci, et al., 2006)

Krishnapriya et al., (2013) conducted an antibacterial activity on the seaweed extracts, carried out by agar disc diffusion assay. The Muller Hinton agar (MHA) medium was used for this study using bacterial pathogens. Among the solvent extracts, methanol extract showed best results for both positive and negative strains. Chloroform extract of *G. verrucosa* gave the highest zone of inhibition measuring  $21 \pm 1.0$  mm. Ethanol extract of *G. acerosa* also showed a zone of inhibition of  $12 \pm 1.0$  mm. Ethanol and chloroform extracts of *G. verrucosa* gave clearly distinct zone of inhibition measuring  $8 \pm 1.0$  and  $9 \pm 1.0$  mm, with respect to control ( $25 \pm 1.0$  mm) against *Staphylococcus*. (Varier, Krishnapriya Madhu, et al., 2013)

Saranraj, P. (2013) conducted a study and the methanol extract of *Gracilaria folifera* (5.0mg/ml) showed highest mean zone of inhibition ( $18 \pm 0.4$ mm) against the Gram positive cocci *Streptococcus pyogenes* followed by *Bacillus subtilis* ( $17 \pm 0.5$ mm), *Staphylococcus aureus* ( $17 \pm 0.3$ mm), *Streptococcus epidermis* ( $16 \pm 0.6$ mm) and *Bacillus cereus* ( $16 \pm 0.2$ mm). For Gram negative bacterium, the maximum zone of inhibition was recorded in methanol extract of *Gracilaria folifera* against *Klebsiella pneumoniae* ( $17 \pm 0.5$ mm) followed by *Salmonella typhi* ( $16 \pm 0.6$ mm), *Pseudomonas aeruginosa* ( $16 \pm 0.5$ mm), *Escherichia coli* ( $16 \pm 0.3$ mm). The zone of inhibition obtained from the Hexane extract of seaweed *Gracilaria*

*folifera* against bacterial pathogens was comparatively very less when compared to the other solvent extracts. No zone of inhibition was seen in DMSO control and the positive control Ampicillin showed zone of inhibition ranging from  $13\pm 0.8$  mm to  $20\pm 0.8$  mm against the test bacterial pathogens. (Saranraj, P., 2013)

The antibacterial properties of eight crude extracts of local *Acanthophora spicifera* obtained by two distinct extraction methods were investigated by Zakaria (2010) using soxhlet extraction and solvent partitioning. By using the Disc diffusion method, these extracts were evaluated in vitro against 18 bacteria, 3 yeasts, and 6 fungal strains. The results demonstrated that the solvent partitioning extracts of methanol and ethyl acetate had a greater spectrum of action against the tested bacterial strains. *Bacillus cereus* ATCC 10876, *Bacillus licheniformis* ATCC 12759, Methicillin Resistance *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* ATCC 27853, *Yersinia* sp., and *Citrobacter freundii* displayed inhibitory zones against these two extracts. While methanol extracts from Soxhlet extraction and butanol from solvent partitioning had no antibacterial activity against *P. aeruginosa* ATCC 27853, the other six extracts did. (Zakaria, et al., 2010)

In a study done by Ibraheem et al.; 2017; simplex extracts of *Acanthophora* showed potent inhibitory growth activities against three Gram positive bacteria [*Streptococcus agalactiae*, *pyogenes* and *Streptococcus sanguis* of inhibition ranging from  $[23.1\pm 0.58$  to  $20.6\pm 0.63$  mm] and showed moderate activities with [*Corynebacterium diphtheriae*, *Bacillus subtilis* and *Staphylococcus aureus*] with inhibition zones ranging from  $[20.1\pm 1.5$  to  $16.3\pm 2.1$  mm].

Also the crude extracts were found to be more active than the positive control Ampicillin, ( $22.3\pm 1.5$  mm), against *Streptococcus agalactiae* which showing inhibition zone. The hydro alcoholic extracts of the selected species were investigated for their antimicrobial activities using Agar well diffusion and Muller Henton against gram positive and gram negative bacteria. (Ibraheem, Ibraheem BM, et al., 2017)

In a study by Nurul Aili Zakaria et al.; (2011), the antimicrobial activities of the hexane extract were evaluated using disc diffusion method against 8 Gram-negative and 10 Gram-positive bacterial strains. Out of all bacterial tested, only a Gram-positive bacterium and a Gram-negative bacterium were susceptible to the extracts. The hexane extract showed antibacterial activity against both Gram-positive bacterium and Gram-negative bacterium (*P. aeruginosa* ATCC 27853). While, chloroform and ethyl acetate extract only showed inhibitory effect on

*P. aeruginosa* ATCC 27853 with inhibition zone of 9.0 mm. No inhibitory effect was showed by methanol extract on bacteria tested. (Zakaria, Nurul Aili, et al., 2011).

Marine macroalgae are an important renewable resource of bioactive compounds useful for healthy food and alternative medications capable of regulator diseases or multi-resistant strains of pathogenic microorganisms (Pérez et al., 2016).

Phytochemicals are chemicals produced by plants through secondary metabolism. They generally have biological activities in the plant host and play a role in plant growth or defense against predators, pathogens or competitors (Molyneux RJ et al., 2007). They are commonly found in fruits, vegetables, nuts, legumes, and grains. Phytochemicals include all plant compounds both plant chemicals that are beneficial and those that are toxic. Some phytochemicals possess incredible health benefits while others are toxic to health (Hennemen K, 2016). Secondary constituents are the remaining plant chemicals such as alkaloids, terpenes, flavonoids, lignins, plant steroids, curcumines, saponins, phenolics, flavonoids and glucosides (Hahn NI, 1998). Phenolics have been reported to be the most abundant and structurally diverse plant phytochemicals (Yoshie Y et al., 2001). Marine algae are a rich source of bioactive secondary metabolites, including phenols and polyphenols (Andrade et al., 2013; Maharana et al., 2015; Fernando et al., 2016). Flavonoids are perhaps best known to enhance the effects of ascorbic acid (Yasantha A et al., 2007).

Isaiah Nirmal Kumar et al., (2014) determined total phenolic assay by using Folin Ciocalteu assay. Zhishen J et al., (1999) and Isaiah Nirmal Kumar et al., (2014) used aluminum chloride calorimetric assay for measuring total flavonoid content of selected seaweeds from Okha coast.

Harder (1917) was the first to note seaweed's antimicrobial properties. Bactericidal compounds have been discovered in a variety of algal organisms (Glombitza, 1979; Banerjee et al., 2009). In a study conducted by Inci Tuney (2006), antibacterial activity of extracts or components from various algae has been demonstrated in vitro against both gram-positive and gram-negative bacteria. The antibacterial susceptibility test was performed using the agar disc diffusion method, with 6 mm discs impregnated with 20 µl of extracts and placed in infected agar (Inci Tuney 2006). The antimicrobial activity of seaweeds, including *Gracilaria corticata*, *Acanthophora spicifera* extracts was studied by ethanolic solvents against antimicrobial activity of *Staphylococcus aureus*, *Bacillus thuringiensis*, *Pseudomonas* and *Klebsiella* human pathogens (Ahilya Vitthal Waghmode et al., 2021). Antimicrobial activity was measured using ELISA microplate reader.

A number of antimicrobial compounds have been identified in microalgae as well as macroalgae (De Marsac and Houmard, 1993). Antimicrobial activity was evaluated using the disc diffusion technique in petri dishes (NCCLS, 1993). Briefly, sterile filter paper discs, 6 mm in diameter were loaded with 25  $\mu$ L of the different antibacterial compound extracts and were air dried. Discs containing standard concentration of ciprofloxacin for bacteria and amphotericin B for fungi were used as control. The discs were placed on Muller Hinton agar plates (Chowdhury et al., 2015). Ethanolic and methanolic extracts of *Acanthaphora spicifera* performed a good antimicrobial activity but chloroform extract was not good enough (Chowdhury et al., 2015).

The antibacterial activity of five gracilaria species was determined in both gram positive and gram-negative bacteria. In the preliminary assay ten different organic solvents like Acetone, Butanol, Ethanol, Ethyl acetate, Isoamyl alcohol, Methanol and Propanol (polar) and Benzene, Chloroform and Hexane (non-polar) were evaluated (Prasad M. P., ShekharSushant, Rindhe Ganesh, 2012).

Antioxidants are compounds that protect human, animal and plant cells against the damaging effects of free radicals. Free radicals can be defined as any species containing one or more unpaired electrons in atomic or molecular orbitals and capable of independent existence (Halliwell, 2011). In recent times, marine algae have been gaining importance as sources of pharmacologically active constituents possessing antioxidant, antiproliferative, antimutagenic, antidiabetic, anticoagulant, antibacterial and antitumor activities (Smit AJ, 2004; Folmer F et al., 2010). Exploration for bioactive compounds led to the screening of selected marine algae from the Tamil Nadu coast for antiproliferative and antioxidant activities (Murugan K & Iyer VV, 2013).

Ahilya Vitthal Waghmode et al., (2021) determined antioxidant potential of various seaweed extracts using the DPPH and FRAP assay. The FRAP assay showed a highest antioxidant activity in methanolic extract of the green seaweed *Ulva*. The most FRAP activity was observed in *U. lactuca* (81.80%) followed by *C. peltata* and *Batrachospermum*, while less activity was detected in *S. ilicifolium* (48.70%). The antioxidant activity pattern of methanolic solvents varied due to the presence of various compounds with different species. A high value of astaxanthin has been recorded in green alga, *Ulva intestinalis* (Banerjee et al., 2009).

## **MATERIALS AND METHODS**

### **SPECIMEN COLLECTION**

The specimen was collected by hand picking from Thikkodi beach, Calicut. The collected samples were washed immediately in seawater and then washed with fresh water and transported to the laboratory. It was again washed thoroughly to remove impurities and sand and rinsed with distilled water. The sample was identified taxonomically as *Gracilaria corticata*. Collected sample was taxonomically evaluated using the standard literature.

### **PHYTOCHEMICAL ANALYSIS**

#### **Qualitative Analysis**

##### **Extract Preparation**

2g of shade dried plant material is taken in clean dry conical flask to it 20ml of the extracting solvent, ethanol, methanol and water was added and kept in the mechanical shaker for 24 hours. Then it was filtered using Whatman No 1 filter paper and made up to 50ml.

The following standard protocols were used for qualitative analysis of samples to check for the presence of Alkaloids, Cardiac glycosides, Flavonoids, Phenols, Saponins, Tannins and Terpenoids.

##### **Test for Flavonoids:**

2 ml of each extract was added with few drops of 20% sodium hydroxide, formation of intense yellow colour is observed. To this, few drops of 70% dilute hydrochloric acid were added and yellow colour was disappeared. Formation and disappearance of yellow colour indicates the presence of flavonoids in the sample extract.

##### **Test for Alkaloids:**

To 1ml of the extract 1ml of any one of the below reagent is added.

Mayer's reagent:

1.36g of HgCl<sub>2</sub> was dissolved in 60ml distilled water (solution A ) and 5g of potassium iodide was dissolved in 10ml distilled water (solution B ) .Both solutions A and B were mixed and made upto 100ml.

Dragendroff's reagent :

8g Bismuth Sub Nitrite was dissolved in 20ml con.HNO<sub>3</sub> to form solution A. 27g of potassium iodide was dissolved in 50ml of distilled water to form solution B. Both solution A and B were mixed and allowed to stand when KNO<sub>3</sub> precipitates out, supernatant was discarded and made up to 100ml with distilled water.

Wagner's reagent:

1027g of iodine and 2g potassium iodide were dissolved in 5ml distilled water. It was then made up to 100ml with distilled water.

Presence of precipitate in all three reagents confirms the presence of alkaloids

#### **Test for Saponins:**

To 2 ml of each extract, 6 ml of distilled water were added and shaken vigorously; formation of bubbles or persistent foam indicates the presence of saponins.

#### **Test for Tannins:**

To 2 ml of each extract, 10% of alcoholic ferric chloride was added; formation of brownish blue or black colour indicates the presence of tannins.

#### **Test for Phenols:**

To 2 ml of each extract, 2 ml of 5% aqueous ferric chloride were added; formation of blue colour indicates the presence of phenols in the sample extract.

#### **Test for Cardiac Glycosides:**

To 1 ml of each extract, 0.5ml of glacial acetic acid and 3 drops of 1% aqueous ferric chloride solution were added, formation of brown ring at the interface indicates the presence of cardiac glycosides in the sample extract.

#### **Test for Terpenoids:**

Take 1 ml of extract of each solvent and add 0.5 ml of chloroform followed by a few drops of concentrated sulphuric acid, formation of reddish brown precipitate indicates the presence of terpenoids in the extract.

#### **Preparation of algal extract for antimicrobial and antioxidant studies**

The cleaned samples were shade dried, cut into small pieces and powdered in a mixer grinder. The organic solvents chloroform and ethanol were used for the extraction process due to its higher efficiency using Soxhlet extraction method. 20g of samples were packed in a thimble and placed in the extractor. 200ml of the solvent was added into the flask and heated. The temperature was maintained at 80<sup>0</sup>C to 85<sup>0</sup>C throughout the extraction. The soluble active constituents of the extract remained in the flask and the process was repeated until the compounds were completely extracted. The liquid extract was then cooled and concentrated by using an evaporator.

The beaker with dried extract was weighed and noted. DMSO was used to dissolve the extracts from the beaker. Later the weight of the beaker alone was noted. Hence, the actual weight of the dried extract was obtained. Similarly, the weight of dried extract of *Gracilaria*, in ethanol and chloroform was 0.46g and 10mg respectively. From this the extractive value was calculated using the formula

Extractive value (%) = (Weight of dried extract/ Weight of plant material) X 100

#### **PREPARATION OF EXTRACT IN VARIOUS CONCENTRATIONS**

From the stock extract, concentrations of 10%, 20%, 40%, 60% (v/v) was made. The stock concentration of *Gracilaria* in ethanol and chloroform was 10mg/ml and 10mg/ml respectively. From the stock the appropriate amounts was pipetted out and made up to the required concentrations using DMSO.

## **ANTIBACTERIAL ACTIVITY IN *GRACILARIA***

### **PREPARATION OF BACTERIAL CULTURE**

In the present study, the extracts were evaluated for antimicrobial activity against *Staphylococcus* strain and *E. coli*, a Gram positive and a Gram negative bacteria respectively. 3g of nutrient broth was dissolved in 100ml of distilled water in a conical flask. The broth is sterilized by autoclaving for 15 minutes. Both of the obtained bacterial stains were inoculated in the nutrient broth in laminar air flow and incubated in appropriate conditions for 24hrs.

### **PREPARATION OF PETRI PLATES**

The selected two species of seaweeds were analysed for the antimicrobial activity for gram negative *Escherichia coli* and gram positive *Staphylococcus* by disc diffusion methods. Agar medium was prepared by dissolving 4g agar and 2.6g of nutrient broth in 100ml distilled water. The mixture is sterilized in an autoclave for 15 minutes. Just after sterilization the mixture was poured into petri plates in laminar air flow. The petri plates were allowed to solidify under aseptic conditions.

### **ANTIMICROBIAL TEST BY DISC DIFFUSION METHOD**

Bacteria were inoculated onto the prepared agar petri plates using sterilized cotton swabs. Sterilized 6mm discs were taken from filter paper and autoclaved and is used for the method. The disc was then dipped in different concentrations of stock (10, 20, 40, 60) and placed on the agar plate using sterile forceps. Tetracycline was used as positive control and DMSO was used as negative control. This was done for both extracts of *Gracilaria* against the two strains of bacteria. The petri plates were incubated at 37°C for 24 hours and results were recorded.

### **ANTIOXIDANT ASSAY**

#### **Ferric reducing power assay**

The total antioxidant activity can be measured by the ferric reducing antioxidant power assay (FRAP). The flavonoids and phenolic acids present in the medicinal plant exhibit strong

antioxidant activity which is depending on their potential to form the complex with metal atoms, particularly iron and copper. This method is based on the principle of, increase in the absorbance of the reaction mixture, indicates an increase in antioxidant activity.

The antioxidant compound present in the samples forms a coloured complex with potassium ferricyanide, trichloroacetic acid and ferric chloride, which is measured at 700nm by UV-Spectrophotometer.

### **Reagent preparation**

0.2M Phosphate buffer : Dissolve 27.218g of  $\text{KH}_2\text{PO}_4$  in 1000ml distilled  $\text{H}_2\text{O}$

Potassium ferricyanide (1%) : 1g of  $\text{K}_3\text{Fe}(\text{CN})_6$  was dissolved in 100ml distilled  $\text{H}_2\text{O}$

Trichloroacetic acid (10%) : Dissolve 10ml of TCA was dissolved in 90ml distilled  $\text{H}_2\text{O}$

Ferric chloride (0.1%) : 0.1g of  $\text{FeCl}_3$  was dissolved in 100ml distilled  $\text{H}_2\text{O}$

Ascorbic acid (0.1%) : 1mg of Ascorbic acid was dissolved in 1ml of distilled  $\text{H}_2\text{O}$

### **Working procedure**

0.02g of the algal residue was dissolved in 30ml ethanol and used as the stock. Various concentrations of the extract was prepared by taking 2ml, 4ml, 6 ml, 8ml and 10ml of the stock and making up to 10ml using distilled  $\text{H}_2\text{O}$ . Then 1 ml from each dilution was pipetted out into separate test tubes. To this 2.5 ml of 0.2M sodium phosphate buffer and 2.5ml of 1%  $\text{K}_3\text{Fe}(\text{CN})_6$  solutions were added and the reaction mixture was incubated in a boiling water bath at 50o C for 20 minutes. Following this 2.5 ml of 10% trichloroacetic acid was added to the mixture and mixed. Then 2.5ml of solution was pipetted out from each reaction mix into separate test tubes, to which 2.5 ml of distilled water and 0.5ml of 0.1%  $\text{FeCl}_3$  were added. Solvent solution along with the above stated reagents, was used as control. The coloured solutions including control were read at 700nm with reference to standard using UV-Spectrophotometer to find the absorbance. Here, Ascorbic acid was used as a reference standard, the reducing power of the samples were comparable with the reference standard.

## OBSERVATION AND RESULTS

The current study aimed at the taxonomic description of the red seaweed *Gracilaria corticata* and the estimation of its extractive value and antimicrobial potential in two solvents, ethanol and chloroform. The antimicrobial potential activity was studied against Gram positive *Staphylococcus* and Gram negative *E. coli*, two non-pathogenic bacteria. The results obtained are described below.

### TAXONOMIC DESCRIPTION

Kingdom: Plantae

Phylum: Rhodophyta

Class: Florideophyceae

Order: Gracilariales

Family: Gracilariaceae

Genus: *Gracilaria*

Species: *corticata*

*Gracilaria corticata* (J. Agardh) J. Agardh

Thallus erect, up to 14cm in length, arising singly from a discoid holdfast. Stipe very short, terete, up to 5mm long, often inconspicuous. Branching frequently, becoming denser in upper parts of the plant; mostly dichotomous, and producing a bushy appearance. Axes compressed, almost cartilaginous; constricted at the base in basal branches. Blades linear, up to 15cm long, up to 4mm wide; apices generally obtuse, acute in finer branches. Blade surface and margins smooth. Fresh specimens purple to green and firm but pliable (Iyer et al, 2004).



*Gracilaria corticata* (J. Agardh) J. Agardh

### **EXTRACTIVE VALUE**

Extractive values of plant materials are used to evaluate extracts of the sample, in order to get an idea about the nature of chemical constituents present in it. It can also be used to assess quality, purity and detect adulteration of the extract.

In the present study, polar and non-polar solvents were used for eluting the valuable phyto-compounds present in the sample. Extractive values of ethanol and chloroform extracts of *Gracilaria corticata* used in the antibacterial study, are estimated in the table 1 given below;

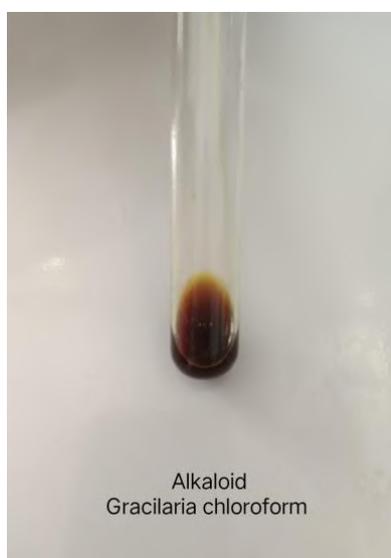
**Table 1: Extractive value of solvents administered for *Gracilaria corticata***

<b>Solvent</b>	<b>Extractive value of the sample (%)</b>
Ethanol	2.3
Chloroform	0.5

The extractive value was greater for the ethanolic extract than for chloroform suggesting that polar solvent was more efficient in extracting the phytochemicals from the algae.

## PHYTOCHEMICAL ANALYSIS

	<b>Ethanol</b>	<b>Chloroform</b>
<b>Alkaloid</b>	+	+
<b>Flavonoid</b>	+	+
<b>Phenol</b>	-	-
<b>Tannin</b>	+	+
<b>Saponin</b>	+	+
<b>Terpenoid</b>	-	-
<b>Cardiac glycosides</b>	+	+





Tannin  
Gracilaria  
Ethanol



Tannin  
Gracilaria chloroform



Saponin  
Gracilaria



Terpenoid  
Gracilaria  
(chloroform)



Terpenoid  
gracilaria (ethanol)



Cardiac glycos  
Gracilaria ( ethanol  
and chloroform)

## ANTIBACTERIAL ACTIVITY

The extracts of the algae exhibited moderate to mild antibacterial activity against the two microorganisms. The activity observed can be described as being bacteriostatic showing very mild zones of inhibition. The ethanol extract of the algae showed mild antibacterial activity against both the test organisms. *Gracilaria* shows mild action against gram negative bacteria at all concentrations of ethanol extract used in the current study against both test organisms.

Table 2; Fig. 2

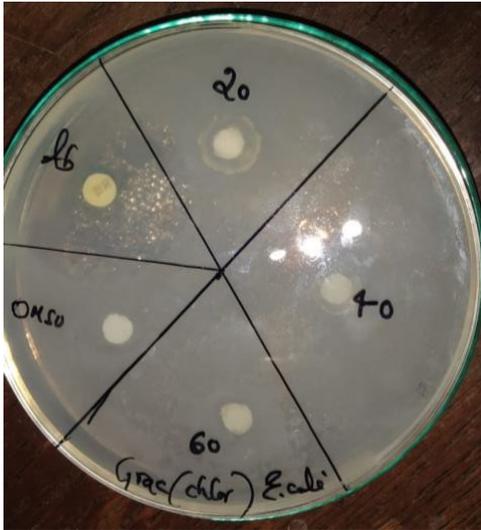
Table 2: Antibacterial activity of ethanolic extract of *Gracilaria corticata* against *E. coli* and *Staphylococcus* bacteria:

Concentration (%)	<i>E. coli</i>	<i>Staphylococcus</i>
20	Mild action	Mild action
40	Mild action	Mild action
60	Mild action	Mild action

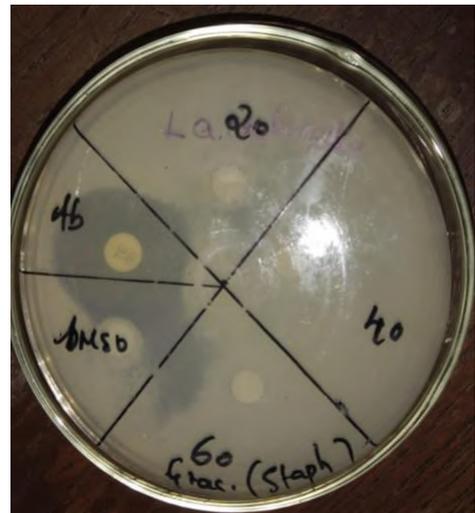
Table 3: Antibacterial activity of chloroform extract of *Gracilaria corticata* against *E. coli* and *Staphylococcus* bacteria

Concentration (%)	<i>E. coli</i>	<i>Staphylococcus</i>
20	No action	No action
40	No action	No action
60	No action	Mild action

The chloroform extract of *Gracilaria* has no significant effect on the bacterial growth. Mild bacteriaostatic activity is observed at higher extract concentrations on *Staphylococcus*. No potential activity could be observed on the growth of *E. coli* in any of the concentrations used for the current study Table 3: Fig. 3

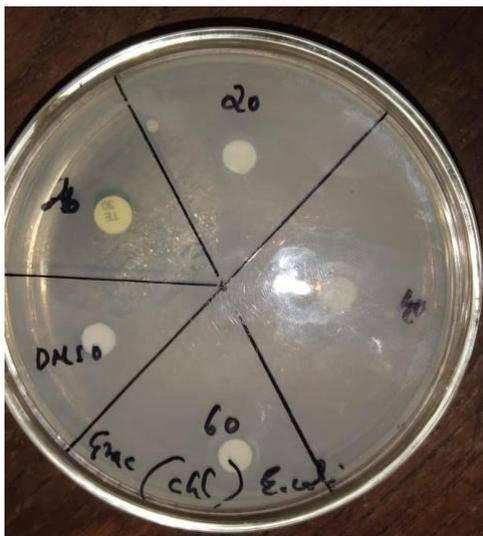


*E. coli*

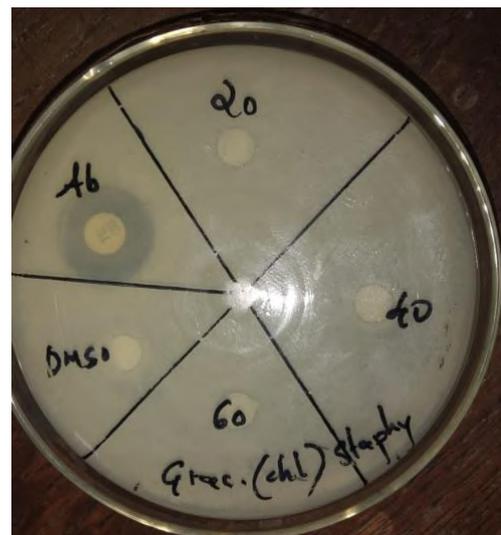


*Staphylococci*

Fig 2: Antimicrobial activity of Ethanol extract of *Gracilaria*



*E. coli*



*Staphylococci*

Fig 3: Antimicrobial activity of Chloroform extract of *Gracilaria*

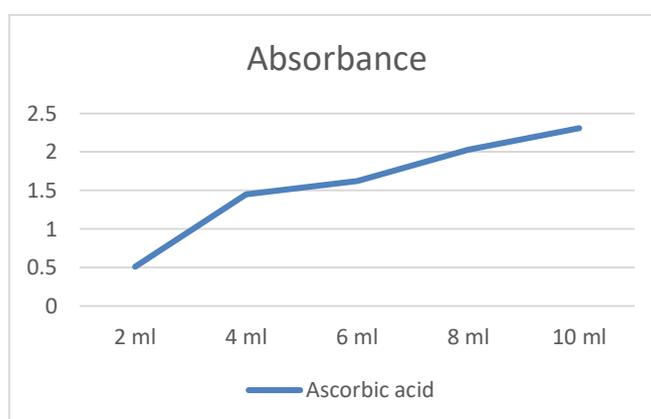
### Ferric Reducing Antioxidant Power (FRAP) Assay

The total antioxidant activity can be measured by the ferric reducing antioxidant power assay (FRAP). The flavonoids and phenolic acids present in the medicinal plant exhibit strong antioxidant activity which is depending on their potential to form the complex with metal atoms, particularly iron and copper. This method is based on the principle of, increase in the absorbance of the reaction mixture, indicates an increase in antioxidant activity.

The antioxidant compound present in the samples forms a coloured complex with potassium ferricyanide, trichloroacetic acid and ferric chloride, which is measured at 700nm by UV-Spectrophotometer.

**Table 4: Absorbance of various concentration of standard, ascorbic acid in FRAP assay**

Solvent/Std/Conc	Absorbance
2ml	0.51
4ml	1.45
6ml	1.62
8ml	2.03
10ml	2.31



**Table 5: Absorbance of various concentrations of ethanol and chloroform extracts of *G. corticata* in FRAP assay**

Extract Conc	Absorbance of ethanol extract	Absorbance of chloroform extract
2 ml	0.030	0.023
4 ml	0.034	0.034
6 ml	0.065	0.045
8 ml	0.067	0.048
10 ml	0.070	0.064

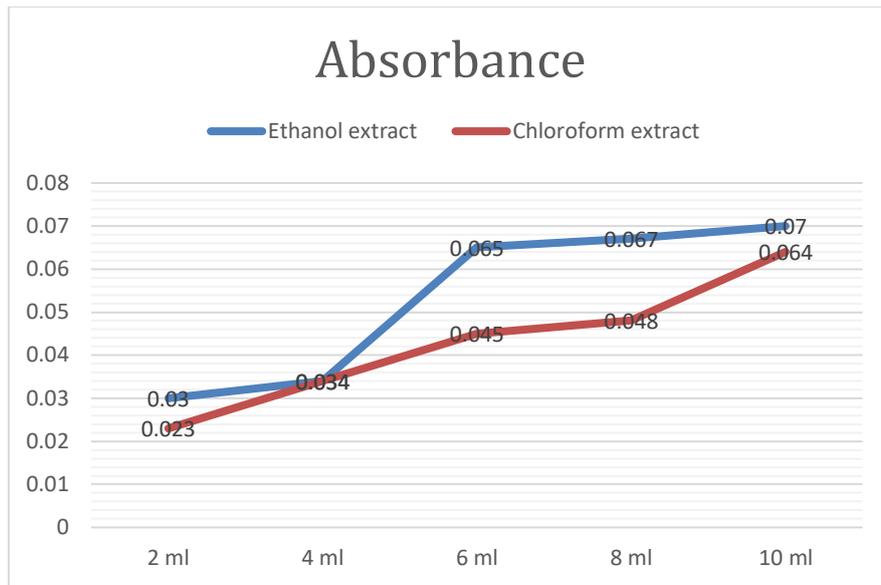
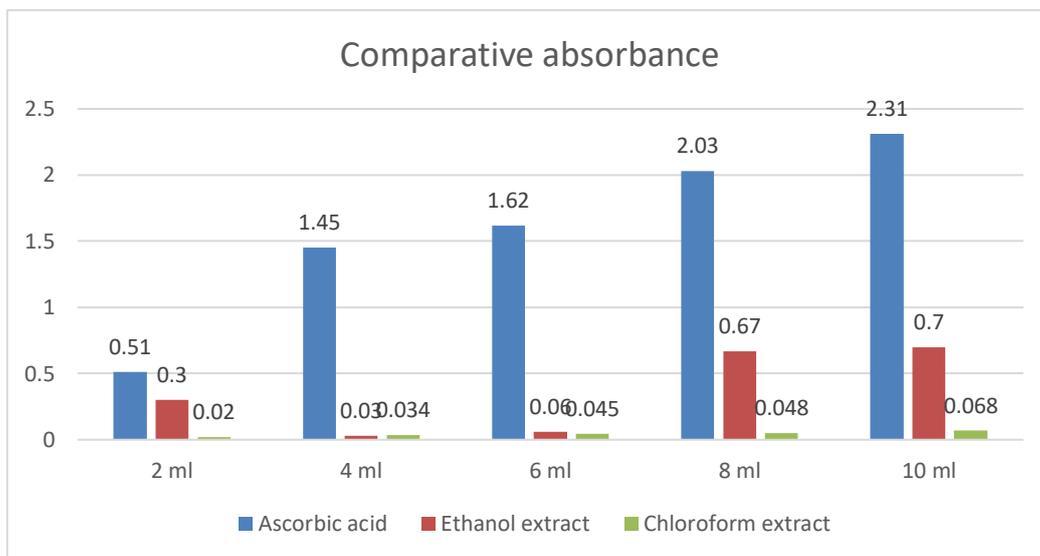


Fig. 4: The absorbance of ethanol and chloroform extracts of *G. corticata* in FRAP assay

The inhibition of ferric radicals by ethanol and chloroform extract of *Gracilaria corticata* was in a concentration dependant manner. The ethanol extract exhibits slightly better antioxidant activity than chloroform extract as shown in Table 5 and fig 4.



**A comparative chart of the absorbance of Ascorbic acid, ethanol and chloroform extracts of *G. corticata* in FRAP assay**

## DISCUSSION

Algae have attracted great importance in the recent years due to the large number and amounts of bioactive components in them. More than 600 trace elements are found in high concentration in the seaweeds compared to the terrestrial plants, because of which it has various pharmacological activities. The seaweeds offer greatest wealth in terms of biomass and Rhodophytes show the largest representation among them. The red sea weed *Gracilaria* is amongst the largest group with over 150 species world wide and nearly 28 species in India (Sahoo *et al.*, 2001).

*Gracilaria* has been identified as a rich source of various bioactive compounds as assessed by the studies on its different species such as *G. corticata*, *G. dentata*, *G. edulis*, *G. opuntia*, *G. pygmaea* and *G. verrucosa* carried out by various researchers. In a study carried out by Balakrishnan *et al.* in 2013, phytochemical screening of *G. corticata* was done using different solvents like methanol, ethanol, petroleum ether and acetone revealing the presence of most of the bioactive components of which alkaloids, phenols, quinones and steroids are most abundant. In a similar investigation led by Gnanaprakasam *et al.* (2017), the hexane, chloroform, ethyl acetate, acetone and methanol extracts of *G. corticata* were used to analyse the phytochemicals, and results revealed that the terpenoids, tannins and phenolic compounds were present in the all the extracts and alkaloids were present only in the chloroform and ethyl acetate extracts.

Antibacterial activity refers to the process of killing or inhibiting the disease-causing bacteria. Several plants have been traditionally used for their antibacterial activity. Like plants some algae also exhibit antibacterial properties due to the presence of terpenoids, steroids, saponins, tannins, and flavonoids. There are numerous reports regarding the inhibitory activities of macroalgae against human pathogens, fungi and yeasts. So, the use of algae as an alternative for prevention and treatment of infectious diseases has been suggested by Abirami and Kowsalya (2012). In the present study ethanolic and chloroform extract were evaluated for activity against Gram positive *Staphylococci* and Gram-negative *E. coli*. It was found that ethanolic extract had bacteriostatic activity against both the bacteria at all concentrations treated and the effect was dose dependent. Sanaraj P., 2013, in his study on *G. edulis* also reported maximum activity against Gram positive bacteria in ethanol extracts. Rashida et al

(2019) also report ethanol extract of *Gracilaria* to have higher antibacterial activity than other solvents.

In the preliminary assay conducted to evaluate antibacterial activity of *Gracilaria* species against human pathogens by Sushanth (2012), ten different organic solvents were considered. This study also reported that the extracts of ethanol and chloroform were the most potent of all.

Johnsi et al (2011), studied the antibacterial activity of aqueous extract of four seaweeds against ten pathogenic bacteria. This study reports the aqueous extract of *Gracilaria corticata* as having the highest potency against the pathogen *Proteus mirabilis*. In the current study however extracts in both solvents show bacteriostatic activity against *E. coli* and *Staphylococci*. Neither extracts are bactericidal and show a mild inhibitory zone of 7 - 8 mm.

Different solvent systems were used to extract bioactive principles from macroalgae with concomitant changes in the antibacterial activities. The solvents such as acetone, benzene, butanol (Vanitha et al., 2003; Prakash et al., 2005), ethanol (Selvi et al., 2001) were used to extract antimicrobial compounds from macroalgae. The aqueous extracts prepared from seven macroalgal samples showed varying degrees of activity against tested pathogens, including the Gram positive and Gram negative bacteria. (Johnsi et al, 2011). Padmakumar (2002) is of the opinion that these differences are due to the different solubility behaviour of secondary metabolites which could be influenced by seasonal and geographical distribution of the species.

Antioxidants are compounds that protect human, animal and plant cells against the damaging effects of free radicals. Free radicals can be defined as any species containing one or more unpaired electrons in atomic or molecular orbitals and capable of independent existence (Halliwell, 2011). In recent times, marine algae have been gaining importance as sources of pharmacologically active constituents possessing antioxidant, antiproliferative, antimutagenic, antidiabetic, anticoagulant, antibacterial and antitumor activities (Smit AJ, 2004; Folmer F et al., 2010). Exploration for bioactive compounds led to the screening of selected marine algae from the Tamil Nadu coast for antiproliferative and antioxidant activities (Murugan K & Iyer VV, 2013).

The standard protocols were used for qualitative analysis of samples to check for the presence of alkaloids, cardiac glycosides, flavonoids, phenols, tannins, saponins and terpenoids. It is

concluded that *Gracilaria corticata* has alkaloids, flavonoids, tannins, saponins and cardiac glycosides. Alkaloids are reported to be biologically and therapeutically active (e.g. morphine, atropine and quinine) and have numerous medical applications. Flavonoids are reported to possess antioxidant, free radical scavenger, antileukemic, vasodilator and antibacterial properties and are reported to be useful for improving blood circulation in brain of Alzheimeric patients. Saponins have a wide range of medicinal properties including hypo-cholesterolemic, anticarcinogenic, anti-inflammatory, anti-microbial and antioxidant. The cardiac glycosides are basically steroids with an inherent ability to afford a very specific and powerful action mainly on the cardiac muscle when administered through injection into man or animal. Cardiac glycosides and catecholamine are agents of choice in treatment of congestive cardiac failure.

The total antioxidant activity can be measured by the ferric reducing antioxidant power assay (FRAP). The flavonoids and phenolic acids present in the medicinal plant exhibit strong antioxidant activity which is depending on their potential to form the complex with metal atoms, particularly iron and copper. This method is based on the principle of, increase in the absorbance of the reaction mixture, indicates an increase in antioxidant activity. From the results it is concluded that the inhibition of ferric radicals by ethanol and chloroform extract of *Gracilaria corticata* was in a concentration dependant manner. The ethanol extract exhibits slightly better antioxidant activity than chloroform extract.

Marine algal extracts have been demonstrated to possess strong antioxidant properties (Fernando et al., 2016). The present study indicates that the seaweed possesses strong antioxidant activity. The reducing capacity of a compound may serve as a vital recorder of its potential anti-oxidant activity. For the estimation of reductive ability, transformation of  $Fe^{3+}$  to  $Fe^{2+}$  was investigated. The change in the optical density of the mixture was measured at 700 nm (Polterait, 1997). An increase in optical density indicates higher reductive ability (Repetto M.G et al., 2002). The study also evaluated the difference in antioxidant potential shown by the algae in two different solvents; Ethanol and Chloroform.

## SUMMARY AND CONCLUSION

Algae are an important constituent of the aquatic ecosystems and can be seen in water bodies like oceans, seas, lakes, estuaries and so on. They can be of different types and in different colours. Mostly seen seaweeds are macroalgae. They can be used as food and are a storehouse of bioactive components like vitamins, phenolics, terpenoids and other secondary metabolites. They also possess antibacterial, antioxidant, antifungal properties. Red algae is used for the extraction of agar (*Gracilaria*). It also shows few antibacterial properties.

The present study was done to estimate the difference in extractive yield, phytochemical analysis, antioxidant and antimicrobial potential of the dried form of, *Gracilaria corticata* in polar and non-polar solvents, ethanol and chloroform respectively. The whole plant body was taken for the study. The cleaned, dried and powdered sample was extracted using the soxhlet apparatus. Extractive values of plant materials are often used to evaluate extracts of the sample, in order to get an idea about the nature of chemical constituents present in it. It can also be used to assess quality, purity and detect adulteration of the extract. *G. corticata* showed a better elution for polar solvent than non-polar solvent. The extractive yield obtained was more for ethanolic extract (2.3%) as compared to chloroform extract (0.5%).

The standard protocols were used for qualitative analysis of samples to check for the presence of alkaloids, cardiac glycosides, flavonoids, phenols, tannins, saponins and terpenoids. It is concluded that *Gracilaria corticata* has alkaloids, flavonoids, tannins, saponins and cardiac glycosides.

In the present project, antibacterial potential of *Gracilaria corticata* was tested against two non-pathogenic bacteria, the Gram negative *E. coli* and the Gram negative *Staphylococcus* by the disc diffusion method. It is concluded that the organic solvent extraction by ethanol and chloroform was suitable to verify the antimicrobial properties of *Gracilaria corticata* and they were supported by many investigations.

The current investigation showed that *G. corticata* has antimicrobial potential. The ethanol extract has better antimicrobial activity when compared to chloroform extracts. Ethanol extract

was bacteriostatic for both gram negative (*E. coli*) and gram positive (*Staphylococcus*) bacteria at all concentrations studied. Whereas the extract in chloroform showed no significant activity except in the higher concentration (60%) and only against the Gram positive *Staphylococcus*.

The total antioxidant activity is measured by the ferric reducing antioxidant power assay (FRAP). The flavonoids and phenolic acids present in the medicinal plant exhibit strong antioxidant activity which is depending on their potential to form the complex with metal atoms, particularly iron and copper. This method is based on the principle of, increase in the absorbance of the reaction mixture, indicates an increase in antioxidant activity. From the results it is concluded that the inhibition of ferric radicals by ethanol and chloroform extract of *Gracilaria corticata* was in a concentration dependant manner. The ethanol extract exhibits slightly better antioxidant activity than chloroform extract.

The present study justifies the claimed uses of *G. corticata* in the traditional system of medicine to treat various infectious diseases caused by the microbes. These results suggest the possibility of using marine algae extracts in therapy as natural alternatives to antibiotics currently in the market, and clearly show that seaweeds are a valuable source of biologically active compounds.

Antioxidants are compounds that inhibit oxidation. Oxidation is a chemical reaction that can produce free radicals, thereby leading to chain reactions that may damage the cells of organisms. Antioxidants such as thiols or ascorbic acid (vitamin C) terminate these chain reactions. To balance the oxidative stress, plants and animals maintain complex systems of overlapping antioxidants, such as glutathione and enzymes (e.g., catalase and superoxide dismutase), produced internally, or the dietary antioxidants vitamin C and vitamin E. Algae possess potent antioxidant compounds that are suitable for protecting human bodies against damaging effects of reactive oxygen species produced as a result of normal metabolism of the body. Thus, it reduces the risk of various cancers, as well as prevents menopausal symptoms.

The total antioxidant activity of ethanol and chloroform extracts of *Gracilaria corticata* was measured using Ferric Reducing Antioxidant Power (FRAP) Assay. The assay measures the antioxidant potential in the sample through the reduction of ferric ion ( $Fe^{3+}$ ) to ferrous ion ( $Fe^{2+}$ ). Following the reduction of ferric ion, a colored complex develops which is read using spectrophotometer at 700nm. Thus, the colored complex formed by ethanolic and chloroform extract of *Gracilaria corticata* signifies its antioxidant potential. Both the extracts administered in the Ferric Reducing Antioxidant Power Assay, were found to possess good antioxidant effect

which was concentration dependent. Hence, this potential can be further utilized and can be studied further.

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# PROJECT REPORT

On

**“ZnO INCORPORATED BIOPLASTICS FROM POTATO  
STARCH: PREPARATION, BIODEGRADABILITY  
STUDIES AND MECHANICAL PROPERTIES”**

Submitted by

**ALEENA XAVIER  
(AM20CHE001)**

*In partial fulfillment for the award of the  
Post graduate Degree in Chemistry*



**DEPARTMENT OF CHEMISTRY  
AND  
CENTRE FOR RESEARCH**

**ST. TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM**

**2021-2022**

DEPARTMENT OF CHEMISTRY  
AND  
CENTRE FOR RESEARCH

ST. TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM



M.Sc. CHEMISTRY PROJECT REPORT

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Year of Work : 2021 - 2022

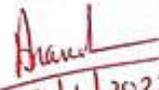
This is to certify that the project "ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by ALEENA XAVIER.

  
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Submitted to the Examination of Master's degree in Chemistry

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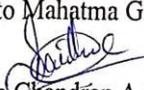


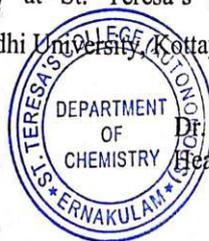
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CERTIFICATE

This is to certify that the project work entitled "ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by Aleena Xavier under the guidance of Dr. Saritha Chandran A., Assistant Professor and Research Guide, Department of Chemistry and Centre for Research, St. Teresa's College, Ernakulam in partial fulfilment of the award of the Degree of Master of Science in Chemistry at St. Teresa's College, Ernakulam affiliated to Mahatma Gandhi University, Kottayam.

  
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**CERTIFICATE**

This is to certify that the project work entitled "**ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES**" is the work done by **ALEENA XAVIER** under my guidance in the partial fulfilment of the award of the Degree of Master of Science in Chemistry at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam.



Dr. Saritha Chandran A.

Project Guide

## **DECLARATION**

I hereby declare that the project work entitled “**ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES**” submitted to Department of Chemistry and Centre for Research, St. Teresa’s College (Autonomous) affiliated to Mahatma Gandhi University, Kottayam, Kerala is a record of an original work done by me under the guidance of Dr. SARITHA CHANDRAN A., ASSISTANT PROFESSOR AND RESEARCH GUIDE, Department of Chemistry and Centre for Research, St. Teresa’s College (Autonomous), Ernakulam. This project work is submitted in the partial fulfillment of the requirements for the award of the Degree of Master of Science in Chemistry.

**ALEENA XAVIER**

## *Acknowledgements*

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The success and outcome of this project required a lot of guidance and assistance from many people, and I am extremely fortunate to have got this all along the completion of my project work. Whatever I have done are only due to such guidance and assistance and I would not forget to thank them.

First, I thank God almighty for being with me throughout all the days and helping me to complete the project successfully.

I respect and thank my project guide Dr. Saritha Chandran A., Assistant Professor and Research Guide, Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for her valuable and enlightened guidance and the support and suggestions which helped me in completing this project.

I extend my sincere gratitude to Dr. Jaya T. Varkey, Head of the Department, Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for providing me with all the facilities and support to meet my project requirements.

I convey my sincere gratitude to Dr. Ushamani M., Assistant Professor and Research Guide, Department of Chemistry, St.

### *Acknowledgements*

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Teresa's College (Autonomous), Ernakulam for her valuable suggestions and support during my project.

I also express my sincere gratitude to Dr. Sr. Vinita CSST, Director, St. Teresa's College (Autonomous), Ernakulam and Dr. Lizzy Mathew, Principal, St. Teresa's College(Autonomous), Ernakulam for their extended support and cooperation during my project work.

I also like to extend my sincere thanks to Sophisticated Test and Instrumentation Centre and Department of Polymer Science and Rubber Technology, CUSAT for their assistance in various stages of completion of project.

I would like to convey my gratitude towards my parents and friends for their cooperation and encouragement which helped me in the completion of this project.

I thank all the teachers and non-teaching staffs of Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for their support and cooperation during my entire project work.

*Aleena Xavier*

## *Contents*

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<b>Chapter 1 Introduction</b>	<b>1</b>
1.1 Potato	1
1.2 Potato Plant	3
1.3 Starch	5
1.4 Application of Starch	7
1.4.1 In Food Industry	7
1.4.2 In Pharmaceutical Industry	8
1.4.2.1 As Binder	8
1.4.2.2 As Tablet Disintegrant	9
1.4.2.3 In Bone Tissue Engineering	9
1.4.2.4 In Artificial Red Blood cells	10
1.4.3 In Paper Making	10
1.4.4 In the Synthesis of Bioplastics	11
1.5 Significance of Nanoparticles in increasing shelf – life	13
1.6 Objectives	15
<b>Chapter 2 Materials and Methods</b>	<b>17</b>
2.1 Materials	17
2.2 Methods	17
2.2.1 Synthesis of Zinc Oxide Nanoparticles	17

## Contents

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2.2.2 Extraction of Potato starch from Potato	18
2.2.3 Synthesis of Bioplastic film from Potato starch	20
2.2.4 Incorporation of Zinc Oxide Nanoparticles into the bioplastic film	21
2.2.5 Degradation Studies	22
2.2.5.1 Air Degradation	23
2.2.5.2 Soil Degradation	23
2.2.5.3 Bacterial Degradation	23
2.2.6 Mechanical Strength	24
2.3 Characterization Techniques	24
2.3.1 X-Ray Diffraction Analysis	24
2.3.2 Scanning Electron Microscope	27
<b>Chapter 3 Results and Discussion</b>	<b>29</b>
3.1 X-Ray Diffraction Studies – Zinc Oxide Nanoparticles	29
3.1.1 XRD – Particle Size Calculation	30
3.1.2 Calculations – Particle size Determination by XRD	30
3.2 X-Ray Diffraction Studies – Bioplastic from Potato starch	33
3.3 X-Ray Diffraction Studies – Bioplastic with ZnO nanoparticles	34
3.4 SEM Analysis	36
3.5 Degradation Studies	38
3.5.1 Air Degradation: Study of Shelf – life of bioplastic	38

3.5.2 Soil Degradation	47
3.5.3 Bacterial Degradation	61
3.6 Mechanical Properties	67
<b>Chapter 4 Conclusion</b>	<b>70</b>
<b>References</b>	<b>73</b>

# Chapter 1

## Introduction

### 1.1 POTATO

The potato is a starchy tuber of the plant *Solanum tuberosum* and is a root vegetable native to the Americas. The plant is a perennial in the nightshade family Solanaceae. Wild potato species can be found throughout the Americas, from Canada to southern Chile. A typical raw potato is 79% water, 17% carbohydrates (88% is starch), 2% protein, and contains negligible fat. It provides 322 kilojoules (77 kilocalories) of food energy and is a rich source of vitamin B6 and vitamin C. They are often broadly classified as having a high glycemic index (GI).

The vegetative and fruiting parts of the potato contain the toxin solanine which is dangerous for human consumption. Normal potato tubers that have been grown and stored properly produce glycoalkaloids in amounts small enough to be negligible to human health, but if green sections of the plant (namely sprouts and skins) are exposed to light, the tuber can accumulate a high enough concentration of glycoalkaloids to affect human health.

The English word *potato* comes from Spanish *patata* (the name used in Spain). Potatoes are occasionally referred to as *Irish*

*potatoes* or *white potatoes* in the United States, to distinguish them from sweet potatoes. The name *spud* for a potato comes from the digging of soil (or a hole) prior to the planting of potatoes [1]. Potatoes are the world's most widely grown tuber crop, and the fourth largest crop in terms of fresh produce (after rice, wheat, and maize).



Fig:1 Potato

They are easy to grow and have excellent nutritional value (although raw and wild potatoes have some toxicity concerns) [2]. Potatoes are prepared in many ways: skin-on or peeled, whole or cut up, with seasonings or without. The only requirement involves cooking to swell the starch granules. Most potato dishes are potato salad, potato chips, French fried potatoes, potato pancakes, potato chunks etc. They are used to brew alcoholic beverages such as vodka. They are also used as fodder for livestock. Potato starch is used in the food

industry as a thickener and binder for soups and sauces, in the textile industry as an adhesive, and for the manufacturing of papers and boards [3].

It is anti-scorbutic. Persons with neurotic and liver dyspepsia digest it well. It is also employed as a diuretic and galactagogue, nervous sedative and stimulant in gout. The leaves in the form of extract are employed as an antispasmodic in chronic cough producing effects as those of optimum etc. Potato grind into a paste is applied as plaster to burns caused by fire with good results. The juice of the potato is a dark coloured liquid due to the presence of citric and succinic acids [4].

## **1.2 POTATO PLANT**

The potato plant is an *herbaceous* perennial in that it lacks a woody stem and lives more than two years. It grows 90 to 100 centimetres (3 to 4 feet) tall and is covered with dark green leaves. The above-ground part of the plant dies each winter and regrows in spring. It flowers three to four weeks after sprouting. The flowers are white, pink, or purple with yellow stamens. After many years of cultivation, the potato has lost much of its ability to produce seeds. Only very rarely does a flower produce some fruit. These are called seed balls and look like small green tomatoes. Each contains up to three

hundred seeds, which are sometimes planted to create new potato varieties. They should not be eaten as they have poisonous substances.

The below-ground part of the potato plant continues to live after the above-ground part has died in winter. Food energy for the next year's growth, in the form of protein and starch, and also water is stored in tubers, called potatoes, which are rhizomes (modified stems) attached to the root system. They are covered by an outer skin called the periderm. Inside that is the cortex, which serves as a storage area for protein and starch. Inside that is the vascular ring that receives starch from the plant's leaves and stem. The starch moves out of the vascular ring to the parenchyma cells that surround it. These cells are the tuber's main storage areas for starch. The pith, which makes up the centre of the tuber, is the main area for water storage.



Fig: 2 Potato Plant

A potato plant grows anywhere from three to 20 tubers during its growing season. In the spring the tubers sprout, and the above-ground plants grow anew [5].

Potatoes are mostly cross-pollinated by insects such as bumblebees, which carry pollen from other potato plants, though a substantial amount of self-fertilizing occurs as well. After flowering, potato plants produce small green fruits that resemble green cherry tomatoes, each containing about 300 seeds. Like all parts of the plant except the tubers, the fruit contain the toxic alkaloid solanine and are therefore unsuitable for consumption. All new potato varieties are grown from seeds, also called "true potato seed", "TPS" or "botanical seed" to distinguish it from seed tubers [6].

### **1.3 STARCH**

Starch or amyllum is a polymeric carbohydrate consisting of numerous glucose units joined by glycosidic bonds.

This polysaccharide is produced by most green plants for energy storage. Worldwide, it is the most common carbohydrate in human diets, and is contained in large amounts in staple foods like wheat, potatoes, maize (corn), rice, and cassava (manioc). The word "starch" is from its Germanic root with the meanings "strong, stiff, strengthen, stiffen".

Pure starch is a white, tasteless, and odourless powder that is insoluble in cold water or alcohol. It consists of two types of

molecules: the linear and helical amylose and the branched amylopectin. Depending on the plant, starch generally contains 20 to 25% amylose and 75 to 80% amylopectin by weight. Glycogen, the glucose store of animals, is a more highly branched version of amylopectin.

In industry, starch is converted into sugars, for example by malting, and fermented to produce ethanol in the manufacture of beer, whisky and biofuel. It is processed to produce many of the sugars used in processed foods. Mixing most starches in warm water produces a paste, such as wheat paste, which can be used as a thickening, stiffening or gluing agent. The greatest industrial non-food use of starch is as an adhesive in the papermaking process. Starch solution may be applied to certain textile goods before ironing, to stiffen them.



Fig: 3 Potato Starch

## **1.4 APPLICATIONS OF STARCH**

### **1.4.1 IN FOOD INDUSTRY**

Starch is the most common carbohydrate in the human diet and is contained in many staple foods. The major sources of starch intake worldwide are the cereals (rice, wheat, and maize) and the root vegetables (potatoes and cassava). Many other starchy foods are grown, some only in specific climates, including acorns, arrowroot, bananas, barley, breadfruit, colocasia, millet, oats, sweet potatoes, yams.

Before processed foods, people consumed large amounts of uncooked and unprocessed starch-containing plants, which contained high amounts of resistant starch. Microbes within the large intestine ferment or consume the starch, producing short-chain fatty acids, which are used as energy, and support the maintenance and growth of the microbes. Upon cooking, starch is transformed from an insoluble, difficult-to-digest granule into readily accessible glucose chains with very different nutritional and functional properties. Starch has been classified as rapidly digestible starch, slowly digestible starch, and resistant starch, depending upon its digestion profile. Raw starch granules resist digestion by human enzymes and do not break down into glucose in the small intestine - they reach the large intestine instead and function as prebiotic dietary fibre. When starch granules are fully gelatinized and cooked, the starch becomes easily digestible and releases glucose quickly within the small intestine. When starchy

foods are cooked and cooled, some of the glucose chains re-crystallize and become resistant to digestion again. Slowly digestible starch can be found in raw cereals, where digestion is slow but relatively complete within the small intestine. Widely used prepared foods containing starch are bread, pancakes, cereals, noodles, pasta, porridge and tortilla. Starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas. They function as thickeners, extenders, emulsion stabilizers and are exceptional binders in processed meats [7].

#### **1.4.2 IN PHARMACEUTICAL INDUSTRY**

Starch is used in the pharmaceutical industry as an excipient, a tablet and capsule diluent, a tablet and capsule disintegrant, a glidant, or as a binder [8].

##### **1.4.2.1 AS BINDER**

In tablet formulations, starch prepared to gel (freshly prepared starch paste) by heat treatment of the starch dispersion in water is used at a concentration of 3–20% w/w (usually 5–10%, depending on the starch type) as a binder for wet granulation. This provides the necessary binding force that holds the powder particles together to form the required agglomerates. The quantity of the freshly prepared starch

paste used should be determined by optimization studies, using parameters such as tablet friability and hardness, disintegration time, and drug dissolution rate. This also serves to ensure a uniform distribution and controllable release of the APIs.

#### **1.4.2.2 AS TABLET DISINTEGRANT**

Starch is one of the most commonly used disintegrants for immediate release tablet dosage forms at concentrations of 3–25% w/w (optimum concentration of 15%). The disintegration ability of native starch is due to wicking and restoration of deformed starch particles on contact with aqueous fluid. Some newer sources of starch have been chemically, physically, or enzymatically modified to enhance their disintegrant properties e.g., carboxymethyl starch (CMS) which possesses high swelling capacity (absorb an amount of water 23 times its initial weight) combined with a high rate of water permeation.

#### **1.4.2.3 IN BONE TISSUE ENGINEERING**

As an alternative to the use of metals and ceramics in TE, biodegradable polymers such as starch, collagen, fibrinogen, chitosan, hyaluronic acid (HA), poly(hydroxybutyrate), poly( $\alpha$ -hydroxy acids), poly( $\epsilon$ -caprolactone), poly(propylene

fumarates), poly(carbonates), poly-(phosphazenes) and poly(anhydrides) are believed to be the ideal materials for bone TE. Starch-based biodegradable polymers (SBBP), when used in bone tissue engineering scaffolds, can provide immediate structural support because of its good mechanical properties. It also allows for increased degradation time (producing non-toxic degradation products) and consequently expanded porosity as cellular integration increases, which is optimal for bone tissue engineering.

#### **1.4.2.4 IN ARTIFICIAL RED BLOOD CELLS**

Starch particularly, potato starch has been used to produce artificial red blood cells with good oxygen-carrying capacity. It was prepared by encapsulating hemoglobin (Hb) with long-chain fatty acid grafted potato starch by self-assembly [9].

#### **1.4.3 IN PAPER MAKING**

Papermaking is the largest non-food application for starches globally, consuming many millions of metric tons annually.<sup>[12]</sup> In a typical sheet of copy paper for instance, the starch content may be as high as 8%. Both chemically modified and unmodified starches are used in papermaking. In the wet part of the papermaking process, generally called the "wet-end", the starches used are cationic and have a positive charge bound to the starch polymer. These starch derivatives associate with the anionic or negatively

charged paper fibres / cellulose and inorganic fillers. Cationic starches together with other retention and internal sizing agents help to give the necessary strength properties to the paper web formed in the papermaking process (wet strength), and to provide strength to the final paper sheet (dry strength).

In the dry end of the papermaking process, the paper web is rewetted with a starch-based solution. The process is called surface sizing. Starches used have been chemically, or enzymatically depolymerized at the paper mill or by the starch industry (oxidized starch). The size/starch solutions are applied to the paper web by means of various mechanical presses (size presses). Together with surface sizing agents the surface starches impart additional strength to the paper web and additionally provide water hold out or "size" for superior printing properties. Starch is also used in paper coatings as one of the binders for the coating formulations which include a mixture of pigments, binders, and thickeners. Coated paper has improved smoothness, hardness, whiteness, and gloss and thus improves printing characteristics [10].

#### **1.4.4 IN THE SYNTHESIS OF BIOPLASTICS**

Plastics are indispensable for our society. The extensive use of petroleum-based plastic and dumping of the same in soil and water body greatly affects our environment and biodiversity. The modern world is using synthetic plastics as packaging material, household, disposable medical equipment, and electronics. The

petroleum-based plastics take more than 500 years to decompose in landfills. Petroleum-based polymers are the biggest threat to the environment as these polymers are non-degradable. However, biodegradable plastics can reduce the volume of waste in packaging materials, and thus, the biomass-derived polymer could be a promising alternative to the petroleum-based non-degradable polymer to address environmental issues. Bio-based and biodegradable polymers are promising materials as they are environment friendly and able to make a sustainable future and restore the biodiversity.

Biopolymers are polymers either extracted from living organisms or made from biological sources. However, the biodegradable property does not depend on the origin of the polymers or the corresponding monomeric units. It depends on the monomeric units and the chemical bonding of the polymers. A polymer is categorized as biodegradable if it is metabolized by microorganisms (bacteria, fungi, algae, yeasts, etc.) present in the natural environment such as soil or land surface, river or seawater, compost, etc. within a given time (2 to 6 months). Polysaccharides such as starch and cellulose are the most abundant and simplest biobased polymers. However, the use of these polymers was restricted in a few sectors such as textiles, construction, etc [11].

Plasticizers are molecules with low molecular weight and low volatility, which reduce intermolecular forces and increase polymer chains mobility. The most common plasticizers include water,

glycerol, propylene glycol and polyethylene glycol [12]. It can improve physical and mechanical properties. Glycerol as the plasticizer can improve bioplastic properties. It has the function to improve the ability of bioplastic in absorbing water and as crystal forming agent. Other characteristics of glycerol are related to toxicity and low mass transfer as natural plasticizers. Glycerol is a non-toxic, edible, and biodegradable substance that is good for the environment [13].

### **1.5 SIGNIFICANCE OF NANOPARTICLES IN INCREASING SHELF-LIFE**

The incorporation of nanoparticles in the polymer matrix or the fabrication of nanocomposites overcomes the shortcomings of the biodegradable polymers. One of the great advantages of nanoparticles is the ability to tune the rate of biodegradation (it is possible to both increase and decrease the rate as compared to that of the pure polymer) depending upon the need. Thus, chemical, physical, and biological properties of the biodegradable polymers can be modified and controlled for sustainable applications in medicine and other areas.

Biopolymers are biodegradable materials, because at least one step in the process of degradation appeared because of metabolism of microorganisms that occur naturally in the environment. Under certain conditions of humidity, temperature and exposure to oxygen, biodegradation leads to the decomposition and degradation of the polymeric material to a non-toxic and

environmentally acceptable residue. Biopolymers as packaging material are relatively poor material because of its mechanical and barrier properties which currently limits its industrial use. A particular challenge is the development of moisture barrier properties because of the hydrophilic nature of biopolymers. However, it has been shown that the disadvantages of packaging materials based on biopolymers or biodegradable plastics can be reduced by application of nano composites technology. The use of biopolymer/biodegradable plastics is still limited due to these challenges and problems. However, the application of nanotechnology, i.e., by incorporation of nanoparticles or preparing polymer nano composites can help to overcome these problems. The nanoparticles have a high specific surface, and the advantage of ultra large contact area per unit volume between the polymer matrix and nano elements, greater functionality per unit weight and the lack of high surface energy which results in agglomeration of the particles [14].

Zinc Oxide is well-known environmentally friendly, biocompatible, and multifunctional inorganic filler characterized by effective antibacterial function and intensive ultraviolet absorption. Zinc oxide nanoparticles (ZnO NPs) amongst other nanoparticles have gained a vital position in the enhancement of packaging properties like barrier, mechanical and antimicrobial properties [15]. It is commonly used as preservative and incorporated in polymeric packaging material to prevent food material from damage by microbes. Incorporating ZnO nanoparticles generates other

additional benefits such as the antimicrobial activity that allows bioplastics can be used as a pesticide [16]. Its crystalline structure, very large surface area and excellent mechanical properties also become advantages of ZnO to reinforce polymeric nanocomposites. Since it has high mechanical properties, the good interaction between ZnO and polymers would generate better transfer of ZnO mechanical properties to polymer matrices. The antibacterial activity of ZnO is due to the production of reactive oxygen species that generates the oxidation of bacterial cells cytoplasm, resulting in cell death. ZnO-nanorods decrease the moisture content and water absorption capacity of starch and gelatin-based bioplastics while improving their mechanical properties and antimicrobial activity by increasing the inhibition zone of nano-incorporated films [17].

### **1.6 OBJECTIVES**

- To synthesize bioplastic film from potato starch.
- To characterize the synthesized bioplastic film using SEM and XRD.
- To synthesize zinc oxide nanoparticles.
- To characterize the synthesized nanoparticles using XRD.
- Incorporation of Zinc oxide nanoparticles to the bioplastic.

- To study the enhancement of shelf-life of nano ZnO incorporated bioplastic film.
  
- To compare the soil and bacterial degradation of the prepared bioplastic and the nano ZnO incorporated bioplastic.
  
- To compare the mechanical properties of the prepared bioplastic and the nano ZnO incorporated bioplastic.

# Chapter 2

## Materials and Methods

### 2.1 MATERIALS

Potatoes were collected from Ernakulam Market, Kerala, India. The starch was extracted from potatoes. Glycerol, glacial acetic acid (10% acetic acid prepared from it), zinc acetate and sodium hydroxide pellets supplied by Nice Chemicals (P) Ltd, Kochi, Kerala were used.

### 2.2 METHODS

#### 2.2.1 SYNTHESIS OF ZINC OXIDE NANOPARTICLES

400 ml of 0.1M zinc acetate solution and 400 ml of 0.1M sodium hydroxide solution were prepared. 400 ml zinc acetate solution was taken in a 1000 ml beaker. Sodium hydroxide solution was taken in a burette. NaOH solution was added slowly dropwise under vigorous stirring. The addition was continued overnight. A dense white precipitate was obtained. The nanoparticles were separated by centrifugation and washed with distilled water. They were

dried in an oven at 60 °C for 12 hour and ignited in muffle furnace at 500°C for 15 minutes.

### **2.2.2 EXTRACTION OF POTATO STARCH FROM POTATO**

1 kg of potato was washed, and the peels were removed. The cleaned potatoes were smashed and grinded thoroughly with water. The ground potato was strained, and water was poured into the paste and kept for an hour to settle down. The water was removed, and starch was washed with distilled water and dried in an oven at 60°C for 2 hours.



Fig: 4 Cleaned potatoes



Fig: 5 Smashed and strained potatoes



Fig: 6 Settled starch



Fig: 7 Dried starch powder

### 2.2.3 SYNTHESIS OF BIOPLASTIC FILM FROM POTATO STARCH

5g of potato starch was taken in a 200 ml beaker. 20 ml of distilled water was added into the beaker. 10 ml of 10% acetic acid was then added to the beaker. The solution was heated with continuous stirring and another 20 ml of distilled water was also added to the solution. 2 ml of glycerol was added to the solution when it boiled. The solution was heated for 15 minutes with the addition of 20 ml of distilled water. The mixture was spread on the ceramic plate and kept for 3 days to get the dry plastic film.



Fig: 8 The bioplastic prepared from potato starch

#### **2.2.4 INCORPORATION OF ZINC OXIDE NANOPARTICLES INTO THE BIOPLASTIC FILM**

Zinc oxide nanoparticles were incorporated in the bioplastic in various concentrations.

5g potato starch was added in a 200 ml beaker. 20 ml distilled water and 10ml 10% acetic acid was added. 0.0200g ZnO nanoparticles was added to it and the solution was boiled with continuous stirring. Another 20 ml distilled water and 2 ml of glycerol was added and allowed to boil. Boiling was continued for 15 minutes. The mixture was spread on the ceramic plate and kept for 3 days for drying. The bioplastic film was then peeled off. Thus, bioplastic film with 0.4% ZnO NPs was prepared.

Similarly, by adding 0.0505g and 0.1020g ZnO NPs to the potato starch solution, bioplastic film with 1% and 2% ZnO NPs were prepared.

Bioplastic films were prepared by adding zinc oxide nanoparticles in different quantities as shown in the table 1.

Table: 1 Samples prepared

	Potato starch	ZnO NPs
Sample-1	5 g	0 %
Sample-2	5 g	0.4 %
Sample-3	5 g	1 %
Sample-4	5 g	2 %

### 2.2.5 DEGRADATION STUDIES

Starch is a biopolymer and hence, starch-based bioplastic can degrade in the natural environment. We carried out biodegradation study at different experimental conditions.

The biodegradability of the prepared bioplastic films was studied by three methods.

1. Air degradation
2. Soil degradation
3. Bacterial degradation

### 2.2.5.1 AIR DEGRADATION

Small pieces of bioplastic from four samples were kept in air at room temperature. Observations were taken on every 3 days until 65 days.

### 2.2.5.2 SOIL DEGRADATION

Weight loss measurement is a standard method for biodegradation of polymer. Pre-weighed pieces of bioplastic from four samples were buried in soil. The samples were taken out from soil every 3 days and the weight was measured. This process was done for 55 days, and final weight was measured. Amount of biodegradation was calculated by following equation:

$$\text{Weight loss \%} = \left( \frac{W_0 - W}{W_0} \right) \times 100$$

where  $W_0$  and  $W$  are the initial and final weights of bioplastic samples respectively.

### 2.2.5.3 BACTERIAL DEGRADATION

Pre-weighed pieces of bioplastic from four samples were inoculated in a cultured bacteria solution for 7 days. The same was repeated in a solution without bacteria also for the same period.

### **2.2.6 MECHANICAL STRENGTH**

Pieces of bioplastic from four samples were cut in dimensions of 5cm length and 1cm width and tested using Universal Testing Machine (UTM).

### **2.3 CHARACTERIZATION TECHNIQUES**

Characterization, when used in material science, refers to the use of external techniques to probe into the internal structure and properties of a material. Characterization can take the form of actual materials testing or analysis. Analysis techniques are used to simplify to magnify the specimen, to visualize its internal structure, and to gain knowledge as to the distribution of elements within the specimens and their interactions.

#### **2.3.1 X-RAY DIFFRACTION ANALYSIS**

X-Ray diffraction technique is a precise and popular tool for determining the crystal structure of thin films. It yields complete information about the crystal structure, orientation, lattice constants, crystalline size and composition, defects, and stress in the thin film. From the position and shape of the lines, one can obtain information regarding the unit cell parameters and microstructural parameters (grain size, micro

strain, etc.), respectively. It requires no sample preparation and is essentially non-destructive. The wave nature of X-Rays means that they are diffracted by the lattice of the crystal to give a unique pattern of peaks of reflections at differing angles and of different intensity, just as light can be diffracted by a grating of suitably spaced lines.

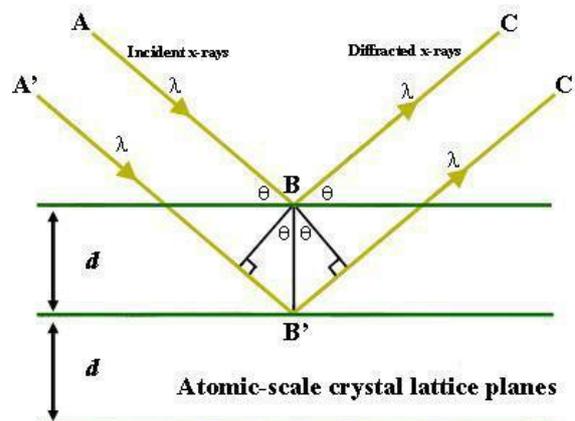


Fig: 9 Bragg's Law of X-Ray Diffraction

The diffracted beam from atoms in successive planes cancels unless they are in phase, and the condition for this is given by Bragg's relationship.

$$n\lambda = 2d\sin\theta$$

Here  $d$  is the inter-spacing,  $\Theta$  is the angle of diffraction,  $\lambda$  is the wavelength of the incident beam and  $n$  is the order of diffraction. Diffraction peak position is accurately measured with XRD, which makes it the best method for characterizing homogeneous and inhomogeneous strains. Homogeneous or uniform elastic strain shifts the diffraction peak position. From the shift in peak position, one can calculate the change in  $d$ -spacing, which is the result of the change of lattice constants under a strain. In homogeneous strains vary from crystallite to crystallite or within a single crystallite and this cause a broadening of the diffraction peaks that increase with  $\cos \Theta$ . The crystallite size,  $D$  can be determined using Debye-Scherrer formula

$$D = \frac{K\lambda}{B \cos\theta}$$

Where,  $\lambda$  is the X-ray wavelength,  $K$  is the scherrer constant,  $B$  is the full width of the height of a diffraction peak,  $\Theta$  is the diffraction angle. XRD is a non-destructive technique and does not require elaborate sample preparation, which partly explains the wide usage of XRD method in materials characterization. In addition, X-ray diffraction only provides the collective information of the particle sizes and usually requires a sizeable amount of powder. It should be noted that

since the estimation would work only for very small particles, this technique is very useful in characterizing nanoparticles.

XRD of the synthesized ZnO nanoparticles and prepared bioplastic films were analysed.

### **2.3.2 SCANNING ELECTRON MICROSCOPE**

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image. In the most common SEM mode, secondary electrons emitted by atoms excited by the electron beam are detected using a secondary electron detector (Everhart-Thornley detector). The number of secondary electrons that can be detected, and thus the signal intensity, depends, among other things, on specimen topography. Some SEMs can achieve resolutions better than 1 nanometer.

Specimens are observed in high vacuum in a conventional SEM, or in low vacuum or wet conditions in a variable

pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments [18].



Fig: 10 Scanning Electron Microscope

SEM analysis of the prepared bioplastic films were done.

# Chapter 3

## Results and discussion

### 3.1 X-RAY DIFFRACTION STUDIES - ZINC OXIDE NANOPARTICLES

The XRD pattern of the zinc oxide nanoparticles is shown in Fig: 11.

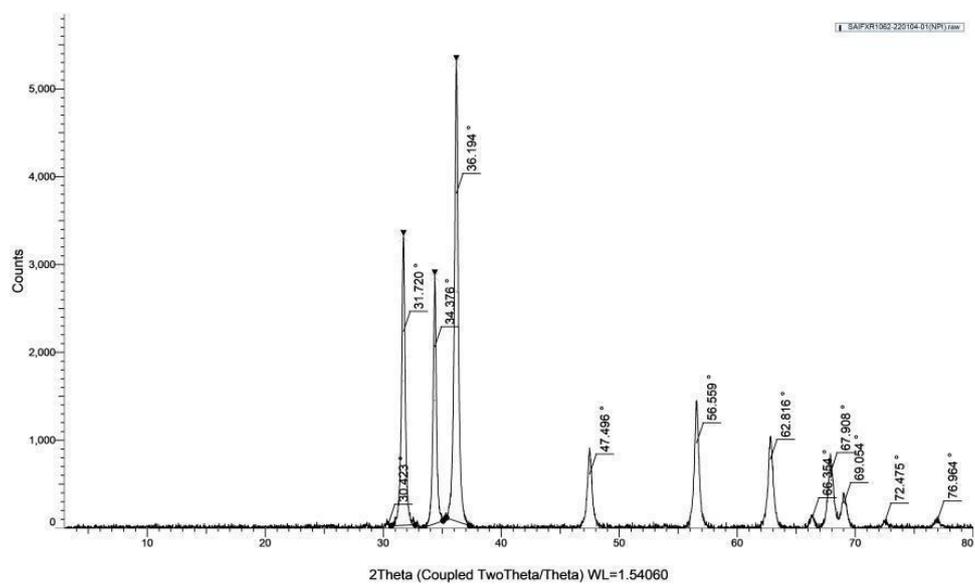


Fig: 11 XRD pattern of Zinc Oxide Nanoparticles

The XRD analysis showed diffraction peaks characteristic of ZnO nanoparticles. The diffraction peaks observed at 31.710°, 34.370°, 36.370°, 47.496°, 56.559°, 62.816°, 67.908° and 69.054° attributed to the hexagonal wurtzite phase of ZnO nanoparticles, which were reported in earlier studies.

### 3.1.1 XRD - Particle Size Calculation

From this study, considering the peak at degrees, average particle size has been estimated by using Debye-Scherrer formula,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

where  $\lambda$  is the wavelength of X-ray (0.1541nm), B is FWHM (full width at half maximum),  $\theta$  is the diffraction angle and D is the particle diameter size. The calculated particle size details are in Table 2.

### 3.1.2 Calculations - Particle size determination by XRD

**Peak 1:**

$$2\theta = 31.710^\circ$$

$$= 15.855^\circ = 0.2767 \text{ radian}$$

$$B = 0.315^\circ = 0.00549 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.00549 \times \cos(0.2767)}$$

$$= 25.256 \text{ nm}$$

**Peak 2:**

$$2\theta = 34.370^\circ$$

$$= 17.185^\circ = 0.2999 \text{ radian}$$

$$B = 0.279^\circ = 0.00486 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.00486 \times \cos(0.2999)} = 28.530 \text{ nm}$$

**Peak 3:**

$$2\theta = 36.370^\circ$$

$$= 18.185^\circ = 0.3173 \text{ radian}$$

$$B = 0.334^\circ = 0.0058 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.0058 \times \cos(0.3173)} = 23.906 \text{ nm}$$

$$\text{Mean value} = \frac{(25.256 + 28.530 + 23.906)}{3} = 25.897 \text{ nm}$$

Table 2: Particle size calculation from XRD

2 of the intense peak (degree)	FWHM of intense peak	Size of the particle (D) (nm)	Average
31.710	0.315	25.256	<b>25.897nm</b>
34.370	0.279	28.530	
36.370	0.334	23.906	

Full width at half maximum (FWHM) data was used with Scherrer's formula to determine the average particle size. The results are tabulated in table 2. The average particle size estimated was 25.897nm.

### 3.2 X-RAY DIFFRACTION STUDIES - BIOPLASTIC FROM POTATO STARCH

The XRD pattern of the bioplastic film from potato starch is shown in Fig: 12.

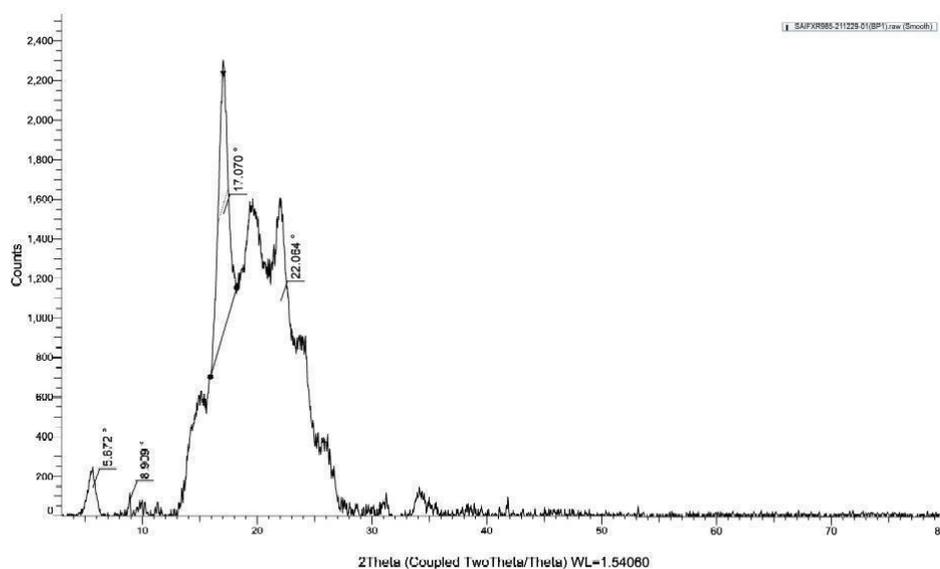


Fig: 12 XRD pattern of sample 1

The XRD analysis showed diffraction peaks characteristic of potato starch films. The characteristic diffraction peaks

appeared clearly at  $22.064^\circ$  and  $17.070^\circ$ , which could be attributed to the crystalline and amorphous fractions of the potato starch.

### 3.3 X-RAY DIFFRACTION STUDIES - BIOPLASTIC WITH ZnO NANOPARTICLES

To study the incorporation of ZnO nanoparticles in bioplastic film, XRD studies have been done. The XRD patterns of the bioplastic film with ZnO nanoparticles in concentration such as 0.4%, 1%, and 2% are shown in fig 13, fig 14 and fig 15 respectively.

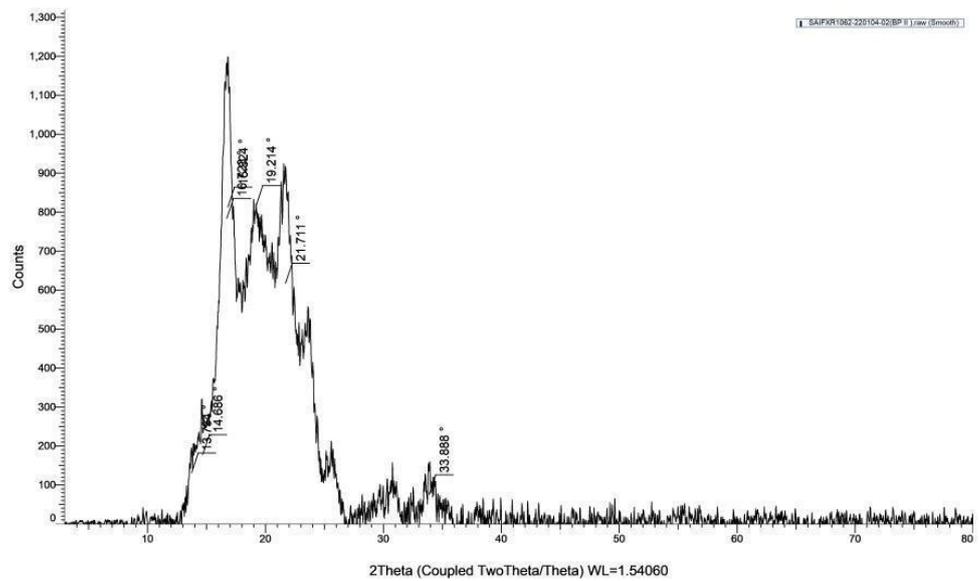


Fig: 13 XRD pattern of sample 2

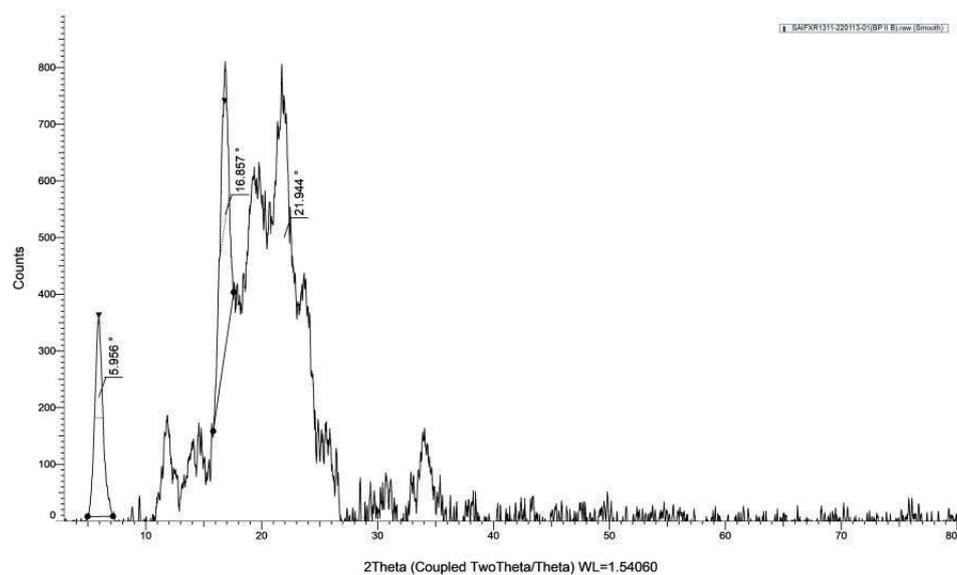


Fig: 14 XRD pattern of sample 3

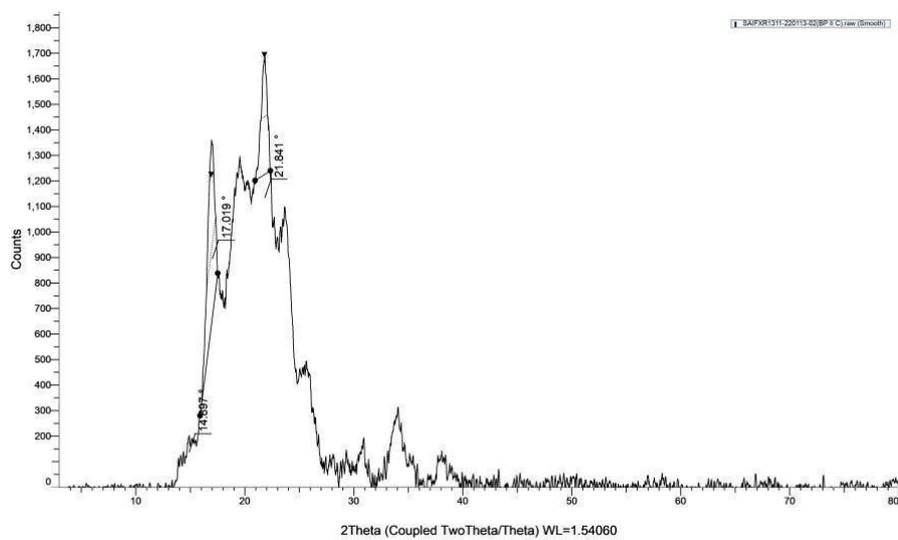


Fig: 15 XRD pattern of sample 4

XRD pattern showed that peaks between 2 values  $30^\circ$  and  $40^\circ$  are characteristic to those present in XRD pattern of ZnO nanoparticle. Due to the presence of very small number of nanoparticles, the intensity of these peaks is weak. The presence of these peaks indicates the incorporation of ZnO nanoparticles.

### **3.4 SEM ANALYSIS**

SEM images of the samples were taken to study the surface change before and after the incorporation of nanoparticles. SEM image of all the four samples is shown in fig 16 to fig 19. These images reveals that the incorporation does not cause any surface modification to the bioplastic films. Surfaces were found to be smooth and uniform before and after the incorporation.

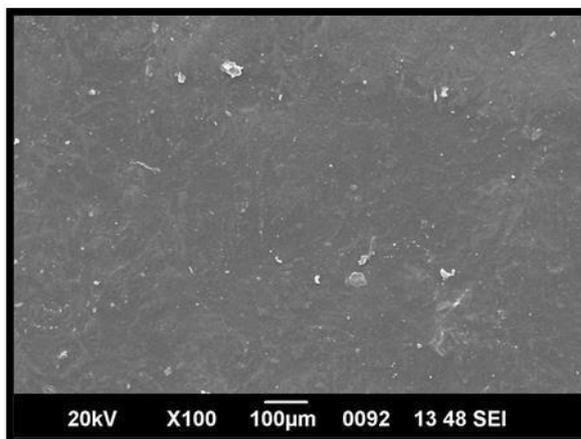


Fig: 16 SEM image of sample 1

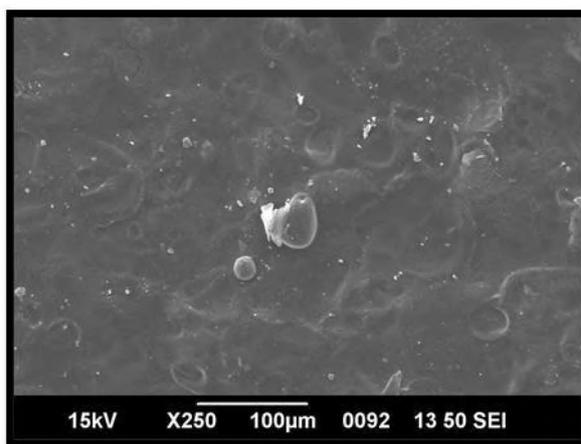


Fig: 17 SEM image of sample 2

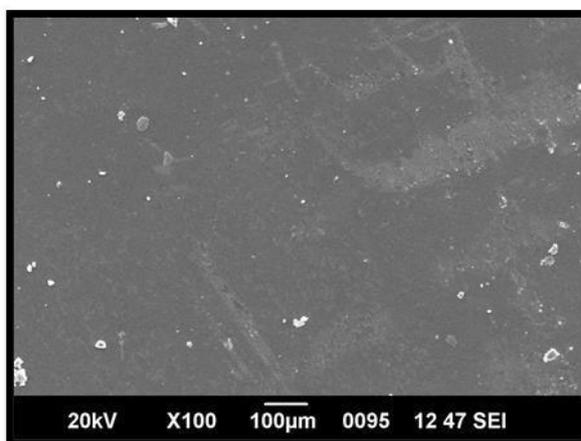


Fig: 18 SEM image of sample 3

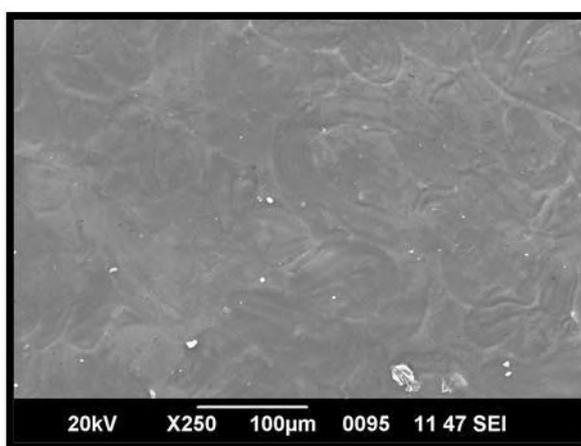


Fig: 19 SEM image of sample 4

### **3.5 DEGRADATION STUDIES**

#### **3.5.1 AIR DEGRADATION: STUDY OF SHELF-LIFE OF BIOPLASTIC**

**SAMPLE 1 (0% ZnO NPs)**

A piece of bioplastic film prepared from potato starch (Sample 1) was kept in the open and was observed for 56 days to study its shelf-life. Pictures were taken on day 1, day 25, day 50 and day 56 and are shown in figures 20 to 23.



Fig: 20 Day 1



Fig: 21 Day 25



Fig: 22 Day 50



Fig: 23 Day 56

The fungal attack occurred on 56<sup>th</sup> day and the sample started degrading.

**SAMPLE 2 (0.4% ZnO NPs)**

Photographs were taken on day 1, day 25, day 50 and day 65 and are shown in figures 24 to 27.



Fig: 24 Day 1



Fig: 25 Day 25



Fig: 26 Day 50



Fig: 27 Day 65

**SAMPLE 3 (1% ZnO NPs)**

Photographs were taken on day 1, day 25, day 50 and day 65 and are shown in figures 28 to 31.

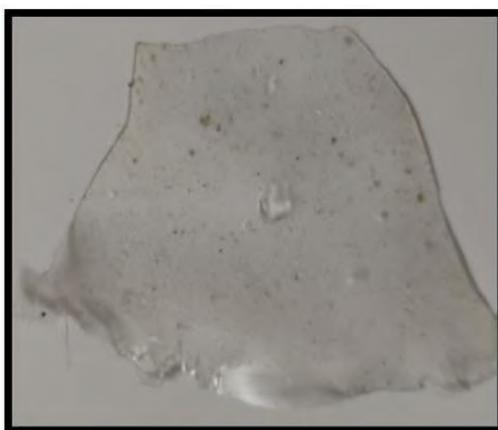


Fig: 28 Day 1



Fig: 29 Day 25



Fig: 30 Day 50



Fig: 31 Day 65

**SAMPLE 4 (2% ZnO NPs)**

Photographs taken on day 1, day 25, day 50 and day 65 and are shown in figures 32 to 35.



Fig: 32 Day 1



Fig: 33 Day 25



Fig: 34 Day 50



Fig: 35 Day 65

As it is clear from the above photographs, the bioplastic films incorporated with zinc oxide nanoparticles showed an increase in shelf-life. Observations were made only upto 65 days. None of the samples degraded even until 65 days.

### 3.5.2 SOIL DEGRADATION

Pre-weighed pieces of all samples were immersed in soil and observations were made up to 55 days. Weight loss percentage was found out by using the following equation where  $W_0$  and  $W$  are the initial and final weights of bioplastic samples respectively.

$$\text{Weight loss \%} = \left( \frac{W_0 - W}{W_0} \right) \times 100$$

The weight loss data is tabulated in table 3.

#### SAMPLE 1 (0% ZnO NPs)

The photographs taken on day 1, day 4 and day 7 are shown in figures 36 to 38.



Fig: 36 Day 1



Fig: 37 Day 4



Fig: 38 Day 7

The piece of sample taken had an initial weight of 0.21g and after 10 days, it degraded completely. Thus, sample 1 which is virgin bioplastic film from potato starch showed 100% weight loss within 10 days (Table 3).

**SAMPLE 2 (0.4% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 39 to 44.



Fig: 39 Day 1



Fig: 40 Day 7



Fig: 41 Day 16



Fig: 42 Day 31



Fig: 43 Day 49



Fig: 44 Day 55

**SAMPLE 3 (1% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 45 to 50.



Fig: 45 Day 1



Fig: 46 Day 7



Fig: 47 Day 16



Fig: 48 Day 31



Fig: 49 Day 49



Fig: 50 Day 55

**SAMPLE 4 (2% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 51 to 56.



Fig: 51 Day 1



Fig: 52 Day 7



Fig: 53 Day 16



Fig: 54 Day 31



Fig: 55 Day 49



Fig: 56 Day 55

The weight loss percentage of each sample has been determined and tabulated in Table 3 and fig. 57 shows the graph of weight reduction of bioplastic samples up to 55 days.

**Table 3: Weight loss percentage of each sample after soil degradation**

Bioplastic	No. of days observed	Weight Loss %
Sample 1	10	100
Sample 2	55	48.74
Sample 3	55	86.40
Sample 4	55	89.31

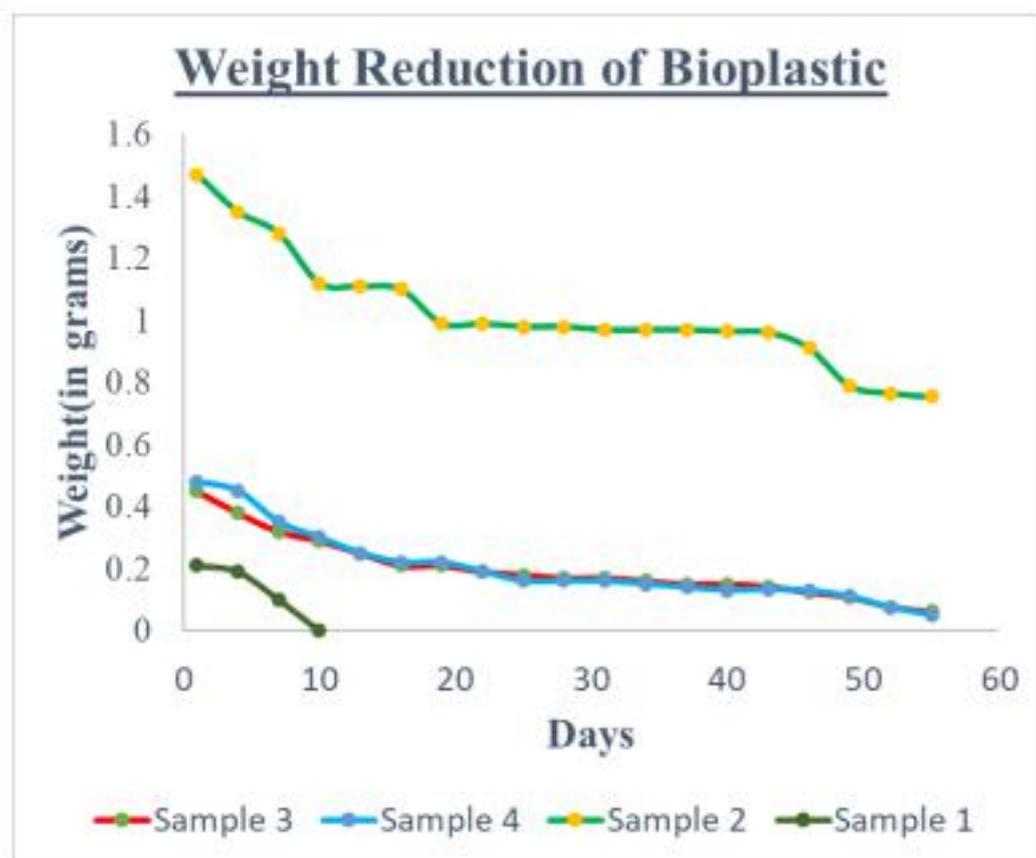


Fig: 57 Weight reduction of bioplastic in soil upto 55 days

As the concentration of ZnO nanoparticles increases, the degradability of bioplastic also increases. Weight loss percentage was greater for sample 4 i.e., bioplastic with 2% ZnO nanoparticles.

### 3.5.3 BACTERIAL DEGRADATION

The weight loss percentage for 7 days is tabulated in Table 4. Weight loss % of each bioplastic is shown in fig 58.

Table 4: Weight loss percentage of each sample after 7 days bacterial degradation

Bioplastic	With bacteria		Weight loss %	Without bacteria		Weight loss %
	Initial weight (g)	Final weight (g)		Initial weight (g)	Final weight (g)	
Sample 1	0.22	0.08	63.63	0.27	0.21	22.22
Sample 2	0.25	0.14	44	0.30	0.30	0
Sample 3	0.21	0.14	33.33	0.23	0.21	8.69
Sample 4	0.20	0.15	25	0.34	0.31	8.82

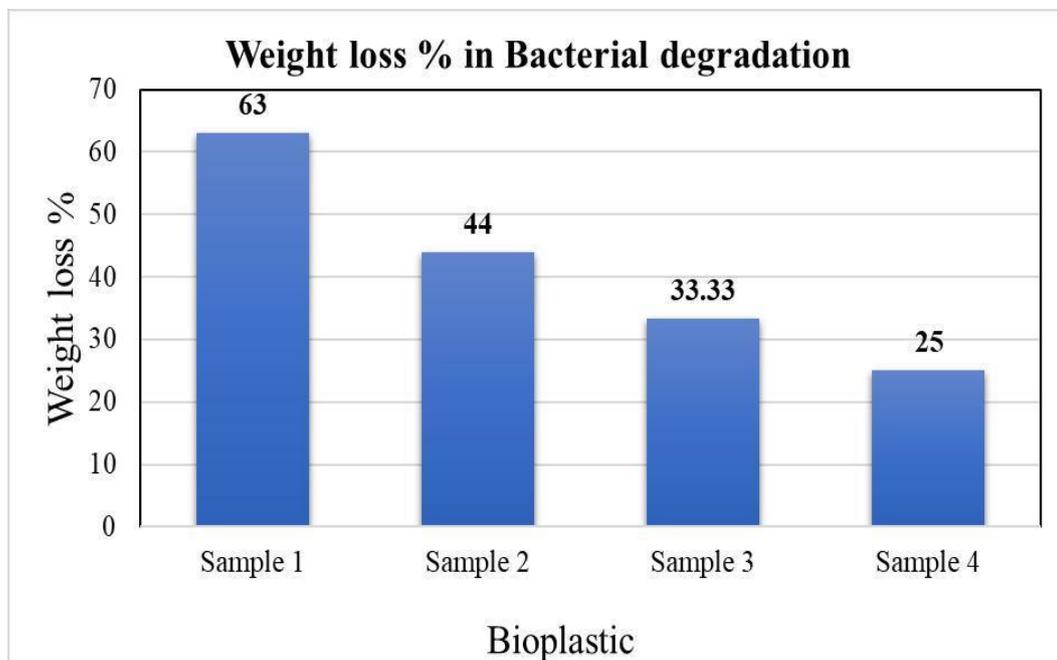


Fig: 58 Weight loss % of bioplastic after bacterial degradation

Bacterial degradation studies of bioplastic samples reveal that as the concentration of ZnO nanoparticles increases weight loss percentage decreases. This may be due to the antibacterial property of ZnO nanoparticles. Weight loss percentage was greater for sample 1 with 0% ZnO nanoparticles and lesser for sample 4 with 2% ZnO nanoparticles.

The pictures taken on day 1 and day 7 of various samples with bacteria are shown in fig 59 – fig 66.

**SAMPLE 1 (0% ZnO NPs)**

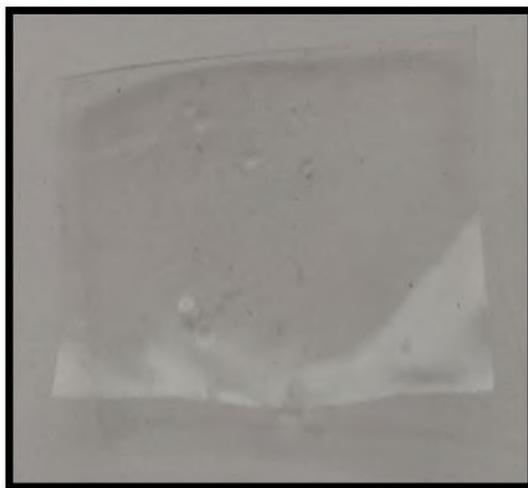


Fig:59 Day 1



Fig:60 Day 7

**SAMPLE 2 (0.4% ZnO NPs)**



Fig:61 Day 1



Fig:62 Day 7

**SAMPLE 3 (1% ZnO NPs)**

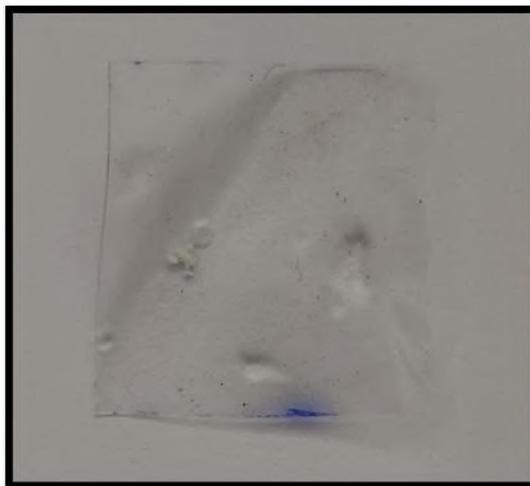


Fig:63 Day 1



Fig:64 Day 7

**SAMPLE 4 (2% ZnO NPs)**

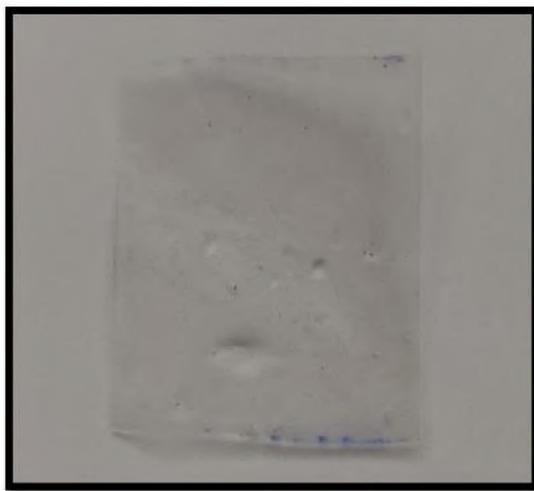


Fig:65 Day 1



Fig:66 Day 7

### **3.6 MECHANICAL PROPERTIES**

To know the quality of resulted bioplastic film, several parameters which are usually used to analyse the samples are measured such as tensile strength, elongation at break. Mostly, bioplastic materials are used because they have desirable mechanical properties such as tensile strength and elongation at break. For this reason, the mechanical properties may be considered as the most important of all the physical properties of bioplastic for most applications.

Tensile strength indicates the ability to accept load or tension without damaging the composite or broken which is stated with a maximum tension before breaking namely ultimate tensile strength. Tensile strength of composite material can be affected by several factors, including the relative comparison between the matrix and the reinforcement materials in composite materials, namely how many zinc oxide is added to the polymer matrix compared with composite materials. Elongation at Break indicates the quantity of the change of maximum film length while obtaining tensile strength until the film breaks, compared to the initial length. The result of tensile strength and elongation at break is given in Table 5.

**Table 5: Tensile strength and percentage elongation of bioplastic films**

Bioplastic	Tensile strength (N/mm <sup>2</sup> )	Percentage elongation (%)
Sample 1	2.6879	43.437
Sample 2	1.5866	37.309
Sample 3	1.0832	46.749
Sample 4	0.9424	49.8527

The increase of zinc oxide quantity indicates the tendency to decrease tensile strength value. In other words, higher the concentration of nano zinc oxide, the tensile strength is found to diminish. This is because the particles have more space in the matrix (starch), thus affecting the tensile strength of the bioplastic film. Percentage elongation will increase with increasing concentration of zinc oxide nanoparticles. The maximum tensile strength obtained was 2.6879 N/mm<sup>2</sup> for the virgin sample (sample 1: without any addition of ZnO nanoparticles).

Fig 67 and fig 68 shows the variation in tensile strength and percentage elongation of bioplastic, respectively.

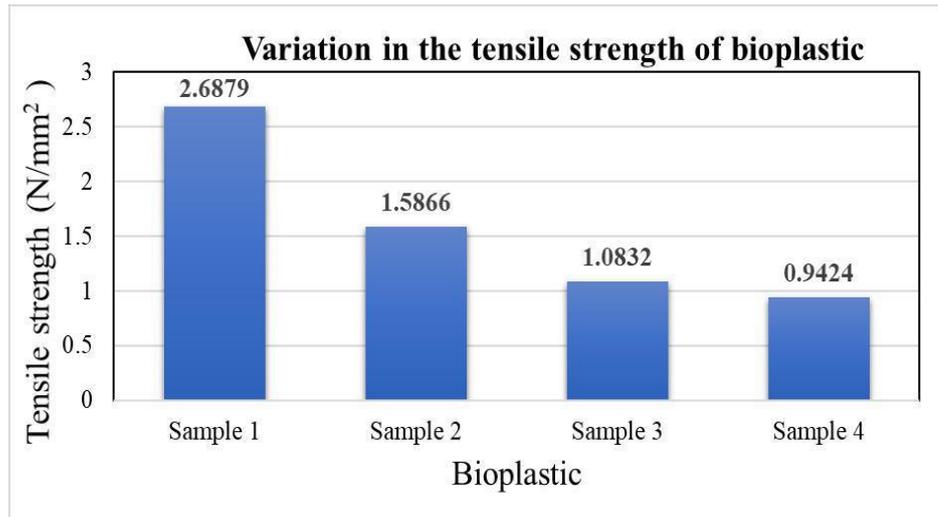


Fig: 67 Variation in tensile strength of bioplastic

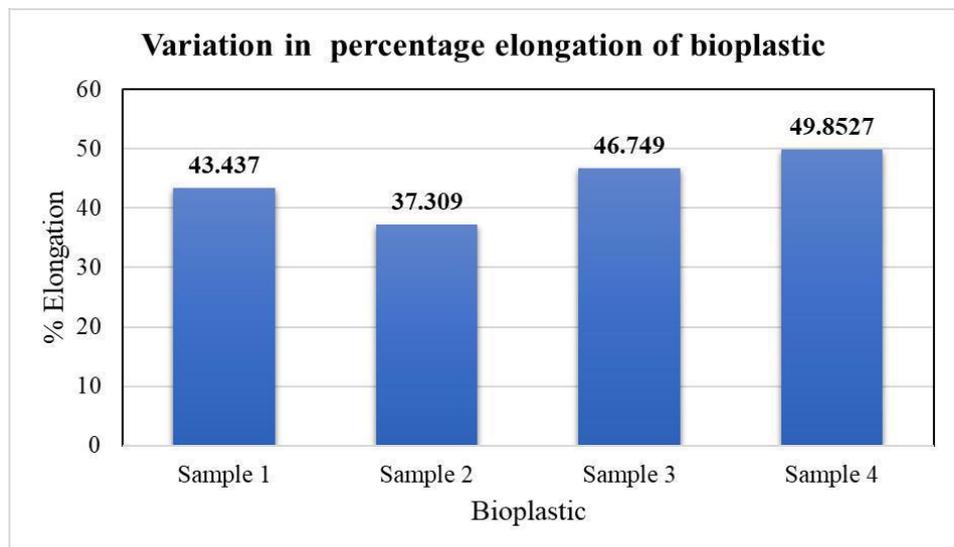


Fig: 68 Variation in percentage elongation of bioplastic

# Chapter 4

## Conclusions

Potato starch was extracted, and bioplastic was prepared from it. The prepared bioplastic films were characterized using SEM and XRD

Zinc oxide nanoparticles were prepared by precipitation method and characterized using XRD. The average particle size was found to be 25.897nm.

Different sheets of bioplastic were prepared by adding ZnO nanoparticles in various concentration i.e., 0.4%, 1% and 2%.

The incorporation of ZnO nanoparticles to the film was analysed using XRD. XRD of these films shows the characteristic 2 values between 30° and 40° which is present as in the XRD of ZnO nanoparticles.

The bioplastic films were analysed using SEM to study the surface morphology before and after the incorporation of nanoparticles. Surface was found to be smooth and uniform.

The prepared bioplastic films were kept in the open and observations were made. The virgin bioplastic film had a shelf-life of 56 days. The bioplastic films incorporated with zinc oxide nanoparticles showed an increase in shelf-life. None of the samples degraded even until 65 days.

Biodegradability of prepared bioplastic films were studied.

Soil degradation studies shows that as the concentration of ZnO nanoparticles increases, the degradability of bioplastic also increases. Weight loss percentage was lesser for bioplastic with 0.4% ZnO nanoparticles, i.e., 48.74% and greater for bioplastic with 2% ZnO nanoparticles, i.e., 89.31%.

Bacterial degradation studies show that as the concentration of ZnO nanoparticle increases degradation decreases. This may be due to the antibacterial property of ZnO nanoparticles. Weight loss percentage was lesser for bioplastic with 2% ZnO nanoparticles, i.e., 25% and greater for virgin bioplastic film, i.e., 63.63%.

Tensile strength and % elongation were determined. It was observed that as the concentration of nanoparticles increases the tensile strength tends to decrease. The

maximum tensile strength obtained was 2.6879 N/mm<sup>2</sup> for the virgin sample without any addition of ZnO nanoparticles.

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- [18] Analysis of Nanosized Jackfruit Seed Powder for synthesis of Bioplastic and enhancement of shelf life using Silver Nanoparticles

# PROJECT REPORT

On

**“ZnO INCORPORATED BIOPLASTICS FROM POTATO  
STARCH: PREPARATION, BIODEGRADABILITY  
STUDIES AND MECHANICAL PROPERTIES”**

Submitted by

**ASWATHY RAVI  
(AM20CHE005)**

*In partial fulfillment for the award of the  
Post graduate Degree in Chemistry*



**DEPARTMENT OF CHEMISTRY  
AND  
CENTRE FOR RESEARCH**

**ST. TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM**

**2021-2022**

BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by ASWATHY RAVI.

Dr. Jaya L Varkey  
Head of the Department

Dr. Saritha Chandran A.  
Staff-member in charge

*Aswathy*  
10/6/2022

DEPARTMENT OF CHEMISTRY  
AND  
CENTRE FOR RESEARCH

ST. TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM



M.Sc. CHEMISTRY PROJECT REPORT

Name : Aswathy Ravi  
Register Number : AM20CHE005  
Year of Work : 2021 - 2022

This is to certify that the project "ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by ASWATHY RAVI.

Dr. Jaya L Varkey  
Head of the Department

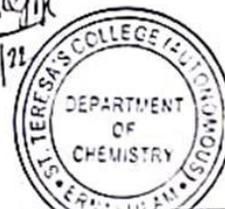
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Staff-member in charge

Submitted to the Examination of Master's degree in Chemistry

Date: 10/6/2022

Examiners: Dr. P. Ananthapadmanabhan *Aswathy*  
10/6/2022

Dr. Jesu George *Jesug*  
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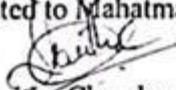
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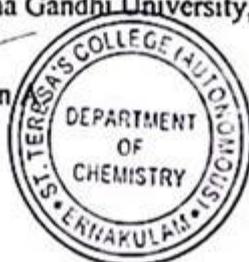
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CERTIFICATE

This is to certify that the project work entitled "ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by Aswathy Ravi under the guidance of Dr. Saritha Chandran A., Assistant Professor and Research Guide, Department of Chemistry and Centre for Research, St. Teresa's College, Ernakulam in partial fulfilment of the award of the Degree of Master of Science in Chemistry at St. Teresa's College, Ernakulam affiliated to Mahatma Gandhi University, Kottayam.

  
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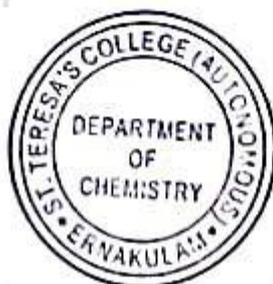


**CERTIFICATE**

This is to certify that the project work entitled "ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES" is the work done by ASWATHY RAVI under my guidance in the partial fulfilment of the award of the Degree of Master of Science in Chemistry at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam.

Dr. Saritha Chandran A.

Project Guide



## **DECLARATION**

I hereby declare that the project work entitled “**ZnO INCORPORATED BIOPLASTICS FROM POTATO STARCH: PREPARATION, BIODEGRADABILITY STUDIES AND MECHANICAL PROPERTIES**” submitted to Department of Chemistry and Centre for Research, St. Teresa’s College (Autonomous) affiliated to Mahatma Gandhi University, Kottayam, Kerala is a record of an original work done by me under the guidance of Dr. SARITHA CHANDRAN A., ASSISTANT PROFESSOR AND RESEARCH GUIDE, Department of Chemistry and Centre for Research, St. Teresa’s College (Autonomous), Ernakulam. This project work is submitted in the partial fulfillment of the requirements for the award of the Degree of Master of Science in Chemistry.

**ASWATHY RAVI**

## *Acknowledgements*

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The success and outcome of this project required a lot of guidance and assistance from many people, and I am extremely fortunate to have got this all along the completion of my project work. Whatever I have done are only due to such guidance and assistance and I would not forget to thank them.

First, I thank God almighty for being with me throughout all the days and helping me to complete the project successfully.

I respect and thank my project guide Dr. Saritha Chandran A., Assistant Professor and Research Guide, Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for her valuable and enlightened guidance and the support and suggestions which helped me in completing this project.

I extend my sincere gratitude to Dr. Jaya T. Varkey, Head of the Department, Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for providing me with all the facilities and support to meet my project requirements.

I convey my sincere gratitude to Dr. Ushamani M., Assistant Professor and Research Guide, Department of Chemistry, St.

### *Acknowledgements*

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Teresa's College (Autonomous), Ernakulam for her valuable suggestions and support during my project.

I also express my sincere gratitude to Dr. Sr. Vinita CSST, Director, St. Teresa's College (Autonomous), Ernakulam and Dr. Lizzy Mathew, Principal, St. Teresa's College(Autonomous), Ernakulam for their extended support and cooperation during my project work.

I also like to extend my sincere thanks to Sophisticated Test and Instrumentation Centre and Department of Polymer Science and Rubber Technology, CUSAT for their assistance in various stages of completion of project.

I would like to convey my gratitude towards my parents and friends for their cooperation and encouragement which helped me in the completion of this project.

I thank all the teachers and non-teaching staffs of Department of Chemistry, St. Teresa's College (Autonomous), Ernakulam for their support and cooperation during my entire project work.

*Aswathy Ravi*

## *Contents*

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<b>Chapter 1 Introduction</b>	<b>1</b>
1.1 Potato	1
1.2 Potato Plant	3
1.3 Starch	5
1.4 Application of Starch	7
1.4.1 In Food Industry	7
1.4.2 In Pharmaceutical Industry	8
1.4.2.1 As Binder	8
1.4.2.2 As Tablet Disintegrant	9
1.4.2.3 In Bone Tissue Engineering	9
1.4.2.4 In Artificial Red Blood cells	10
1.4.3 In Paper Making	10
1.4.4 In the Synthesis of Bioplastics	11
1.5 Significance of Nanoparticles in increasing shelf – life	13
1.6 Objectives	15
<b>Chapter 2 Materials and Methods</b>	<b>17</b>
2.1 Materials	17
2.2 Methods	17
2.2.1 Synthesis of Zinc Oxide Nanoparticles	17

## Contents

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2.2.2 Extraction of Potato starch from Potato	18
2.2.3 Synthesis of Bioplastic film from Potato starch	20
2.2.4 Incorporation of Zinc Oxide Nanoparticles into the bioplastic film	21
2.2.5 Degradation Studies	22
2.2.5.1 Air Degradation	23
2.2.5.2 Soil Degradation	23
2.2.5.3 Bacterial Degradation	23
2.2.6 Mechanical Strength	24
2.3 Characterization Techniques	24
2.3.1 X-Ray Diffraction Analysis	24
2.3.2 Scanning Electron Microscope	27
<b>Chapter 3 Results and Discussion</b>	<b>29</b>
3.1 X-Ray Diffraction Studies – Zinc Oxide Nanoparticles	29
3.1.1 XRD – Particle Size Calculation	30
3.1.2 Calculations – Particle size Determination by XRD	30
3.2 X-Ray Diffraction Studies – Bioplastic from Potato starch	33
3.3 X-Ray Diffraction Studies – Bioplastic with ZnO nanoparticles	34
3.4 SEM Analysis	36
3.5 Degradation Studies	38
3.5.1 Air Degradation: Study of Shelf – life of bioplastic	38

3.5.2 Soil Degradation	47
3.5.3 Bacterial Degradation	61
3.6 Mechanical Properties	67
<b>Chapter 4 Conclusion</b>	<b>70</b>
<b>References</b>	<b>73</b>

# Chapter 1

## Introduction

### 1.1 POTATO

The potato is a starchy tuber of the plant *Solanum tuberosum* and is a root vegetable native to the Americas. The plant is a perennial in the nightshade family Solanaceae. Wild potato species can be found throughout the Americas, from Canada to southern Chile. A typical raw potato is 79% water, 17% carbohydrates (88% is starch), 2% protein, and contains negligible fat. It provides 322 kilojoules (77 kilocalories) of food energy and is a rich source of vitamin B6 and vitamin C. They are often broadly classified as having a high glycemic index (GI).

The vegetative and fruiting parts of the potato contain the toxin solanine which is dangerous for human consumption. Normal potato tubers that have been grown and stored properly produce glycoalkaloids in amounts small enough to be negligible to human health, but if green sections of the plant (namely sprouts and skins) are exposed to light, the tuber can accumulate a high enough concentration of glycoalkaloids to affect human health.

The English word *potato* comes from Spanish *patata* (the name used in Spain). Potatoes are occasionally referred to as *Irish*

*potatoes* or *white potatoes* in the United States, to distinguish them from sweet potatoes. The name *spud* for a potato comes from the digging of soil (or a hole) prior to the planting of potatoes [1]. Potatoes are the world's most widely grown tuber crop, and the fourth largest crop in terms of fresh produce (after rice, wheat, and maize).



Fig:1 Potato

They are easy to grow and have excellent nutritional value (although raw and wild potatoes have some toxicity concerns) [2]. Potatoes are prepared in many ways: skin-on or peeled, whole or cut up, with seasonings or without. The only requirement involves cooking to swell the starch granules. Most potato dishes are potato salad, potato chips, French fried potatoes, potato pancakes, potato chunks etc. They are used to brew alcoholic beverages such as vodka. They are also used as fodder for livestock. Potato starch is used in the food

industry as a thickener and binder for soups and sauces, in the textile industry as an adhesive, and for the manufacturing of papers and boards [3].

It is anti-scorbutic. Persons with neurotic and liver dyspepsia digest it well. It is also employed as a diuretic and galactagogue, nervous sedative and stimulant in gout. The leaves in the form of extract are employed as an antispasmodic in chronic cough producing effects as those of optimum etc. Potato grind into a paste is applied as plaster to burns caused by fire with good results. The juice of the potato is a dark coloured liquid due to the presence of citric and succinic acids [4].

## **1.2 POTATO PLANT**

The potato plant is an *herbaceous* perennial in that it lacks a woody stem and lives more than two years. It grows 90 to 100 centimetres (3 to 4 feet) tall and is covered with dark green leaves. The above-ground part of the plant dies each winter and regrows in spring. It flowers three to four weeks after sprouting. The flowers are white, pink, or purple with yellow stamens. After many years of cultivation, the potato has lost much of its ability to produce seeds. Only very rarely does a flower produce some fruit. These are called seed balls and look like small green tomatoes. Each contains up to three

hundred seeds, which are sometimes planted to create new potato varieties. They should not be eaten as they have poisonous substances.

The below-ground part of the potato plant continues to live after the above-ground part has died in winter. Food energy for the next year's growth, in the form of protein and starch, and also water is stored in tubers, called potatoes, which are rhizomes (modified stems) attached to the root system. They are covered by an outer skin called the periderm. Inside that is the cortex, which serves as a storage area for protein and starch. Inside that is the vascular ring that receives starch from the plant's leaves and stem. The starch moves out of the vascular ring to the parenchyma cells that surround it. These cells are the tuber's main storage areas for starch. The pith, which makes up the centre of the tuber, is the main area for water storage.



Fig: 2 Potato Plant

A potato plant grows anywhere from three to 20 tubers during its growing season. In the spring the tubers sprout, and the above-ground plants grow anew [5].

Potatoes are mostly cross-pollinated by insects such as bumblebees, which carry pollen from other potato plants, though a substantial amount of self-fertilizing occurs as well. After flowering, potato plants produce small green fruits that resemble green cherry tomatoes, each containing about 300 seeds. Like all parts of the plant except the tubers, the fruit contain the toxic alkaloid solanine and are therefore unsuitable for consumption. All new potato varieties are grown from seeds, also called "true potato seed", "TPS" or "botanical seed" to distinguish it from seed tubers [6].

### **1.3 STARCH**

Starch or amyllum is a polymeric carbohydrate consisting of numerous glucose units joined by glycosidic bonds.

This polysaccharide is produced by most green plants for energy storage. Worldwide, it is the most common carbohydrate in human diets, and is contained in large amounts in staple foods like wheat, potatoes, maize (corn), rice, and cassava (manioc). The word "starch" is from its Germanic root with the meanings "strong, stiff, strengthen, stiffen".

Pure starch is a white, tasteless, and odourless powder that is insoluble in cold water or alcohol. It consists of two types of

molecules: the linear and helical amylose and the branched amylopectin. Depending on the plant, starch generally contains 20 to 25% amylose and 75 to 80% amylopectin by weight. Glycogen, the glucose store of animals, is a more highly branched version of amylopectin.

In industry, starch is converted into sugars, for example by malting, and fermented to produce ethanol in the manufacture of beer, whisky and biofuel. It is processed to produce many of the sugars used in processed foods. Mixing most starches in warm water produces a paste, such as wheat paste, which can be used as a thickening, stiffening or gluing agent. The greatest industrial non-food use of starch is as an adhesive in the papermaking process. Starch solution may be applied to certain textile goods before ironing, to stiffen them.



Fig: 3 Potato Starch

## **1.4 APPLICATIONS OF STARCH**

### **1.4.1 IN FOOD INDUSTRY**

Starch is the most common carbohydrate in the human diet and is contained in many staple foods. The major sources of starch intake worldwide are the cereals (rice, wheat, and maize) and the root vegetables (potatoes and cassava). Many other starchy foods are grown, some only in specific climates, including acorns, arrowroot, bananas, barley, breadfruit, colocasia, millet, oats, sweet potatoes, yams.

Before processed foods, people consumed large amounts of uncooked and unprocessed starch-containing plants, which contained high amounts of resistant starch. Microbes within the large intestine ferment or consume the starch, producing short-chain fatty acids, which are used as energy, and support the maintenance and growth of the microbes. Upon cooking, starch is transformed from an insoluble, difficult-to-digest granule into readily accessible glucose chains with very different nutritional and functional properties. Starch has been classified as rapidly digestible starch, slowly digestible starch, and resistant starch, depending upon its digestion profile. Raw starch granules resist digestion by human enzymes and do not break down into glucose in the small intestine - they reach the large intestine instead and function as prebiotic dietary fibre. When starch granules are fully gelatinized and cooked, the starch becomes easily digestible and releases glucose quickly within the small intestine. When starchy

foods are cooked and cooled, some of the glucose chains re-crystallize and become resistant to digestion again. Slowly digestible starch can be found in raw cereals, where digestion is slow but relatively complete within the small intestine. Widely used prepared foods containing starch are bread, pancakes, cereals, noodles, pasta, porridge and tortilla. Starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas. They function as thickeners, extenders, emulsion stabilizers and are exceptional binders in processed meats [7].

#### **1.4.2 IN PHARMACEUTICAL INDUSTRY**

Starch is used in the pharmaceutical industry as an excipient, a tablet and capsule diluent, a tablet and capsule disintegrant, a glidant, or as a binder [8].

##### **1.4.2.1 AS BINDER**

In tablet formulations, starch prepared to gel (freshly prepared starch paste) by heat treatment of the starch dispersion in water is used at a concentration of 3–20% w/w (usually 5–10%, depending on the starch type) as a binder for wet granulation. This provides the necessary binding force that holds the powder particles together to form the required agglomerates. The quantity of the freshly prepared starch

paste used should be determined by optimization studies, using parameters such as tablet friability and hardness, disintegration time, and drug dissolution rate. This also serves to ensure a uniform distribution and controllable release of the APIs.

#### **1.4.2.2 AS TABLET DISINTEGRANT**

Starch is one of the most commonly used disintegrants for immediate release tablet dosage forms at concentrations of 3–25% w/w (optimum concentration of 15%). The disintegration ability of native starch is due to wicking and restoration of deformed starch particles on contact with aqueous fluid. Some newer sources of starch have been chemically, physically, or enzymatically modified to enhance their disintegrant properties e.g., carboxymethyl starch (CMS) which possesses high swelling capacity (absorb an amount of water 23 times its initial weight) combined with a high rate of water permeation.

#### **1.4.2.3 IN BONE TISSUE ENGINEERING**

As an alternative to the use of metals and ceramics in TE, biodegradable polymers such as starch, collagen, fibrinogen, chitosan, hyaluronic acid (HA), poly(hydroxybutyrate), poly( $\alpha$ -hydroxy acids), poly( $\epsilon$ -caprolactone), poly(propylene

fumarates), poly(carbonates), poly-(phosphazenes) and poly(anhydrides) are believed to be the ideal materials for bone TE. Starch-based biodegradable polymers (SBBP), when used in bone tissue engineering scaffolds, can provide immediate structural support because of its good mechanical properties. It also allows for increased degradation time (producing non-toxic degradation products) and consequently expanded porosity as cellular integration increases, which is optimal for bone tissue engineering.

#### **1.4.2.4 IN ARTIFICIAL RED BLOOD CELLS**

Starch particularly, potato starch has been used to produce artificial red blood cells with good oxygen-carrying capacity. It was prepared by encapsulating hemoglobin (Hb) with long-chain fatty acid grafted potato starch by self-assembly [9].

#### **1.4.3 IN PAPER MAKING**

Papermaking is the largest non-food application for starches globally, consuming many millions of metric tons annually.<sup>[12]</sup> In a typical sheet of copy paper for instance, the starch content may be as high as 8%. Both chemically modified and unmodified starches are used in papermaking. In the wet part of the papermaking process, generally called the "wet-end", the starches used are cationic and have a positive charge bound to the starch polymer. These starch derivatives associate with the anionic or negatively

charged paper fibres / cellulose and inorganic fillers. Cationic starches together with other retention and internal sizing agents help to give the necessary strength properties to the paper web formed in the papermaking process (wet strength), and to provide strength to the final paper sheet (dry strength).

In the dry end of the papermaking process, the paper web is rewetted with a starch-based solution. The process is called surface sizing. Starches used have been chemically, or enzymatically depolymerized at the paper mill or by the starch industry (oxidized starch). The size/starch solutions are applied to the paper web by means of various mechanical presses (size presses). Together with surface sizing agents the surface starches impart additional strength to the paper web and additionally provide water hold out or "size" for superior printing properties. Starch is also used in paper coatings as one of the binders for the coating formulations which include a mixture of pigments, binders, and thickeners. Coated paper has improved smoothness, hardness, whiteness, and gloss and thus improves printing characteristics [10].

#### **1.4.4 IN THE SYNTHESIS OF BIOPLASTICS**

Plastics are indispensable for our society. The extensive use of petroleum-based plastic and dumping of the same in soil and water body greatly affects our environment and biodiversity. The modern world is using synthetic plastics as packaging material, household, disposable medical equipment, and electronics. The

petroleum-based plastics take more than 500 years to decompose in landfills. Petroleum-based polymers are the biggest threat to the environment as these polymers are non-degradable. However, biodegradable plastics can reduce the volume of waste in packaging materials, and thus, the biomass-derived polymer could be a promising alternative to the petroleum-based non-degradable polymer to address environmental issues. Bio-based and biodegradable polymers are promising materials as they are environment friendly and able to make a sustainable future and restore the biodiversity.

Biopolymers are polymers either extracted from living organisms or made from biological sources. However, the biodegradable property does not depend on the origin of the polymers or the corresponding monomeric units. It depends on the monomeric units and the chemical bonding of the polymers. A polymer is categorized as biodegradable if it is metabolized by microorganisms (bacteria, fungi, algae, yeasts, etc.) present in the natural environment such as soil or land surface, river or seawater, compost, etc. within a given time (2 to 6 months). Polysaccharides such as starch and cellulose are the most abundant and simplest biobased polymers. However, the use of these polymers was restricted in a few sectors such as textiles, construction, etc [11].

Plasticizers are molecules with low molecular weight and low volatility, which reduce intermolecular forces and increase polymer chains mobility. The most common plasticizers include water,

glycerol, propylene glycol and polyethylene glycol [12]. It can improve physical and mechanical properties. Glycerol as the plasticizer can improve bioplastic properties. It has the function to improve the ability of bioplastic in absorbing water and as crystal forming agent. Other characteristics of glycerol are related to toxicity and low mass transfer as natural plasticizers. Glycerol is a non-toxic, edible, and biodegradable substance that is good for the environment [13].

### **1.5 SIGNIFICANCE OF NANOPARTICLES IN INCREASING SHELF-LIFE**

The incorporation of nanoparticles in the polymer matrix or the fabrication of nanocomposites overcomes the shortcomings of the biodegradable polymers. One of the great advantages of nanoparticles is the ability to tune the rate of biodegradation (it is possible to both increase and decrease the rate as compared to that of the pure polymer) depending upon the need. Thus, chemical, physical, and biological properties of the biodegradable polymers can be modified and controlled for sustainable applications in medicine and other areas.

Biopolymers are biodegradable materials, because at least one step in the process of degradation appeared because of metabolism of microorganisms that occur naturally in the environment. Under certain conditions of humidity, temperature and exposure to oxygen, biodegradation leads to the decomposition and degradation of the polymeric material to a non-toxic and

environmentally acceptable residue. Biopolymers as packaging material are relatively poor material because of its mechanical and barrier properties which currently limits its industrial use. A particular challenge is the development of moisture barrier properties because of the hydrophilic nature of biopolymers. However, it has been shown that the disadvantages of packaging materials based on biopolymers or biodegradable plastics can be reduced by application of nano composites technology. The use of biopolymer/biodegradable plastics is still limited due to these challenges and problems. However, the application of nanotechnology, i.e., by incorporation of nanoparticles or preparing polymer nano composites can help to overcome these problems. The nanoparticles have a high specific surface, and the advantage of ultra large contact area per unit volume between the polymer matrix and nano elements, greater functionality per unit weight and the lack of high surface energy which results in agglomeration of the particles [14].

Zinc Oxide is well-known environmentally friendly, biocompatible, and multifunctional inorganic filler characterized by effective antibacterial function and intensive ultraviolet absorption. Zinc oxide nanoparticles (ZnO NPs) amongst other nanoparticles have gained a vital position in the enhancement of packaging properties like barrier, mechanical and antimicrobial properties [15]. It is commonly used as preservative and incorporated in polymeric packaging material to prevent food material from damage by microbes. Incorporating ZnO nanoparticles generates other

additional benefits such as the antimicrobial activity that allows bioplastics can be used as a pesticide [16]. Its crystalline structure, very large surface area and excellent mechanical properties also become advantages of ZnO to reinforce polymeric nanocomposites. Since it has high mechanical properties, the good interaction between ZnO and polymers would generate better transfer of ZnO mechanical properties to polymer matrices. The antibacterial activity of ZnO is due to the production of reactive oxygen species that generates the oxidation of bacterial cells cytoplasm, resulting in cell death. ZnO-nanorods decrease the moisture content and water absorption capacity of starch and gelatin-based bioplastics while improving their mechanical properties and antimicrobial activity by increasing the inhibition zone of nano-incorporated films [17].

### **1.6 OBJECTIVES**

- To synthesize bioplastic film from potato starch.
- To characterize the synthesized bioplastic film using SEM and XRD.
- To synthesize zinc oxide nanoparticles.
- To characterize the synthesized nanoparticles using XRD.
- Incorporation of Zinc oxide nanoparticles to the bioplastic.

- To study the enhancement of shelf-life of nano ZnO incorporated bioplastic film.
  
- To compare the soil and bacterial degradation of the prepared bioplastic and the nano ZnO incorporated bioplastic.
  
- To compare the mechanical properties of the prepared bioplastic and the nano ZnO incorporated bioplastic.

# Chapter 2

## Materials and Methods

### 2.1 MATERIALS

Potatoes were collected from Ernakulam Market, Kerala, India. The starch was extracted from potatoes. Glycerol, glacial acetic acid (10% acetic acid prepared from it), zinc acetate and sodium hydroxide pellets supplied by Nice Chemicals (P) Ltd, Kochi, Kerala were used.

### 2.2 METHODS

#### 2.2.1 SYNTHESIS OF ZINC OXIDE NANOPARTICLES

400 ml of 0.1M zinc acetate solution and 400 ml of 0.1M sodium hydroxide solution were prepared. 400 ml zinc acetate solution was taken in a 1000 ml beaker. Sodium hydroxide solution was taken in a burette. NaOH solution was added slowly dropwise under vigorous stirring. The addition was continued overnight. A dense white precipitate was obtained. The nanoparticles were separated by centrifugation and washed with distilled water. They were

dried in an oven at 60 °C for 12 hour and ignited in muffle furnace at 500°C for 15 minutes.

### **2.2.2 EXTRACTION OF POTATO STARCH FROM POTATO**

1 kg of potato was washed, and the peels were removed. The cleaned potatoes were smashed and grinded thoroughly with water. The ground potato was strained, and water was poured into the paste and kept for an hour to settle down. The water was removed, and starch was washed with distilled water and dried in an oven at 60°C for 2 hours.



Fig: 4 Cleaned potatoes



Fig: 5 Smashed and strained potatoes



Fig: 6 Settled starch



Fig: 7 Dried starch powder

### 2.2.3 SYNTHESIS OF BIOPLASTIC FILM FROM POTATO STARCH

5g of potato starch was taken in a 200 ml beaker. 20 ml of distilled water was added into the beaker. 10 ml of 10% acetic acid was then added to the beaker. The solution was heated with continuous stirring and another 20 ml of distilled water was also added to the solution. 2 ml of glycerol was added to the solution when it boiled. The solution was heated for 15 minutes with the addition of 20 ml of distilled water. The mixture was spread on the ceramic plate and kept for 3 days to get the dry plastic film.



Fig: 8 The bioplastic prepared from potato starch

#### **2.2.4 INCORPORATION OF ZINC OXIDE NANOPARTICLES INTO THE BIOPLASTIC FILM**

Zinc oxide nanoparticles were incorporated in the bioplastic in various concentrations.

5g potato starch was added in a 200 ml beaker. 20 ml distilled water and 10ml 10% acetic acid was added. 0.0200g ZnO nanoparticles was added to it and the solution was boiled with continuous stirring. Another 20 ml distilled water and 2 ml of glycerol was added and allowed to boil. Boiling was continued for 15 minutes. The mixture was spread on the ceramic plate and kept for 3 days for drying. The bioplastic film was then peeled off. Thus, bioplastic film with 0.4% ZnO NPs was prepared.

Similarly, by adding 0.0505g and 0.1020g ZnO NPs to the potato starch solution, bioplastic film with 1% and 2% ZnO NPs were prepared.

Bioplastic films were prepared by adding zinc oxide nanoparticles in different quantities as shown in the table 1.

Table: 1 Samples prepared

	Potato starch	ZnO NPs
Sample-1	5 g	0 %
Sample-2	5 g	0.4 %
Sample-3	5 g	1 %
Sample-4	5 g	2 %

### 2.2.5 DEGRADATION STUDIES

Starch is a biopolymer and hence, starch-based bioplastic can degrade in the natural environment. We carried out biodegradation study at different experimental conditions.

The biodegradability of the prepared bioplastic films was studied by three methods.

1. Air degradation
2. Soil degradation
3. Bacterial degradation

### 2.2.5.1 AIR DEGRADATION

Small pieces of bioplastic from four samples were kept in air at room temperature. Observations were taken on every 3 days until 65 days.

### 2.2.5.2 SOIL DEGRADATION

Weight loss measurement is a standard method for biodegradation of polymer. Pre-weighed pieces of bioplastic from four samples were buried in soil. The samples were taken out from soil every 3 days and the weight was measured. This process was done for 55 days, and final weight was measured. Amount of biodegradation was calculated by following equation:

$$\text{Weight loss \%} = \left( \frac{W_0 - W}{W_0} \right) \times 100$$

where  $W_0$  and  $W$  are the initial and final weights of bioplastic samples respectively.

### 2.2.5.3 BACTERIAL DEGRADATION

Pre-weighed pieces of bioplastic from four samples were inoculated in a cultured bacteria solution for 7 days. The same was repeated in a solution without bacteria also for the same period.

### **2.2.6 MECHANICAL STRENGTH**

Pieces of bioplastic from four samples were cut in dimensions of 5cm length and 1cm width and tested using Universal Testing Machine (UTM).

### **2.3 CHARACTERIZATION TECHNIQUES**

Characterization, when used in material science, refers to the use of external techniques to probe into the internal structure and properties of a material. Characterization can take the form of actual materials testing or analysis. Analysis techniques are used to simplify to magnify the specimen, to visualize its internal structure, and to gain knowledge as to the distribution of elements within the specimens and their interactions.

#### **2.3.1 X-RAY DIFFRACTION ANALYSIS**

X-Ray diffraction technique is a precise and popular tool for determining the crystal structure of thin films. It yields complete information about the crystal structure, orientation, lattice constants, crystalline size and composition, defects, and stress in the thin film. From the position and shape of the lines, one can obtain information regarding the unit cell parameters and microstructural parameters (grain size, micro

strain, etc.), respectively. It requires no sample preparation and is essentially non-destructive. The wave nature of X-Rays means that they are diffracted by the lattice of the crystal to give a unique pattern of peaks of reflections at differing angles and of different intensity, just as light can be diffracted by a grating of suitably spaced lines.

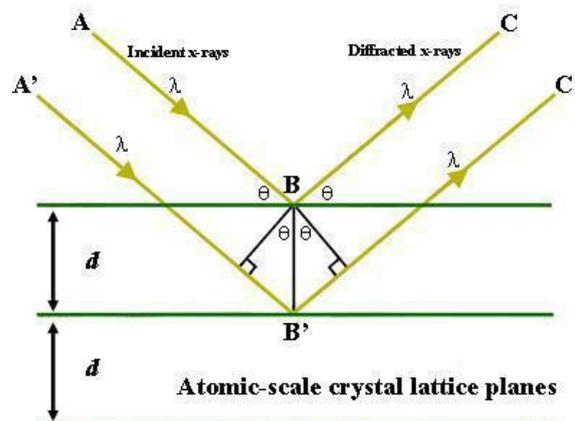


Fig: 9 Bragg's Law of X-Ray Diffraction

The diffracted beam from atoms in successive planes cancels unless they are in phase, and the condition for this is given by Bragg's relationship.

$$n\lambda = 2d\sin\theta$$

Here  $d$  is the inter-spacing,  $\Theta$  is the angle of diffraction,  $\lambda$  is the wavelength of the incident beam and  $n$  is the order of diffraction. Diffraction peak position is accurately measured with XRD, which makes it the best method for characterizing homogeneous and inhomogeneous strains. Homogeneous or uniform elastic strain shifts the diffraction peak position. From the shift in peak position, one can calculate the change in  $d$ -spacing, which is the result of the change of lattice constants under a strain. In homogeneous strains vary from crystallite to crystallite or within a single crystallite and this cause a broadening of the diffraction peaks that increase with  $\cos \Theta$ . The crystallite size,  $D$  can be determined using Debye-Scherrer formula

$$D = \frac{K\lambda}{B \cos\theta}$$

Where,  $\lambda$  is the X-ray wavelength,  $K$  is the scherrer constant,  $B$  is the full width of the height of a diffraction peak,  $\Theta$  is the diffraction angle. XRD is a non-destructive technique and does not require elaborate sample preparation, which partly explains the wide usage of XRD method in materials characterization. In addition, X-ray diffraction only provides the collective information of the particle sizes and usually requires a sizeable amount of powder. It should be noted that

since the estimation would work only for very small particles, this technique is very useful in characterizing nanoparticles.

XRD of the synthesized ZnO nanoparticles and prepared bioplastic films were analysed.

### **2.3.2 SCANNING ELECTRON MICROSCOPE**

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image. In the most common SEM mode, secondary electrons emitted by atoms excited by the electron beam are detected using a secondary electron detector (Everhart-Thornley detector). The number of secondary electrons that can be detected, and thus the signal intensity, depends, among other things, on specimen topography. Some SEMs can achieve resolutions better than 1 nanometer.

Specimens are observed in high vacuum in a conventional SEM, or in low vacuum or wet conditions in a variable

pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments [18].



Fig: 10 Scanning Electron Microscope

SEM analysis of the prepared bioplastic films were done.

# Chapter 3

## Results and discussion

### 3.1 X-RAY DIFFRACTION STUDIES - ZINC OXIDE NANOPARTICLES

The XRD pattern of the zinc oxide nanoparticles is shown in Fig: 11.

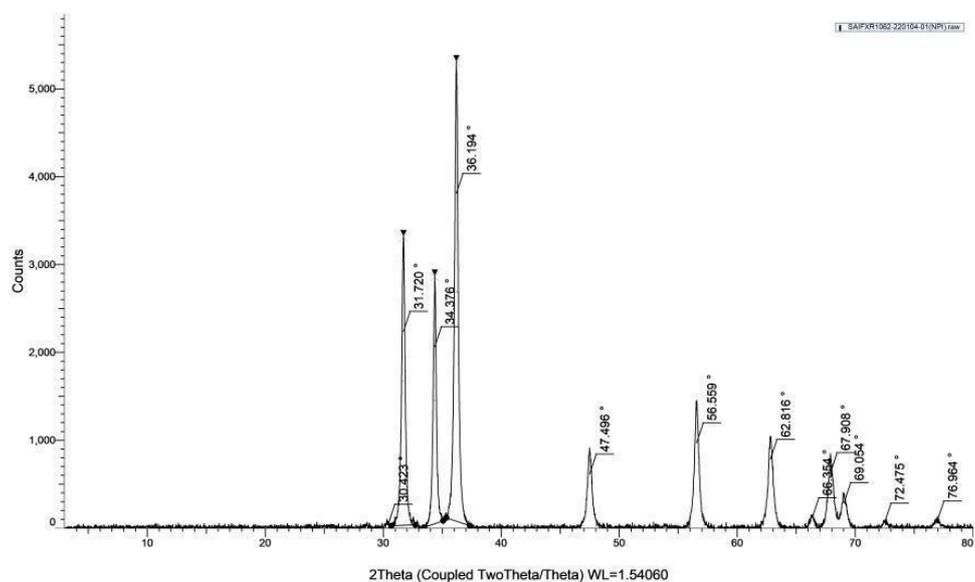


Fig: 11 XRD pattern of Zinc Oxide Nanoparticles

The XRD analysis showed diffraction peaks characteristic of ZnO nanoparticles. The diffraction peaks observed at 31.710°, 34.370°, 36.370°, 47.496°, 56.559°, 62.816°, 67.908° and 69.054° attributed to the hexagonal wurtzite phase of ZnO nanoparticles, which were reported in earlier studies.

### 3.1.1 XRD - Particle Size Calculation

From this study, considering the peak at degrees, average particle size has been estimated by using Debye-Scherrer formula,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

where  $\lambda$  is the wavelength of X-ray (0.1541nm), B is FWHM (full width at half maximum),  $\theta$  is the diffraction angle and D is the particle diameter size. The calculated particle size details are in Table 2.

### 3.1.2 Calculations - Particle size determination by XRD

**Peak 1:**

$$2\theta = 31.710^\circ$$

$$= 15.855^\circ = 0.2767 \text{ radian}$$

$$B = 0.315^\circ = 0.00549 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.00549 \times \cos(0.2767)}$$

$$= 25.256 \text{ nm}$$

**Peak 2:**

$$2\theta = 34.370^\circ$$

$$= 17.185^\circ = 0.2999 \text{ radian}$$

$$B = 0.279^\circ = 0.00486 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.00486 \times \cos(0.2999)} = 28.530 \text{ nm}$$

**Peak 3:**

$$2\theta = 36.370^\circ$$

$$= 18.185^\circ = 0.3173 \text{ radian}$$

$$B = 0.334^\circ = 0.0058 \text{ radian}$$

$$= 1.5406 \times 10^{-10} \text{ m}$$

From Debye - Scherrer equation,

$$D = \frac{0.9\lambda}{B \cos\theta}$$

$$= \frac{0.90 \times 1.5406 \times 10^{-10}}{0.0058 \times \cos(0.3173)} = 23.906 \text{ nm}$$

$$\text{Mean value} = \frac{(25.256 + 28.530 + 23.906)}{3} = 25.897 \text{ nm}$$

Table 2: Particle size calculation from XRD

2 of the intense peak (degree)	FWHM of intense peak	Size of the particle (D) (nm)	Average
31.710	0.315	25.256	<b>25.897nm</b>
34.370	0.279	28.530	
36.370	0.334	23.906	

Full width at half maximum (FWHM) data was used with Scherrer's formula to determine the average particle size. The results are tabulated in table 2. The average particle size estimated was 25.897nm.

### 3.2 X-RAY DIFFRACTION STUDIES - BIOPLASTIC FROM POTATO STARCH

The XRD pattern of the bioplastic film from potato starch is shown in Fig: 12.

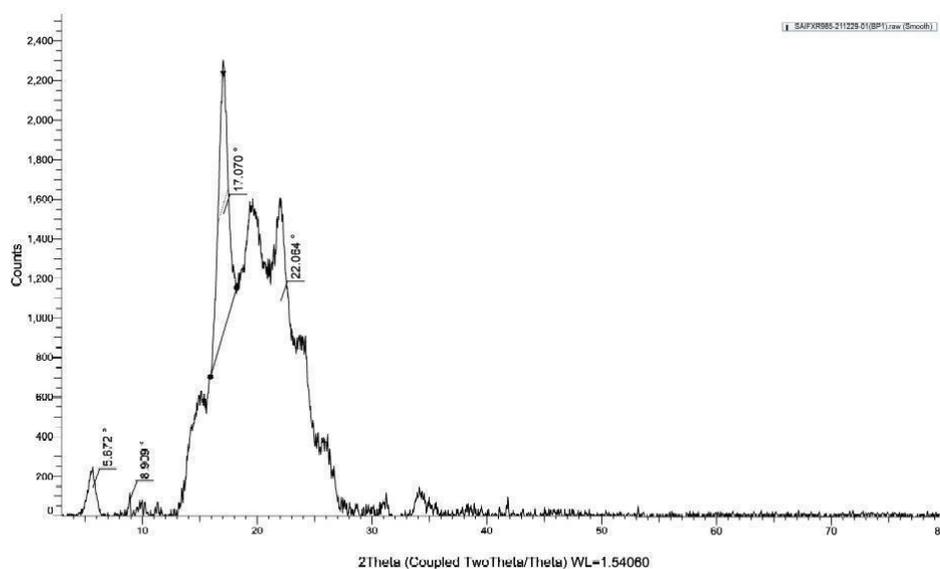


Fig: 12 XRD pattern of sample 1

The XRD analysis showed diffraction peaks characteristic of potato starch films. The characteristic diffraction peaks

appeared clearly at  $22.064^\circ$  and  $17.070^\circ$ , which could be attributed to the crystalline and amorphous fractions of the potato starch.

### 3.3 X-RAY DIFFRACTION STUDIES - BIOPLASTIC WITH ZnO NANOPARTICLES

To study the incorporation of ZnO nanoparticles in bioplastic film, XRD studies have been done. The XRD patterns of the bioplastic film with ZnO nanoparticles in concentration such as 0.4%, 1%, and 2% are shown in fig 13, fig 14 and fig 15 respectively.

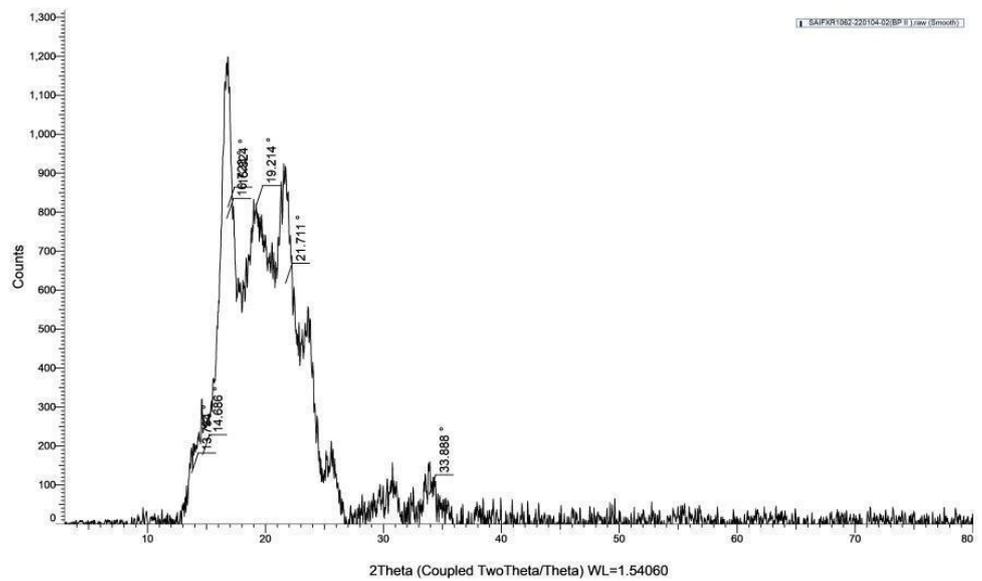


Fig: 13 XRD pattern of sample 2

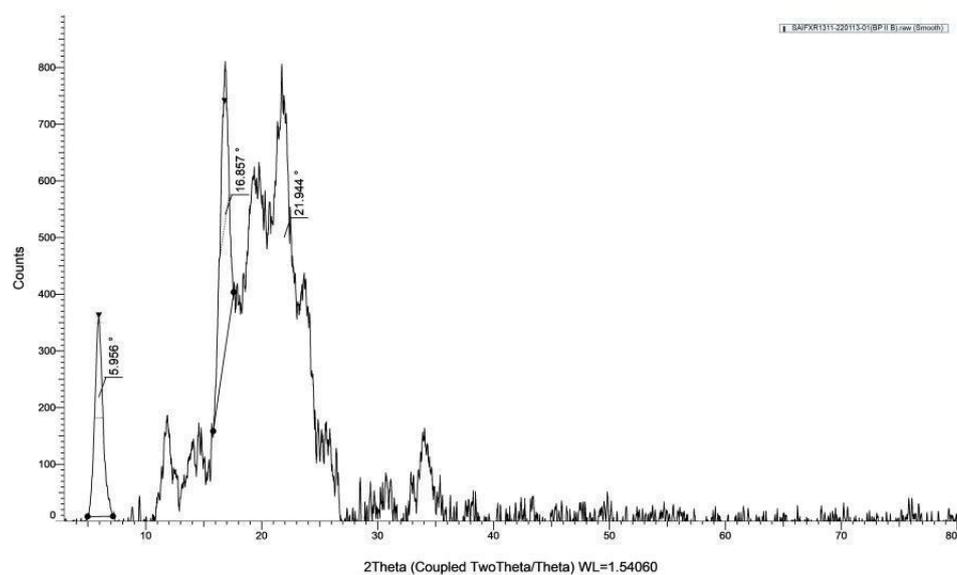


Fig: 14 XRD pattern of sample 3

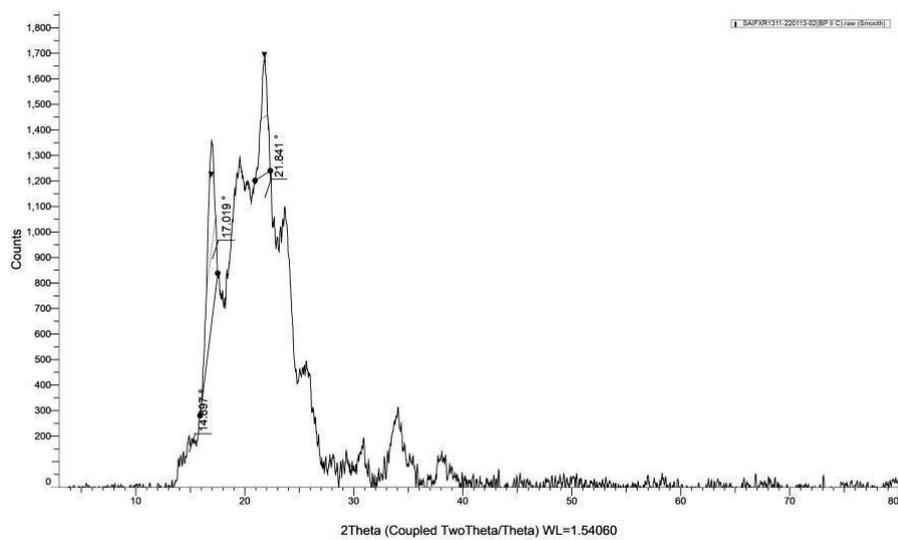


Fig: 15 XRD pattern of sample 4

XRD pattern showed that peaks between 2 values  $30^\circ$  and  $40^\circ$  are characteristic to those present in XRD pattern of ZnO nanoparticle. Due to the presence of very small number of nanoparticles, the intensity of these peaks is weak. The presence of these peaks indicates the incorporation of ZnO nanoparticles.

### **3.4 SEM ANALYSIS**

SEM images of the samples were taken to study the surface change before and after the incorporation of nanoparticles. SEM image of all the four samples is shown in fig 16 to fig 19. These images reveals that the incorporation does not cause any surface modification to the bioplastic films. Surfaces were found to be smooth and uniform before and after the incorporation.

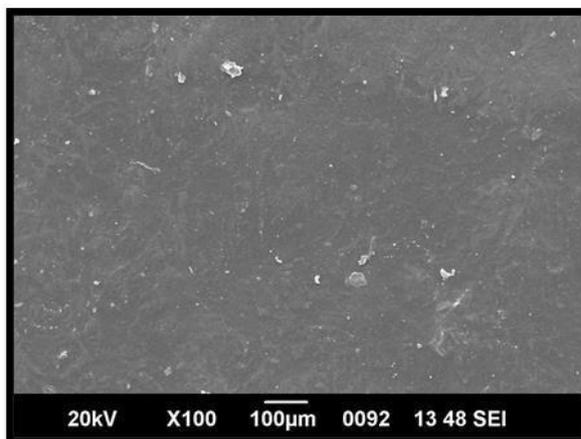


Fig: 16 SEM image of sample 1

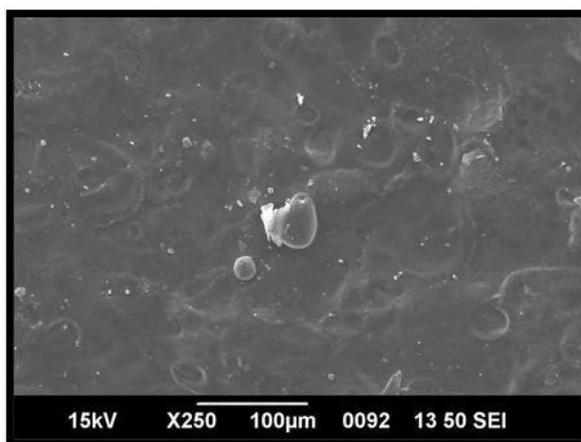


Fig: 17 SEM image of sample 2

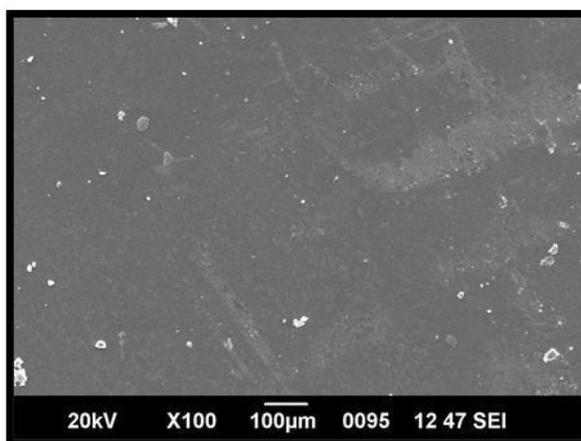


Fig: 18 SEM image of sample 3

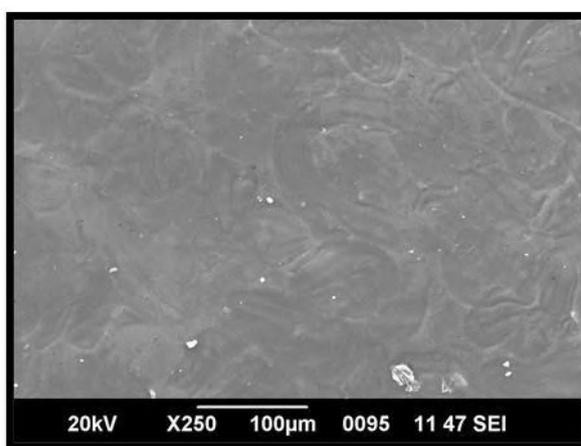


Fig: 19 SEM image of sample 4

### **3.5 DEGRADATION STUDIES**

#### **3.5.1 AIR DEGRADATION: STUDY OF SHELF-LIFE OF BIOPLASTIC**

**SAMPLE 1 (0% ZnO NPs)**

A piece of bioplastic film prepared from potato starch (Sample 1) was kept in the open and was observed for 56 days to study its shelf-life. Pictures were taken on day 1, day 25, day 50 and day 56 and are shown in figures 20 to 23.



Fig: 20 Day 1



Fig: 21 Day 25



Fig: 22 Day 50



Fig: 23 Day 56

The fungal attack occurred on 56<sup>th</sup> day and the sample started degrading.

**SAMPLE 2 (0.4% ZnO NPs)**

Photographs were taken on day 1, day 25, day 50 and day 65 and are shown in figures 24 to 27.



Fig: 24 Day 1



Fig: 25 Day 25



Fig: 26 Day 50



Fig: 27 Day 65

**SAMPLE 3 (1% ZnO NPs)**

Photographs were taken on day 1, day 25, day 50 and day 65 and are shown in figures 28 to 31.

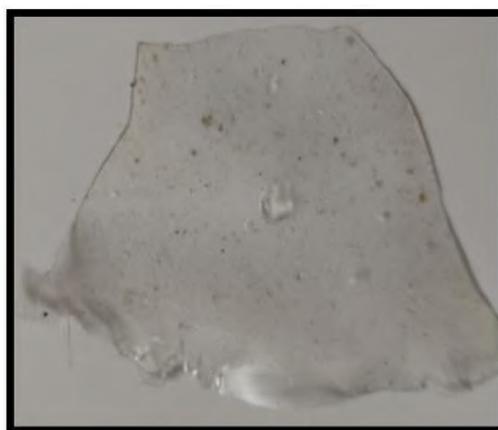


Fig: 28 Day 1



Fig: 29 Day 25



Fig: 30 Day 50



Fig: 31 Day 65

**SAMPLE 4 (2% ZnO NPs)**

Photographs taken on day 1, day 25, day 50 and day 65 and are shown in figures 32 to 35.



Fig: 32 Day 1



Fig: 33 Day 25



Fig: 34 Day 50



Fig: 35 Day 65

As it is clear from the above photographs, the bioplastic films incorporated with zinc oxide nanoparticles showed an increase in shelf-life. Observations were made only upto 65 days. None of the samples degraded even until 65 days.

### 3.5.2 SOIL DEGRADATION

Pre-weighed pieces of all samples were immersed in soil and observations were made up to 55 days. Weight loss percentage was found out by using the following equation where  $W_0$  and  $W$  are the initial and final weights of bioplastic samples respectively.

$$\text{Weight loss \%} = \left( \frac{W_0 - W}{W_0} \right) \times 100$$

The weight loss data is tabulated in table 3.

#### SAMPLE 1 (0% ZnO NPs)

The photographs taken on day 1, day 4 and day 7 are shown in figures 36 to 38.



Fig: 36 Day 1



Fig: 37 Day 4



Fig: 38 Day 7

The piece of sample taken had an initial weight of 0.21g and after 10 days, it degraded completely. Thus, sample 1 which is virgin bioplastic film from potato starch showed 100% weight loss within 10 days (Table 3).

**SAMPLE 2 (0.4% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 39 to 44.



Fig: 39 Day 1



Fig: 40 Day 7



Fig: 41 Day 16



Fig: 42 Day 31



Fig: 43 Day 49



Fig: 44 Day 55

**SAMPLE 3 (1% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 45 to 50.



Fig: 45 Day 1



Fig: 46 Day 7



Fig: 47 Day 16



Fig: 48 Day 31



Fig: 49 Day 49



Fig: 50 Day 55

**SAMPLE 4 (2% ZnO NPs)**

The pictures taken on day 1, day 7, day 16, day 31, day 49 and day 55 are shown in figures 51 to 56.



Fig: 51 Day 1



Fig: 52 Day 7



Fig: 53 Day 16



Fig: 54 Day 31



Fig: 55 Day 49



Fig: 56 Day 55

The weight loss percentage of each sample has been determined and tabulated in Table 3 and fig. 57 shows the graph of weight reduction of bioplastic samples up to 55 days.

**Table 3: Weight loss percentage of each sample after soil degradation**

Bioplastic	No. of days observed	Weight Loss %
Sample 1	10	100
Sample 2	55	48.74
Sample 3	55	86.40
Sample 4	55	89.31

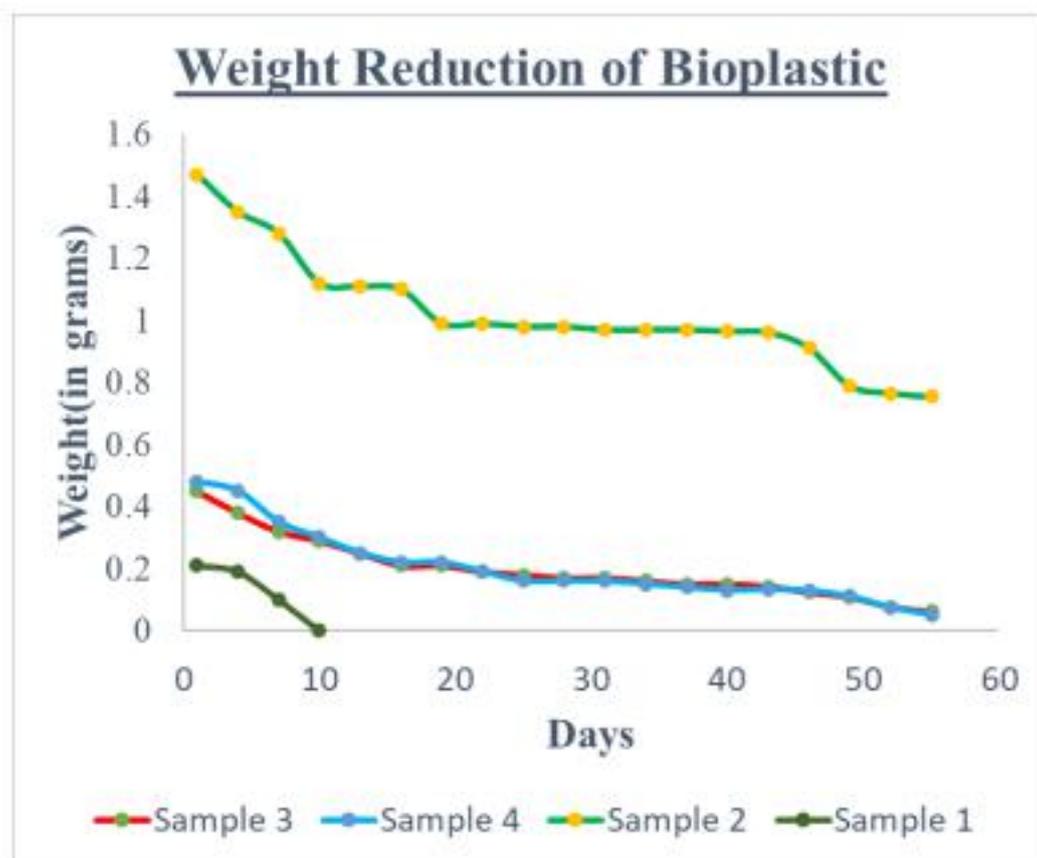


Fig: 57 Weight reduction of bioplastic in soil upto 55 days

As the concentration of ZnO nanoparticles increases, the degradability of bioplastic also increases. Weight loss percentage was greater for sample 4 i.e., bioplastic with 2% ZnO nanoparticles.

### 3.5.3 BACTERIAL DEGRADATION

The weight loss percentage for 7 days is tabulated in Table 4. Weight loss % of each bioplastic is shown in fig 58.

Table 4: Weight loss percentage of each sample after 7 days bacterial degradation

Bioplastic	With bacteria		Weight loss %	Without bacteria		Weight loss %
	Initial weight (g)	Final weight (g)		Initial weight (g)	Final weight (g)	
Sample 1	0.22	0.08	63.63	0.27	0.21	22.22
Sample 2	0.25	0.14	44	0.30	0.30	0
Sample 3	0.21	0.14	33.33	0.23	0.21	8.69
Sample 4	0.20	0.15	25	0.34	0.31	8.82

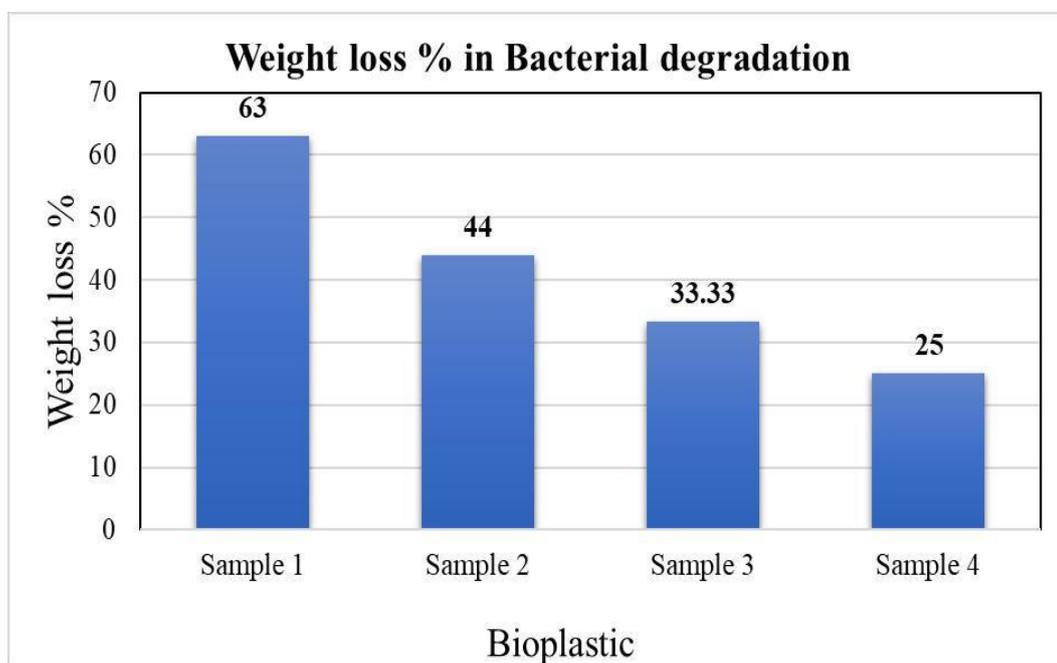


Fig: 58 Weight loss % of bioplastic after bacterial degradation

Bacterial degradation studies of bioplastic samples reveal that as the concentration of ZnO nanoparticles increases weight loss percentage decreases. This may be due to the antibacterial property of ZnO nanoparticles. Weight loss percentage was greater for sample 1 with 0% ZnO nanoparticles and lesser for sample 4 with 2% ZnO nanoparticles.

The pictures taken on day 1 and day 7 of various samples with bacteria are shown in fig 59 – fig 66.

**SAMPLE 1 (0% ZnO NPs)**

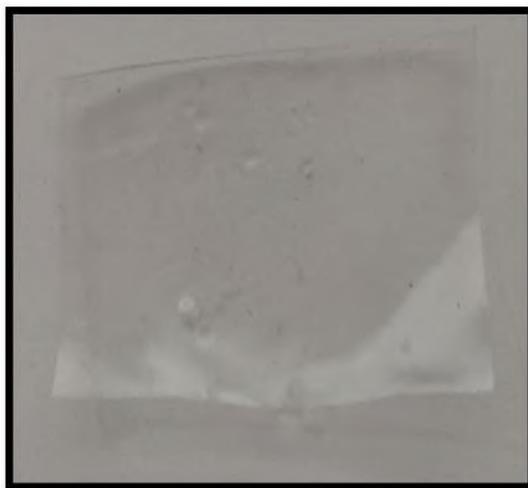


Fig:59 Day 1



Fig:60 Day 7

**SAMPLE 2 (0.4% ZnO NPs)**

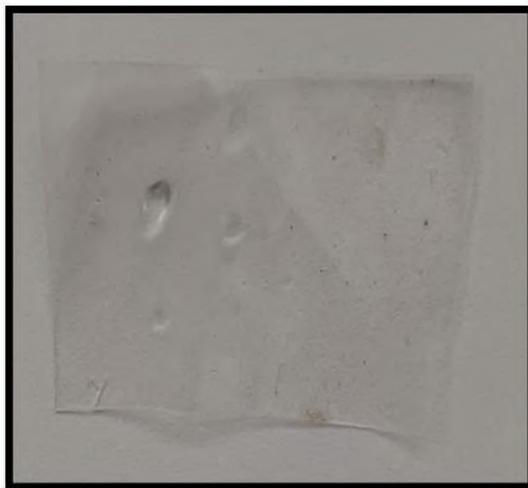


Fig:61 Day 1



Fig:62 Day 7

**SAMPLE 3 (1% ZnO NPs)**

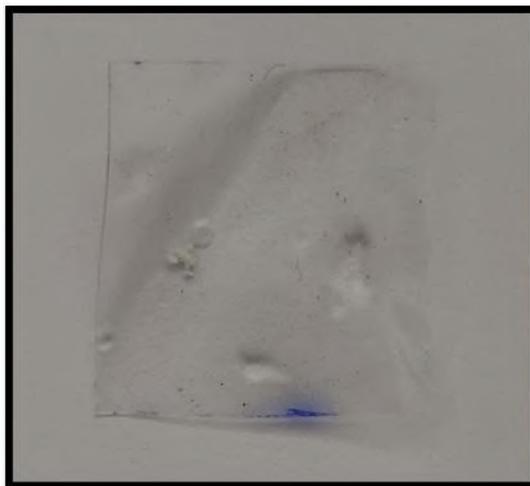


Fig:63 Day 1



Fig:64 Day 7

**SAMPLE 4 (2% ZnO NPs)**

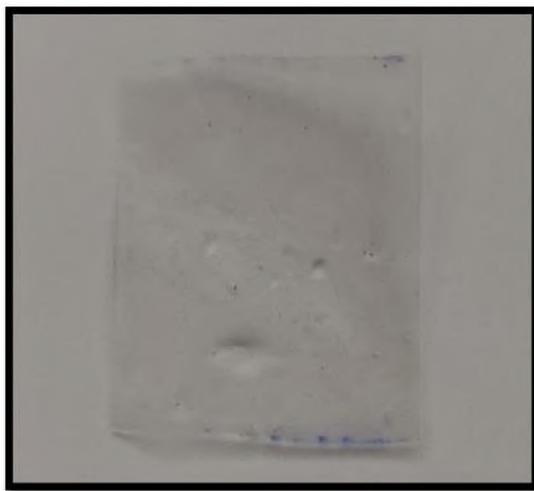


Fig:65 Day 1



Fig:66 Day 7

### **3.6 MECHANICAL PROPERTIES**

To know the quality of resulted bioplastic film, several parameters which are usually used to analyse the samples are measured such as tensile strength, elongation at break. Mostly, bioplastic materials are used because they have desirable mechanical properties such as tensile strength and elongation at break. For this reason, the mechanical properties may be considered as the most important of all the physical properties of bioplastic for most applications.

Tensile strength indicates the ability to accept load or tension without damaging the composite or broken which is stated with a maximum tension before breaking namely ultimate tensile strength. Tensile strength of composite material can be affected by several factors, including the relative comparison between the matrix and the reinforcement materials in composite materials, namely how many zinc oxide is added to the polymer matrix compared with composite materials. Elongation at Break indicates the quantity of the change of maximum film length while obtaining tensile strength until the film breaks, compared to the initial length. The result of tensile strength and elongation at break is given in Table 5.

**Table 5: Tensile strength and percentage elongation of bioplastic films**

Bioplastic	Tensile strength (N/mm <sup>2</sup> )	Percentage elongation (%)
Sample 1	2.6879	43.437
Sample 2	1.5866	37.309
Sample 3	1.0832	46.749
Sample 4	0.9424	49.8527

The increase of zinc oxide quantity indicates the tendency to decrease tensile strength value. In other words, higher the concentration of nano zinc oxide, the tensile strength is found to diminish. This is because the particles have more space in the matrix (starch), thus affecting the tensile strength of the bioplastic film. Percentage elongation will increase with increasing concentration of zinc oxide nanoparticles. The maximum tensile strength obtained was 2.6879 N/mm<sup>2</sup> for the virgin sample (sample 1: without any addition of ZnO nanoparticles).

Fig 67 and fig 68 shows the variation in tensile strength and percentage elongation of bioplastic, respectively.

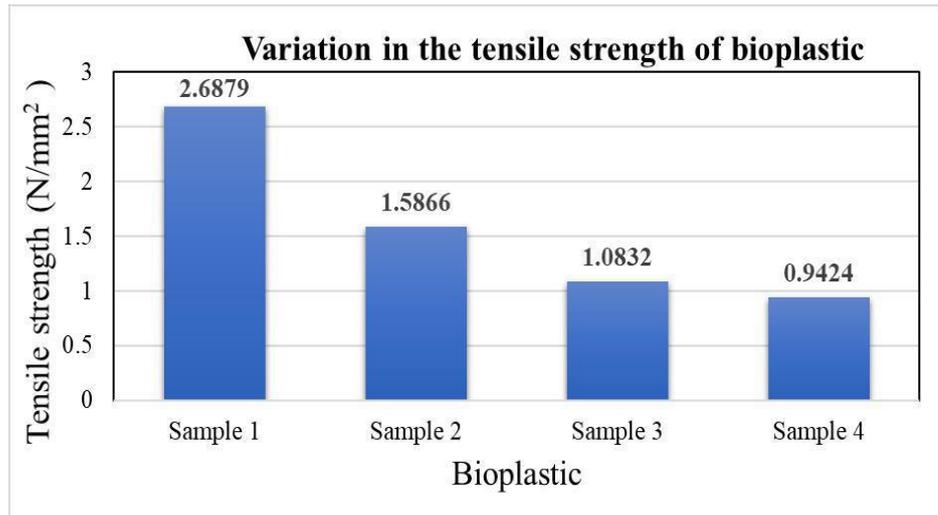


Fig: 67 Variation in tensile strength of bioplastic

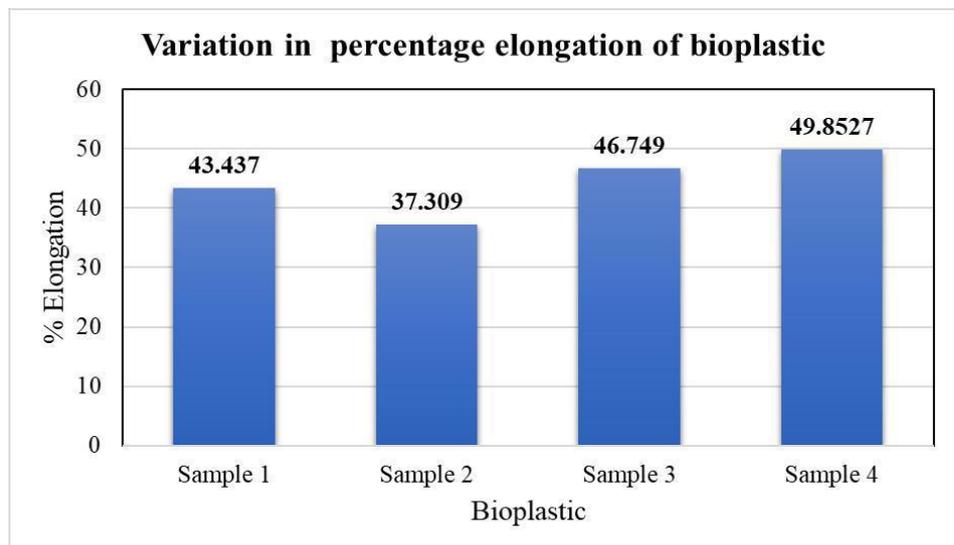


Fig: 68 Variation in percentage elongation of bioplastic

# Chapter 4

## Conclusions

Potato starch was extracted, and bioplastic was prepared from it. The prepared bioplastic films were characterized using SEM and XRD

Zinc oxide nanoparticles were prepared by precipitation method and characterized using XRD. The average particle size was found to be 25.897nm.

Different sheets of bioplastic were prepared by adding ZnO nanoparticles in various concentration i.e., 0.4%, 1% and 2%.

The incorporation of ZnO nanoparticles to the film was analysed using XRD. XRD of these films shows the characteristic  $2\theta$  values between  $30^\circ$  and  $40^\circ$  which is present as in the XRD of ZnO nanoparticles.

The bioplastic films were analysed using SEM to study the surface morphology before and after the incorporation of nanoparticles. Surface was found to be smooth and uniform.

The prepared bioplastic films were kept in the open and observations were made. The virgin bioplastic film had a shelf-life of 56 days. The bioplastic films incorporated with zinc oxide nanoparticles showed an increase in shelf-life. None of the samples degraded even until 65 days.

Biodegradability of prepared bioplastic films were studied.

Soil degradation studies shows that as the concentration of ZnO nanoparticles increases, the degradability of bioplastic also increases. Weight loss percentage was lesser for bioplastic with 0.4% ZnO nanoparticles, i.e., 48.74% and greater for bioplastic with 2% ZnO nanoparticles, i.e., 89.31%.

Bacterial degradation studies show that as the concentration of ZnO nanoparticle increases degradation decreases. This may be due to the antibacterial property of ZnO nanoparticles. Weight loss percentage was lesser for bioplastic with 2% ZnO nanoparticles, i.e., 25% and greater for virgin bioplastic film, i.e., 63.63%.

Tensile strength and % elongation were determined. It was observed that as the concentration of nanoparticles increases the tensile strength tends to decrease. The

maximum tensile strength obtained was 2.6879 N/mm<sup>2</sup> for the virgin sample without any addition of ZnO nanoparticles.

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**DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM**  
**PROJECT REPORT**

Submitted by

ANNA JOY

Register No: AM20PHY002

Under the guidance of

DR. MARY VINAYA

In partial fulfillment of the requirement for the award

Of

**MASTERS DEGREE OF SCIENCE IN**  
**PHYSICS**



**ST.TERESA'S COLLEGE (AUTONOMOUS),**  
**ERNAKULAM, KOCHI-682011**

# ST. TERESAS COLLEGE, ERNAKULAM



## MSc PHYSICS PROJECT REPORT

Name : ANNA JOY  
Register No. : AM20PHY002  
Year of work : 2020-2022

This is to certify that the project "DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM" was done by ANNA JOY.

*Memo*  
Staff member in charge

*Dr. Mary Vunja*



*Pooja*  
Head of the Department

Submitted for the university examination held in St. Teresa's College  
(Autonomous), Ernakulam.

Examiners 1) *Dr. Issac Paul, Vunja*

2) *Dr. Gishamol Mathew, John*

Date: 13.06.2022

**ST.TERESA'S COLLEGE**  
**(AUTONOMOUS)**  
**ERNAKULAM**



**CERTIFICATE**

This is to certify that the project report title “**DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM**” submitted by **ANNA JOY**, towards partial fulfillment of the requirements for the award of the degree of Master of Physics is a record of bonafide work carried out by them during the academic year 2020-2022.

**Supervising guide**

**Dr. Mary Vinaya**

**Assistant professor**

**Department of Physics**

**Head of the department**

**Dr. Priya Parvathi Ameena Jose**

**Associate Professor**

**Department of Physics**



**PLACE: Ernakulam**

**DATE: 13-06-2022**

## **DECLARATION**

I, ANNA JOY, Register No. AM20PHY002, Department of Physics, St. Teresa's College (Autonomous), Ernakulam do hereby declare that this project work entitled **"DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM"** submitted to Mahatma Gandhi University, Kottayam in partial fulfillment of the requirements for the award of the degree of Master of Science in Physics is a record of original work done by us under the supervision of Dr. Mary Vinaya, Assistant Professor, St. Teresa's College (Autonomous), Ernakulam.

Place: Ernakulam

Date:13/06/2022

## **ACKNOWLEDGEMENT**

Every project big or small is successful largely due to the effort of a number of wonderful people who have always given their valuable or extensive cooperation.

First and foremost we would like to thank God Almighty for showering his blessings on us in this endeavor.

We express our sincere gratitude to Dr. Mary Vinaya, Assistant Professor, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, under whose able guidance and supervision, we could complete our project. Her extensive cooperation and valuable guidance were the light in the dark for us in the course of this project.

We take this opportunity to thank Dr. Priya Parvathy Ameena Jose, Head of the Physics Department for the generous concern and support given to us. We express our sincere sense of gratitude to both teaching and non-teaching staffs of Department of Physics, St. Teresa's College (Autonomous), Ernakulam, for extending facilities required from time to time.

We would like to thank each and every one who has contributed to this work by their unfailing support throughout the preparation of the project.

**DBS DYNAMICS OF MEMRISTIVE LIF  
NEURON SYSTEM**

# CONTENTS

Abstract.....	1
Chapter 1: NON LINEAR DYNAMICS	
1.1 Dynamical systems.....	2
1.2 Linearity versus Non linearity .....	3
1.3 Nonlinear systems.....	4
1.4 Characteristics of nonlinear systems.....	5
1.5 Characterization of nonlinear systems.....	9
Chapter 2: NEURAL NETWORK	
2.1 What is a Neuron?.....	10
2.2 Structure of a Neuron.....	11
2.3 What is Synapse?.....	12
2.4 Neurotransmitters and Action potential.....	14
2.5 Communication of Neurons.....	15
Chapter 3: REVIEW OF BRAIN STIMULATION ON TM MODEL	
3.1 Deep Brain Stimulation.....	17
3.2 Tsodyks-Markram (TM) model.....	19
3.3 Synaptic response to DBS.....	21

## Chapter 4: THE LIF SPIKING NEURON MODEL

4.1 Introduction.....	24
4.2 Post-synaptic neuron firing.....	26
4.3 Result.....	27

## Chapter 5: DYNAMICS OF MEMRISTIVE LIF MODEL UNDER DEEP BRAIN STIMULATION

5.1 Introduction.....	38
5.2 Memristor properties.....	40
5.3 The Memristive LIF (MLIF) spiking neuron model.....	44
5.4 Result.....	46

## Chapter 6: DISCUSSION.....67

MATLAB code for TM Model.....	69
-------------------------------	----

MATLAB code for LIF Neuron Model.....	73
---------------------------------------	----

MATLAB code for MLIF Neuron Model.....	78
--	----

REFERENCES.....	84
-----------------	----

## ABSTRACT

Deep brain stimulation (DBS) is a successful clinical therapy for a wide range of neurological disorders; however, the physiological mechanisms of DBS remain unresolved. While many different hypotheses currently exist, our analyses suggest that high frequency (130 Hz) stimulation-induced synaptic suppression represents the most basic concept that can be directly reconciled with experimental recordings of spiking activity in neurons that are being driven by DBS inputs.

The goal of this project was to develop a simple model system to characterize the excitatory post-synaptic currents (EPSCs) and action potential signaling generated in a neuron that is strongly connected to pre-synaptic glutamatergic inputs that are being directly activated by DBS.

We used the Tsodyks-Markram (TM) phenomenological synapse model to represent depressing, facilitating, and pseudo-linear synapses driven by DBS over a wide range of stimulation frequencies. The EPSCs were then used as inputs to a leaky integrate-and-fire neuron model (LIF) and later to a memristor leaky integrate-and-fire neuron model (MLIF) in order to measure the DBS-triggered post-synaptic spiking activity.

The result we obtained is that the synaptic suppression was a robust feature of high frequency stimulation, independent of the synapse type and MLIF neuron model exhibits greater spiking activity than LIF neuron model.

# CHAPTER 1

## NON-LINEAR DYNAMICS

### 1.1 Dynamical systems

Dynamical systems are found all around us. A dynamical system is a system whose state is distinctively specified by a set of variables and whose behavior is outlined by certain predefined rules. Some examples of dynamical systems are population growth, a swinging pendulum, the motions of celestial bodies, and the behavior of “rational” individuals playing a negotiation game, to name a few. If you assume that individuals make decisions always perfectly rationally, then the decision making process becomes deterministic, and therefore the interactions among them may be modeled as a deterministic dynamical system. Of course, this doesn't guarantee whether it is a good model or not [1]. The main reason behind studying dynamic systems is to predict system behavior and to control it.

Dynamical systems first developed from the geometry of Newton's equations and the question of the stability of the solar system motivated further researches inspired by celestial mechanics. Then dynamical systems developed intensively from stability theory (Lyapunov's theory) to generic properties (based on functional analysis techniques,) hyperbolic structures and to perturbation theory [2].

Dynamical systems are deterministic mathematical models, where time can be either a continuous or a discrete variable. Both qualitative and quantitative properties of such models are of interest to researchers [3]. Dynamical systems are usually studied in order to figure out their complex behaviors such as chaos, hyperchaos, transient chaos, bursting oscillations, mixed mode oscillations, multistability and extreme multistability [4].

The equations representing a dynamical system describe the change in time of variables taken to adequately describe the target system and these equations are referred to as dynamical or evolution equations. A complete specification of the initial state of such equations is referred to as the initial conditions for the model, while a characterization of the boundaries for the model domain are

known as the boundary conditions. A simple example of a dynamical system would be the equations modelling a particular chemical reaction, where a set of equations relates the temperature, pressure, amounts of the various compounds and their reaction rates. The boundary condition might be that the container walls are maintained at a fixed temperature. The initial conditions would be the starting concentrations of the chemical compounds. The dynamical system would then be taken to describe the behavior of the chemical mixture over time [3].

The variables that completely describe the state of the dynamical system are called the state variables. The set of all the possible values of the state variables is the state space. An instantaneous state is taken to be characterized by the instantaneous values of the variables considered crucial for a complete description of the state. The state space can be discrete, consisting of isolated points, such as if the state variables could only take on integer values. It could be continuous, consisting of a smooth set of points, such as if the state variables could take on any real value. The number of state variables is the dimension of the dynamical system. The state space can also be infinite-dimensional. When the state of the system is fully characterized by position and momentum variables, the resulting space is often called a phase space. A model can be studied in state space by following its trajectory, which is a history of the model's behavior in terms of its state transitions from the initial state to some chosen final state [3, 4].

## **1.2 Linearity Versus Non linearity**

Linear systems are rare in nature. A linear system is one in which the cause produces a constant proportionality effect. The dynamics of a linear system can be reconstructed by summing up the individual causes acting on a single component. Small initial errors in prediction or from a random measurement grow linearly over time. Linear phenomena are concerned with inter relationship between cause and effect, which can be determined with great accuracy.

A linear system can be characterized in several different ways. Its dynamics can be represented by a system of linear differential equations (for continuous-time systems) or linear difference equations (for discrete-time systems). It has a

transfer function and obeys the law of superposition. A sinusoidal input produces a sinusoidal output of the same frequency. One of the most common ways to test for a system's linearity is by verifying if it follows the law of superposition. Superposition is composed of two parts, scaling and additively.

Nonlinear systems are ubiquitous in nature. A nonlinear system is simply one that is not linear. However, there are several reasons why a system might be nonlinear, and different classes of nonlinearities come about because of different physical reasons.

### **1.3 Nonlinear systems**

A nonlinear system is a system in which the variation in the output is not proportional to the variations occurring in the input. As most real physical systems are inherently nonlinear in nature, nonlinear systems are of great interest to physicists, engineers and mathematicians [5]. For a nonlinear system a small change in a parameter may cause sudden and dramatic changes, resulting in a complex and unpredictable trajectory. A curve for a nonlinear system consists of a smooth curve, wiggles, an abrupt cut-off or any number of different types of lines. That is a nonlinear system can be considered as a sum of its parts. A small initial error in prediction or from a random measurement grows exponentially over time. A large scale deviation and huge unpredictable effects can take place from small initial changes.

The behavior of a nonlinear system is described in mathematics by a nonlinear system of equations. In a nonlinear system of equations, the equation(s) to be solved cannot be written as a linear combination of the unknown variables or functions that appear in them. Non-linear dynamic systems do not obey superposition principle. They have multiple isolated equilibrium points. The state of an unstable nonlinear system can reach up to infinity in finite time [6]. Nonlinear equations are difficult to be solved by analytical methods and give rise to interesting phenomena such as bifurcation, limit cycle and chaos.

The purpose of nonlinear dynamic systems is twofold. To begin with, it serves as an instrument to analyze information (e.g., EEG rhythms, eye developments, and so on). Second, it is utilized to show the various areas being scrutinized

(from neuroscience to imagination). Time and change are the two factors behind the strength of the nonlinear dynamic systems approach [7]. Nonlinearity might stay inactive or, lead to subjective changes of conduct contingent upon the values of the control parameters portraying the manner in which a framework has been at first ready or is being permanently requested by the external world [8].

## **1.4 Characteristics of nonlinear systems**

### **1.4.1 Limit cycle**

One peculiar behavior exhibited by nonlinear systems is a limit cycle. Although linear systems may oscillate, this oscillatory behavior cannot be explained in terms of linear theory. It is characterized by a constant amplitude and frequency determined by the nonlinear properties of the system irrespective of the initial conditions, external data inputs, or perturbations [9, 10].

A limit cycle is a closed trajectory in phase space exhibiting the property that at least one other trajectory spirals into it either as time approaches infinity or as time approaches negative infinity [10]. A limit cycle is said to be asymptotic stable if all trajectories nearby the limit cycle converge to it as  $t \rightarrow \infty$ . Otherwise the limit cycle is said semi-stable or unstable, that is, all neighboring trajectories approach it as time approaches negative infinity [11].

Stable limit cycles are vital scientifically, since they model systems that display self-sustained oscillations, for example systems which oscillate even without any external driving force (e.g. thumping of a heart, rhythms in body heat level, chemical discharge). In the event that the system is perturbed marginally, it always gets back to the stable limit cycle. If a system has a stable limit cycle, the system will tend to fall into the limit cycle, with the output approaching the amplitude of that limit cycle regardless of the initial condition and forcing function.

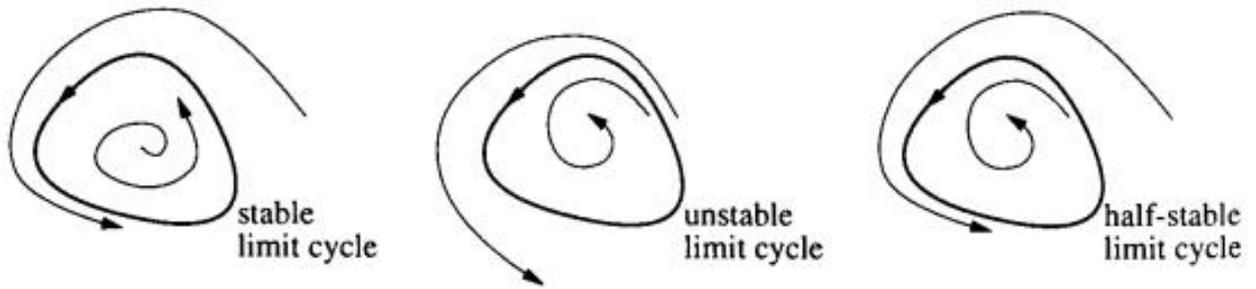


Fig. 1.1 Different types of Limit cycles

### 1.4.2 Bifurcation

As we mentioned earlier, a system's nonlinearities are not awakened gradually rather it involves a succession of explosive events in the form of instabilities. When the constraints exerted by environment reach certain threshold, small perturbation or small spontaneously arising fluctuations become amplified the system moves out from its basic state and is pushed toward a new regime called bifurcation.

Bifurcation in a nonlinear system can be defined as a change in behavior resulting from a small change in a parameter. By behavior, we mean a change in the number equilibrium points, a change in the type of equilibrium points (stable or unstable), or the emergence of a limit cycle. By small change in a parameter, we mean that there is a threshold above which the system exhibits one type of behavior and below it exhibits another [9].

When the initial state become unstable, it is replaced by a multitude of stable regimes that are accessible simultaneously. To decide which particular branch will be followed is decided by chance in the form of critical variation at that moment. This makes the system sensitive to parameters which controls the position of bifurcation point since two macroscopically indiscernible systems at same constraints follow entirely different path.

As system undergoes not just a single transition but a whole sequence of transition as the constraints are varied and its characteristics depend on the nature of nonlinearities present. One such phenomenon is deterministic chaos, where the transition eliminates in regime which is characterized by as irregular evolution of the variables in space and time.

### 1.4.3 Chaos

Chaos is the phenomenon of occurrence of bounded non periodic evolution, deterministic but not predictable, nonlinear dynamical systems with very high sensitive dependence on initial conditions. If we begin a system at two different initial conditions then the trajectories resulting from each initial condition may be extremely different from each other. Whereas in linear systems, two initial conditions that start close to each other will have trajectories that behave similarly and stay relatively close to each other.

The idea of Chaos theory was acquainted with the cutting edge world by Edward Lorenz in 1972 with conceptualization of “Butterfly Effect”. A butterfly flapping its wings causes a hurricane on the other side of the world. The relatively small amplitude of butterfly wings is equivalent to a small change in initial condition. Surely a butterfly can't have much of an effect on atmospheric conditions. But even this small change is enough to make the difference between a nice sunny day and a storm (weather trajectory) in another part of the world. Knowledge of this hypothesis will assist with making a complex system more predictable [9].

In theoretical physics, chaos is a kind of moderated randomness that, unlike true randomness, contains complex patterns that are mostly unknown. The first evidence for an underlying design in chaos was observed by American physicist Mitchell Feigenbaum, who in 1976 discovered that when an ordered system begins to break down into chaos, a consistent pattern of rate doubling occurs [1]. In 1975, Yorke and Li showed a sustained periodic behavior could be found in 1-D maps. They coined the term chaos for the various phenomena that showed a periodicity along with sensitive dependence on initial conditions. In addition to showing that the existence of a periodic three orbit in 1-D continuous map implies sensitive dependence, they showed another remarkable consequence: the existence of infinitely many other periodic orbits.

If the equations governing a chaotic system and the initial conditions are known, then the behavior can be predicted by simple iteration. In practice, however, the initial condition can never be specified to 100% accuracy. This initial uncertainty, coupled with the sensitive dependence, means that such attempts at prediction are futile.

Other hallmarks of chaos include the existence of a dense set of unstable periodic orbits in its regime[12], positive Lyapunov exponents or finite Kolmogorov-Sinai entropy[13], continuous power spectrum, non-ergodicity, mixing (Arnold's cat map), as well as some other limiting properties [1].

Chaos is "ubiquitous". Interesting chaotic dynamical systems include:

- Hamiltonian systems of many different kinds,
- Digital filters, electrical and electronics systems,
- Celestial mechanics (the three-body problem),
- Laser, plasmas, solid state, and quantum mechanics,
- Nonlinear optics,
- Chemical reactions,
- Power systems,
- Neural networks,
- Economic behaviour, and
- Biological systems (heart, brain, population, etc.).

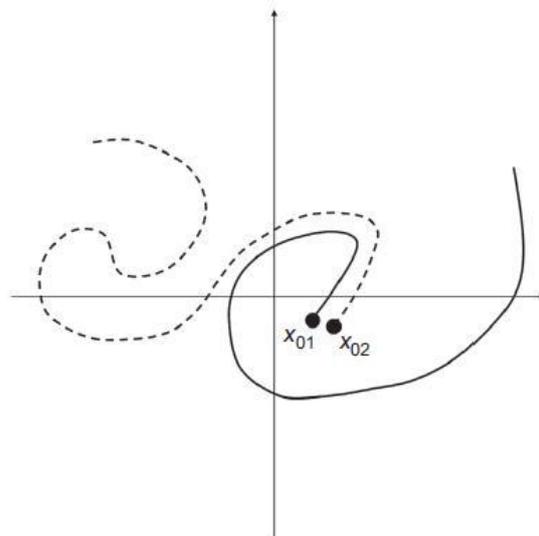


Fig.1.2 Trajectories in a chaotic system may diverge from each other even if the initial conditions are close.

## **1.5 Characterization of nonlinear systems**

Consider a system with finite set of observables such as temperature, chemical composition, flow velocity, pressure etc. The evolution into the abstract space spanned by all these variables is phase space. In this space, an instantaneous state of the system is represented by a point. As the time goes on, the point follows a curve called phase trajectory. By following these trajectories from different initial states, a phase portrait is obtained which provides a valuable qualitative idea of system potentialities. For every natural system the phase trajectory will converge to an object in phase space which is referred to as the attractor.

In recent years, it has been realized that ordinary systems obeying nonlinear laws leads to complexity associated with abrupt transitions, multiplicity of states referred to as deterministic chaos. Thermal convection in a fluid layer heated from below, turbulence etc. provide well established example of property of nonlinear systems which is referred to as self-organization. The self-organization become a powerful tool for analyzing complex systems, mainly biological systems and systems encountered in environmental science.

## CHAPTER - 2

### NEURAL NETWORK

#### 2.1 What is a neuron?

Human brain consists of neurons or nerve cells which transmit and process the information received from our senses. They use electrical impulses and chemical signals to transmit information between different areas of the brain, and between the brain and the rest of the nervous system. Everything we think and feel and do would be impossible without the work of neurons and their support cells, the glial cells [14]. Many such nerve cells are arranged together in our brain and they form a network of nerves. They pass electrical impulses i.e. the excitation from one neuron to the other.

The dendrites receive the impulse from synapse of an adjoining neuron. These dendrites carry the impulse to the nucleus of the nerve cells which is called as soma. The electrical impulse is processed here and the passed on to the axon. The axon is the longer branch among the dendrites which carries the impulse from the soma to the synapse. The synapse then passes the impulse to dendrites of the second neuron. A complex network of neuron is thus created in the human brain.

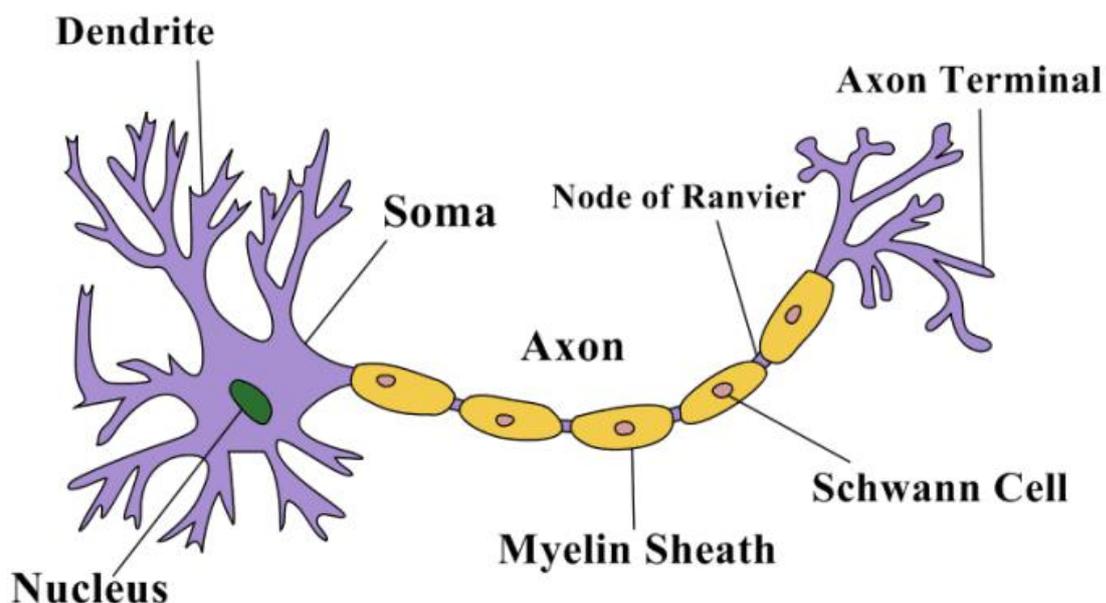


Fig. 2.1 Structure of a Neuron

The basic building block of the brain and central nervous system is the neuron. They are specialized cells that transmit chemical and electrical signals. The brain is made up of neurons and glial cells. Glial cells are non-neuronal cells which provide structure and support for the neurons. Nearly there are 86 billion neurons work together within the nervous system to communicate with the rest of the body. They control everything from consciousness and thought to pain and hunger. There are three primary types of neuron: sensory neurons, motor neurons and inter-neurons.

*Sensory neurons* respond to stimuli such as touch, sound, or light that affect the cells of the sensory organs, and they send signals to the spinal cord or brain.

*Motor neurons* receive signals from the brain and spinal cord to control everything from muscle contractions to glandular output.

*Inter-neurons* connect neurons to other neurons within the same region of the brain or spinal cord. When multiple neurons are connected together they form what is called a neural circuit.

## **2.2 Structure of neuron**

Neurons contain unique structure for receiving and sending the electrical signals that make neuronal communication possible. They consist of a nucleus, cell body, axon, dendrite and a myelin sheath.

### **Dendrite**

Dendrites are branch-like structure extending away from the cell body. Their job is to receive message from other neurons and allow those messages to travel to the cell body. Although some neurons do not have any dendrites, other types of neurons have multiple dendrites.

### **Cell Body**

Each neuron has a cell body (or soma) that contains a nucleus, smooth and endoplasmic reticulum, Golgi apparatus, mitochondria, and other cellular components. They control the functions of a cell. They contain different organelles which help them to do its job.

## **Axon**

An axon is a tube like structure that carries an electrical impulse from the cell body (or from another cell's dendrites) to the structure at opposite end of the neuron i.e. axon terminals, which then pass the impulse to another neuron.

## **Synapse**

The synapse is a chemical junction between the axon terminals of one neuron and the dendrites of the next. It is a gap where chemical interactions can occur. Its function is to transfer electrical activity (information) from one cell to another.

### **2.3 What is synapse?**

"Coming together" is the meaning of the word synapse. A synapse is formed when two structures or entities come together. Although the term synapse can refer to any cellular junction, it is most commonly used in physiology to refer to the junction of two neurons, the junction of a neuron and a target cell (ex. the neuromuscular junction), or the interface between adjacent cardiac muscle cells or adjacent smooth muscle cells. A synapse is a structure in the nervous system that permits a neuron to send an electrical or chemical signal to another cell.

#### Synapse cell

The presynaptic cell is the cell that sends the signal to the synapse. The postsynaptic cell is the cell that receives the signal after it crosses the synapse. A postsynaptic neuron at one synapse may become the presynaptic neuron for another cell downstream since most brain pathways contain several neurons.

With a postsynaptic neuron, a presynaptic neuron can make one of three types of synapses. The axon of the presynaptic neuron synapses with a dendrite of the postsynaptic neuron in an axodendritic synapse, which is the most frequent form of synapse. An axosomatic synapse occurs when the presynaptic neuron synapses with the postsynaptic neuron's soma, while an axoaxonic synapse occurs when it synapses with the postsynaptic cell's axon.

## Synapse Transmission

In your body, there are two types of synapses: electrical and chemical. Electrical synapses allow ions and signalling molecules to move directly from one cell to the next. Chemical synapses, on the other hand, do not transmit signals directly from the presynaptic cell to the postsynaptic cell. An action potential in the presynaptic neuron causes the release of a chemical message known as a neurotransmitter in a chemical synapse. The neurotransmitter then diffuses across the synapse and binds to postsynaptic cell receptors. When a neurotransmitter binds to a receptor, an electrical signal is produced in the postsynaptic cell. Each type of synapse has functional advantages and disadvantages.

### *Electrical synapse:*

The signal is passed through electrical synapse very fast, allowing groups of cells to act in unison. The direct flow of electrical current at gap junctions transmits action potentials in electrical synapses. When the trans-membrane pores of two neighboring cells align, a gap junction is produced. The two cells' membranes are joined together, and the matched pores create a pathway between them. As a result, various chemicals and ions are permitted to flow between the cells. Electrical synapses facilitate bidirectional information flow between cells due to the direct passage of ions and molecules from one cell to another. The function of cardiac myocytes and smooth muscles is dependent on gap junctions.

### *Chemical synapse:*

Chemical synapses allow neurons to integrate information from many presynaptic neurons, determining whether or not the postsynaptic cell will continue to propagate the signal. Multiple chemical synapses send information to neurons, which causes them to respond differently. The majority of synapses in your body are chemical synapses. A synaptic gap or cleft separates the pre- and postsynaptic cells in a chemical synapse. When an action potential is transmitted to the axon terminal, the axon terminals secrete chemical messengers known as neurotransmitters. Neurotransmitter molecules go across the synaptic cleft and bind to receptor proteins on the postsynaptic cell's cell membrane. The neurotransmitter binds to the receptors on the postsynaptic cell, causing a brief shift in the membrane potential of the postsynaptic cell [15].

## 2.4 Neurotransmitters and Action potential

### Neurotransmitters

The chemical messengers of the body are typically referred to as neurotransmitters. They are the chemicals that the nervous system uses to send and receive messages between neurons and between neurons and muscles.

The synaptic cleft is where two neurons communicate with one another (the small gap between the synapses of neurons). The release of neurotransmitters converts electrical messages that have travelled along the axon into chemical signals, generating a specific reaction in the receiving neuron. A neurotransmitter can have one of three effects on a neuron: excitatory, inhibitory, or modulatory.

In the receiving neuron, an excitatory transmitter encourages the formation of an electrical signal known as an action potential, whereas an inhibitory transmitter prevents it. The receptor to which a neurotransmitter binds determines whether it is excitatory or inhibitory.

Neuromodulators are unique in that they are not limited to the synaptic cleft between two neurons and can therefore affect a large number of neurons simultaneously. Neuromodulators, in contrast to excitatory and inhibitory transmitters, influence populations of neurons while functioning at a slower rate [16].

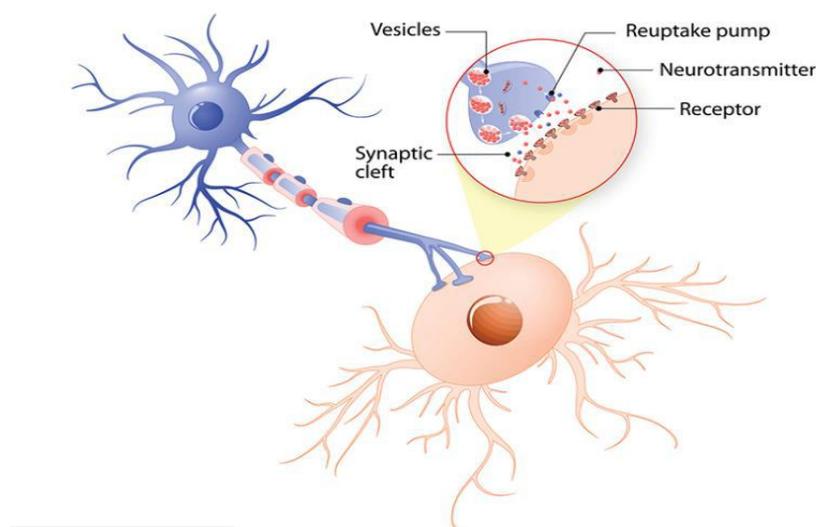


Fig. 2.2 Synapse model

## Action Potential

The cell membrane (the border between the interior and outside of a cell) contains many channels that allow positive and negative ions to flow into and out of the cell. The inside of a cell is normally more negative than the exterior; neuroscientists estimate that the inside is roughly -70 mV in comparison to the outside, or that the cell's resting membrane potential is -70 mV. The potential of the membrane isn't constant. It fluctuates regularly, primarily because to inputs from other neurons' axons. Some inputs cause the membrane potential of the neuron to become more positive (or less negative, for example, from -70 mV to -65 mV), whereas others have the reverse effect.

Because they encourage or inhibit the formation of action potentials, these are referred to as excitatory and inhibitory inputs, respectively (the reason some inputs are excitatory and others inhibitory is that different types of neuron release different neurotransmitters; the neurotransmitter used by a neuron determines its effect). The sum total of all excitatory and inhibitory inputs causes the neuron's membrane potential to hit roughly -50 mV (see diagram), which is known as the action potential threshold.

Action potentials are commonly referred to as 'spikes' by neuroscientists, who also remark that a neuron has 'fired a spike' or 'spiked.' The shape of an action potential as recorded with sensitive electrical equipment is referred to by this word [17].

## **2.5 Communication of Neurons**

Neurons communicate with one another via synapses. Neurotransmitter is released from the neuron into the synaptic cleft, a 20–40nm space between the presynaptic axon terminal and the postsynaptic dendrite, when an action potential reaches the presynaptic terminal (often a spine).

The transmitter will attach to neurotransmitter receptors on the postsynaptic side after crossing the synaptic cleft, and depending on the neurotransmitter released (which is dependent on the type of neuron releasing it), specific positive (e.g. Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>+</sup>) or negative ions (e.g. Cl<sup>-</sup>) will travel through membrane channels.

Synapses can be thought of as converting an electrical signal (the action potential) into a chemical signal in the form of neurotransmitter release, and then switching the signal back into an electrical form as charged ions flow into or out of the postsynaptic neuron after the transmitter binds to the postsynaptic receptor [17].

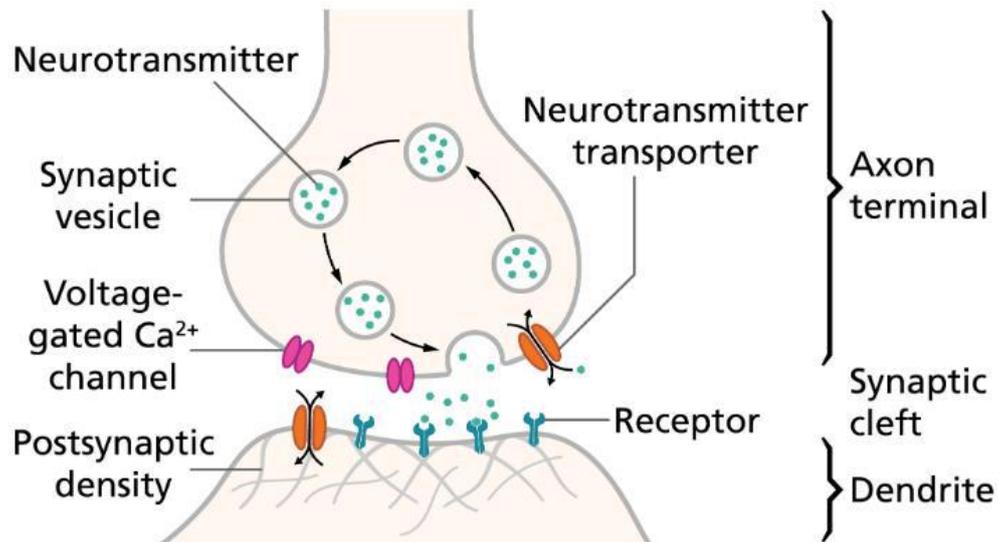


Fig. 2.3 An action potential, or spike, causes neurotransmitters to be released across the synaptic cleft, causing an electrical signal in the postsynaptic neuron

## **CHAPTER 3**

### **REVIEW OF BRAIN STIMULATION**

#### **3.1 Deep Brain Stimulation**

Deep brain stimulation (DBS) is a neurosurgical operation that employs electrical stimulation and implanted electrodes to treat movement disorders such as Parkinson's disease (PD), essential tremor, dystonia, and other neurological illnesses. It can also be used to manage obsessive-compulsive disorder and epilepsy symptoms [18]. When drugs are no longer effective or their negative effects interfere with a person's everyday activities, doctors may utilize DBS to treat movement disorders or neuropsychiatric diseases.

- During a surgical operation, surgeons implant one or more small wires (called leads or electrodes) in the brain.
- A tiny pulse generator implanted in the chest provides gentle electrical stimulation to the leads.
- Successful DBS surgery necessitates careful patient selection, precise electrode insertion, and pulse generator modification.
- DBS cannot completely alleviate the symptoms of Parkinson's disease or other illnesses, but it can help patients take fewer medications and have a better quality of life.

Deep brain stimulation (DBS) has changed the treatment of late-stage Parkinson's disease and has shown promise in the treatment of other intractable neuropsychiatric illnesses. Despite over 25 years of clinical experience, many concerns about the neurophysiological basis for therapeutic mechanisms of action remain unanswered. Electrical stimulation therapies in the nervous system are designed to manipulate the opening and closing of voltage-gated sodium channels on neurons, generate stimulation induced action potentials, and then control the release of neurotransmitters in targeted pathways using an applied electric field.

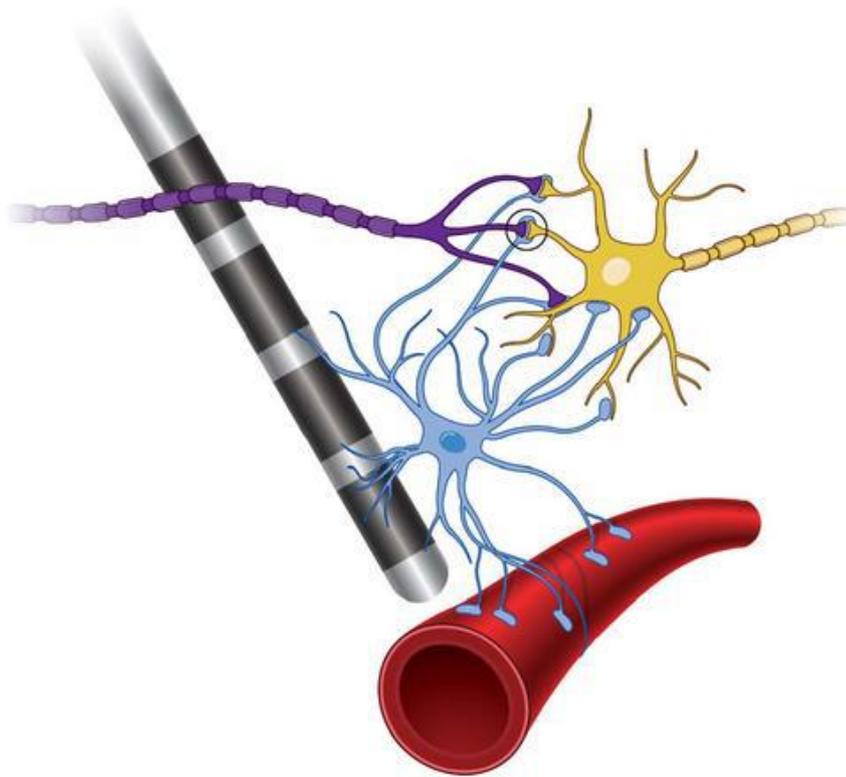


Fig. 3.1 Structural representation of DBS

Deep brain stimulation is a useful clinical tool, although the precise treatment mechanisms are unknown. The most basic concept that can be directly reconciled with experimental recordings of spiking activity in neurons driven by DBS inputs is that high frequency (100 Hz) stimulation-induced synaptic suppression represents the most basic concept that can be directly reconciled with high frequency (100 Hz) stimulation-induced synaptic suppression [19].

Given that therapeutic stimulation methods typically use a constant stimulation frequency, the steady-state PSC generated at the synapse as a function of stimulation frequency is a significant parameter of interest. Low stimulation frequencies (e.g., 10 Hz) can maintain high amplitude PSCs for lengthy periods of time, whereas high stimulation frequencies (e.g., 100 Hz) reduce PSCs immediately after the stimulus train begins.

In most in DBS experiments, communication between the directly stimulated pre-synaptic neuron and a tightly linked post-synaptic neuron does not completely stop. Instead, with high frequency stimulation, signal transmission, which is strong during low frequency stimulation, becomes sporadic and low

fidelity, despite remaining time-locked to the stimulus train. This shows that DBS changes the dynamics of these synaptic connections, and that 100 Hz stimulation acts as a filter, preventing low-frequency oscillatory activity of pre-synaptic neurons from impacting their post-synaptic neurons [20].

The general phenomena of DBS-induced synaptic suppression may be studied most easily at glutamatergic synapses [21, 22], where there is a wealth of experimental data to parameterize synaptic models and post-synaptic neurons can be monitored for synaptically generated APs time-locked to the stimuli. There are several types of glutamatergic synapses, including depressing, facilitating, and pseudo-linear. As a result, we set out to determine how these various synapse types respond to DBS.

Here, Tsodyks-Markram (TM) phenomenological synapse model to represent depressing (D), facilitating (F), and pseudo-linear (P) glutamatergic synapses driven by DBS over a wide range of stimulation frequencies.

### **3.2 Tsodyks-Markram (TM) model**

Short-term synaptic plasticity strongly affects the neural dynamics of cortical networks. The Tsodyks and Markram (TM) model for short-term synaptic plasticity accurately accounts for a wide range of physiological responses at different types of cortical synapses.

To quantify the dynamic behaviour of glutamatergic synapses driven by DBS-induced action potentials, here employed the Tsodyks-Markram (TM) phenomenological model of short-term synaptic plasticity. Short-term depression (related with neurotransmitter depletion) and short-term facilitation (associated with calcium influx into the pre-synaptic terminal) can both be simulated using TM models. The dynamics of the TM model arise from the combination of a depression effect, denoted by normalized variable  $x$ , which represents the fraction of neurotransmitter resources that remain available after synaptic transmission, and a facilitation effect modeled by utilization parameter  $u$  that represents the fraction of available neurotransmitter resources ready to be used (Fig. 2). As such,  $u$  is consumed to produce the postsynaptic current,  $I$ . The combination of the depression and facilitation effects, as well as the time delay,  $D$ , yields the following differential equations:

$$\dot{u} = -\frac{u}{\tau_f} + U(1 - u^-)\delta(t - t_s - \Delta) \quad (1)$$

$$\dot{x} = -\frac{1 - x}{\tau_d} - u^+x^-\delta(t - t_s - \Delta) \quad (2)$$

$$\dot{I} = -\frac{I}{\tau_s} + Au^+x^-\delta(t - t_s - \Delta) \quad (3)$$

where;

- $t_s$  – spike time
- $\delta$  – Dirac delta function
- $U$  – Increment of  $u$  produced by an incoming spike
- $\tau_f$  – decay time constant of variable  $u$
- $\tau_d$  – recovery time constant of variable  $x$
- $\tau_s$  – decay time constant of variable of  $I$
- $A$  – denotes the synaptic response amplitude that would be produced with the release of all neurotransmitter resources

The specific parameter values for the D, F, and P synapses are listed below, which were previously defined to match the experimentally measured characteristics of intracortical glutamatergic EPSCs.

Synapse	$\tau_f(ms)$	$\tau_d(ms)$	$\tau_s(ms)$	U	$A(\mu s)$
F	670	138	3	0.09	2.5
D	17	671	3	0.5	2.5
P	326	329	3	0.29	2.5

### 3.3 Obtained synaptic response to DBS

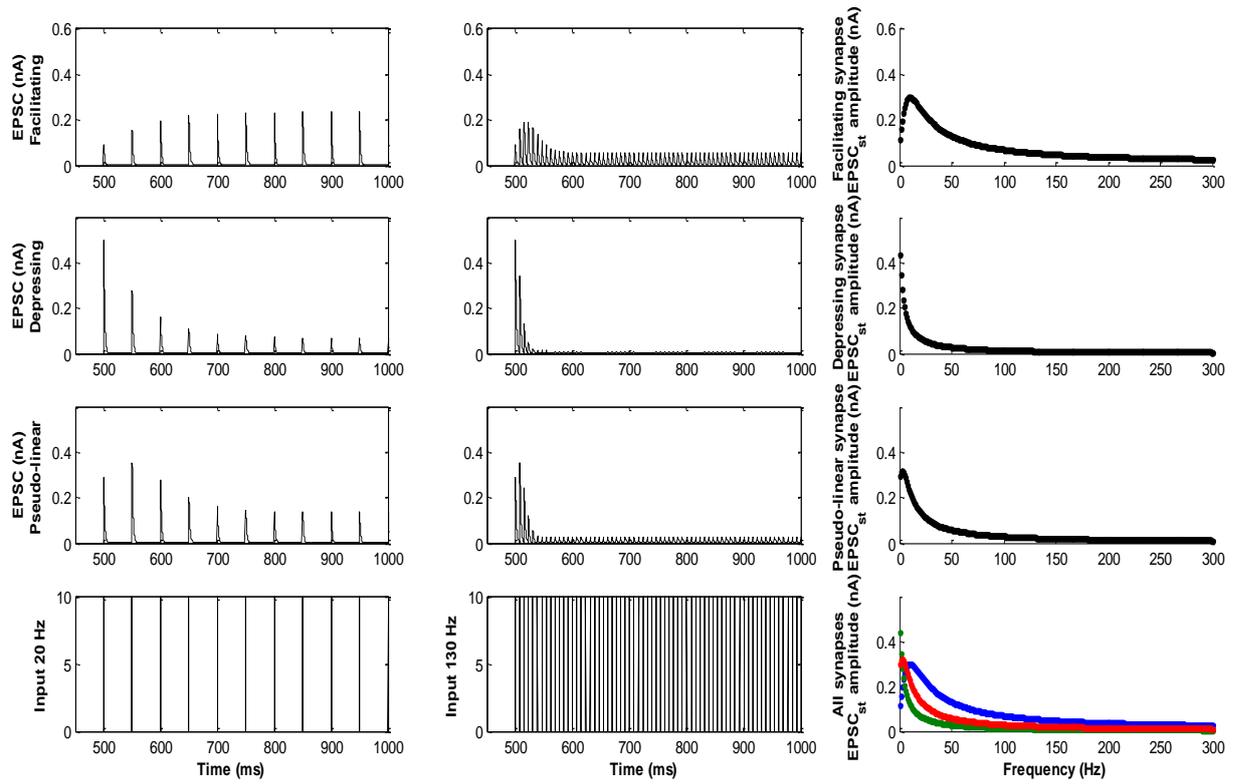


Fig 3.2 shows the EPSC generated by each of the F,D and P synapses for 20HZ and 130Hz.

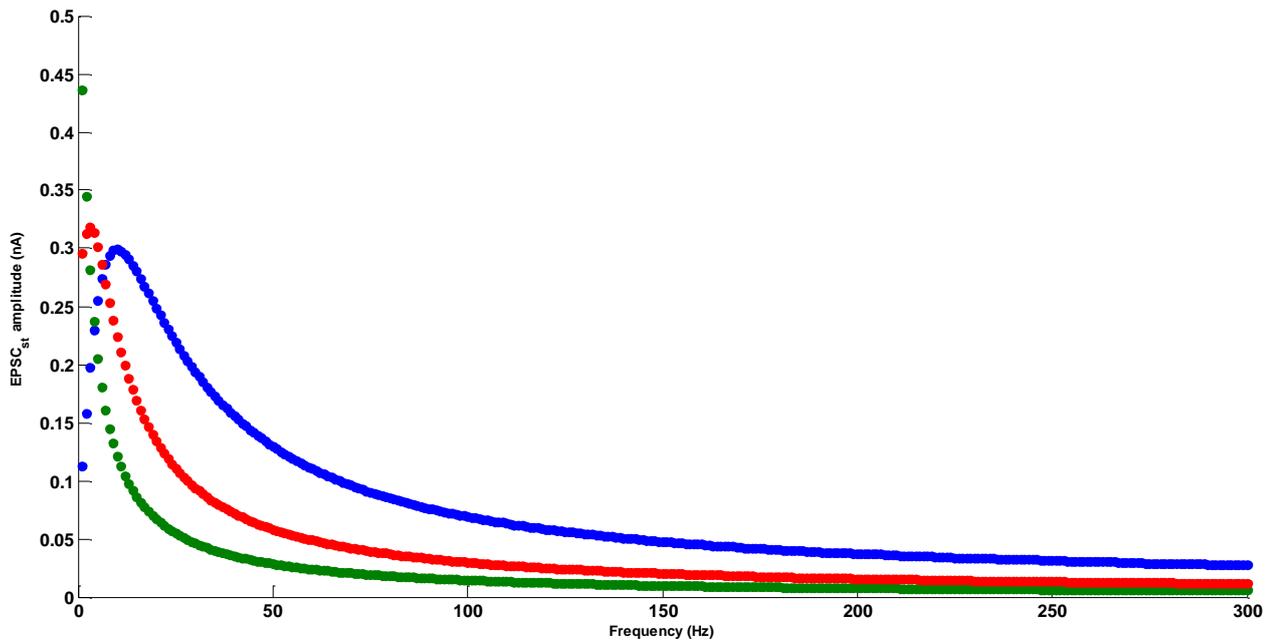


Fig 3.3 EPSC amplitude Vs Frequency plot

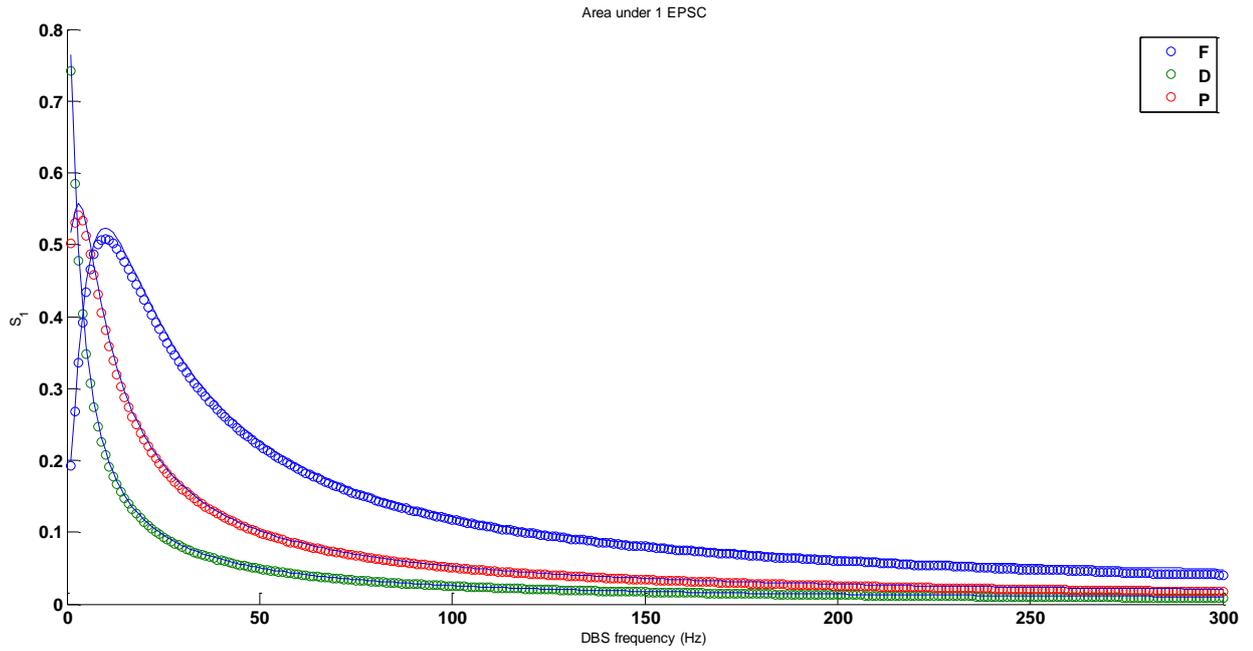


Fig 3.4 Area under 1EPSC

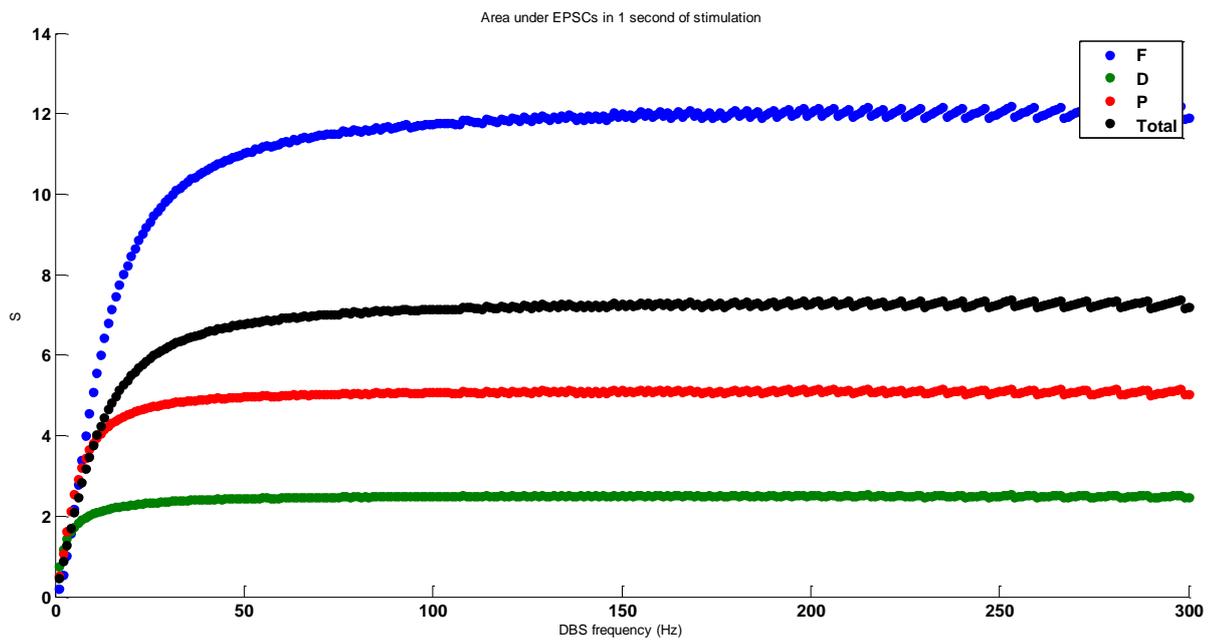


Fig 3.5 Area under EPSCs in 1 second of stimulation

Low frequency stimulation can produce a wide range of EPSCs, depending on the type of synapse (depressing (D), facilitating (F), or pseudo-linear (P)), as well as the timing of when the EPSC is evaluated throughout the stimulus train,

according to simulations of the TM synaptic model. The number of available transmission resources,  $x$ , for a D synapse stimulated at 20 Hz decays with a fast time constant. EPSCs are initially very strong, but in the steady-state, they degrade to a modest amplitude.

F synapses stimulated at 20 Hz, on the other hand, have an  $x$  that does not decrease rapidly because the utilisation fractions,  $u$ , are less. As a result, EPSCs start out small but grow in size with time to reach a larger amplitude in the steady-state. Under high frequency driving, however, both the F and D synapses show a similar tendency of steady-state EPSC suppression. During 130 Hz driving, F synapses have tiny EPSC amplitudes while D synapse EPSCs are essentially zero.

Thus we can conclude that Independent of the synapse type (D, F, P), high frequency driving of the synapse models generates marked EPSC suppression.

## **CHAPTER 4**

### **THE LIF SPIKING NEURON MODEL**

#### **4.1 Introduction**

Many neuron models emerged to mimic the functions of a biological neuron, especially the LIF spiking model. It is a simplified and much easier model for hardware implementation and large-scale integration. The primary purpose of an artificial neuron is to mimic the functions of biological neurons in an energy effectiveness and scalability way. The typical LIF model consists of a capacitor and a resistor. The external stimulus is applied to the LIF model until a threshold is reached, and then the action potential is produced. Although the LIF model can reproduce the firing behaviors of neurons after each activation, the previous pulse cannot be retained, and the biological spiking frequency adaptability does not perform very well. To solve these deficiencies, we need to find a new device to promote the LIF neuron model. A memristor is a potential element to emulate the function and behavior of a biological synapse or neuron gets a lot of attention. The non-volatile memristor modulates its conductance due to ion motion, similar to the phenomena in biological neurons and synapses. Therefore, these advantages enable the memristor to become an inevitable choice as a building block between artificial neural networks and biological neural networks.

Even though the LIF neuron model with a memristor had achieved lots of progress in emulating biological neurons, the implementation of retaining the previous pulse and performing the biological spiking frequency adaptability has not been yet explored in the MLIF neuron model.

The LIF spiking circuit model is put forward which is closer to the real biological neuron, as shown in Figure 4.7

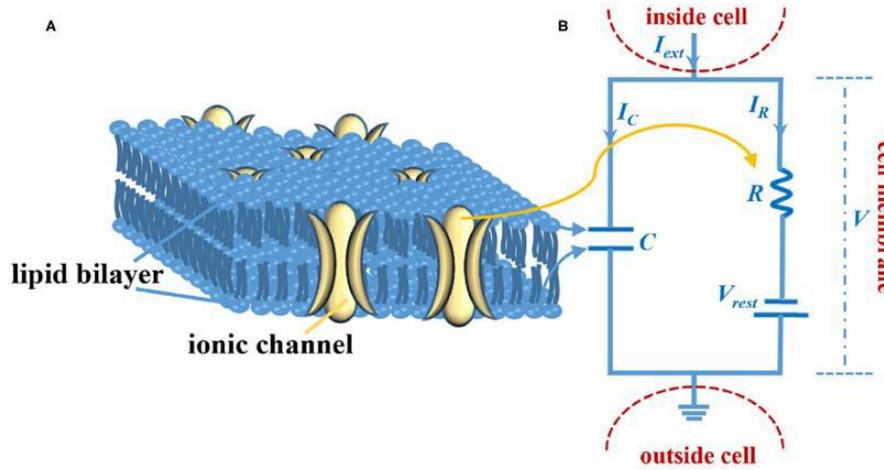


Fig 4.7 The LIF circuit model of the axon membrane. (A) The sketch of the cell membrane. (B) The circuit model of the cell membrane.

The cell membrane consists of the lipid bilayer and the ionic channel (Fig 4.7 A). The lipid bilayer can be represented by a capacitor, and the ionic channel can be characterized by a resistor (Fig 4.7 B).  $I_{ext}$  is external stimulus,  $C$  is the membrane capacitor,  $R$  is the membrane resistor (leaky resistor),  $V_{rest}$  is the resting voltage,  $V - V_{rest}$  is the resistive voltage,  $I_c$  is the current that passes through membrane capacitor,  $I_R$  is the current that passes through the membrane resistor, and  $V$  is the membrane voltage. Current passes through the membrane capacitor:

$$q = CV \tag{1}$$

$$I_c = \frac{dq}{dt} = Cdv/dt \tag{2}$$

Current passes through the membrane resistor:

$$I_R = (V - V_{rest})/R \tag{3}$$

According to Kirchhoff's current law:

$$I_{ext} = I_c + I_R \tag{4}$$

The time constant:

$$\tau = RC \tag{5}$$

The differential equation of the LIF model, which represents the leaky integration process:

$$dt = -(V - V_{rest}) + RI_{ext} \quad (6)$$

Using the finite differential method to solve (6) and compute the membrane potential at a time step of duration  $\Delta t$ :

$$V(t + \Delta t) - V(t) = \frac{\Delta t}{\tau} (-V(t) + V_{rest} + RI_{ext}) \quad (7)$$

## 4.2 Post-synaptic neuron firing

We used a noisy leaky-integrate-and-fire (LIF) neuron model to evaluate the post-synaptic response to the DBS-driven synaptic inputs. The LIF neuron was parameterized to exhibit an intrinsic tonic firing pattern at 20 Hz. This was achieved by incorporating a bias current,  $I_e$  (0.56 nA), background synaptic inputs that arrived stochastically at  $t_k$  via a Poissonian process with rate  $\omega_k$ , and white Gaussian noise,  $n(t)$ , that had a mean of 0 and variance ( $\sigma^2$ ) of 2.5. The LIF neuron also received glutamatergic inputs from DBS-driven synapses, where TM models simulated EPSCs that could also be modulated by a synaptic fidelity coefficient ( $\omega_{sf}$ ). Therefore, the transmembrane potential,  $v$ , of the LIF neuron model was defined by the following differential equation:

$$C_m \dot{v} = \frac{E_l - v}{R_m} + I_e + \omega_{sf} EPSC + \sum_{k, t_k} \omega_k \delta(t - t_k) + n(t) \quad (8)$$

Where  $C_m$  ( $1 \mu F$ ) and  $R_m$  ( $100 M\Omega$ ) are the membrane capacitance and resistance respectively, and  $E_l$  ( $-70 mV$ ) is the leak voltage. In eq. (8) EPSC represents the summated post-synaptic currents from all DBS-driven inputs [31].

## 4.3 Results

### Varying DBS frequency

**fdbs=60Hz**

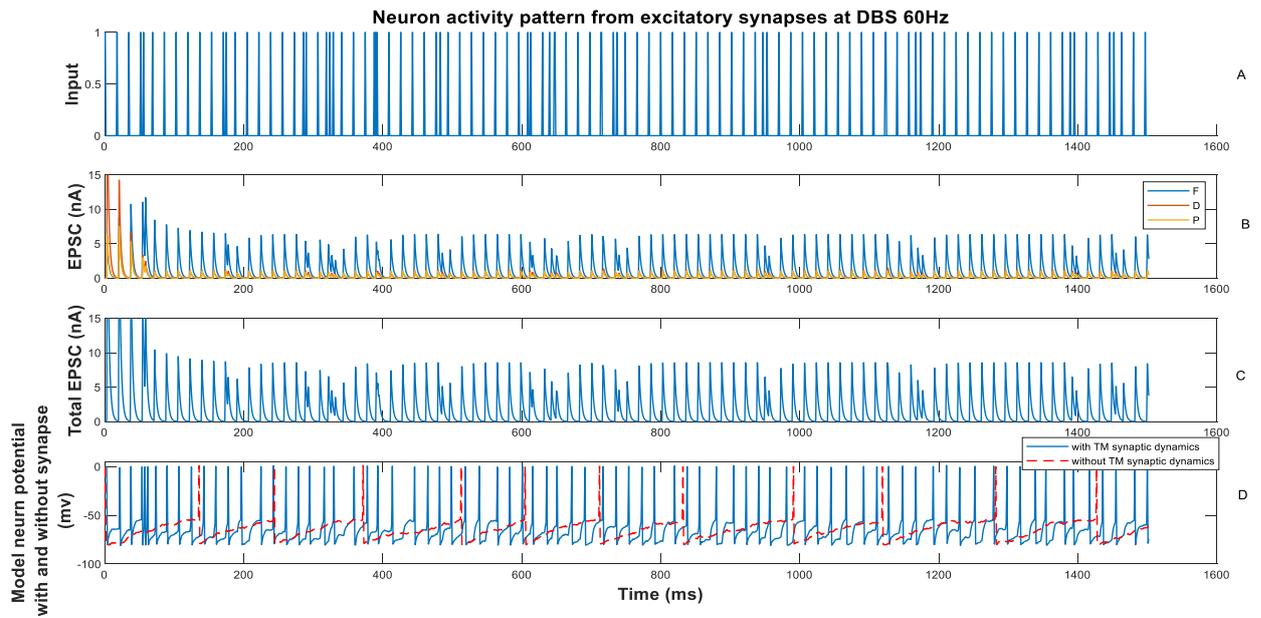


Fig.4.8

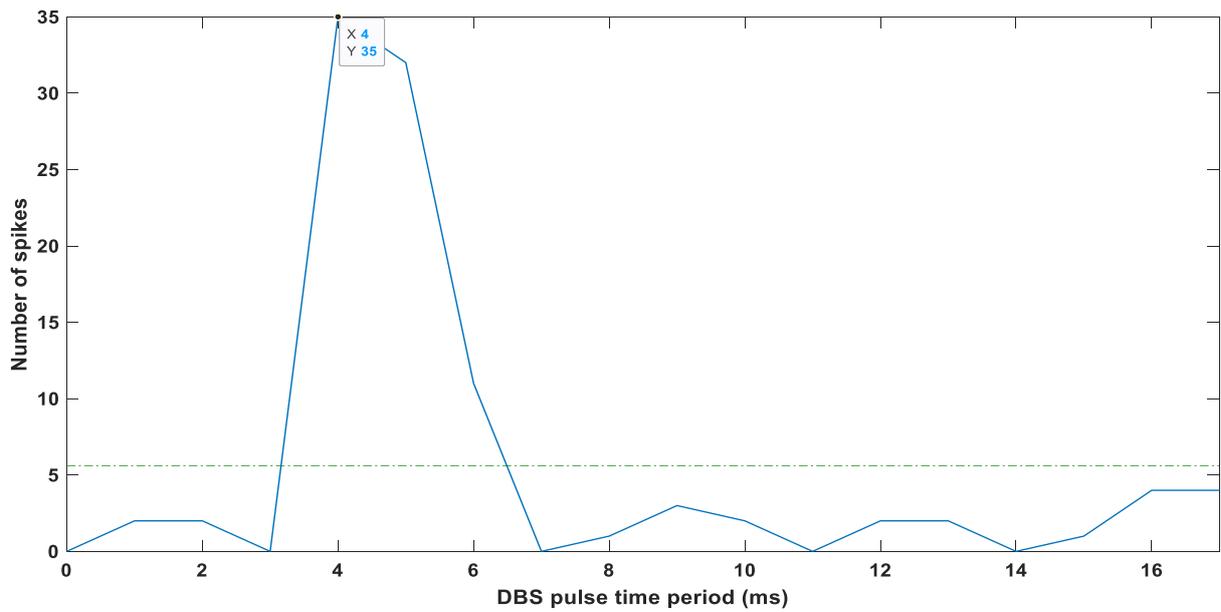


Fig.4.9

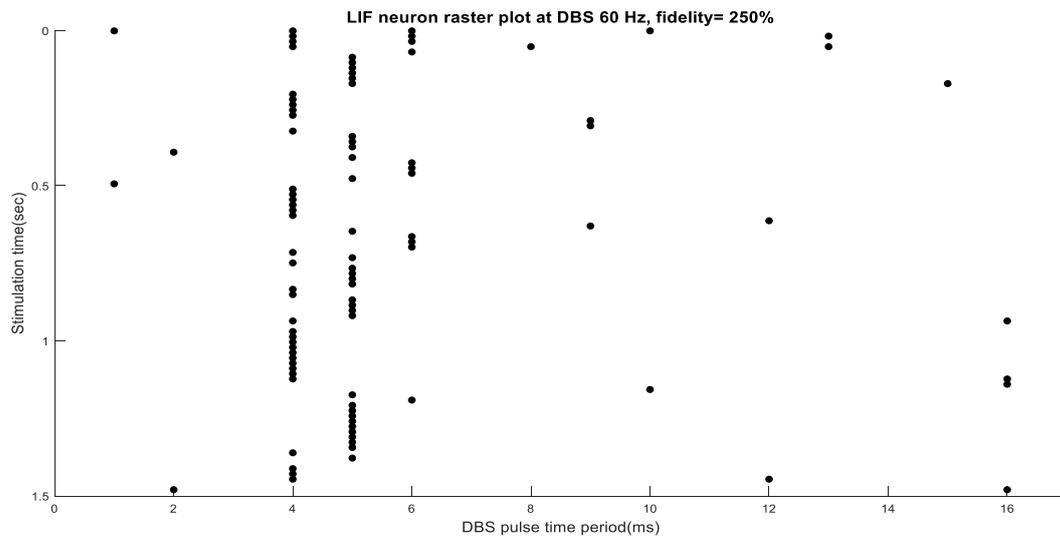


Fig.4.10

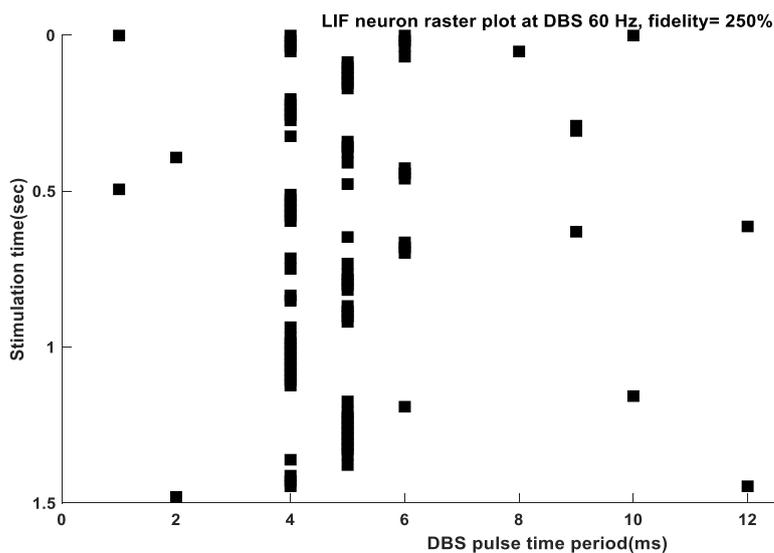


Fig.4.11

Fig. 4.8(A) shows the input frequency, i.e. 60Hz. Fig.4.8(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.8(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.8(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.9 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 35 at 4ms, whereas the average no. of spikes generated is 5.6.

Fig.4.10 and Fig.4.11 shows stimulus triggered action potentials during DBS. Fig.4.10 shows raster plot of the LIF neuron model without TM synaptic dynamics and Fig. 4.11 with TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 53.3689 (Hz)

LIF rate with all synapses during DBS10Hz = 66.7111 Hz

Elapsed time is 12.924753 seconds.

### fdbs=80Hz

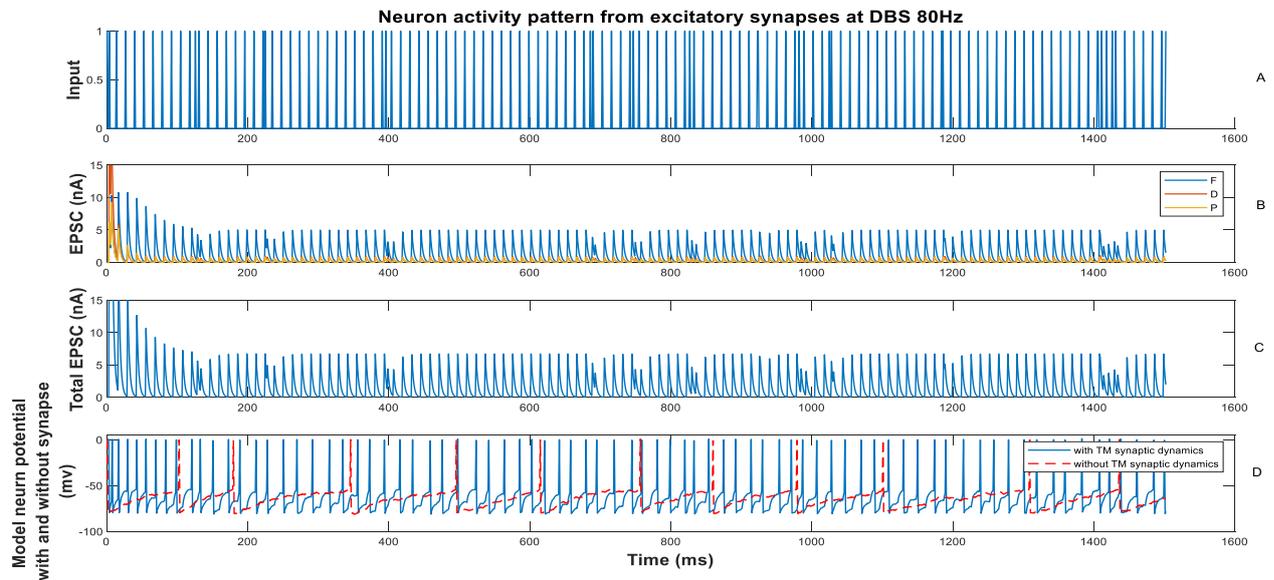


Fig.4.12

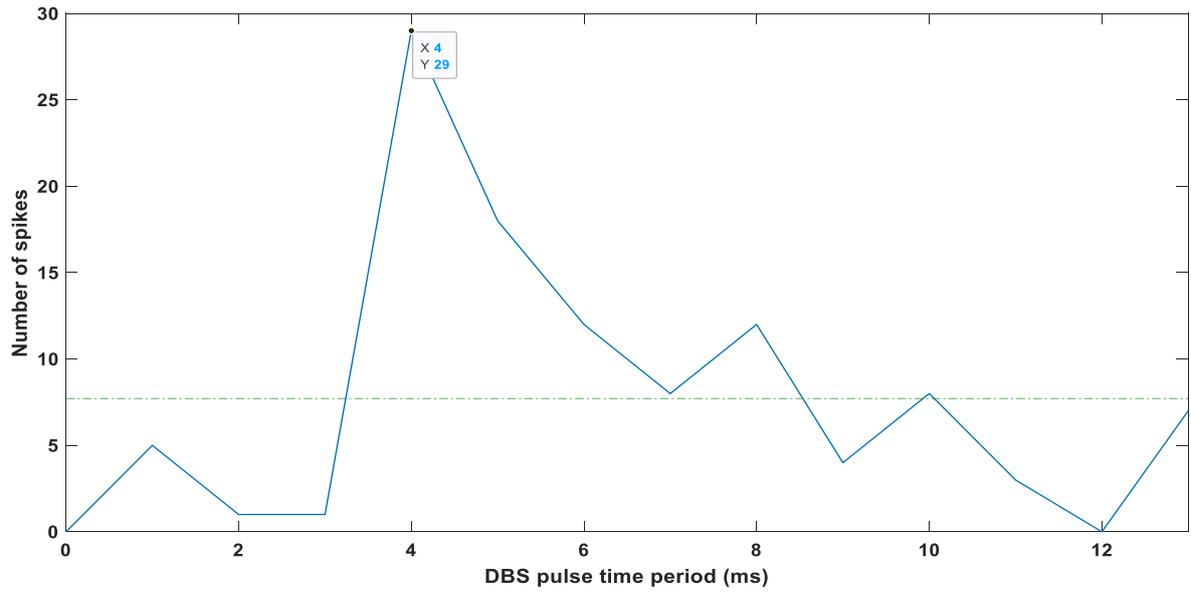


Fig.4.13

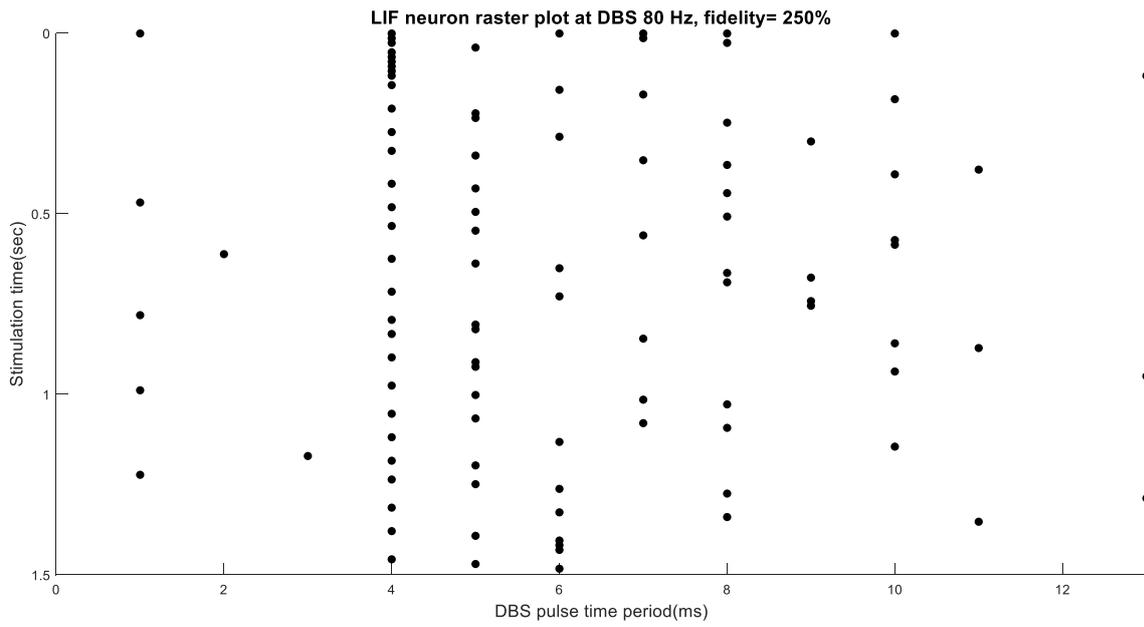


Fig.4.14

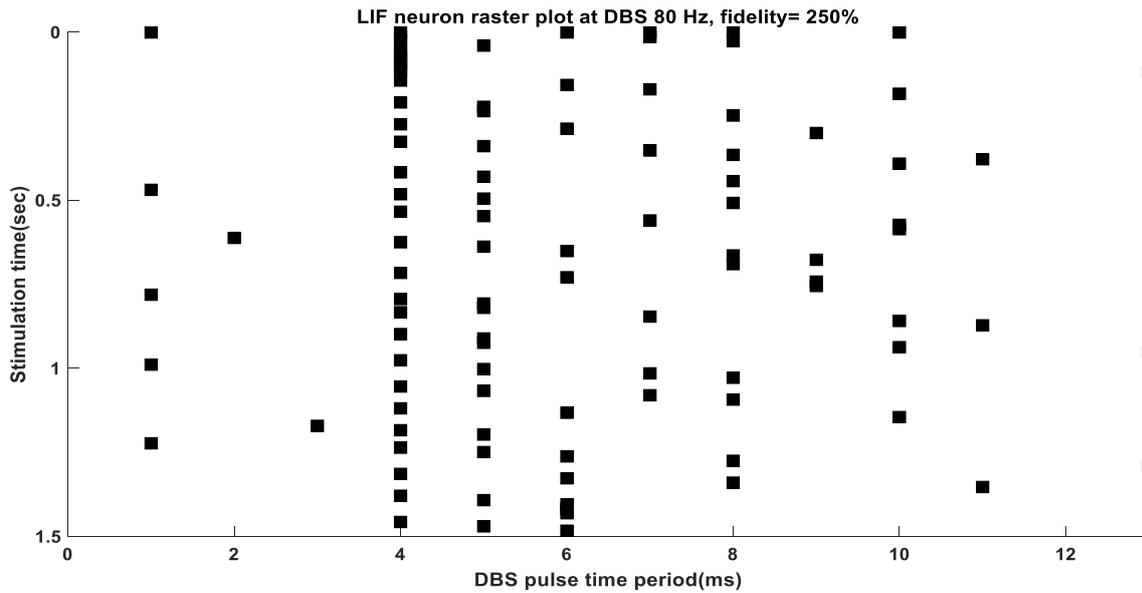


Fig. 4.15

Fig. 4.12(A) shows the input frequency, i.e. 80Hz. Fig.4.12(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.12(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.12(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.13 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 29 at 4ms, whereas the average no. of spikes generated is 7.7.

Fig.4.14 and Fig.4.15 shows stimulus triggered action potentials during DBS. Fig.4.14 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.15 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 5ms.

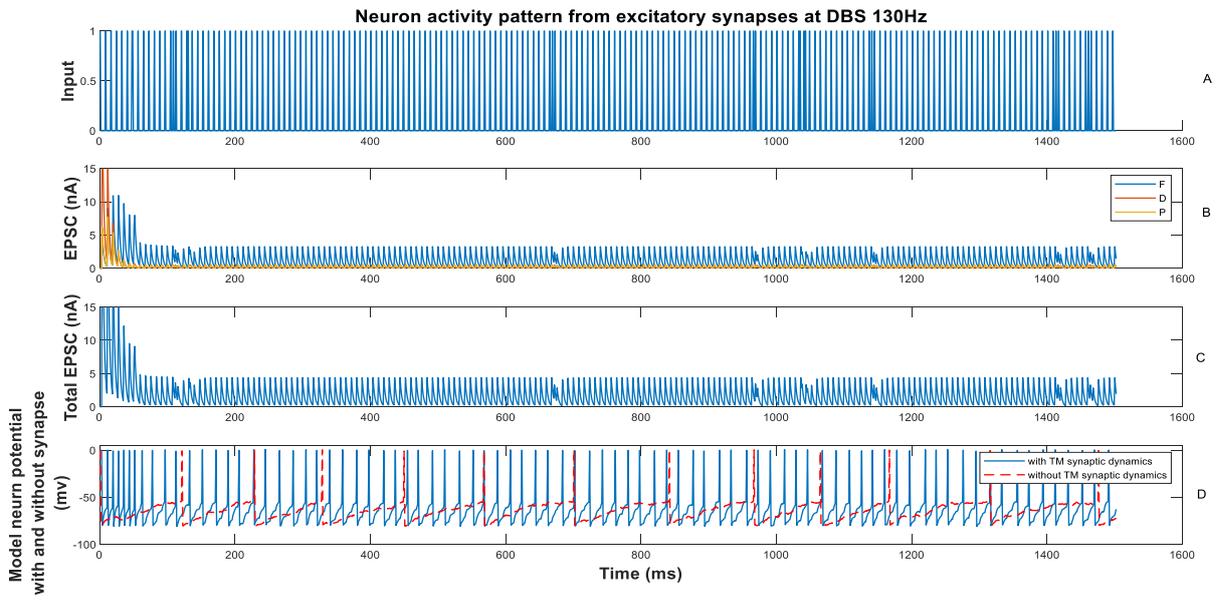
LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 54.036 (Hz)

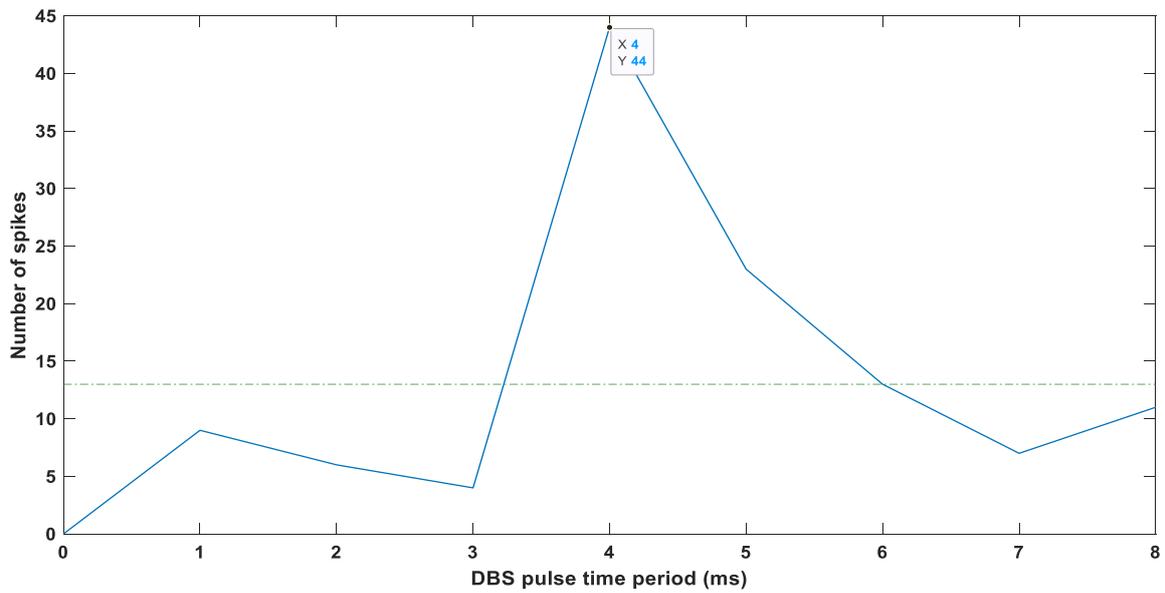
LIF rate with all synapses during DBS10Hz = 69.3796 Hz

Elapsed time is 10.173028 seconds.

**fdfs=130Hz**



**Fig. 4.16**



**Fig.4.17**

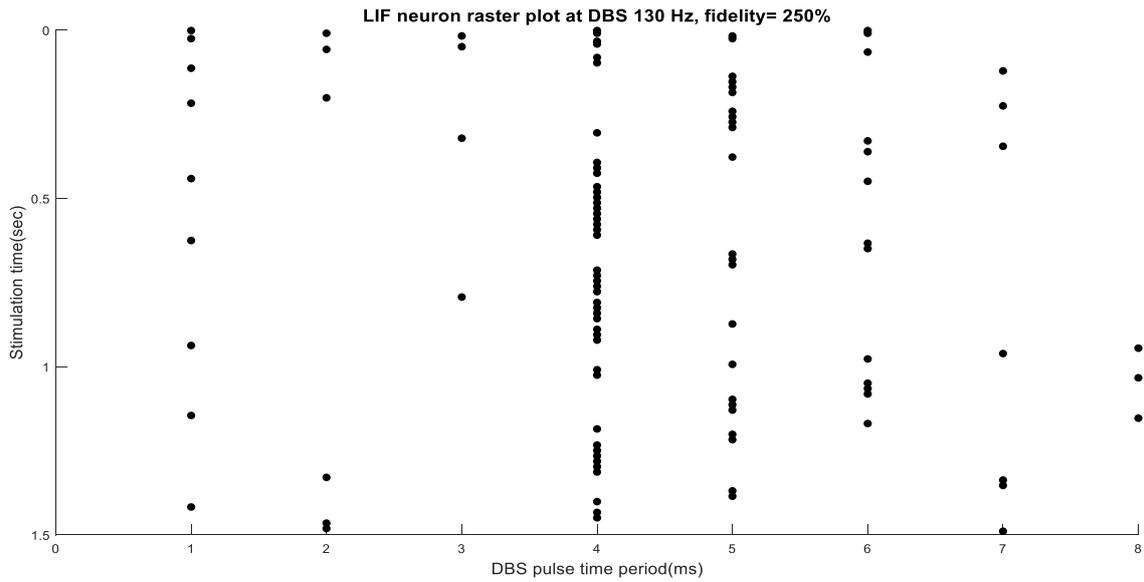


Fig.4.18

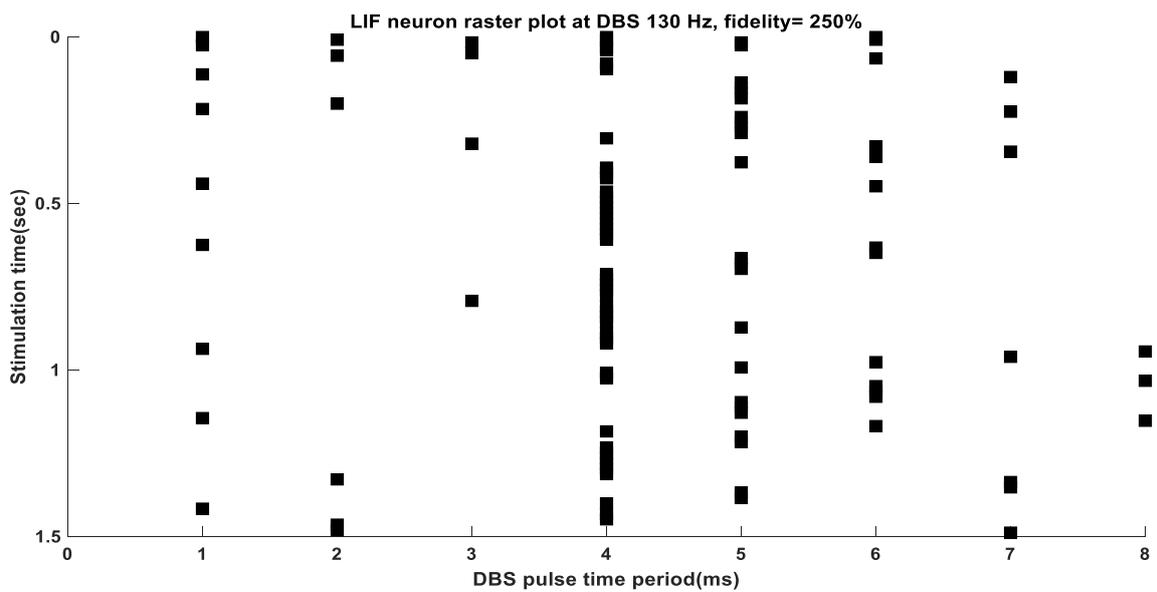


Fig.4.19

Fig. 4.16(A) shows the input frequency, i.e. 130Hz. Fig.4.16(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.16(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.16 (D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.17 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 44 at 4ms, whereas the average no. of spikes generated is 13.

Fig.4.18 and Fig.4.19 shows stimulus triggered action potentials during DBS. Fig.4.18 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.19 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.6724 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 56.7045 (Hz)

LIF rate with all synapses during DBS10Hz = 72.7151 Hz

Elapsed time is 15.008347 seconds.

### fdbs=150Hz

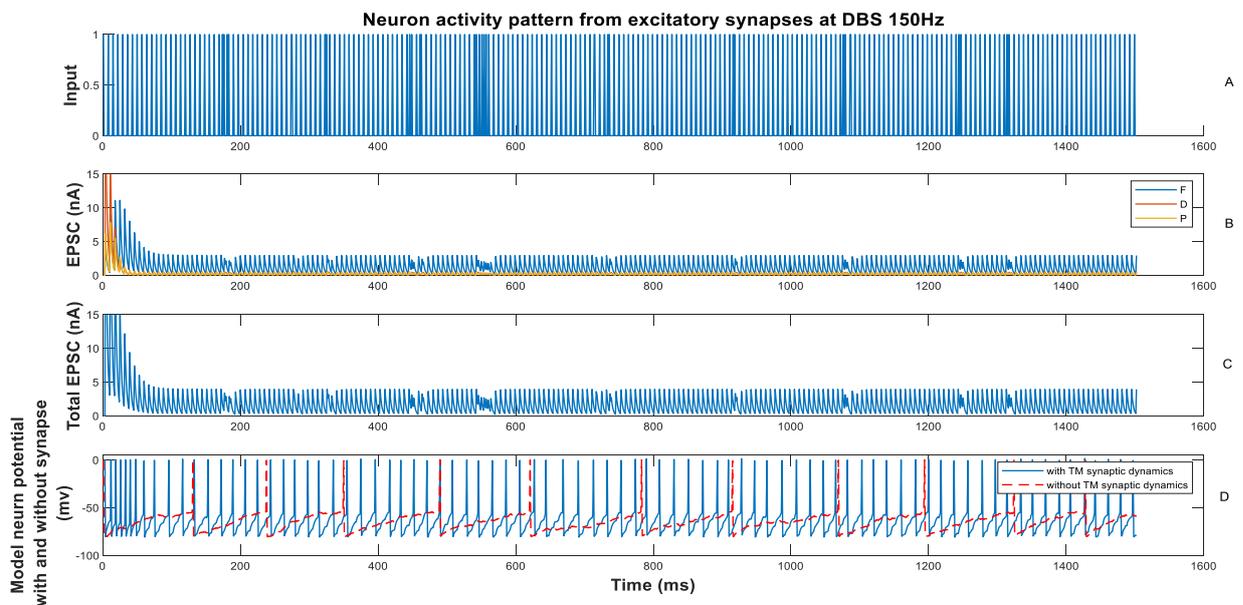


Fig.4.20

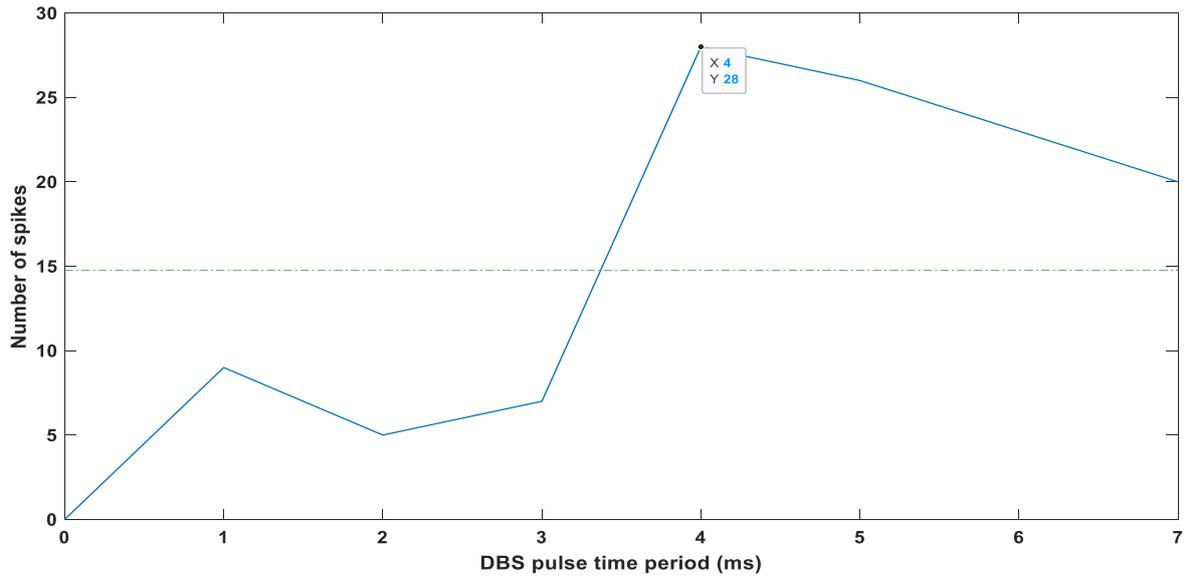


Fig.4.21

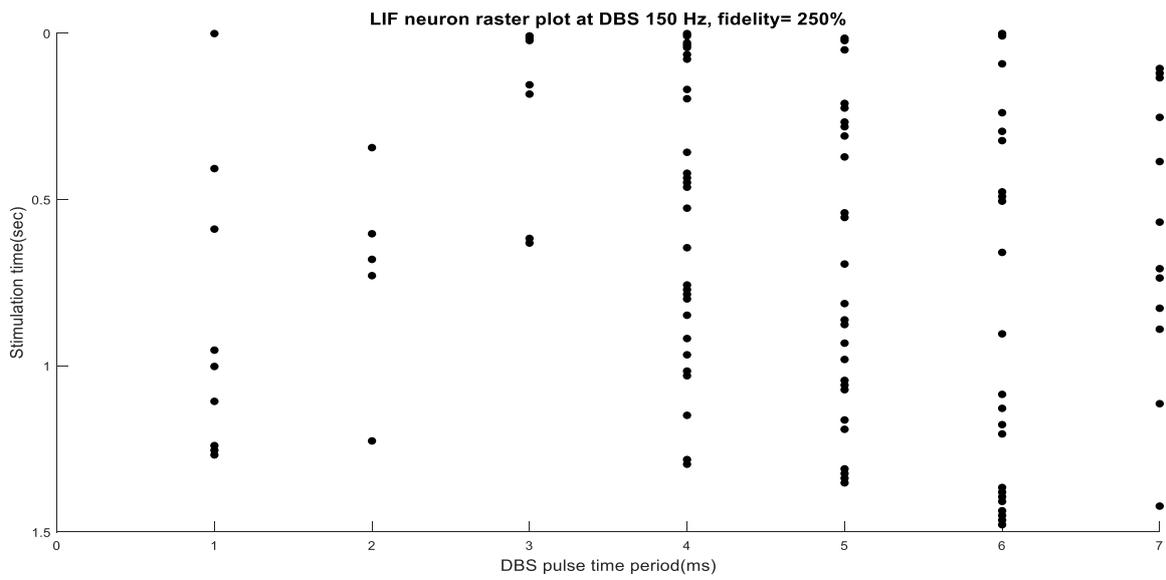


Fig.4.22

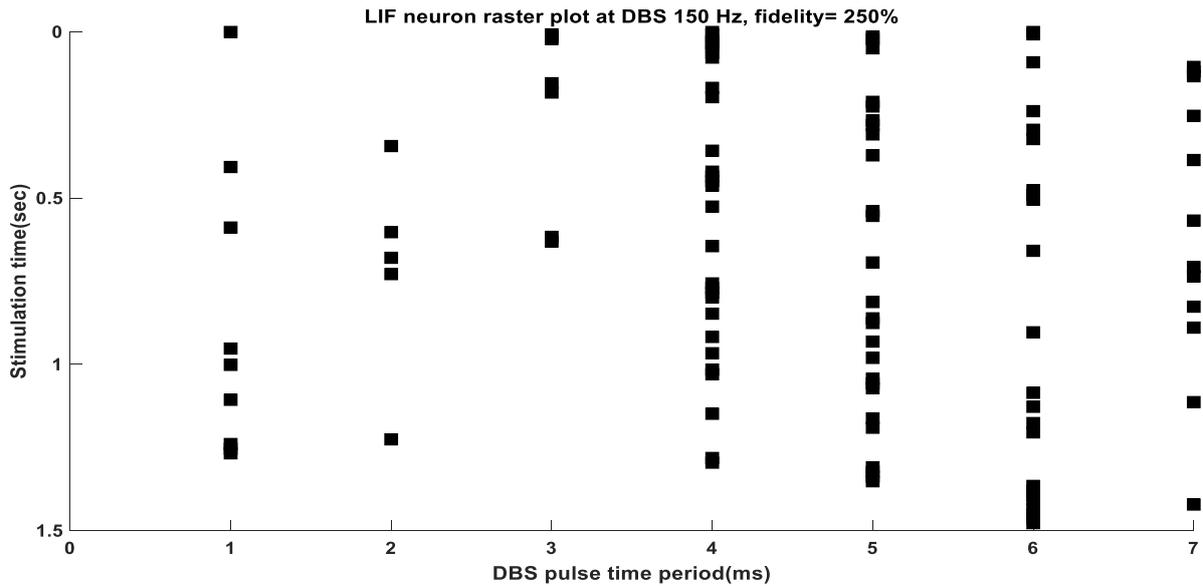


Fig.4.23

Fig. 4.20(A) shows the input frequency, i.e. 150Hz. Fig.4.20(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.20(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.20(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.21 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 28 at 4ms, whereas the average no. of spikes generated is 14.75.

Fig.4.22 and Fig.4.23 shows stimulus triggered action potentials during DBS. Fig.4.22 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.23 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 56.7045 (Hz)

LIF rate with all synapses during DBS10Hz = 74.0494 Hz

Elapsed time is 16.477522 seconds.

Fig.4.8 to Fig.4.23 depicts the post synaptic spiking activity of the F, D and P synapses triggered by DBS. It is found that the average number of spikes generated increased as the applied DBS frequency was increased. This implies that as the DBS frequency increases, the spiking activity also increases.

Glutamatergic synaptic inputs were sent to the LIF neuron model, all of which were explicitly triggered by our DBS signal (with a 2 ms AP transmission delay from thalamus). Based on physiologically realistic distributions of synapse types, the various synaptic inputs were classified as F (45), D (38), or P (17). EPSCs were generated simultaneously in the LIF neuron when a single DBS pulse was initiated in these synaptic inputs, thus resulting in a total DBS EPSC that was a mix of F, D, and P components. A single DBS EPSC, generated with the initial conditions of the synapse models, was suprathreshold for the generation of a stimulus evoked AP in the LIF neuron. High frequency driving (130 Hz) of the DBS synaptic input generated an initial burst of APs in the LIF neuron and then as the total DBS EPSC reduced in amplitude to a steady-state value, the inputs provided subthreshold excitatory inputs to the LIF neuron. The overall result of this DBS-driven excitatory current was an increased average firing rate.

## CHAPTER 5

# DYNAMICS OF MEMRISTIVE LIF MODEL UNDER DEEP BRAIN STIMULATION

### 5.1 Introduction

A memristor is a two-terminal passive electrical component that serves as a fundamental non-linear circuit element that links charge and magnetic flux. The memristor is a promising device in many analogue and digital applications, particularly memory chips, logic circuits, and neural networks [23].



Fig 5.1 Memristor

Three fundamental passive elements such as resistor, capacitor, and inductor are currently used to build electronic circuits. The fourth fundamental element called memristor has recently emerged [24]. Professor Leon O. Chua of the University of California at Berkeley initially described a basic circuit that connects flux to charge in 1971, and it was successfully discovered in 2008 by a team led by Stanley Williams of HP Labs. Members of an HP Lab submitted a paper describing the successful realisation of a nanoscale electronic component whose measured physical attributes can be described by the memristor theory. As illustrated in the figure 2, the HP memristor is a solid state device made up of a nanometer-scale  $\text{TiO}_2$  thin film with a doped and undoped region sandwiched between two Platinum electrodes.

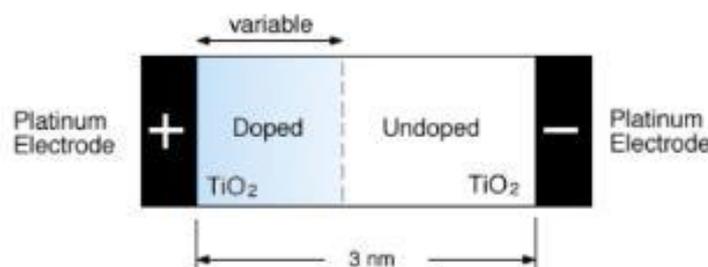


Fig 5.2 Titanium Dioxide Memristor

The new two-terminal passive element is named memristor as it combines the behavior of a memory and a resistor (i.e. memory+resistor). Memristors have shown various outstanding properties, such as good compatibility with CMOS technology, small device area for high-density on-chip integration, non-volatility, fast speed, low power dissipation, and high scalability [25]. One of the basic properties, resistance, of a memristor depends on the magnitude, direction, and duration of the voltage applied across its terminals. Memristor remembers its most recent resistance value when applied voltage was turned off and until the next time when applied voltage is turn on. And has other properties including pinched hysteresis and dynamical-negative resistance that can have significant impact on nanoelectronics.

Many uses for the memristor have been proposed since 2008. Memristors can be utilized in Resistive Random Access Memory (RRAM) cell architectures and Memristor-based Content Addressable Memories (MCAMs) that use a combination of memristor and MOS devices in memory chips. The capacity of the memristor to "memorise" the current pass through it and its direction can be employed efficiently in neural networks to minimize the area and complexity of neuromorphic circuits. A novel form of memristor-based IMPLY logic circuit was developed in the field of logic circuits. Memristor-based logic has the unique capability of being manufactured on the same chip as memory cells. Crossbar-arrays, which are employed in the switching blocks of Field Programmable Gate Arrays, are also designed with memristors (FPGAs) [26]. Thus, although memristors took many years to transform from a purely theoretical derivation into a feasible implementation, these devices has been widely used in applications such as machine learning and neuromorphic computing, as well as non-volatile random-access memory.

Ion motion controls the conductance of the non-volatile memristor, which is analogous to what happens in organic neurons and synapses. As a result of these advantages, the memristor has become an unavoidable choice as a building block for both artificial and organic neural networks.

## 5.2 Memristor properties

### 5.2.1 Flux-Charge relation

A charge-controlled memristor is one in which the flux and charge relationship is expressed as a function of charge, whereas a flux-controlled memristor is one in which the flux and charge relationship is expressed as a function of flux [27]. A linear (constant) memristor acts like resistance. If relation is nonlinear, the device behaviour is more complex, thus the memristor's parameter that relates  $q$  and  $\varphi$  is not a constant [28].

Memristance  $M$  is the missing link between flux and charge. The memristor is said to be charge-controlled with a memristance ' $M(q)$ ' given by:

$$M(q) = \frac{d\varphi}{dq}$$

The memristor is said to be flux-controlled with a memductance ' $W(\varphi)$ ' given by:

$$W(\varphi) = \frac{dq}{d\varphi}$$

Therefore it can be derived that:

$$v = M(q).i$$

$$i = W(\varphi).v$$

Memristance has the same unit (Ohm) as resistance, and  $M(q)$  is logically a charge controlled resistance. Similarly, the memductance has the unit of conductance [29]. The inverse of memductance is memristance,

$$M = 1/W(\varphi)$$

The  $q$ - $\varphi$  curve is characterised by a monotonically increasing trend. The memristance  $M$  is the slope of this curve ( $q$ ). As a result, the memristance is

always positive  $M(q) \geq 0$ . A memristor is a passive element if and only if the memristance has a non-negative value, according to the passivity requirement. The instantaneous power dissipated by the memristor is given by:

$$P(i) = M(q)i(t)^2$$

Since  $M(q) \geq 0$ , the wasted power is always positive. As a result, the memristor is a passive device. This means it can't produce or store energy; it can only consume power. A memristor, like a resistor, is entirely dissipative [23].

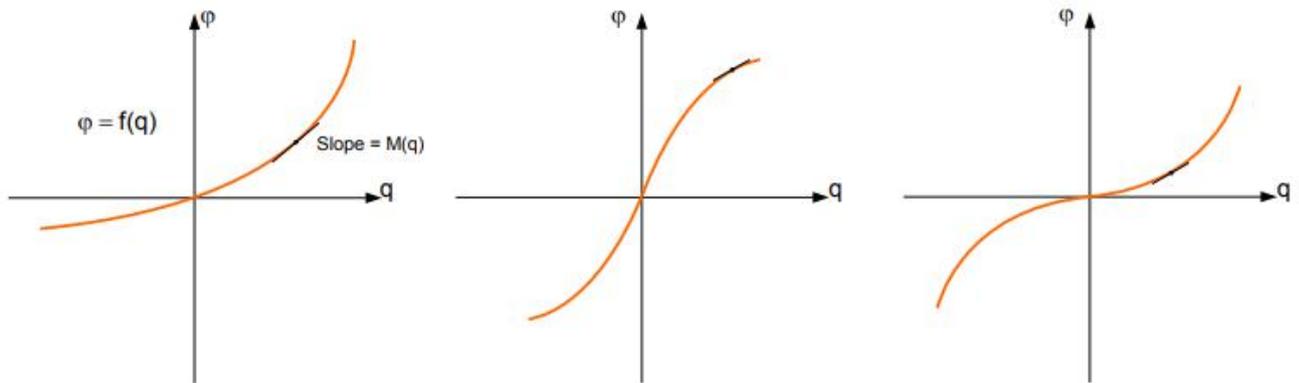


Fig. 5.3 Three examples of charge-flux characteristics of the memristor, which all have monotonically increasing characteristics.

### 5.2.2 Current-Voltage relation

The current-voltage characteristic of a memristor, which exhibits a pinched hysteresis loop, is its most important feature. The I-V characteristic of the memristor cannot be achieved using any combination of the other three basic components, therefore the memristor is considered a basic component [26]. By applying a periodic signal to a memristor, if the voltage is zero, the current will be zero and vice-versa. So, both voltage  $v(t)$  and current  $i(t)$  curves always cross the origin curve. The pinched hysteresis loop's shape will fluctuate with frequency. The hysteresis loop shrinks when the frequency is increased. The memristor will behave like a conventional resistor if the frequency is increased to infinity [23].

The I-V characteristic's slope changes, indicating a changeover between distinct resistance states, with the resistance becoming positive as the applied voltage rises and negative as it falls. Double-loop I-V hysteresis is produced by the symmetrical voltage bias, which can collapse to a straight line at high frequencies [24].

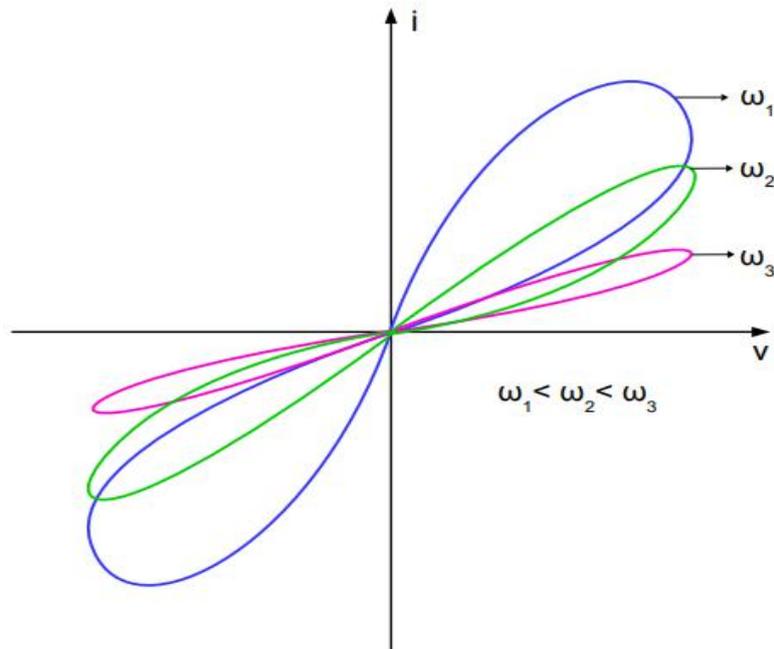


Fig. 5.4 Current-voltage characteristics of the memristor.

### 5.2.3 Resistance – Time Relation

The resistance versus time characteristic of the memristor is depicted in Fig. 4.5. The instantaneous resistance is in the range  $[R_{ON}, R_{OFF}]$ . The resistance values depend on the applied voltage. For a sine-wave voltage with period  $T$ , the memristance has its extreme (maximum or minimum) values at the following time instances:  $t = (2n + 1)T/2$  [30].

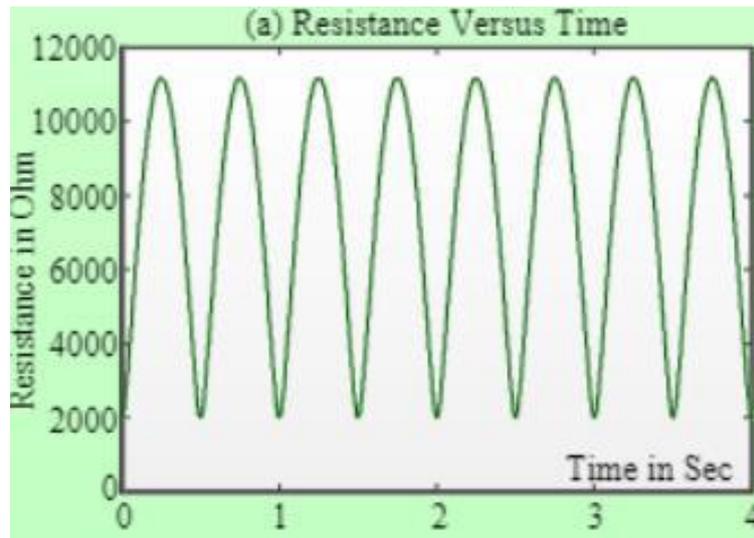


Fig. 5.5 Resistance Versus Time plot of the memristor

#### 5.2.4 Resistance – Voltage Relation

The resistance versus voltage characteristic is depicted in Fig. 4.6. The voltage across the memristor is initially 0 Volt, with a current of 0 Amp and a resistance of  $R_i$  [30].

The memristance value also depends on the sign of  $v(t)$ ; in other words, resistance  $[R_i, R_{OFF}]$  for  $v(t) < 0$  and  $[R_{ON}, R_i]$  for  $v(t) > 0$ . This is because current follows voltage, whereas resistance rises as voltage rises. When the voltage drops to zero, the resistance reaches its maximum,  $R_{OFF}$  [24].

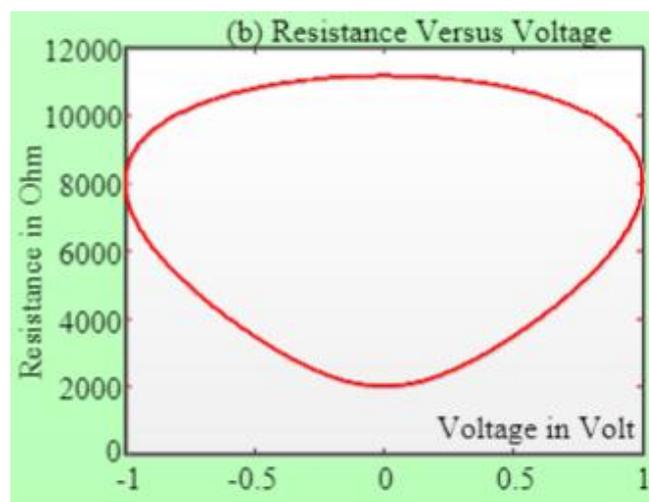


Fig. 5.6 Resistance Versus Voltage plot of the memristor.

### 5.3 The Memristive LIF (MLIF) spiking neuron model

Considering the LIF spiking model has no memory of the previous spike and the memory advantage of the memristor (can “remember” the charges pass through itself, and it is called non-volatile characteristics) we introduce a memristor to the LIF spiking model, as shown in Figure 4.8.

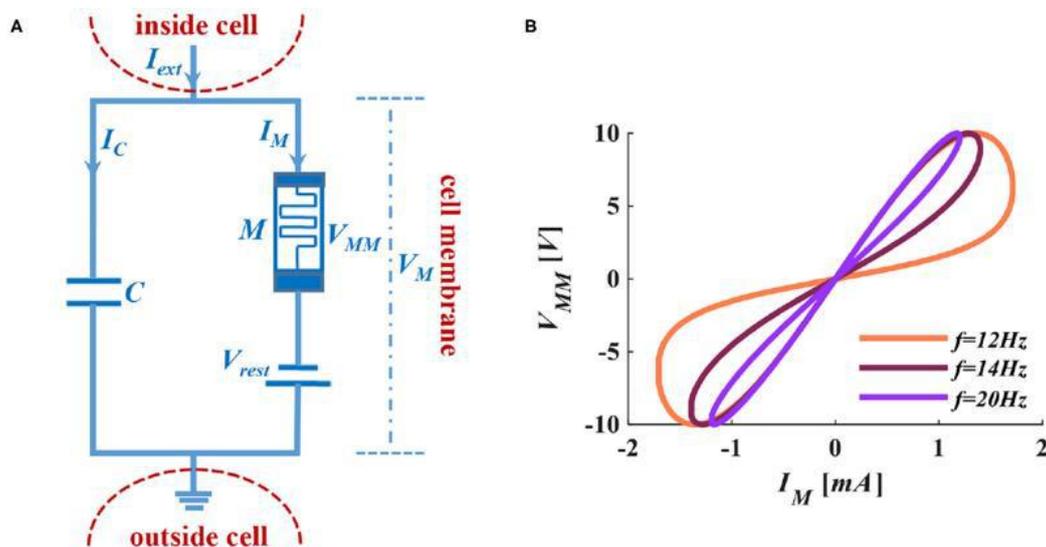


Fig 5.7 The MLIF circuit model and the I-V curve of the memristor. (A) MC membrane circuit of the MLIF model. (B) The pinched hysteresis curve and frequency characteristics of ion channel memristor.

When we apply a sinusoidal voltage to the ion channel memristor, it performs a zero-crossing pinched hysteresis curve. When we adjust the voltage frequency to 100 Hz, the electrical characteristics of the memristor are close to a straight line. The memristor performs the feature of pure resistance. In Figure 4.8 B, the distribution of the curve is in the first and third quadrants, which indicates that the device is passive. The curve has two prominent switching states and keeps a memristance constant without a power supply. It shows that the device is non-volatile.

In the MLIF membrane circuit, the  $\tau$  is not a constant anymore, and it becomes a function of time. Therefore,  $\tau = RC$  is transformed into  $\tau_M(t) = M(t)C$ . The memristor  $M(t)$  is divided into charge-controlled memristor and flux-controlled memristor, and they are the functions of time. According to  $q = CV$ , we get  $q(t) = C(t)V_M$  ( $V_M$  is the membrane voltage of the MLIF model, as shown in

Figure 4.8 A), thereby we can rewrite C as  $C(t) = q(t)/V_M$ , and  $\tau_M(t) = M(t)q(t)/V_M$ . The charge or discharge time of the capacitor always relates to the accumulation of charge [32].

*The charge-controlled memristor:*

$$M(q(t)) = \left\{ \begin{array}{ll} 20000, & q(t) < -0.5 \times 10^{-4} \\ 10^4 + (-1.99) \times 10^8 \times q(t), & q(t) \geq -0.5 \times 10^{-4} \text{ and } q(t) < 0.5 \times 10^{-4} \\ 100, & q(t) \geq 0.5 \times 10^{-4} \end{array} \right\} \quad (9)$$

And then, we get:

$$\tau_M(t) = \left\{ \begin{array}{ll} \frac{20000q(t)}{V_M}, & \varphi(t) < -0.75 \\ \frac{10^4 q(t)}{V_M} + (-1.99) \times 10^8 \times \frac{q(t)^2}{V_M}, & \varphi(t) \geq -0.75 \text{ and } \varphi(t) < 0.25 \\ \frac{100q(t)}{V_M}, & \varphi(t) \geq 0.25 \end{array} \right\} \quad (10)$$

From the above equations, we can get the time constants of charge-controlled memristor.

According to the MLIF membrane circuit and (7), the mathematic expression of the MLIF model can be rewritten as follows:

$$V_M(t + \Delta t) - V_M(t) = \frac{\Delta t}{\tau(t)} (-V_M(t) + V_{rest} + M(t)I_{ext}) \quad (11)$$

In the following experiments, the different stimuli are applied to the MLIF model, and the values of parameters will be set as  $C = 2 \times 10^{-9}F$ ,  $R = 10^6 \Omega$ ,  $V_{rest} = -60 \text{ mV}$ ,  $V_{th} = -50 \text{ mV}$ ,  $V_{rest} = -80 \text{ mV}$

## 5.4 Results

### Varying DBS frequency

$f_{DBS}=60\text{Hz}$

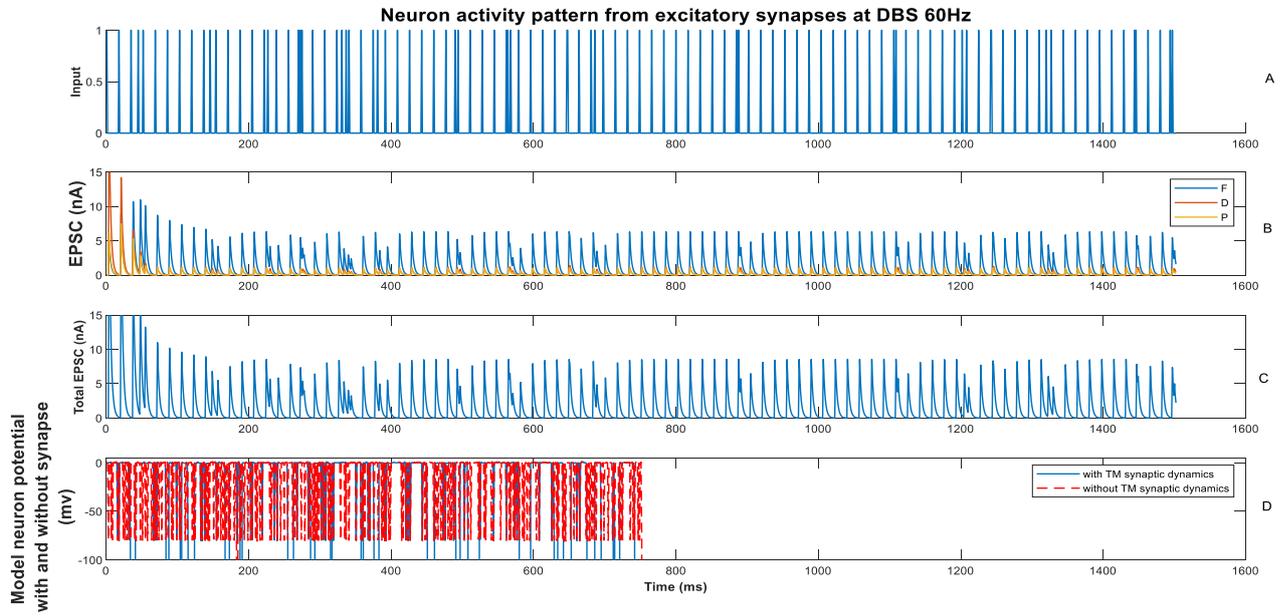


Fig.5.8

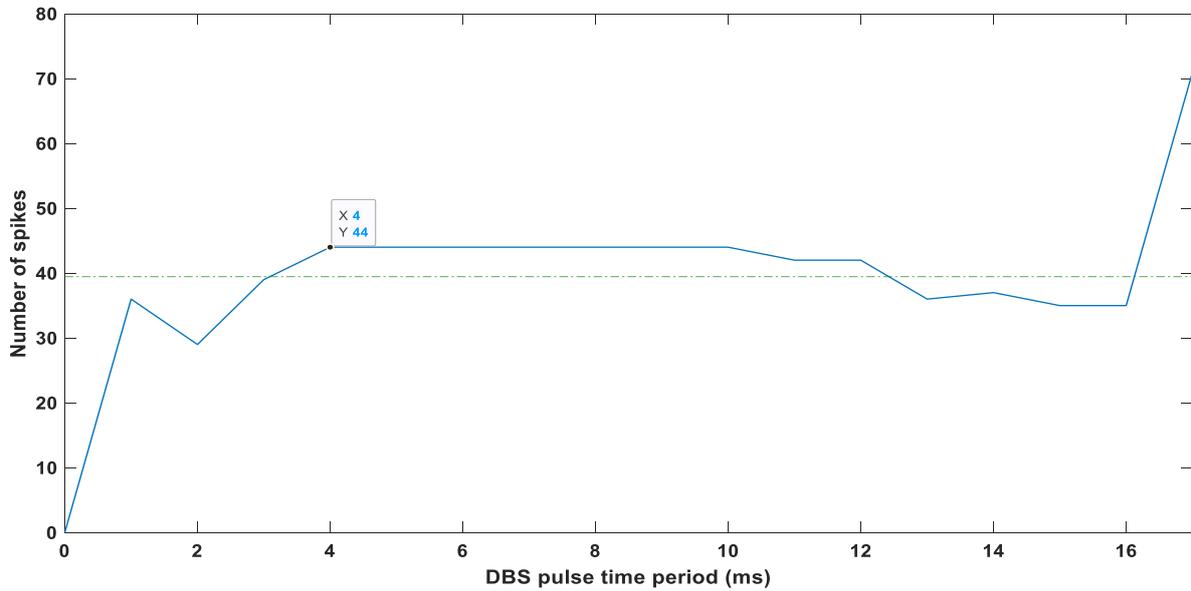


Fig.5.9

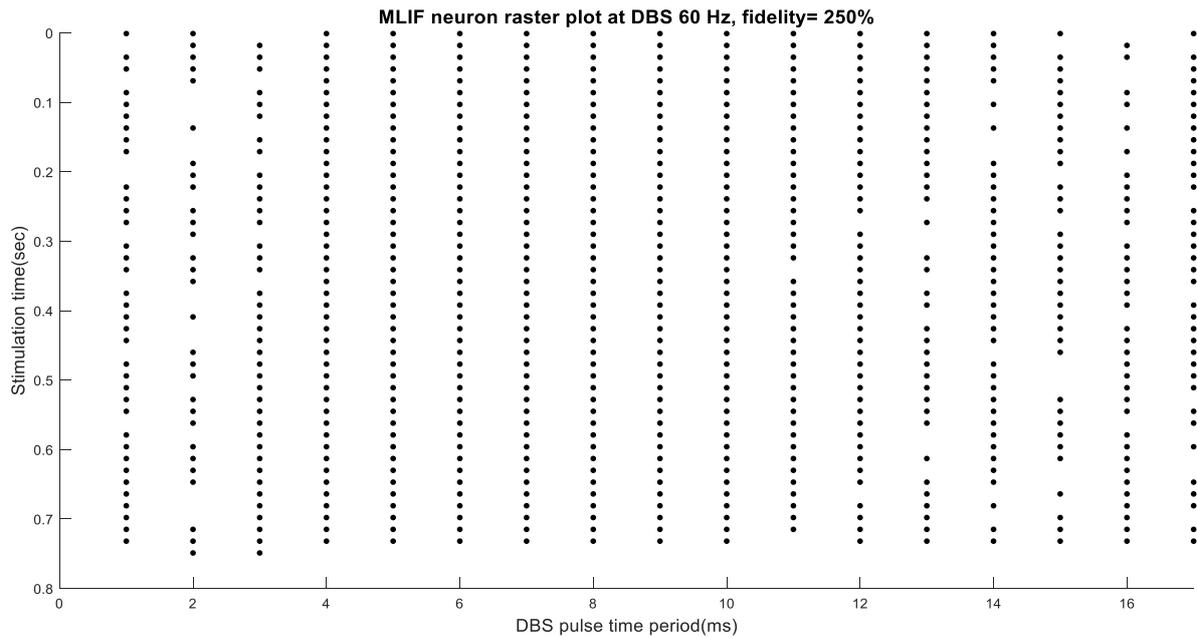


Fig.5.10

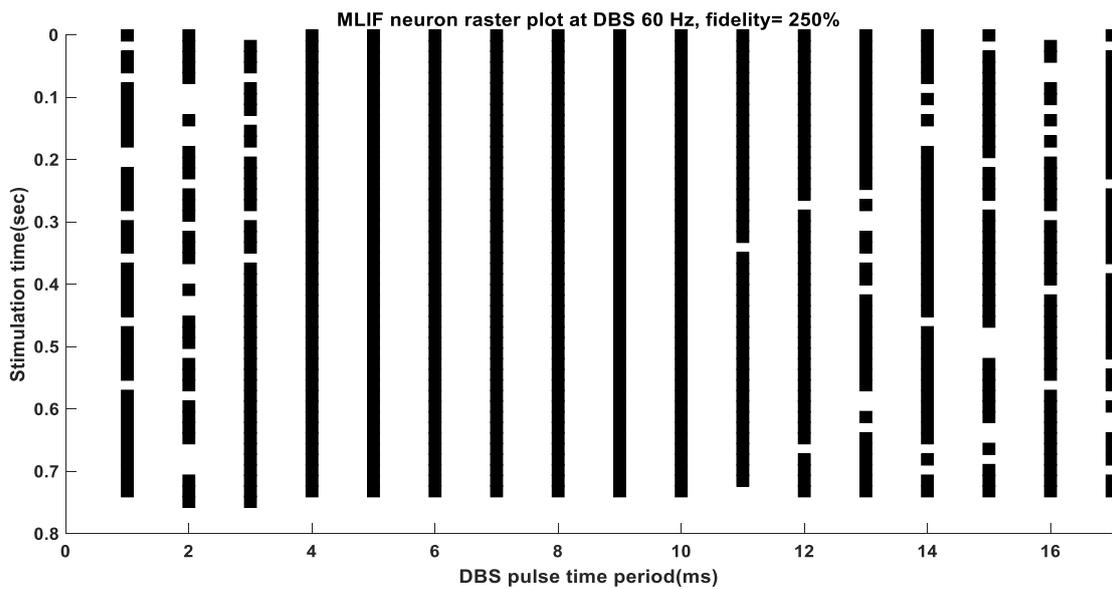


Fig.5.11

Fig.5.8(A) shows the input frequency, i.e. 60Hz. Fig.5.8(B) depicts EPSC from F, D and P synapses distinctly. Fig. 5.8(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.8(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.9 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 44 at 4ms, whereas the average no. of spikes generated is 39.44.

Fig.5.10 and Fig.5.11 shows stimulus triggered action potentials during DBS. Fig.5.10 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.11 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

MLIF rate without any synaptic connection = 381.5877 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 360.2402 (Hz)

MLIF rate with all synapses during DBS10Hz = 450.3002 Hz

Elapsed time is 8.107420 seconds.

**fdbs=80Hz**

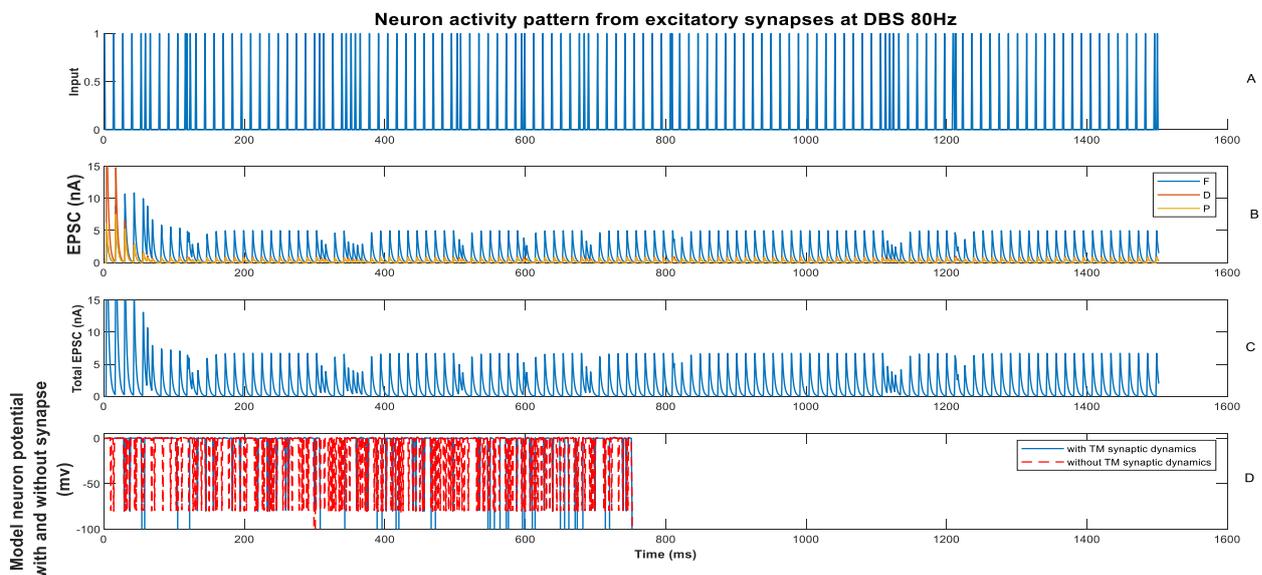


Fig.5.12

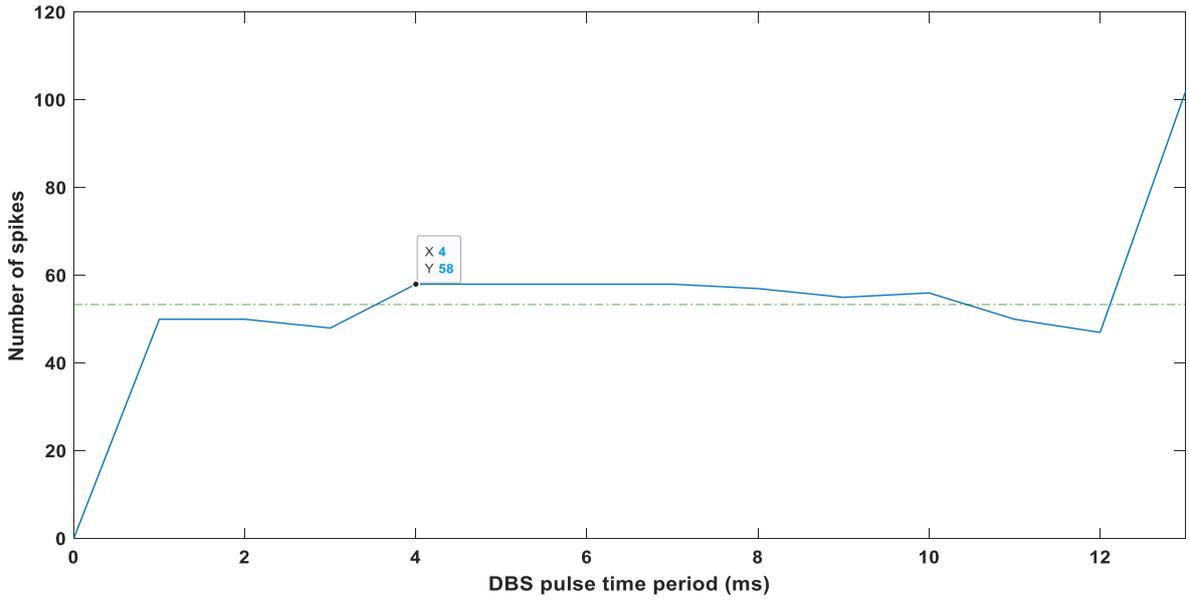


Fig.5.13

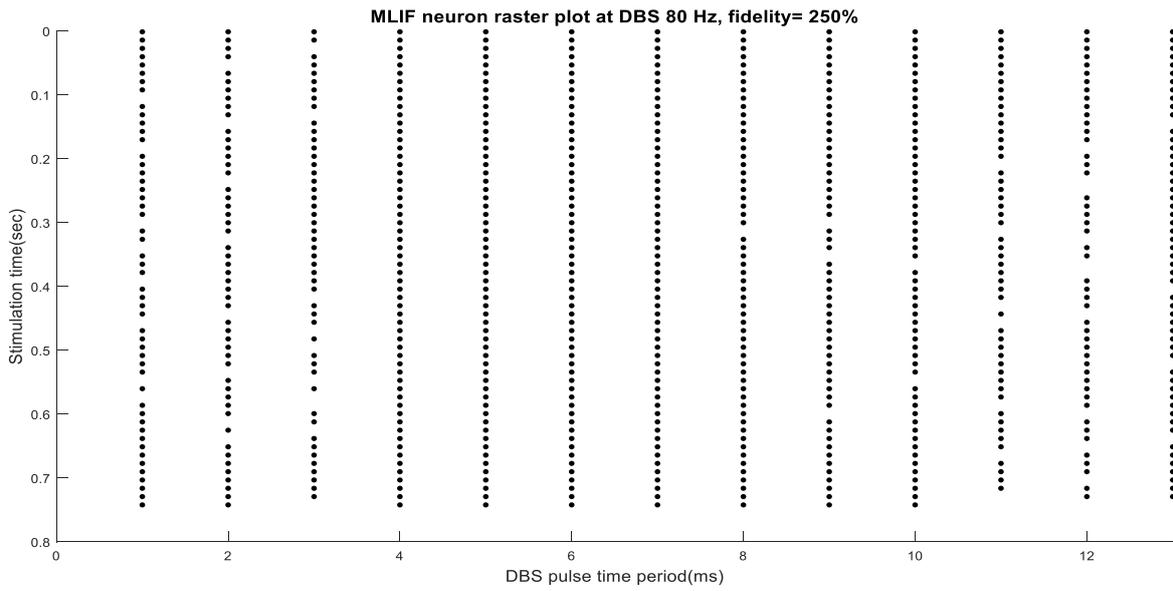


Fig.5.14

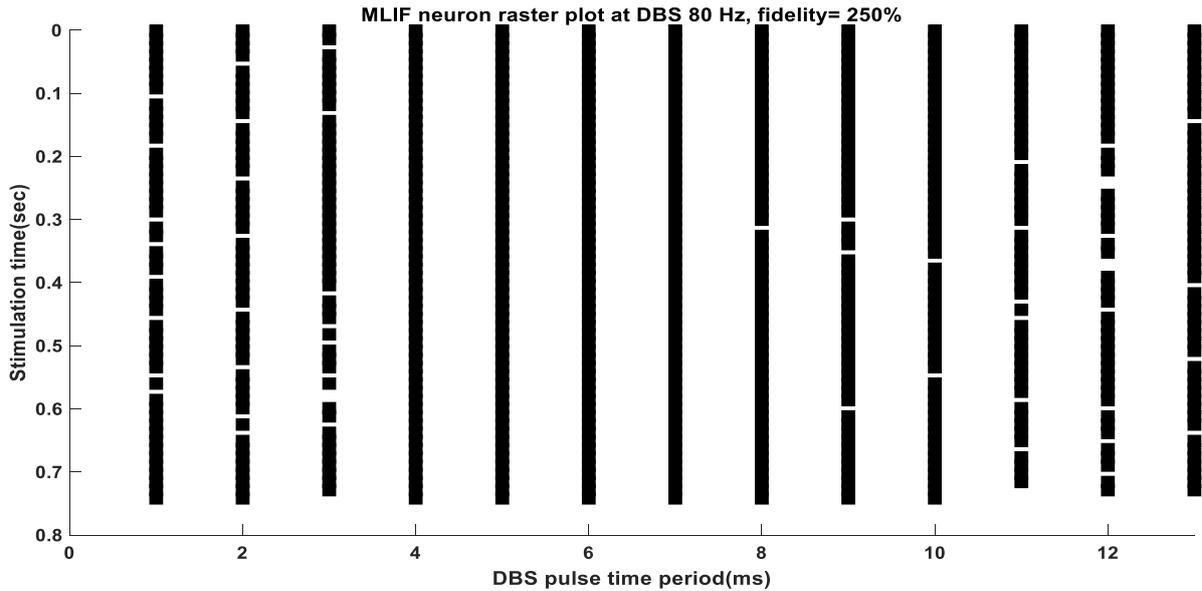


Fig.5.15

Fig.5.12(A) shows the input frequency, i.e. 80Hz. Fig.5.8(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.12(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.12(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.13 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 58 at 4ms, whereas the average no. of spikes generated is 53.36

Fig.5.14 and Fig.5.15 shows stimulus triggered action potentials during DBS. Fig.5.14 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.15 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

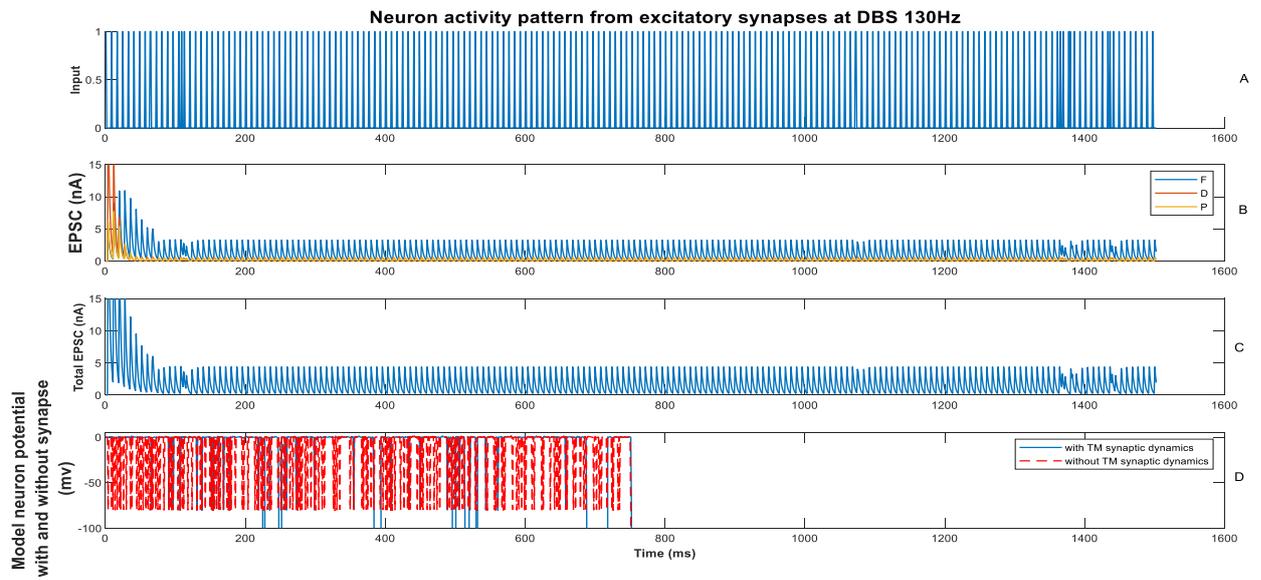
MLIF rate without any synaptic connection = 392.2615 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 396.9313 (Hz)

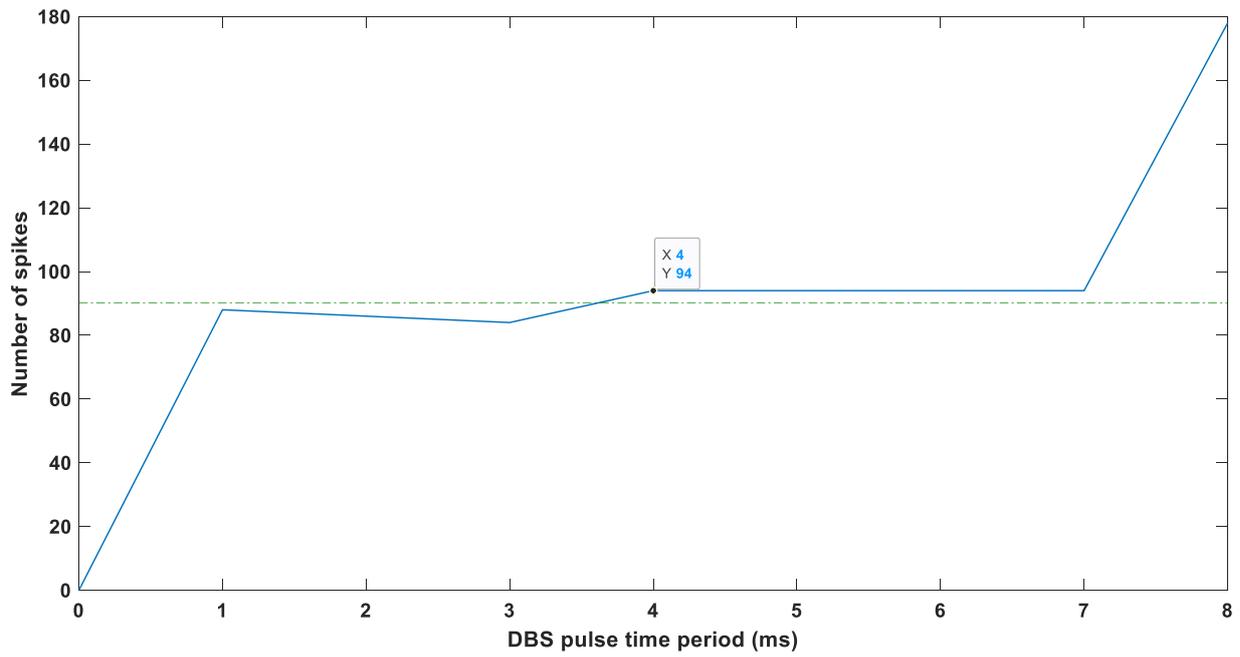
MLIF rate with all synapses during DBS10Hz = 465.6438 Hz

Elapsed time is 9.892783 seconds.

**fdfs=130Hz**



**Fig.5.16**



**Fig.5.17**

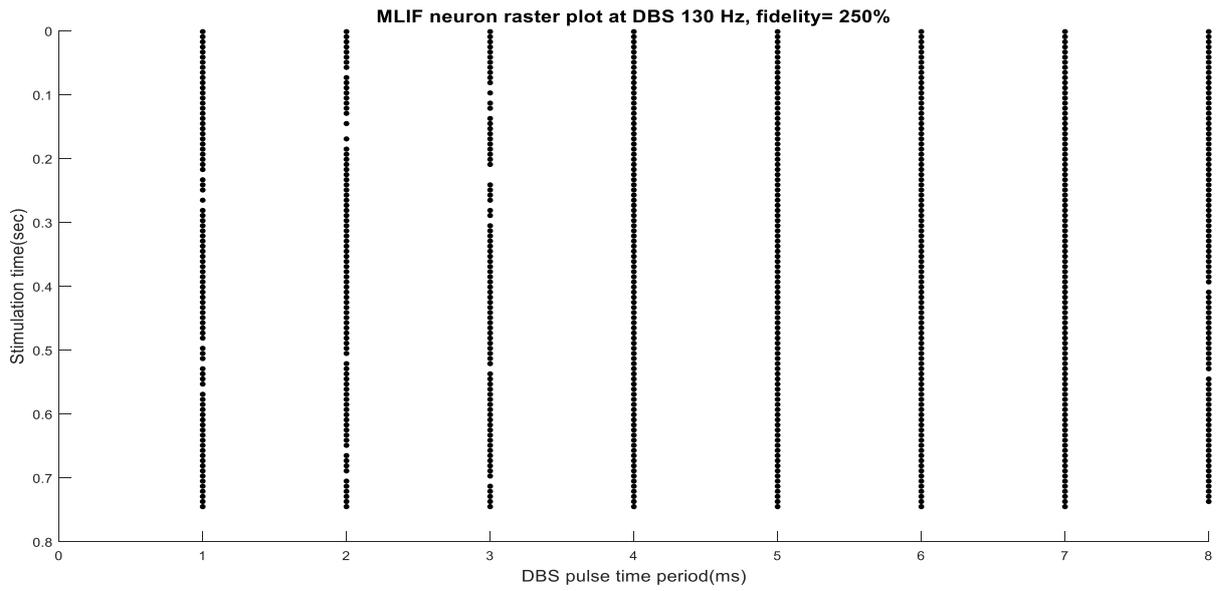


Fig.5.18

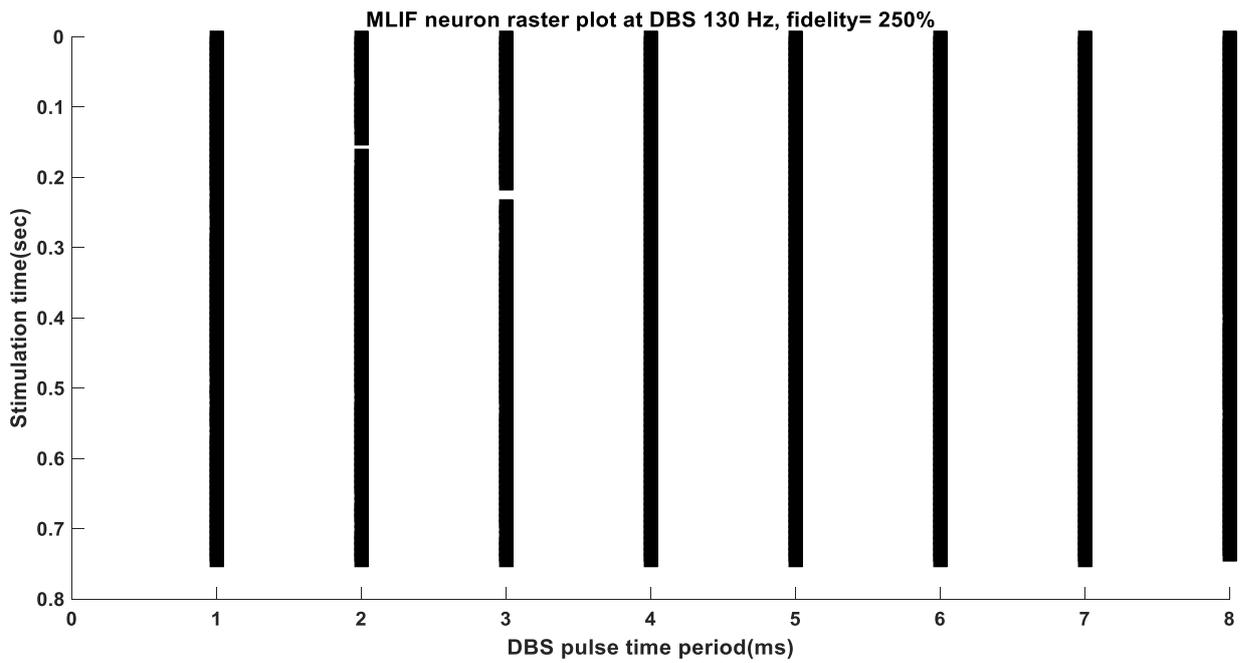


Fig.5.19

Fig.5.16(A) shows the input frequency, i.e. 130Hz. Fig.5.16(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.16(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.16(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.17 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 94 at 4ms, whereas the average no. of spikes generated is 90.22.

Fig.5.18 and Fig.5.19 shows stimulus triggered action potentials during DBS. Fig.5.18 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.19 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 7ms.

MLIF rate without any synaptic connection = 387.5917 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 442.2949 (Hz)

MLIF rate with all synapses during DBS10Hz = 483.6558 Hz

Elapsed time is 15.005125 seconds.

### fdbs=150Hz

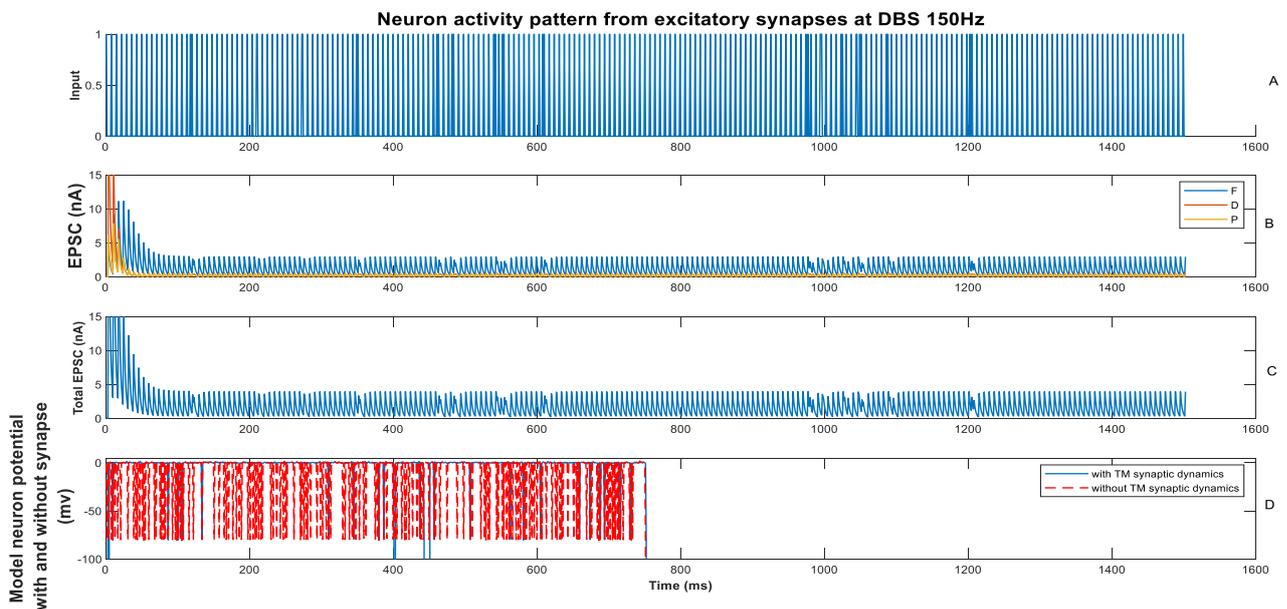


Fig.5.20

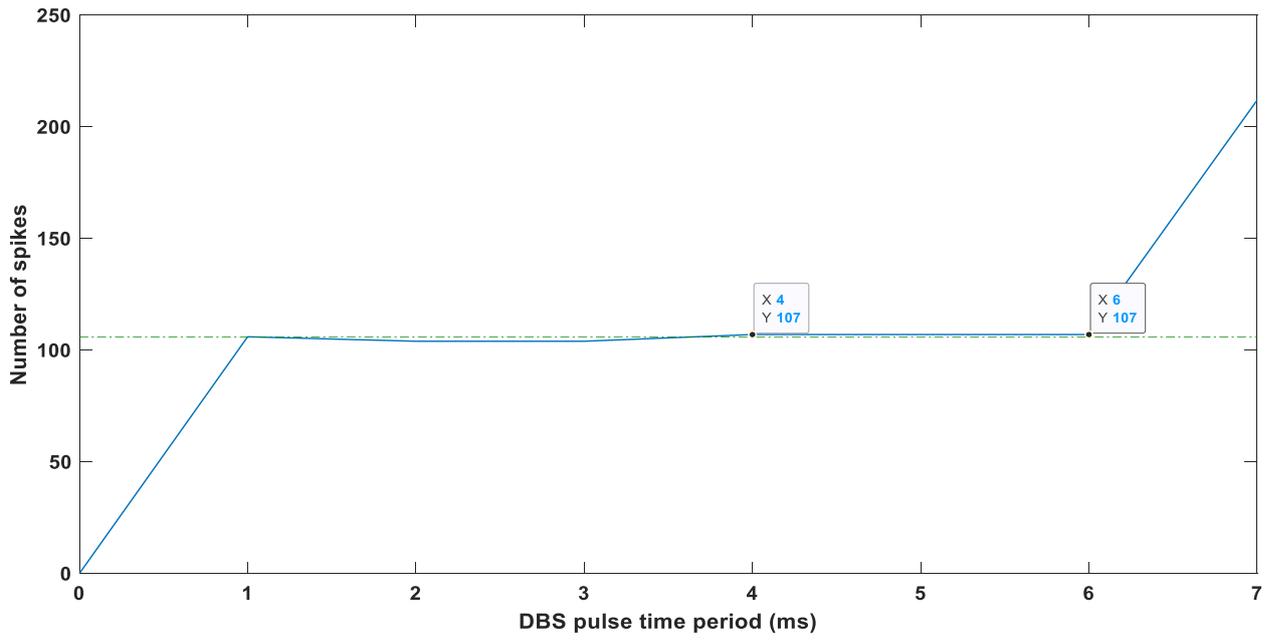


Fig.5.21

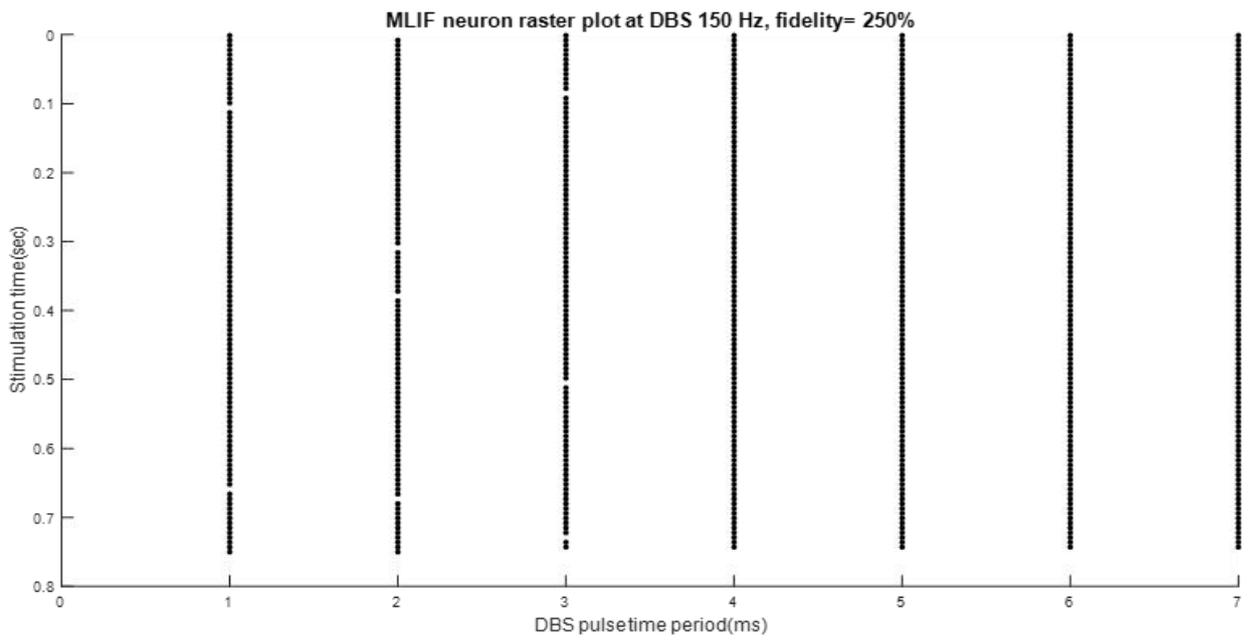


Fig.5.22

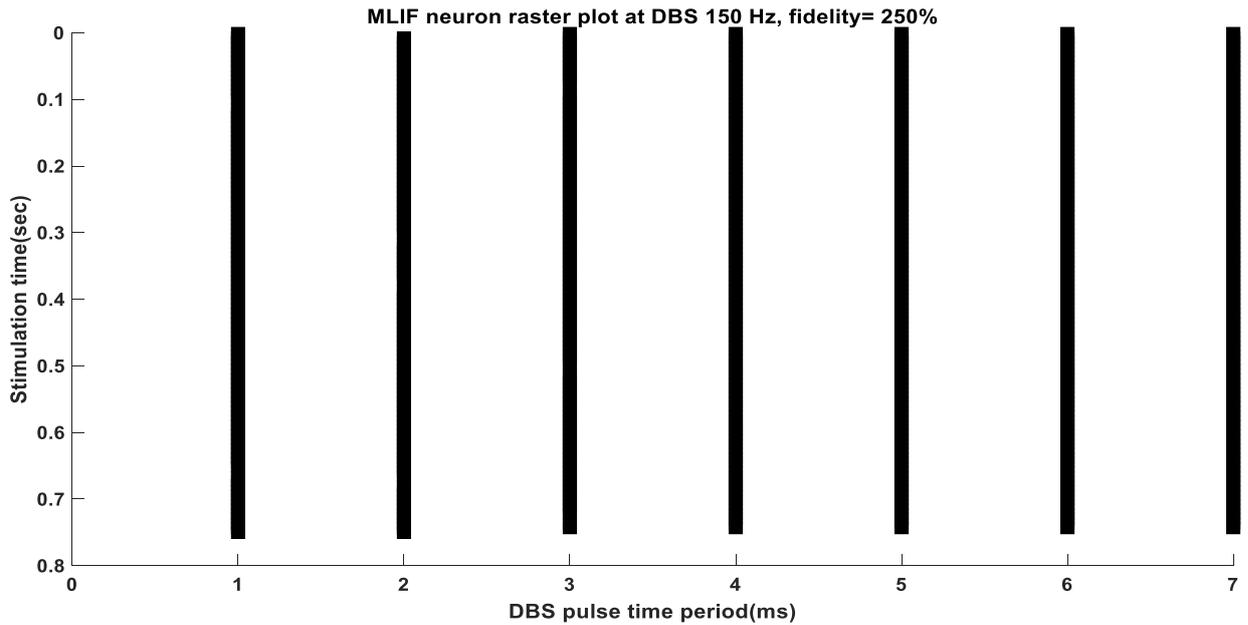


Fig.5.23

Fig.5.20(A) shows the input frequency, i.e. 150Hz. Fig.5.20(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.20(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.20(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.21 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 107 from 4ms to 6ms, whereas the average no. of spikes generated is 105.9.

Fig.5.22 and Fig.5.23 shows stimulus triggered action potentials during DBS. Fig.5.22 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.23 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 6ms.

MLIF rate without any synaptic connection = 392.2615 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 479.6531 (Hz)

MLIF rate with all synapses during DBS10Hz = 494.9967 Hz

Elapsed time is 16.452186 seconds.

Fig.5.8 to Fig.5.23 depicts the post synaptic spiking activity of the F, D and P synapses triggered by DBS. It is found that the average number of spikes

generated by the MLIF neuron model increased as the applied DBS frequency was increased. This implies that as the DBS frequency increases, the spiking activity also increases.

Comparing Fig.4.8-4.23 with corresponding frequency plots in Fig.5.8-5.23, we observe that the number of spikes generated is greater when using MLIF neuron model. Hence, MLIF neuron model exhibits increased spiking activity than LIF neuron model.

## Varying Noise input

(f<sub>DBS</sub>=130Hz)

wght=0

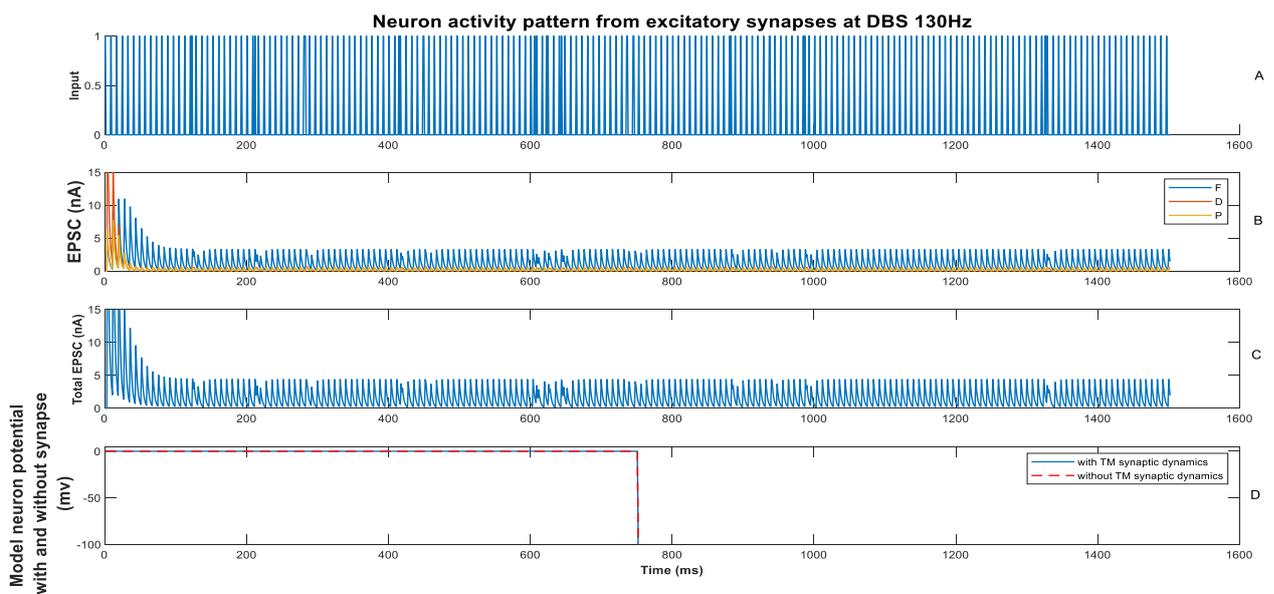


Fig.5.24

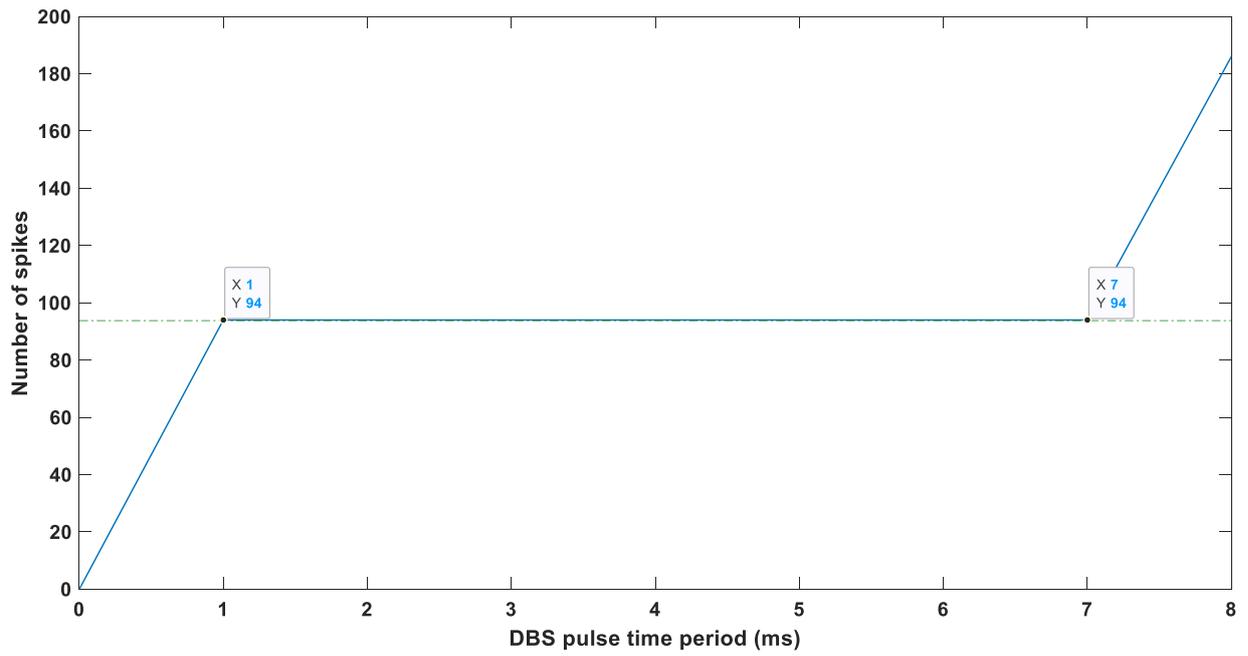


Fig.5.25

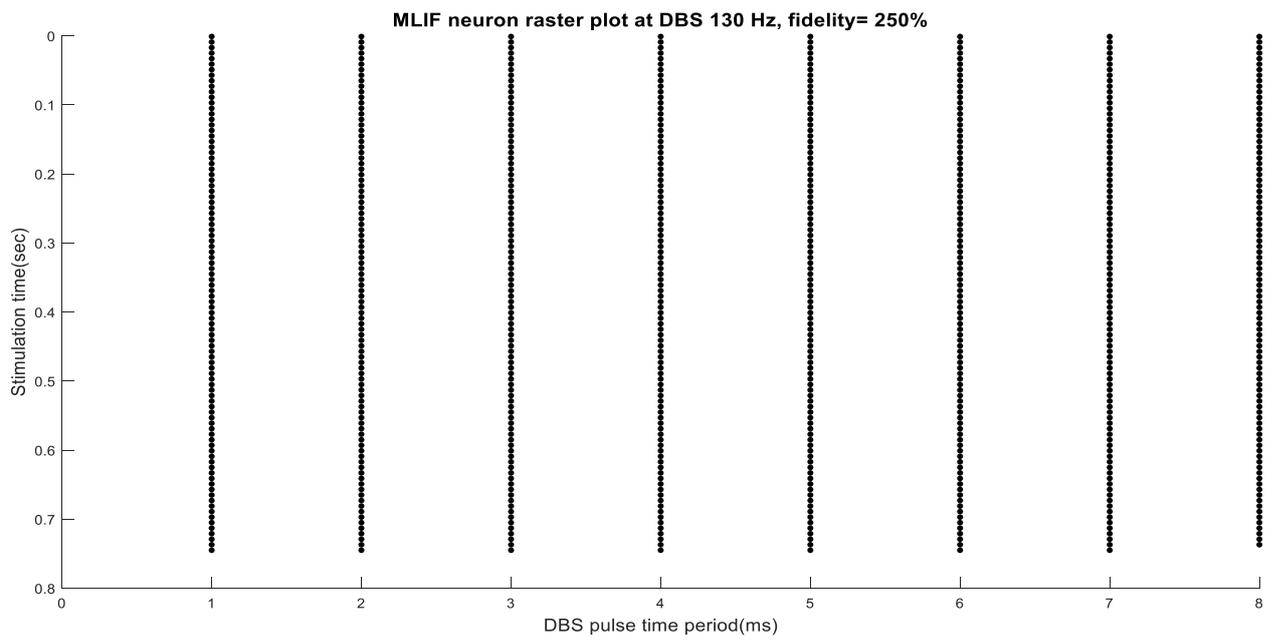


Fig.5.26

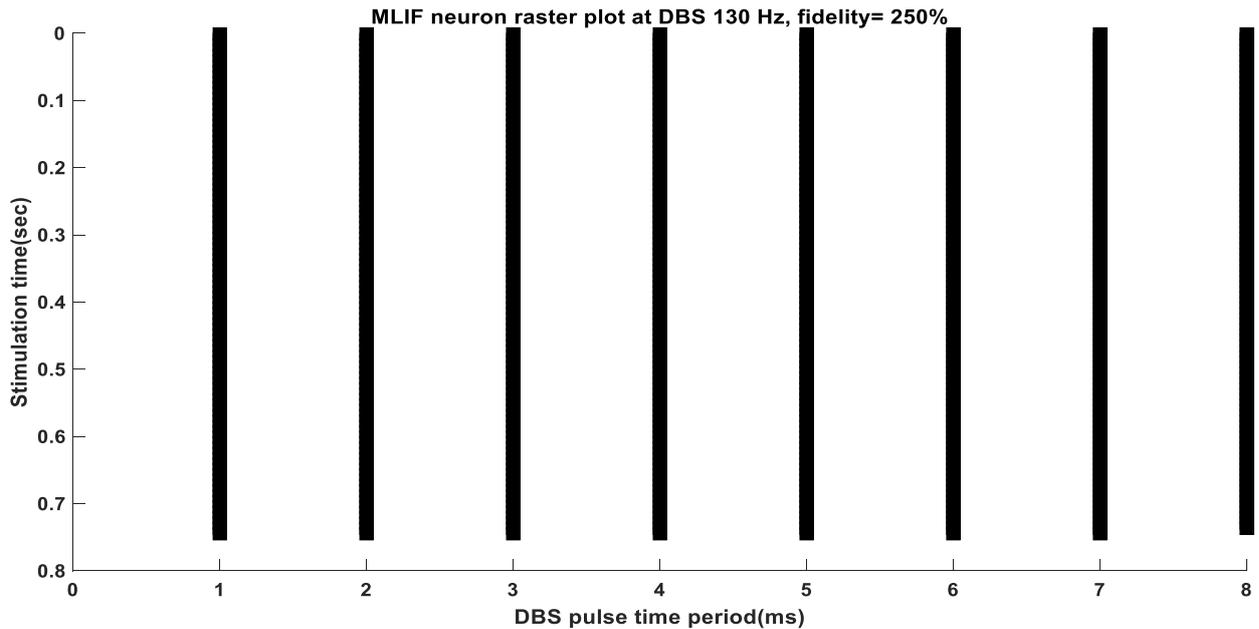


Fig.5.27

Fig.5.24(A) shows the input frequency, i.e. 130Hz. Fig.5.24(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.24(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.24(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. No noise input is given.

Fig. 5.25 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is constant at 94 from 1ms to 7ms, whereas the average no. of spikes generated is 94.

Fig.5.26 and Fig.5.27 shows stimulus triggered action potentials during DBS. Fig.5.26 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.27 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 1ms to 7ms.

MLIF rate without any synaptic connection = 501.0007 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 501.0007 (Hz)

MLIF rate with all synapses during DBS10Hz = 501.0007 Hz

Elapsed time is 17.941460 seconds.

wght=0.5

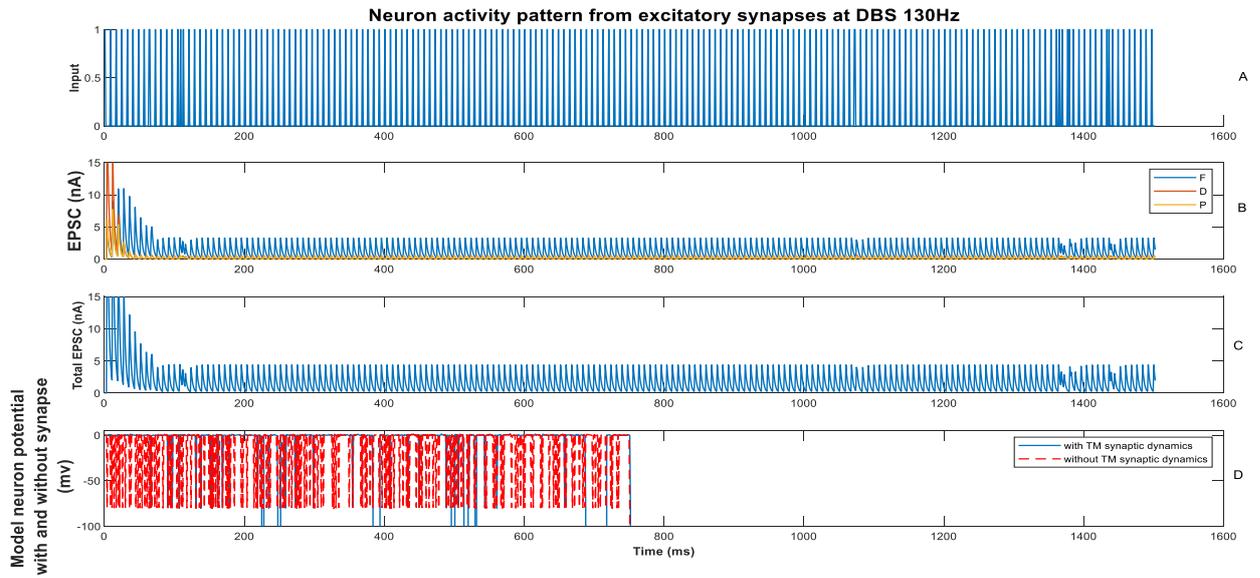


Fig.5.28

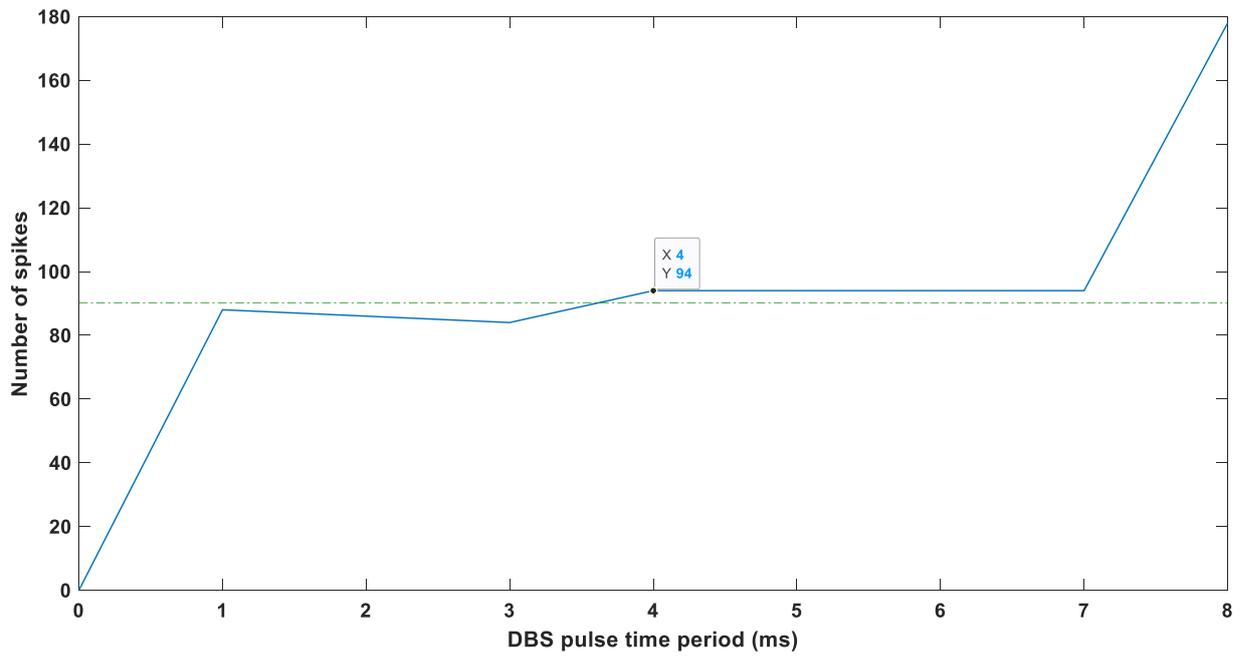


Fig.5.29

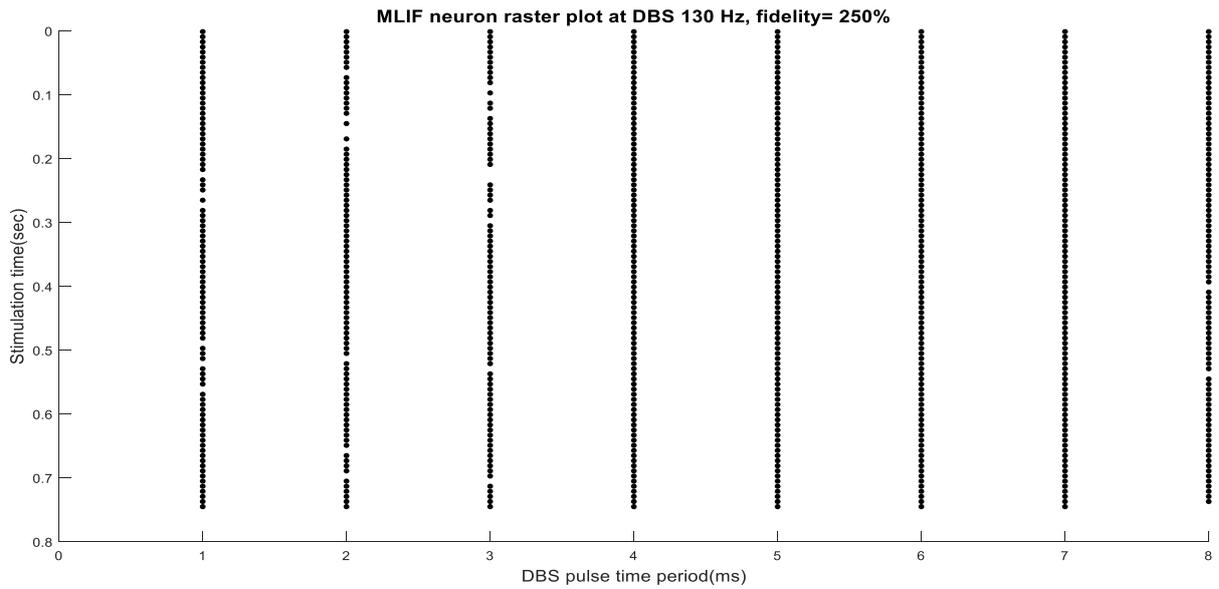


Fig.5.30

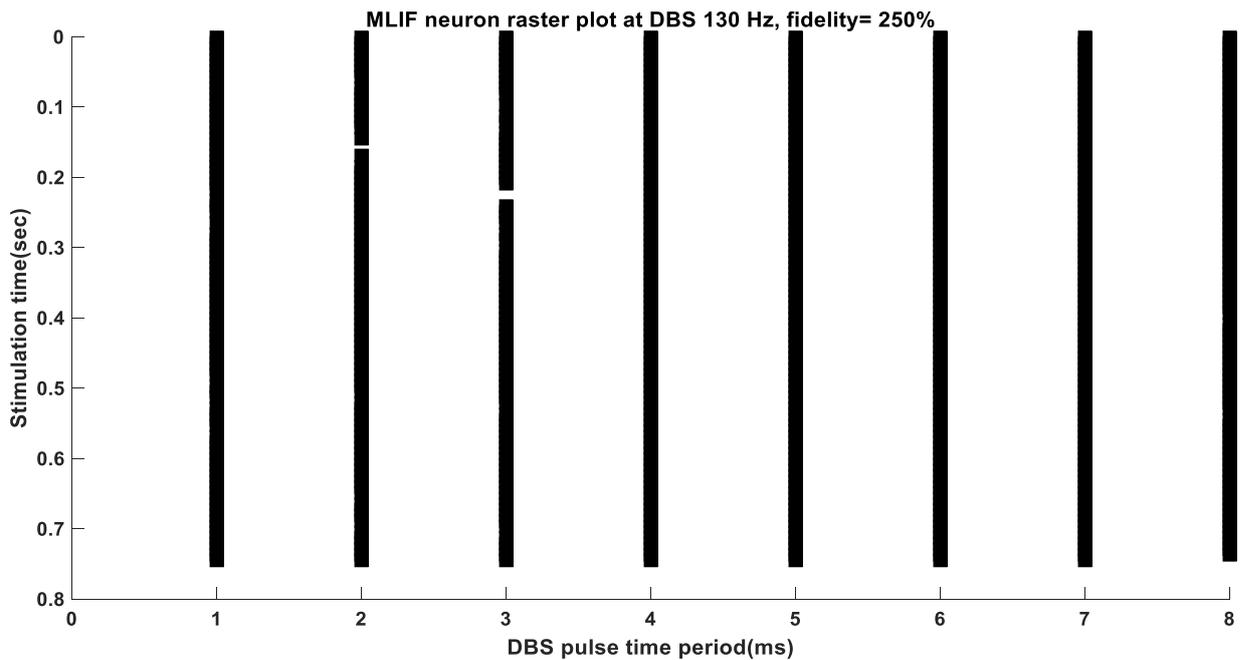


Fig.5.31

Fig.5.28(A) shows the input frequency, i.e. 130Hz. Fig.5.28(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.28(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.28(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. Noise input given is  $wght=0.5$ .

Fig. 5.29 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 94 at 4ms, whereas the average no. of spikes generated is 90.22.

Fig.5.30 and Fig.5.31 shows stimulus triggered action potentials during DBS. Fig.5.30 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.31 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 7ms.

MLIF rate without any synaptic connection = 387.5917 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 442.2949 (Hz)

MLIF rate with all synapses during DBS10Hz = 483.6558 Hz

Elapsed time is 15.005125 seconds.

**wght=5**

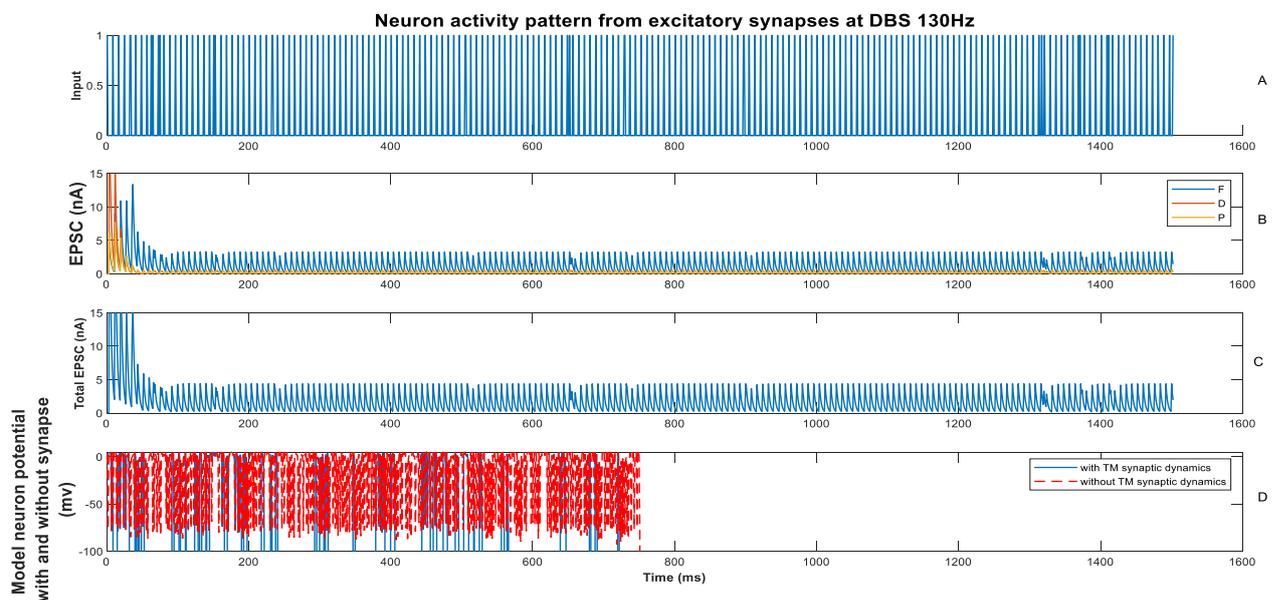


Fig.5.32

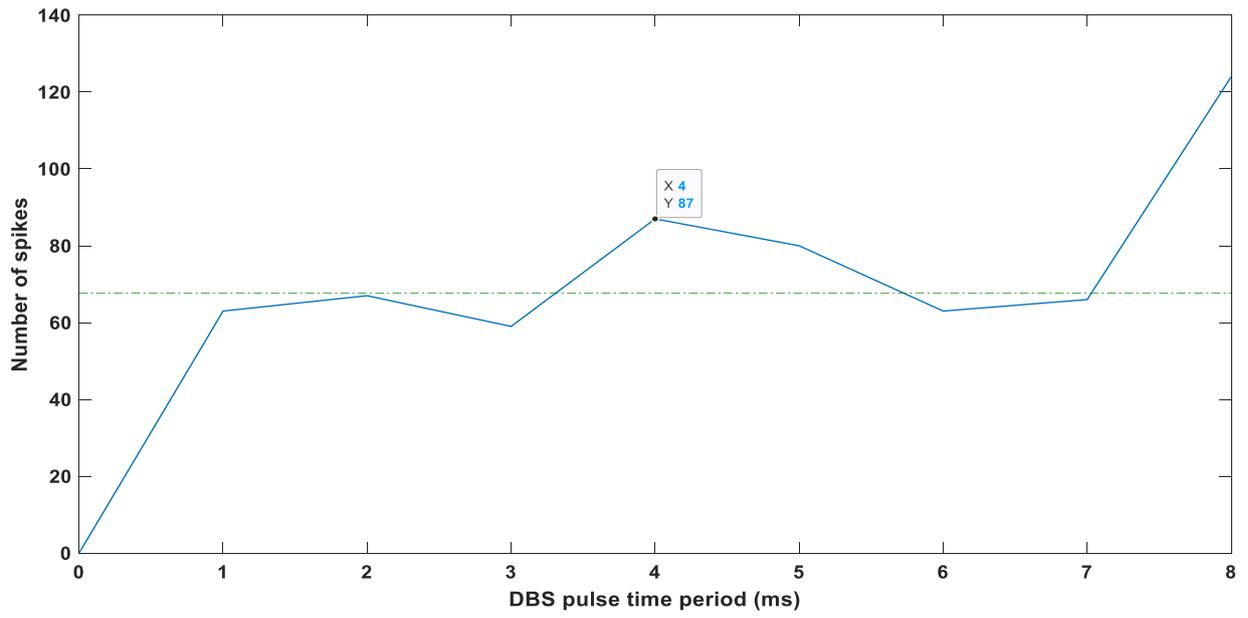


Fig.5.33

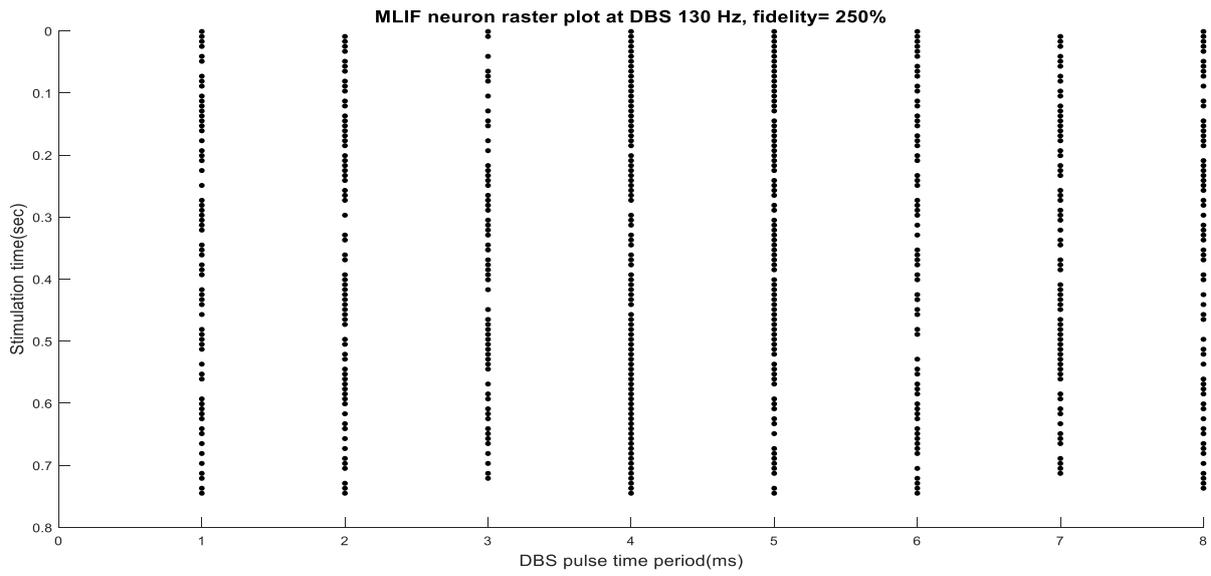


Fig.5.34

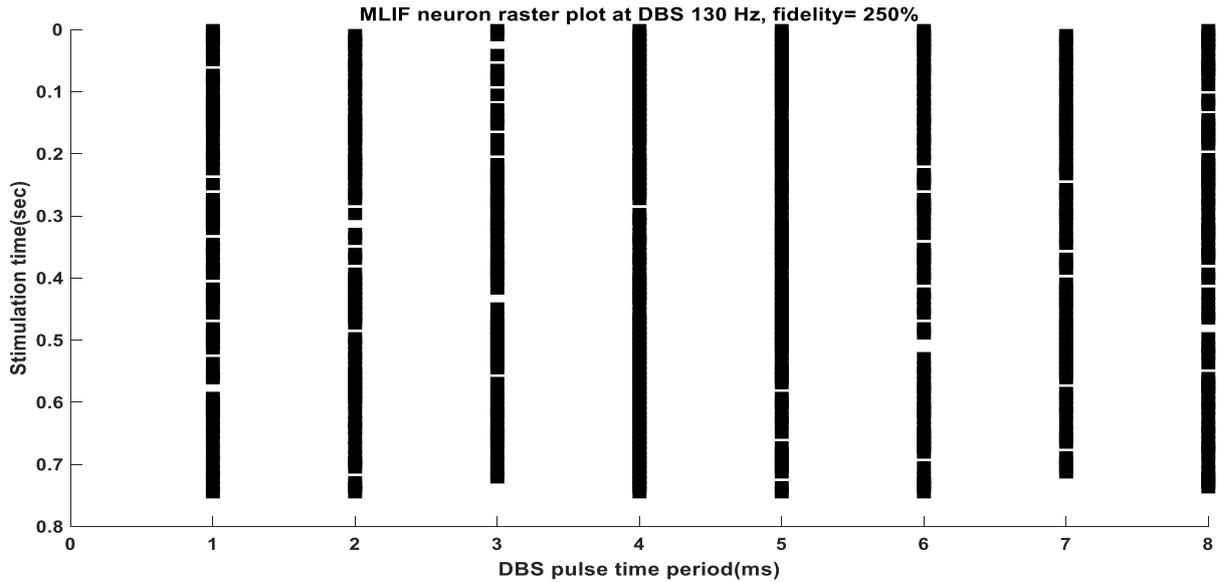


Fig.5.35

Fig.5.32(A) shows the input frequency, i.e. 130Hz. Fig.5.32(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.32(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.32(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. A high noise input is given as wght=5.

Fig. 5.33 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 87 at 4ms, whereas the average no. of spikes generated is 68.

Fig.5.34 and Fig.5.35 shows stimulus triggered action potentials during DBS. Fig.5.34 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig.5.35 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

MLIF rate without any synaptic connection = 334.2228 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 112.0747 (Hz)

MLIF rate with all synapses during DBS10Hz = 364.9099 Hz

Elapsed time is 24.509666 seconds.

wght=10

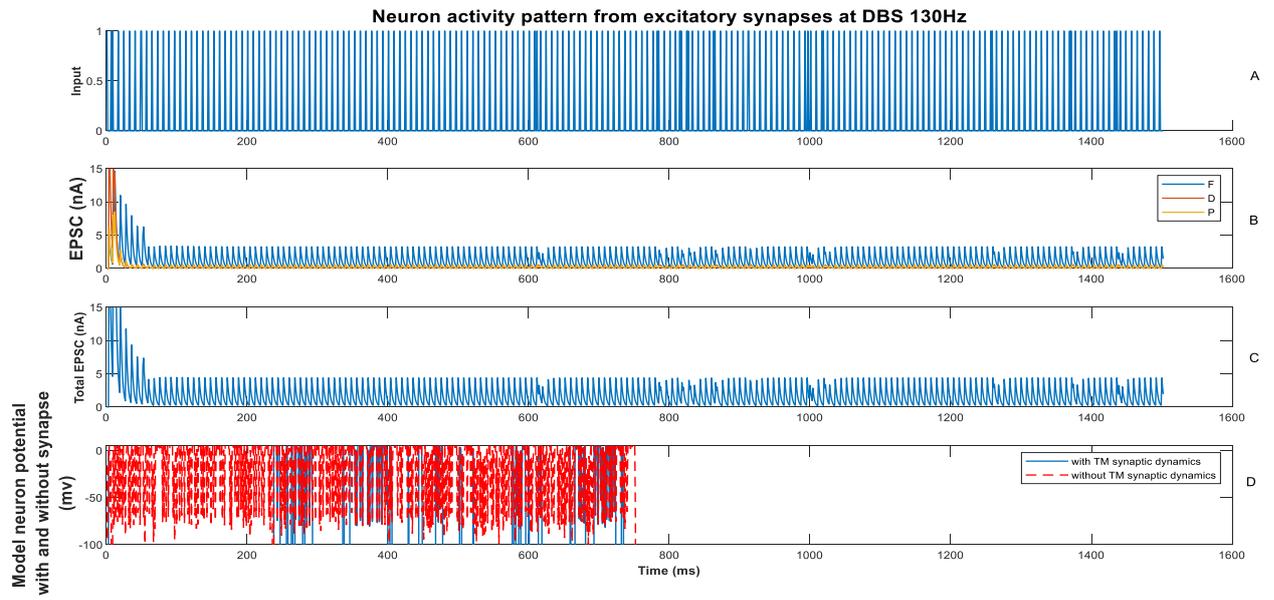


Fig.5.36

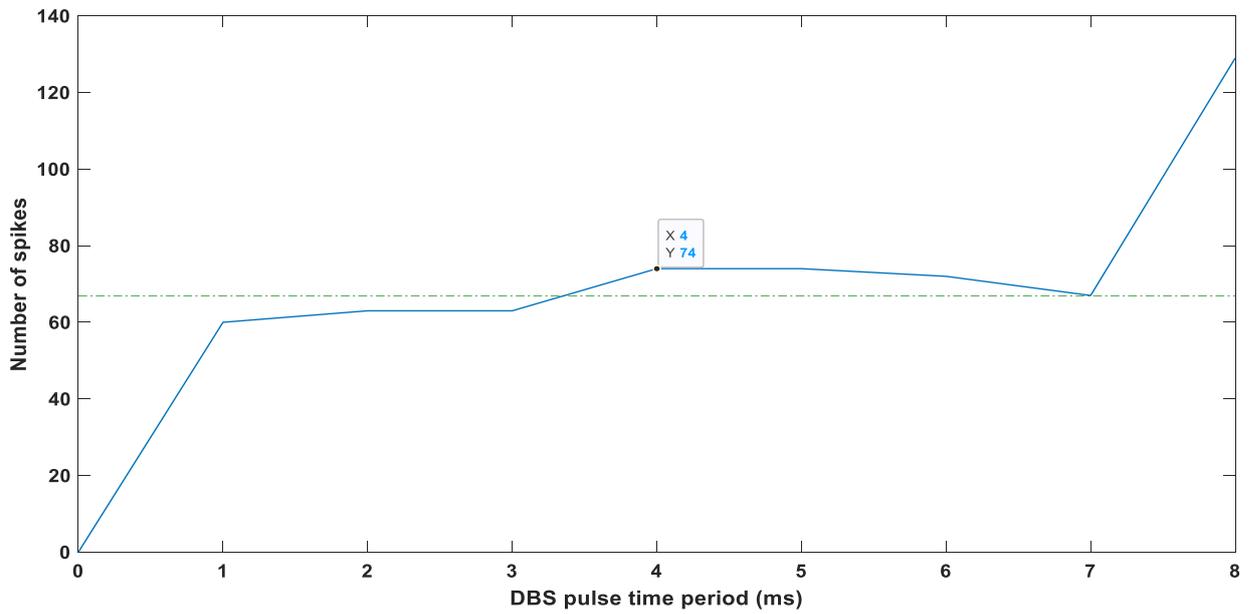


Fig.5.37

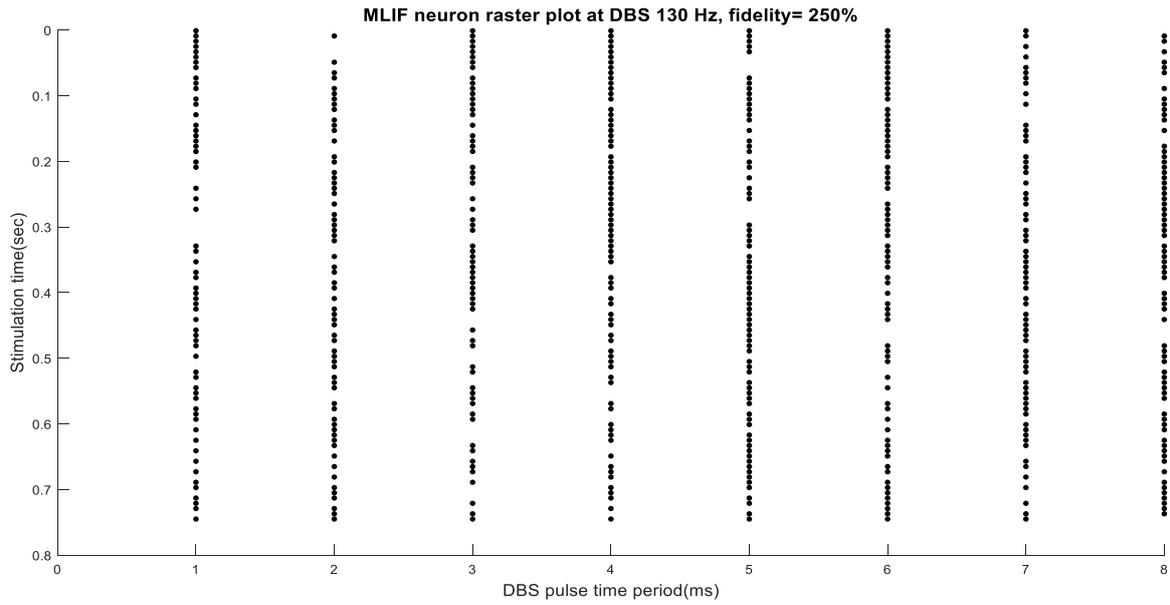


Fig.5.38

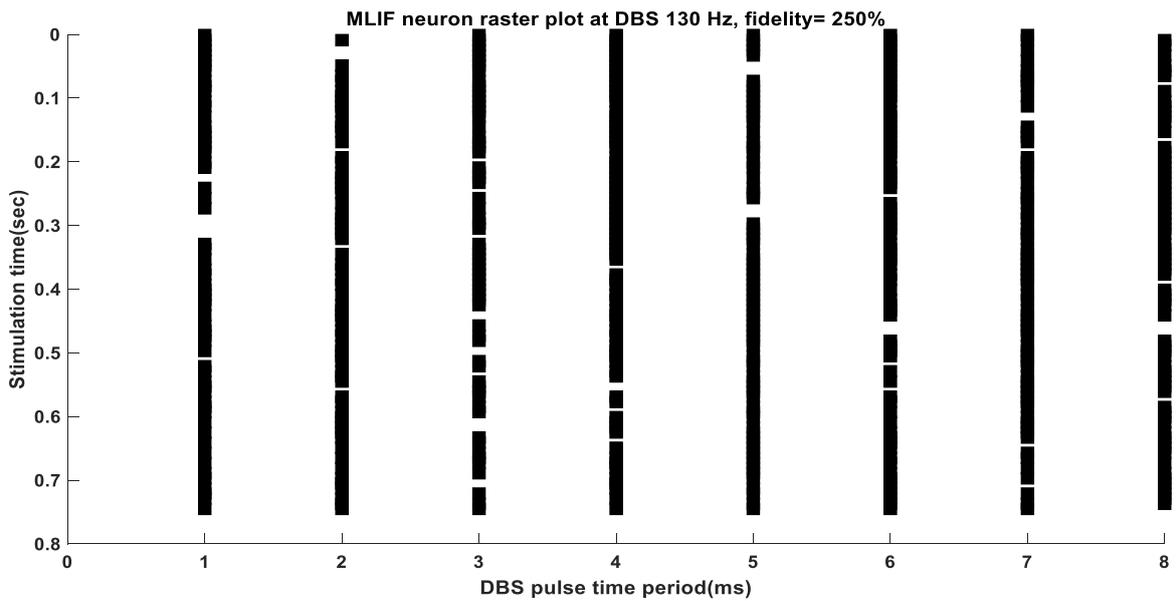


Fig.5.39

Fig.5.36(A) shows the input frequency, i.e. 130Hz. Fig.5.36(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.36(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.36(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. Noise input is given is wght=10.

Fig. 5.37 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 74 at 4ms, whereas the average no. of spikes generated is 66.

Fig.5.38 and Fig.5.39 shows stimulus triggered action potentials during DBS. Fig.5.38 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig.5.39 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 6ms.

MLIF rate without any synaptic connection = 338.8926 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 99.3996 (Hz)

MLIF rate with all synapses during DBS10Hz = 362.2415 Hz

Elapsed time is 12.505596 seconds.

Analyzing Fig.5.24-5.39, we observe that as the applied noise input increases, the average number of spikes generated decreases. This implies that, the spiking activity of MLIF neuron model decreases with increasing noise input.

## CHAPTER 6

### DISCUSSION

The objective of this study was to develop a simple model that could capture the overall characteristics of DBS induced synaptic suppression and the DBS triggered post synaptic spiking. We used the Tsodyks-Markram (TM) phenomenological synapse model to represent depressing, facilitating, and pseudo-linear synapses driven by DBS over a wide range of stimulation frequencies. The EPSCs were then used as inputs to a leaky integrate-and-fire neuron model (LIF) and later to a memristor leaky integrate-and-fire neuron model (MLIF) in order to measure the DBS-triggered post-synaptic spiking activity.

Low frequency stimulation can generate a wide range of EPSCs that depend upon the type of synapse. High frequency driving of the synapse models generate marked EPSC suppression, independent of the synapse type. The average spiking activity increased with increase of applied DBS. The average spiking activity was found to decrease with increase in noise input. The MLIF neuron model was found to exhibit better spiking activity than LIF neuron model. Practically, it is undesirable to expose our body to very high frequency stimulation for DBS treatment to control movement disorders. Thus we prefer MLIF neuron model over LIF neuron model for enhanced spiking activity using a particular DBS frequency. The findings of this study are still theoretical, they do represent a step towards analyzing the consequences of DBS from a synaptic first principles approach. We hypothesize that by first understanding the effects of DBS at the synapse level, we may then extrapolate to network-level effects.

The basic purpose of brain stimulation therapy is to employ electrical pulses to modulate the release of neurotransmitters in specific brain circuits. Low frequency stimulation can be used to enhance neurotransmitter release in directly activated pathways, whereas high frequency stimulation can decrease synaptic communication through the methods described in this project. Furthermore, recent computational research and intraoperative human recordings have proven the importance of synaptic suppression in comprehending and interpreting neural activity patterns recorded during the DBS. We propose that the basic mechanism of DBS is to exploit the

physiological limits of the synaptic machinery to suppress connectivity. A simple model for these processes can help in optimization of DBS pulsing.

The LIF model with the non-volatile memristor is successfully proposed in this study, and we aim to develop the application of memristor in neuroscience. We choose the charge-controlled memristor to combine with the LIF spiking model and get the MLIF spiking model. We examined the firing patterns of LIF and MLIF and found the superiority of MLIF model over LIF model. The simulation results show that the MLIF model has good biological spiking frequency adaptation, higher firing frequency, and rich firing patterns. The MLIF model can reproduce the firing behavior of biological neurons very well.

Recent studies have shown that human skin and other biological tissues are memristors. Many researches have found that human skin exhibits non-volatile memory and that analogue information can actually be stored inside the skin at least for three minutes. Human skin actually contains two different memristor types, one that originates from the sweat ducts and one that is based on thermal changes of the surrounding tissue, the stratum corneum; and information storage is possible in both. Assuming that different physiological conditions of the skin can explain the variations in current responses that we observed among the subjects, it follows that non-linear recordings with DC pulses may find use in sensor applications. A new understanding of skin's electrical properties could have implications for medicine. This can even lead to development of artificially implantable skin.

## MATLAB code for TM Model

```
%%%%%%%% This code generates the excitatory postsynaptic currents of
%%%%%%%% facilitating, depressing and pseudo-linear excitatory synapses
%%%%%%%% based on Tsodyks-Markram synaptic model

clearvars

dt=.1; ti=dt; tf=10000;
t=ti:dt:tf;

% DBS input
fdbs=1:130;
T=ones(1,length(fdbs));
dbsi=500/dt; dbsf=10000/dt;

% I Kernel time constant
taus=1.75; %3

%input spike train
sp=zeros(length(fdbs),length(t));

% Synapse parameters % Each column represents E1, E2 and E3 respectively
tauf=[670,17,326];
taud=[138,671,329];
U=[.09,.5,.29];
% A=[0.0025,0.0025,0.0025];
A=[1,1,1];
n=1;
A=n*A;

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbes),length(t));
I=zeros(length(fdbes),length(t));
% It=zeros(length(fdbes),length(t));
EPSC=zeros(length(A),length(fdbes),length(t));
select_time=dbsf-50000:dbsf;
It=zeros(length(fdbes),length(select_time));
M_I=ones(length(A),length(fdbes));
mi=zeros(length(A),1);
M_Iall=ones(length(A),length(fdbes));
area=zeros(length(A),length(fdbes));
areal=zeros(length(A),length(fdbes));
% Sc=zeros(length(A),length(fdbes));

for p=1:3
    for j=1:length(fdbes)
        T(j)=round(1000/fdbes(j)/dt);
        ts=dbsi:T(j):dbsf;
        sp(j,ts)=1/dt;
        for i=1:length(t)-1
            u(j,(i+1)) = u(j,i)+dt*(-(u(j,i)/tauf(p))+U(p)*(1-
u(j,i))*sp(j,i));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(p)*u(j,i+1)*x(j,i)*sp(j,i));
        end
    end
end
```

```

        EPSC(p,j,:)= I(j,:);
%       M_Iall(p,j)=max(I(j,:));
        It(j,:)=I(j,select_time);
        M_I(p,j)=max(It(j,:));
%       mi(p)=max(M_Iall(p,j));
%       M_I(p,j)=M_I(p,j)./mi(p);
t1{p,j}=ts(end-1)+1:ts(end); %last period EPSC curve
It1{p,j}=I(j,t1{p,j});
areal(p,j)=trapz(t1{p,j},It1{p,j})/10; %area under the EPSC curve for
1 EPSC
area(p,j)=areal(p,j)*j; %area under the EPSC curve in
1 second
    end
end

%gain peak frequency
theta=1000/sqrt(tauf(1)*taud(1)*U(1)); %valid only for facilitating synapse

%Make figure
freq1=20; freq2=130;
figure;
ax1=subplot(4,3,1);

plot(t,squeeze(EPSC(1,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Facilitating'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax2=subplot(4,3,2);
qq=EPSC(1,freq2,:)
ww=squeeze(EPSC(1,freq2,:))
%plot(t,squeeze(EPSC(1,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax3=subplot(4,3,3);
scatter(fdbs,squeeze(M_I(1,:,1)), 'k', '.'); ylabel({'Facilitating
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')

hold on
plot((1./fdbs)+.008, '--', 'LineWidth',1); zoom xon; %ylim([0 .14])
ylim([0 .6]);

ax4=subplot(4,3,4);
plot(t,squeeze(EPSC(2,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Depressing'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax5=subplot(4,3,5);
plot(t,squeeze(EPSC(2,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax6=subplot(4,3,6);
scatter(fdbs,squeeze(M_I(2,:,1)), 'k', '.'); ylabel({'Depressing
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

ax7=subplot(4,3,7);

```

```

plot(t,squeeze(EPSC(3,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Pseudo-linear'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax8=subplot(4,3,8);
plot(t,squeeze(EPSC(3,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax9=subplot(4,3,9);
scatter(fdbs,squeeze(M_I(3,:,1)), 'k', '.'); ylabel({'Pseudo-linear
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

ax10=subplot(4,3,10);
plot(t,sp(freq1,:), 'k', 'LineWidth',1); zoom xon; ylabel(['Input
', num2str(freq1), ' Hz'], 'FontWeight', 'bold')
xlim([450 1000]);
xlabel('Time (ms)', 'FontWeight', 'bold');

ax11=subplot(4,3,11);
plot(t,sp(freq2,:), 'k', 'LineWidth',1); zoom xon; ylabel(['Input
', num2str(freq2), ' Hz'], 'FontWeight', 'bold')
xlim([450 1000]);
xlabel('Time (ms)', 'FontWeight', 'bold');

ax12=subplot(4,3,12);
scatter(fdbs,squeeze(M_I(1,:,1)), '.'); zoom xon; hold on;
scatter(fdbs,squeeze(M_I(2,:,1)), '.'); hold on
scatter(fdbs,squeeze(M_I(3,:,1)), '.'); hold on
xlabel('Frequency (Hz)', 'FontWeight', 'bold');
ylabel({'All synapses'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

figure
scatter(fdbs,squeeze(M_I(1,:,1)), 'filled'); zoom xon; hold on;
scatter(fdbs,squeeze(M_I(2,:,1)), 'filled'); hold on
scatter(fdbs,squeeze(M_I(3,:,1)), 'filled'); hold on
xlabel('Frequency (Hz)', 'FontWeight', 'bold');
ylabel({'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .5])
set(gca, 'FontSize', 12, 'FontWeight', 'bold')

%% Integrals
S1=zeros(length(A),length(fdbs));
S=zeros(length(A),length(fdbs));
for j=1:3
for i=1:length(fdbs)
S1(j,i) = -M_I(j,i)*taus*(exp(-T(i)/taus)-1); %The integral of one EPSC at
the steady state
S(j,i) = S1(j,i)*i;
end
end

arealf=areal(1,:);
areald=areal(2,:);
arealp=areal(3,:);
areaf=area(1,:);
aread=area(2,:);
areap=area(3,:);

```

```

f_weight=.45; d_weight=.38; p_weight=.18;
area_tot=f_weight*areaf+d_weight*aread+p_weight*areap;

figure; title('Area under 1 EPSC'); hold on
for p=1:3
scatter(fdbs,areal(p,:));
hold on
end
legend('F','D','P')
for p=1:3
plot(fdbs,S1(p,:), 'Linewidth',1);
hold on
end
xlabel('DBS frequency (Hz)')
ylabel('S_1')
set(gca, 'FontSize',12, 'FontWeight', 'bold')

figure; title('Area under EPSCs in 1 second of stimulation'); hold on
for p=1:3
scatter(fdbs,area(p,:), 'filled');
hold on
end
scatter(fdbs,area_tot, 'filled', 'k');

legend('F','D','P','Total')
% for p=1:3
% plot(fdbs,S(p,:), 'Linewidth',1);
% hold on
% end
% plot(ff,sf, 'LineWidth',1)
xlabel('DBS frequency (Hz)')
ylabel('S')
set(gca, 'FontSize',12, 'FontWeight', 'bold')

```

## **MATLAB code for LIF Neuron Model**

```
##### This code computes an LIF neuron activity before and during DBS.
tic
clearvars

% transmission + synaptic delay: td
td=2; %2 ms for trasmission and .5 ms for synaptic delay

dt=1; ti=dt; tf=1500+td;%tf=1500+td;%tf=61000+td; %in mili seconds
t=ti:dt:tf;

% DBS input
fdbs=130;
T=ones(1,length(fdb));
% dbsi=(100)/dt; dbsf=1100/dt; %in mili seconds
dbsi=(dt)/dt; dbsf=1500/dt;

%Poissonian input
fr=10; %for fr Hz baseline poissonian firing from other cells
[spikes,tsp]=poissonSpikeGen(fr,tf/1000,1,dt/1000);
tp=find(spikes==1);
% ssp=zeros(1,length(t));
% ssp(tp)=1; %uncomment for stochastic model (adding noise to the system)

%noise term
% wght=0; %no noise
wght=.5; %default noise
% wght=5; %high noise
kisi=wght*randn(1,length(t));

% I Kernel time constant
taus=3; %For excitatory synapse

% transmission + synaptic delay: td
td=td/dt; %convert to simulation step scale

%input spike train
sp=zeros(length(fdb),length(t));

% Synapse parameters % Each column 1,2,3 means F,D,P respectively and each
row means
% Excitatory and inhibitory synapse (1: excitatory, 2: inhibitory)
% In this study we just used the first row, excitstory synapses.
tauf=[670,17,326; 376,21,62];
taud=[138,671,329; 45,706,144];
U=[.09,.5,.29; .016,.25,.32];
A=[.0025,.0025,.0025; .0025,.0025,.0025];
% n=10; A=n*A; % change the strength of A (order of magnitude of totall
number of synapses)
ie=ones(1,2);
w=1;

fid=2.5; %synaptic fidelity
we=fid*200; wi=0;
% Percentage of excitatory and inhibitory synapses:
```

```

ne=we*[45,38,17]; %original: 45,38,17
% ne=zeros(1,3);
% for 1 synapse n1=1 and so forth (approximately giving 2 pA exc. current)
% ne=10; % for 10 synapses (approximately giving 20 pA exc. current)
% ne=100; % for 100 synapses (approximately giving 200 pA exc. current)
% ne=1000;% for 1000 synapses (approximately giving 2 nA exc. current)
% ni=wi*[13,10,6]; % for 1 synapse (approximately giving 10 pA
inhibitory current)
ni=wi*[8,76,16]; %ne=ni;
% ni=zeros(1,3);
% ni=10; % for 10 synapses (approximately giving 100 pA inh. current)
% ni=100; % for 100 synapses (approximately giving 1 nA inh. current)
% ni=1000;% for 1000 synapses (approximately giving 10 nA inh. current)
A=[ne.*A(1,:);ni.*A(2,:)];

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbs),length(t));
I=zeros(length(fdbs),length(t));
Iwo=zeros(length(fdbs),length(t));
% It=zeros(length(fdbs),length(t));
PSC=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSC=zeros(length(A),length(fdbs),length(t));

% Compute EPSP (passive mechanism, membrane potential)
tau_memb=40;
r=10^2; %M Ohm
v=zeros(length(fdbs),length(t));
PSP=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSP=zeros(length(A),length(fdbs),length(t));

% Neuron parameters: (for ~20 Hz base firing .56 and for ~8-10 Hz choose
.26)
Cm= 1; Rm=100; Ie=.26; %(for deterministic model)
% Ie=.16; %subthreshold firing (for noise purpose, stochastic model)
El=-70; Vth=-54;
Vreset=-80;

% % Neuron parameters: (for 62.5 Hz base firing)
% Cm= 1; Rm=100; Ie=1.52; %(for deterministic model)
% % Ie=.18; %subthreshold firing (for noise purpose, stochastic model)
% El=-70; Vth=-54;
% Vreset=-80;

% Compute neuron firing pattern with and without synaptic input:
V=zeros(length(fdbs),length(t));
Vn=zeros(length(ie),length(A),length(fdbs),length(t));
V_all=zeros(length(fdbs),length(t));
% Vn_all=zeros(length(ie),length(A),length(fdbs),length(t));
Vin=zeros(1,length(t));

wk=10; %Poissonian weight
poiss=wk*rand(1,length(sp)).*sp(1,:);
for i=1:length(t)-1
Vin(i+1) = Vin(i) + (dt/Cm)*(((El-Vin(i))/Rm) + Ie + poiss(i) + kisi(i));
if Vin(i+1)>= Vth+kisi(i)
Vin(i)=0+kisi(i);
Vin(i+1)=Vreset+kisi(i);
end
end

```

```

for q=1:length(ie)
    if q==1
        w=1;
    else
        w=-1;
    end
for p=1:length(A)
    for j=1:length(fdfs)
        T(j)=round((1000/fdfs(j))/dt);
        dbs=dbsi:T(j):dbsf;
        ts=[tp,dbs]; %uncomment for Poissonian+DBS
%         ts=dbs; %uncomment for DBS only
        sp(j,ts)=1/dt;
        for i=td+1:length(t)-1
            u(j,(i+1)) = u(j,i) + dt*(-(u(j,i)/tauf(q,p))+U(q,p)*(1-
u(j,i))*sp(j,i-td));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(q,p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i-td));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(q,p)*u(j,i+1)*x(j,i)*sp(j,i-td));
            Iwo(j,(i+1)) = Iwo(j,i) + dt*((-1/taus)*Iwo(j,i) +
A(q,p)*sp(j,i-td));
            v(j,(i+1)) = v(j,i) + dt*(((v(j,i)+r*I(j,i))/tau_memb);
            %Replace I with Iwo for no depletion of synaptic conduction
            V(j,(i+1)) = V(j,i) + (dt/Cm)*((E1-V(j,i))/Rm) +Ie +
w*I(j,i) + poiss(i)+ kisi(i));
            if V(j,i+1)>= Vth+kisi(i)
                V(j,i)=0+kisi(i);
                V(j,i+1)=Vreset+kisi(i);
            end
        end
        %replace I with Iwo for no depletion
        PSC(q,p,j,:)= w*I(j,:); %IPSC(p,j,:)= -I(j,:);
        PSP(q,p,j,:)= w*v(j,:); %IPSP(p,j,:)= -v(j,:);
        Vn(q,p,j,:)= V(j,:);
    end
end
end

PSC_exc=sum(PSC(1, :, :, :), 2);
PSC_inh=sum(PSC(2, :, :, :), 2);
PSC_all=PSC_exc+PSC_inh;

PSP_exc=sum(PSP(1, :, :, :), 2);
PSP_inh=sum(PSP(2, :, :, :), 2);
PSP_all=PSP_exc+PSP_inh;

for j=1:length(fdfs)
for i=1:length(t)-1
    V_all(j,(i+1)) = V_all(j,i) + (dt/Cm)*((E1-V_all(j,i))/Rm)
+ PSC_all(1,1,j,i) +Ie + poiss(i) + kisi(i));
    if V_all(j,i+1)>= Vth+kisi(i)
        V_all(j,i)=0+kisi(i);
        V_all(j,i+1)=Vreset +kisi(i);
    end
end
end
end

```

```

%% Make figure with arbitrary selection of synapse and DBS frequency
(Figure 4 in the paper)
EI=1;    % Choose 1 for excitatory and 2 for inhibitory
syn=1;   % Choose 1 for F, 2 for D and 3 for P synaptic types
freq=1;  % The desired DBS frequency to be illustrated
figure;
ax1=subplot(4,1,1);
hold on
title(['Neuron activity pattern from excitatory synapses at DBS
',num2str(fdbs), 'Hz'], 'FontSize',14, 'FontWeight', 'bold')
plot(t,sp(freq,:), 'LineWidth',1); zoom xon;
ylabel('Input', 'FontSize',13, 'FontWeight', 'bold')
ax2=subplot(4,1,2);
plot(t,squeeze(PSC(EI,syn,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
hold on
plot(t,squeeze(PSC(EI,syn+1,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
hold on
plot(t,squeeze(PSC(EI,syn+2,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
legend('F', 'D', 'P')
ylim([0 15])
ax3=subplot(4,1,3);
plot(t,squeeze(PSC_all(1,1,freq,:)), 'LineWidth',1);
ylabel('Total EPSC (nA)', 'FontSize',13, 'FontWeight', 'bold')
ylim([0 15])
ax4=subplot(4,1,4);
plot(t,squeeze(Vn(EI,syn,freq,:)), 'LineWidth',1);
hold on
plot(t,Vin, '--', 'Color', 'r', 'LineWidth',1);
legend('with TM synaptic dynamics', 'without TM synaptic dynamics')
ylabel({'Model neur n potential'; ' with and without synapse'; '
(mv)'}, 'FontSize',13, 'FontWeight', 'bold')
xlabel('Time (ms)', 'FontSize',13, 'FontWeight', 'bold');
ylim([-100 5])
linkaxes([ax1,ax2,ax3,ax4], 'x')
%% Compute firing rate of the LIF neuron without synaptic input:
r_isi_without_syn=(1000/dt)*length(find(Vin(dbsi:dbsf)>=Vth))/((dbsf-
dbsi));
disp(['LIF rate without any synaptic connection =
',num2str(r_isi_without_syn), ' (Hz)'])
%% Compute firing rate of the LIF neuron with synaptic input:
r_isi_with_syn=(1000/dt)*length(find(Vn(EI,syn,freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['LIF rate with a fraction of synapses during
DBS',num2str(freq*10), 'Hz = ',num2str(r_isi_with_syn), ' (Hz)'])
%% Compute firing rate of the LIF neuron with all synaptic inputs:
r_isi_with_all_syn=(1000/dt)*length(find(V_all(freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['LIF rate with all synapses during DBS', num2str(freq*10), 'Hz =
',num2str(r_isi_with_all_syn), ' Hz'])
%% Raster plot (Figure 5 in the paper) and PSTH for 130 Hz:
for q=1
    for sq=1:2
        dbsT=round((1000/fdbs(q)/dt));
        width=1;
        edges=0:width:dbsT;
        psth=zeros(1,round(dbsT/width)+1);
    end
end
figure;

```

```

title(['LIF neuron raster plot at DBS ', num2str(fdbs(q)), ' Hz, fidelity=
', num2str(fid*100), '%'], 'FontSize', 14, 'FontWeight', 'bold');
xlabel('DBS pulse time period(ms)', 'FontSize', 13);
ylabel('Stimulation time(sec)', 'FontSize', 13);
hold on

if sq==1
for i=dbsi:dbsT:dbsf-dbsT
    [xx, zz]=find(V_all(q, (i:i+dbsT))>=Vth);
    hh=hist(zz, edges);
    psth=psth+hh;
scat=scatter(zz*dt, (i*dt/1000)*ones(1, length(xx)), 'k', 'filled'); hold on
end
axis ij
%axis off
xlim([0 dbsT*dt])
% ylim([0 60])

figure;
plot(edges*dt, psth, 'LineWidth', 1);
xlabel('DBS pulse time period (ms)')
ylabel('Number of spikes')
xlim([0 dbsT*dt])
hold on
set(gca, 'FontSize', 14, 'FontWeight', 'bold')
% saveas(fig, ['DBS_', num2str(fdbs(q)), num2str(fid), 'fidelity'], 'jpg')
end

if sq==2
for i=dbsi:dbsT:dbsf-dbsT
    [xx, zz]=find(V_all(q, (i:i+dbsT))>=Vth);
    hh=hist(zz, edges);
    psth=psth+hh;
scat=scatter(zz*dt, (i*dt/1000)*ones(1, length(xx)), 121, 'k', 'square', 'MarkerFaceColor', 'k'); hold on
end
axis ij
% axis off
xlim([0 dbsT*dt])
% ylim([42 42.2])
set(gca, 'FontSize', 14, 'FontWeight', 'bold')
end
end
end
toc

```

## MATLAB code for MLIF Neuron Model

```
%%%%%%%% This code computes an MLIF neuron activity before and during DBS.
tic
clearvars

% transmission + synaptic delay: td
td=2; %2 ms for trasmission and .5 ms for synaptic delay

dt=1; ti=dt; tf=1500+td;%tf=1500+td;%tf=61000+td; %in mili seconds
t=ti:dt:tf;

% DBS input
fdbs=130;
T=ones(1,length(fdbs));
% dbsi=(100)/dt; dbsf=1100/dt; %in mili seconds
dbsi=(dt)/dt; dbsf=1500/dt;

%Poissonian input
fr=10; %for fr Hz baseline poissonian firing from other cells
[spikes,tsp]=poissonSpikeGen(fr,tf/1000,1,dt/1000);
tp=find(spikes==1);
% ssp=zeros(1,length(t));
% ssp(tp)=1; %uncomment for stochastic model (adding noise to the system)

%noise term
% wght=0; %no noise
wght=.5; %default noise
% wght=5; %high noise
kisi=wght*randn(1,length(t));

% I Kernel time constant
taus=3; %For excitatory synapse

% transmission + synaptic delay: td
td=td/dt; %convert to simulation step scale

%input spike train
sp=zeros(length(fdbs),length(t));

% Synapse parameters % Each column 1,2,3 means F,D,P respectively and each
row means
% Excitatory and inhibitory synapse (1: excitatory, 2: inhibitory)
% In this study we just used the first row, excitstory synapses.
tauf=[670,17,326; 376,21,62];
taud=[138,671,329; 45,706,144];
U=[.09,.5,.29; .016,.25,.32];
A=[.0025,.0025,.0025; .0025,.0025,.0025];
% n=10; A=n*A; % change the strength of A (order of magnitude of totall
number of synapses)
ie=ones(1,2);
w=1;

fid=2.5; %synaptic fidelity
we=fid*200; wi=0;
% Percentage of excitatory and inhibitory synapses:
ne=we*[45,38,17]; %original: 45,38,17
% ne=zeros(1,3);
```

```

% for 1 synapse n1=1 and so forth (approximately giving 2 pA exc. current)
% ne=10; % for 10 synapses (approximately giving 20 pA exc. current)
% ne=100; % for 100 synapses (approximately giving 200 pA exc. current)
% ne=1000;% for 1000 synapses (approximately giving 2 nA exc. current)
% ni=wi*[13,10,6]; % for 1 synapse (approximately giving 10 pA
inhibitory current)
ni=wi*[8,76,16]; %ne=ni;
% ni=zeros(1,3);
% ni=10; % for 10 synapses (approximately giving 100 pA inh. current)
% ni=100; % for 100 synapses (approximately giving 1 nA inh. current)
% ni=1000;% for 1000 synapses (approximately giving 10 nA inh. current)
A=[ne.*A(1,:);ni.*A(2,:)];

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbs),length(t));
I=zeros(length(fdbs),length(t));
Iwo=zeros(length(fdbs),length(t));
% It=zeros(length(fdbs),length(t));
PSC=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSC=zeros(length(A),length(fdbs),length(t));

% Compute EPSP (passive mechanism, membrane potential)
tau_memb=40;
r=10^2; %M Ohm
v=zeros(length(fdbs),length(t));
PSP=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSP=zeros(length(A),length(fdbs),length(t));

% % % Neuron parameters: (for ~20 Hz base firing .56 and for ~8-10 Hz
choose .26)
Cm= 1; Rm=100; Ie=.26; %(for deterministic model)
% Ie=.16; %subthreshold firing (for noise purpose, stochastic model)
El=-70; Vth=-54;
Vreset=-80;

% % % Neuron parameters: (for 62.5 Hz base firing)
% Cm= 1; Rm=100; %Ie=1.52; %(for deterministic model)
% Ie=.18; %subthreshold firing (for noise purpose, stochastic model)
% El=-70;Vth=-54;
% Vreset=-80;

% Compute neuron firing pattern with and without synaptic input:
V=zeros(length(fdbs),length(t));
Vn=zeros(length(ie),length(A),length(fdbs),length(t));

V_all=zeros(length(fdbs),length(t));
d=linspace(-0.5*10^(-4),0.5*10^(-4),1502);
q1=d.*ones(1,length(t));
tau_m=zeros(1,length(t));
o=linspace(-0.75,0.25,1502);
psi=o.*ones(1,length(t));
M=zeros(1,length(t));
% Vn_all=zeros(length(ie),length(A),length(fdbs),length(t));
Vin=zeros(1,length(t));

wk=10; %Poissonian weight;
poiss=wk*rand(1,length(sp)).*sp(1,:);
for i=1:length(t)-1

```

```

    if q1(i)<(-0.5*10^(-4))
        M(i)=20000;
    elseif q1(i)>=(-0.5*10^(-4)) & q1(i)<(0.5*10^(-4))
        M(i)=10^(4)+(-1.99)*10^(8)*q1(i);
    else
        M(i)=100;
    end
    if psi(i)<(-0.75)
        tau_m(i)=20000*q1(i)/Vin(i);
    elseif psi(i)>=(-0.75) & psi(i)<(0.25)
        tau_m(i)=(10^(4)*q1(i)/Vin(i))+((-1.99)*10^(8)*q1(i)*q1(i))/Vin(i);
    else
        tau_m(i)=100*q1(i)/Vin(i);
    end

Vin(i+1) = Vin(i)+ (dt/tau_m(i))*(El-Vin(i) + M(i)*(Ie+ poiss(i) +
kisi(i)));
if Vin(i+1)>= Vth+kisi(i)
    Vin(i)=0+kisi(i);
    Vin(i+1)=Vreset+kisi(i);
end
end

for q=1:length(ie)
    if q==1
        w=1;
    else
        w=-1;
    end
for p=1:length(A)
    for j=1:length(fdbs)
        T(j)=round((1000/fdbs(j))/dt);
        dbs=dbsi:T(j):dbsf;
        ts=[tp,dbs]; %uncomment for Poissonian+DBS
        %      ts=dbs; %uncomment for DBS only
        sp(j,ts)=1/dt;
        for i=td+1:length(t)-1
            u(j,(i+1)) = u(j,i) + dt*(-(u(j,i)/tauf(q,p))+U(q,p)*(1-
u(j,i))*sp(j,i-td));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(q,p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i-td));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(q,p)*u(j,i+1)*x(j,i)*sp(j,i-td));
            Iwo(j,(i+1)) = Iwo(j,i) + dt*((-1/taus)*Iwo(j,i) +
A(q,p)*sp(j,i-td));
            v(j,(i+1)) = v(j,i) + dt*(((v(j,i)+r*I(j,i))/tau_memb);
            %Replace I with Iwo for no depletion of synaptic conduction
            V(j,(i+1)) = V(j,i) + (dt/tau_m(i))*(El-Vin(i) +
M(i)*(w*I(j,i) +Ie+ poiss(i) + kisi(i)));
            if V(j,i+1)>= Vth+kisi(i)
                V(j,i)=0+kisi(i);
                V(j,i+1)=Vreset+kisi(i);
            end
        end
        %replace I with Iwo for no depletion
        PSC(q,p,j,:)= w*I(j,:); %IPSC(p,j,:)= -I(j,:);
        PSP(q,p,j,:)= w*v(j,:); %IPSP(p,j,:)= -v(j,:);
        Vn(q,p,j,:)= V(j,:);
    end
end

```

```

    end
end
end

PSC_exc=sum(PSC(1, :, :, :), 2);
PSC_inh=sum(PSC(2, :, :, :), 2);
PSC_all=PSC_exc+PSC_inh;

PSP_exc=sum(PSP(1, :, :, :), 2);
PSP_inh=sum(PSP(2, :, :, :), 2);
PSP_all=PSP_exc+PSP_inh;

for j=1:length(fdbs)
for i=1:length(t)-1
    V_all(j, (i+1)) = V_all(j, i) + (dt/tau_m(j, i))*(E1-
V_all(j, i)+ M(j, i)*(PSC_all(1, 1, j, i) +Ie+ poiss(i) + kisi(i)));
        if V_all(j, i+1)>= Vth+kisi(i)
            V_all(j, i)=0+kisi(i);
            V_all(j, i+1)=Vreset +kisi(i);
        end
end
end

%% Make figure with arbitrary selection of synapse and DBS frequency
(Figure 4 in the paper)
EI=1; % Choose 1 for excitatory and 2 for inhibitory
syn=1; % Choose 1 for F, 2 for D and 3 for P synaptic types
freq=1; % The desired DBS frequency to be illustrated
figure;
ax1=subplot(4, 1, 1);
hold on
title(['Neuron activity pattern from excitatory synapses at DBS
', num2str(fdbs), 'Hz'], 'FontSize', 14, 'FontWeight', 'bold')
plot(t, sp(freq, :), 'LineWidth', 1); zoom xon;
ylabel('Input', 'FontWeight', 'bold')
ax2=subplot(4, 1, 2);
plot(t, squeeze(PSC(EI, syn, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
hold on
plot(t, squeeze(PSC(EI, syn+1, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
hold on
plot(t, squeeze(PSC(EI, syn+2, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
legend('F', 'D', 'P')
ylim([0 15])
ax3=subplot(4, 1, 3);
plot(t, squeeze(PSC_all(1, 1, freq, :)), 'LineWidth', 1);
ylabel('Total EPSC (nA)', 'FontWeight', 'bold')
ylim([0 15])
ax4=subplot(4, 1, 4);
plot(t, squeeze(Vn(EI, syn, freq, :)), 'LineWidth', 1);
hold on
plot(t, Vin, '--', 'Color', 'r', 'LineWidth', 1);
legend('with TM synaptic dynamics', 'without TM synaptic dynamics')
ylabel({'Model neuron potential'; 'with and without synapse';
(mv) }, 'FontSize', 13, 'FontWeight', 'bold')
xlabel('Time (ms)', 'FontWeight', 'bold');
ylim([-100 5])
linkaxes([ax1, ax2, ax3, ax4], 'x')

```

```

% Compute firing rate of the LIF neuron without synaptic input:
r_isi_without_syn=(1000/dt)*length(find(Vin(dbsi:dbsf)>=Vth))/((dbsf-
dbsi));
disp(['MLIF rate without any synaptic connection =
',num2str(r_isi_without_syn),' (Hz)'])
% Compute firing rate of the LIF neuron with synaptic input:
r_isi_with_syn=(1000/dt)*length(find(Vn(EI,syn,freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['MLIF rate with a fraction of synapses during
DBS',num2str(freq*10),'Hz = ',num2str(r_isi_with_syn),' (Hz)'])
% Compute firing rate of the LIF neuron with all synaptic inputs:
r_isi_with_all_syn=(1000/dt)*length(find(V_all(freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['MLIF rate with all synapses during DBS', num2str(freq*10),'Hz =
',num2str(r_isi_with_all_syn),' Hz'])
% Raster plot (Figure 5 in the paper) and PSTH for 130 Hz:
for q=1
    for sq=1:2
        dbsT=round((1000/fdbs(q)/dt));
        width=1;
        edges=0:width:dbsT;
        psth=zeros(1,round(dbsT/width)+1);
        figure;
        title(['MLIF neuron raster plot at DBS ',num2str(fdbs(q)),' Hz, fidelity=
',num2str(fid*100),'%'],'FontSize',14,'FontWeight','bold');
        xlabel('DBS pulse time period(ms)','FontSize',13);
        ylabel('Stimulation time(sec)','FontSize',13);
        hold on

        if sq==1
            for i=dbsi:dbsT:dbsf-dbsT
                [xx,zz]=find(V_all(q,(i:i+dbsT))>=Vth);
                hh=hist(zz,edges);
                psth=psth+hh;
            end
            scat=scatter(zz*dt,(i*dt/1000)*ones(1,length(xx)),16,'k','filled'); hold on
        end
        axis ij
        % axis off
        xlim([0 dbsT*dt])
        % ylim([0 60])

        figure;
        plot(edges*dt,psth,'LineWidth',1);
        xlabel('DBS pulse time period (ms)')
        ylabel('Number of spikes')
        xlim([0 dbsT*dt])
        hold on
        set(gca,'FontSize',14,'FontWeight','bold')
        % saveas(fig,['DBS_',num2str(fdbs(q)),num2str(fid),'fidelity'],'jpg')
        end

        if sq==2
            for i=dbsi:dbsT:dbsf-dbsT
                [xx,zz]=find(V_all(q,(i:i+dbsT))>=Vth);
                hh=hist(zz,edges);
                psth=psth+hh;
            end
            scat=scatter(zz*dt,(i*dt/1000)*ones(1,length(xx)),121,'k','square','MarkerF
acecolor','k'); hold on
        end
        axis ij
        % axis off

```

```
xlim([0 dbst*dt])
% ylim([42 42.2])
set(gca, 'FontSize',14, 'FontWeight', 'bold')
end
    end
end
toc
```

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**MoS<sub>2</sub> NANO-SHEET LOADED TiO<sub>2</sub> NANOTUBE  
ARRAY FOR VISIBLE LIGHT DRIVEN  
PHOTO-CATALYSIS FOR WATER PURIFICATION  
APPLICATIONS**

**PROJECT REPORT**

Submitted by  
**Aruna Mohandas**  
**AM20PHY003**

Under the guidance of  
**Dr. Kala M.S, Associate Professor**  
**Department of Physics, St. Teresa's College(Autonomous),**  
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Submitted to the  
**Misshankara Gandhi University, Kottayam**  
*In partial fulfillment of the requirements for the award of*  
**MASTER'S DEGREE OF SCIENCE IN PHYSICS**



**ST. TERESA'S COLLEGE (AUTONOMOUS),  
ERNAKULAM, KOCHI-682011**

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(AUTONOMOUS)  
ERNAKULAM**



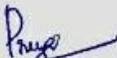
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PROJECT REPORT**

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Staff Member in charge



  
Head of the Department

Submitted for the University examination held in St. Teresa's College (Autonomous),  
Ernakulam.

Examiners

- 1) Dr. Issac Paul, 
- 2) Dr. Vishamol Mathew 

Date: 13.06.2022

**ST. TERESA'S COLLEGE  
(AUTONOMOUS)  
ERNAKULAM**



**CERTIFICATE**

This is to certify that the project report titled "**MoS<sub>2</sub> NANO-SHEET LOADED TiO<sub>2</sub> NANOTUBE ARRAY FOR VISIBLE LIGHT DRIVEN PHOTO-CATALYSIS FOR WATER PURIFICATION APPLICATIONS**" submitted by **ARUNA MOHANDAS** towards partial fulfillment of the requirements for the award of the degree of Master's of Physics is a record of bonafide work carried out by her during the academic year 2021-22.

Supervising guide

**Dr. Kala M.S**  
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Department of Physics



Head of the Department

**Dr. Priya Parvathi Ameena Jose**  
Assistant Professor  
Department of Physics

**PLACE: Ernakulam**

**DATE : 13-06-2022**

## DECLARATION

I, ARUNA MOHANDAS, Register No. AM20PHY003 hereby declare that this project entitled "MoS<sub>2</sub> NANO-SHEET LOADED TiO<sub>2</sub> NANOTUBE ARRAY FOR VISIBLE LIGHT DRIVEN PHOTO-CATALYSIS FOR WATER PURIFICATION APPLICATIONS", is an original work done by me under guidance of Dr.KALA M.S, Associate Professor, Department of Physics and Centre for Research, St. Teresa's College (Autonomous), Ernakulam in partial fulfillment for the award of the Degree of Masters in Physics. I further declare that this project is not partly or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to the best of my knowledge.

PLACE: Ernakulam

DATE : 13-06-2022

ARUNA MOHANDAS

## ACKNOWLEDGEMENT

With immense pleasure, I express my deep sense of gratitude to the great God Almighty without whose divine blessings this work would have been never completed. I express my sincere gratitude towards Dr. Kala M.S, Associate Professor, Department of Physics and Centre for Research, and Dr. Anju K. Nair for their valuable guidance in the formation and successful completion of our study. I owe my sincere thanks to all other teachers and lab assistants for providing the facilities in completing this project and for their helping hands. Being a student of St. Teresa's College (Autonomous), Ernakulam, let me express my profound gratitude to the College. I owe my gratitude to the Department of Zoology, St. Teresa's College (Autonomous) and Dr. Helvin Vincent for their helping hands during completion of our project. I express our heartfelt thanks to the MPhil scholar Merly Ann Peter for their guidance in completing our project. I'm grateful to the Sophisticated Test and Instrumentation Centre (STIC) for helping me during the characterization studies. I sincerely thank our parents for their guidance and support. Finally I thank our classmates for the valuable comments and suggestions they made during this project.

# CONTENTS

SL. NO.	TITLE	PG NO.
	ABSTRACT	1
	<b>CHAPTER 1 : INTRODUCTION</b>	
1.1.	Nanoscience and nanotechnology	2
1.2	The origin of nanotechnology	3
1.3	The importance of nano scale	5
1.4	Different types of nano particles	5
	1.4.1. Carbon-based nano particles	6
	1.4.2. Ceramic nanoparticles	6
	1.4.3. Metal nanoparticles	6
	1.4.4. Semiconductor nanoparticles	6
	1.4.5. Polymeric nanoparticles	7
	1.4.6. Lipid-based nanoparticles	7
1.5	Approaches in nano fabrication	7-8
1.6	Advantages and disadvantages of nanotechnology	8-10
1.7	Water pollution	10
	1.7.1. Need of water purification	11
1.8	Role of nanotechnology in photocatalysis	11-12
	1.8.1. Mechanism for photocatalytic reaction	12
	1.8.2. Material selection for nanomaterials as photocatalyst	13
	1.8.3. Titanium dioxide ( TiO <sub>2</sub> )	14-15
	1.8.4. Modification of TiO <sub>2</sub> photo catalysts-	15
	1.8.4.a . Metal doping	15-16
	1.8.5. Molybdenum disulfide (MoS <sub>2</sub> )	16-17
	1.8.5.a . Applications	17
	References	18-20
	<b>CHAPTER 2 : EXPERIMENTAL METHODS</b>	
2.1.	Synthesis techniques	21
	2.1.1. Hydrothermal method	21
	2.1.1.a. Hydrothermal synthesis of TiO <sub>2</sub> nano powder	21
	2.1.1.b. Synthesis of TiO <sub>2</sub> nano tubes	22
	2.1.1.c. Hydrothermal synthesis of MoS <sub>2</sub> nanosheet	22

	2.1.1.d. Surface sensitization of nano structured TiO <sub>2</sub> by MoS <sub>2</sub> nano sheet.	22-23
	2.1.1.e . Synthesis of TiO <sub>2</sub> @ MoS <sub>2</sub> heterostructure.	23-24
	2.1.2. Preparation of dye solution for photo catalysis	24
	2.1.2.a . Rhodamine B	24
	2.1.2.b. Methylene Blue	24-25
2.2	Characterization techniques	25-36
	2.2.1. X-ray diffraction	25
	2.2.1.a. Basic principle	26-27
	2.2.1.b. Lattice parameters	27-28
	2.2.1.c. XRD pattern	29
	2.2.1.d. Determination of the particle size from XRD pattern	30
	2.2.2. Transmission electron microscopy	30-32
	2.2.3. UV Visible spectroscopy	32-34
	2.2.3.a. UV- Visible absorption spectrum	34-36
	References	37-38
	<b>CHAPTER 3 : RESULT AND DISCUSSION</b>	
3.1	XRD analysis	39
	3.1.1. XRD spectrum of synthesized TiO <sub>2</sub> nanopowder	39-40
	3.1.2. XRD spectra of synthesized MoS <sub>2</sub> nanostructures obtained at different autoclaved time period.	40-41
3.2	TEM images of the synthesized TiO <sub>2</sub> nanotubes	42-43
3.3	Photo catalytic studies	43-61
	3.3.1. Degradation of Methylene Blue dye(MB)	
	3.3.1.a. Degradation of MB with TiO <sub>2</sub> nanotube	43-45
	3.3.1.b. Degradation of MB with MoS <sub>2</sub> nano sheet	45-46
	3.3.1.c . Degradation of MB dye with MoS <sub>2</sub> nanosheet doped TiO <sub>2</sub> nanotube	46-48
	3.3.1.d . Degradation of MB with MoS <sub>2</sub> nano sheet doped TiO <sub>2</sub> nanotube prepared by mechano chemical method	48-49
	3.3.1.e . Comparison of the doped TiO <sub>2</sub> nanotube (MT) with un doped TiO <sub>2</sub> nanotube	50-52
	3.3.2. Degradation of Rhodamine B dye(Rh B)	
	3.3.2.a. Degradation of Rh B with TiO <sub>2</sub> nanotube	52-53
	3.3.2.b. Degradation of Rh B with MoS <sub>2</sub> nanosheet.	53-54
	3.3.2.c. Degradation of Rh B dye with MoS <sub>2</sub> nanosheet doped TiO <sub>2</sub> nanotube	55-56
	3.3.2.d. Degradation of Rh B with MoS <sub>2</sub> nano sheet doped TiO <sub>2</sub> nanotube prepared by mechano chemical method	56-58

	3.3.2.e . Comparison of doped TiO <sub>2</sub> nanotube(MT) with un doped TiO <sub>2</sub> nanotube	58-60
3.4	Re-usability studies	60
	References	61-63
	<b>CHAPTER 4 : CONCLUSION AND FUTURE SCOPE</b>	64-66
	References	67

## **ABSTRACT**

The world is addressing global challenges- energy and water scarcity. Day by day water resources are getting more and more polluted. The sources available when compared to the need of the population are very limited. In such a situation it is necessary to find cost effective and efficient methods to purify the water resources. The water is mainly contaminated by dyes, heavy metals, plastic wastes, other organic and inorganic wastes from industries, households, hospitals etc. One of the methods that can be opted for the purification of water is photo catalytic degradation using nano catalyst. Two such photo catalyst are  $\text{TiO}_2$  and  $\text{MoS}_2$  which fall into the category of semiconductor photo catalysts.

In this work, we have doped  $\text{TiO}_2$  nanotubes (NT) with  $\text{MoS}_2$  so that we can increase the photo catalytic degradation of pollutants more effectively in the presence of visible light. For synthesis, we opted hydrothermal method. Structure and composition were determined using characterisation techniques X-ray diffraction, High resolution Transmission Electron Microscopy, Fourier transform infra-red spectroscopy. The photo catalytic degradation in two most commonly used dyes Rhodamine B and Methylene Blue was studied under visible light. The percentage of degradation was studied by using UV-visible spectroscopy. Our project is a small step for the betterment of society aiming the high scale water purification.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1. NANOSCIENCE AND NANOTECHNOLOGY**

Nanoscience is the study of structures and molecules on the scales of nanometres ranging between 1 and 100 nm, and the technology that utilizes it is known as nanotechnology. Nanotechnology has become one of the most promising technologies of the 21st century. It has the ability to convert the ideas of nanoscience to useful applications by observing, manipulating, measuring, assembling, controlling and manufacturing the matter in the nanometre scale.

Nanoscale science and technology are based on the fact that materials at the nano scale have the properties (i.e., mechanical, optical, chemical, and electrical) quite different than the bulk materials. For example, macromolecules and particles are made up of limited number of molecules, i.e., in the size range of 1–50 nm, having distinct chemical (i.e., reactivity, catalytic potential, etc.) and physical properties (i.e., magnetic, optical). On comparing with bulk materials, it is seen that nanoparticles possess enhanced performance properties when they are used in similar applications. Size-dependent properties are one of the most important features of nanoscale objects.

Nanotechnology contributes to almost every field of science, which includes Physics, Chemistry, Biology, Computer Science and Engineering. In few decades, nanotechnology and nanoscience have become fundamental importance to industrial applications and medical devices such as diagnostic biosensors, drug delivery systems and imaging probes. Nanomaterials are useful in building solar cells, hydrogen fuel cells and novel hydrogen storage systems which are capable of delivering clean energy to countries still rely on traditional, non-renewable contaminating fuels. An important application of nanoparticles is recognized to be the production of a new class of catalysts known as nanocatalysts. The role of nanoparticles as catalysts results in improving chemical reaction performances. The most significant advances in nanotechnology are in the field of biomedicine and especially in cancer therapeutics. The innovative biomedical applications are currently exploited in a variety of clinical trials and in the near future, may support major development in the therapy of cancer. There are many expected advances in nanoscience and nanotechnology with applications in agriculture, electronics, energy, medicine etc., which are

rapidly increasing.

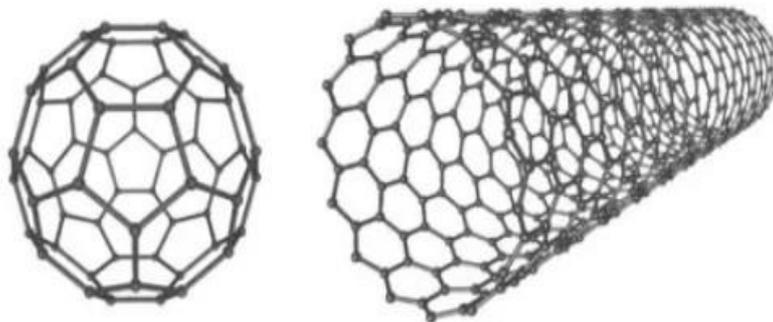
## **1.2. THE ORIGIN OF NANOTECHNOLOGY**

The word ‘nano’ is originated from a Greek word means ‘dwarf’ or something very small and depicts one thousand millionth of a meter ( $10^{-9}$  m). The American physicist and Nobel Prize laureate Richard Feynman introduced the concept of nanotechnology in 1959. In the annual meeting of the American Physical Society, Feynman presented a lecture entitled “There’s Plenty of Room at the Bottom”. In this lecture, Feynman described a vision of using machines to construct smaller machines and down to the molecular level. Feynman is considered as the father of Modern Nanotechnology. It was Norio Taniguchi, a Japanese scientist who coined and defined the term “nanotechnology” in 1974.

In 1986, K. Eric Drexler published the first book on nanotechnology “Engines of Creation: The Coming Era of Nanotechnology”, which led to the theory of “molecular engineering”. Drexler proposed the idea of the build-up of complex machines from individual atoms, which independently manipulate molecules and atoms and thereby produces self-assembly nanostructures. Later on, in 1991, Drexler, Peterson and Pergamit published another book entitled “Unbounding the Future: the Nanotechnology Revolution” in which they use the terms “nanobots” or “assemblers” for nano processes in the medicine applications.

In 1981, a new type of microscope, the Scanning Tunnelling Microscope (STM), was invented by the physicists Gerd Binnig and Heinrich Rohrer at IBM Zurich Research Laboratory. In 1986, Binnig and Rohrer received the Nobel Prize in Physics for the design of the STM. This invention led to the development of the atomic force microscope (AFM) and scanning probe microscopes (SPM).

In 1985, Robert Curl, Harold Kroto and Richard Smalley discovered that carbon can also exist in the form of very stable spheres, the fullerenes or buckyballs. The carbon balls with the chemical formula C<sub>60</sub> or C<sub>70</sub> are formed when graphite is evaporated in an inert atmosphere. In 1991, Iijima et al. observed hollow graphitic tubes or carbon nanotubes by Transmission Electron Microscopy (TEM) which form another member of fullerene family. Carbon nanotubes are used as composite fibers in polymers and to improve the mechanical, thermal and electrical properties of the bulk product.



*Illustration 1: Schematic diagram of a Carbon 60 buckyball(Fullerene) and carbon nanotube.*

In 2004, a new class of carbon nanomaterials called carbon dots (C-dots) with size below 10 nm was discovered. C-dots have interesting properties due to their benign, abundant and inexpensive nature. Low toxicity and good biocompatibility makes C-dots suitable for applications in bioimaging, biosensor and drug delivery. By the discovery of “graphene” in 2004, carbon-based materials become the backbone of every field of science and engineering.

Recently, a number of studies prove that nanotechnology play an important role in biomedicine for the diagnosis and therapy of many human diseases. DNA nanotechnology has already become an interdisciplinary research area which made possible to use DNA and other biopolymers directly in array technologies for sensing and diagnostic applications. Nano-oncology is a very attractive application of nanoscience and allows for the improvement of tumour response rates in addition to a significant reduction of the systemic toxicity associated with current chemotherapy treatments.

Nanotechnology improves the environment and produces more efficient and cost-effective energy which generates less pollution during the manufacture of materials. Nano-informatics deals with the assembling, sharing, envisaging, modelling and evaluation of significant nano scale level data and information.

### **1.3. THE IMPORTANCE OF NANO SCALE**

There are many specific reasons why nano scale has become so important;

- Quantum mechanical (wavelike) properties of electrons inside matter are influenced by variations on the nano scale. Quantum effects can begin to dominate the behaviour of matter at the nano scale – particularly at the lower end – affecting the optical, electrical and magnetic behaviour of materials.
- A key feature of biological entities is the systematic organization of matter on the nanoscale in nanoscience and nanotechnology has allowed us to place man-made nanoscale things inside living cells.
- Nanoscale components have very high surface-to-volume ratio, making them ideal for use in composite materials, reacting systems, drug delivery, and energy storage.
- Macroscopic systems consist of nanostructures with higher density than those made up of microstructures. They are better conductors of electricity which results in new electronic device concepts, smaller and faster circuits and greatly reduced power consumption by controlling nano structure interactions and complexity.

Nanostructured semiconductors are known to show various non-linear optical properties. Semiconductor Q-particles also show quantum confinement effects which has led to properties like luminescence in silicon powders and silicon germanium quantum dots as infrared optoelectronic devices.

Nanostructured metal-oxide finds application for rechargeable batteries for cars or consumer goods. Nanostructured metal-oxide thin films have a special impact in catalytic applications of gas sensors with enhanced sensitivity and selectivity.

### **1.4. DIFFERENT TYPES OF NANO PARTICLES**

Nano particles can be classified into different types according to the size, morphology, physical and chemical properties. Some of them are carbon-based nano particles, ceramic nano particles, metal nano particles, semiconductor nano particles, polymeric nano particles and lipid-based nano particles.

### **1.4.1 CARBON-BASED NANO PARTICLES**

Carbon-based nanoparticles contain two main materials: carbon nano tubes (CNTs) and fullerenes. CNTs are graphene sheets rolled into a tube. These materials are mainly used for the structural reinforcement as they are 100 times stronger than steel.

CNTs can be classified into single-walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs). CNTs are thermally conductive along the length and non-conductive across the tube.

### **1.4.2. CERAMIC NANOPARTICLES**

Ceramic nanoparticles are inorganic solids made up of oxides, carbides, carbonates and phosphates. These nanoparticles have high heat resistance and chemical inertness. They have applications in photo catalysis, photo degradation of dyes, drug delivery and imaging.

By controlling the characteristics like size, surface area, porosity, surface to volume ratio, etc. they perform as good drug delivery agents. These nanoparticles can be used as drug delivery system for a number of diseases like bacterial infections, glaucoma, cancer etc.

### **1.4.3. METAL NANOPARTICLES**

Metal nanoparticles are prepared from metal precursors. These nanoparticles can be synthesized by chemical, electrochemical or photochemical methods. They have the ability to adsorb small molecules and have high surface energy.

These nanoparticles have applications in research areas, detection and imaging of bio molecules and in environmental and bio-analytical applications.

### **1.4.4. SEMICONDUCTOR NANOPARTICLES**

Semiconductor nanoparticles have intermediate properties between metals and non-metals. They are found in the periodic table in groups II-VI, III-V or IV-VI. Some examples of semiconductor nanoparticles are GaN, GaP, InP, InAs from group III-V, ZnO, ZnS, CdS, CdSe, CdTe from II-VI semiconductors and silicon and germanium from group IV.

They have a wide band gap, which on tuning shows different properties. They are used in photocatalysis, electronics devices, photo-optics and water splitting applications.

### **1.4.5. POLYMERIC NANOPARTICLES**

Polymeric nanoparticles are organic based nanoparticles. Depending upon the method of preparation, they have structures shaped like nanocapsular or nanospheres. A nanosphere particle has a matrix-like structure whereas the nanocapsular particle has core-shell morphology.

They have applications in drug delivery and diagnostics. The drug deliveries with polymeric nanoparticles are highly biodegradable and bio-compatible.

### **1.4.6. LIPID-BASED NANOPARTICLES**

Lipid nanoparticles are generally spherical in shape with a diameter ranging from 10 to 100nm. It consists of a solid core made of lipid and a matrix containing soluble lipophilic molecules.

The external core of these nanoparticles is stabilized by surfactants and emulsifiers. These nanoparticles have application in the biomedical field as a drug carrier and delivery and RNA release in cancer therapy.

## **1.5. APPROACHES IN NANO FABRICATION**

Top-down and bottom-up methods are two types of approaches used in nano fabrication. The bottom-up approach is more advantageous than the top-down approach because the former has a better chance of producing nano structures with less defects, more homogeneous chemical composition and better short and long range ordering.

The top-down approach is the breaking down of bulk material to get nano-sized particles. Top-down methods begin with a pattern generated on a larger scale, which is reduced to nano-scale after a sequence of operations is performed over them. All the solid state routes fall into this category. Typical examples are etching through the mask, ball milling, cutting, grinding and application of severe plastic deformation, photo lithography, e-beam lithography etc.

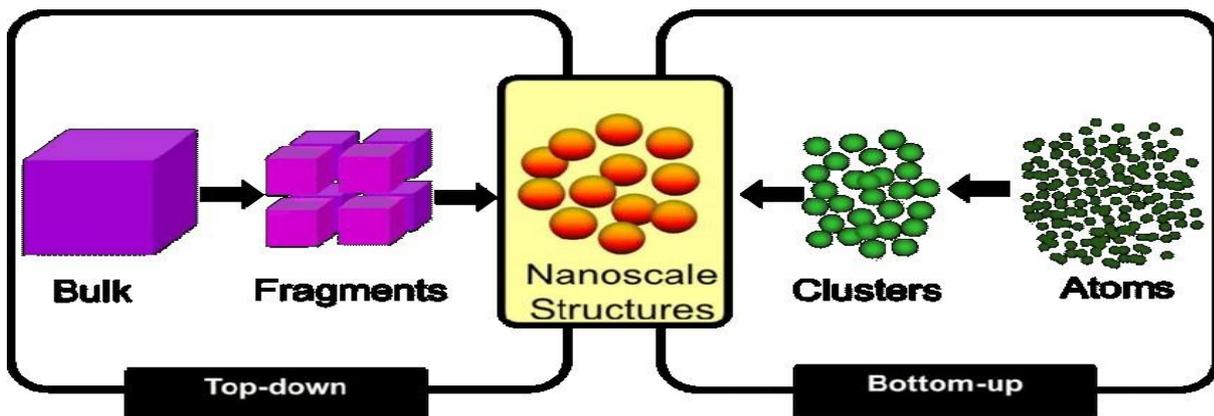
Top-down approaches are based on grinding a material. The parts of mechanical devices used to shape objects are stiff and hard, so these methods are not suitable for soft samples. The major drawback of this method is that they require large installations and huge capital for building their setup and is quite expensive. Moreover the growth process is slow and is not suitable for large

scale production.

The bottom-up approach refers to the build-up of nano-structures from the bottom: atom-by-atom or molecule-by-molecule by physical and chemical methods which are in a nano range (1 nm to 100nm) using controlled manipulation of self-assembly of atoms and molecules. All the techniques that start with liquid and gas as the starting material fall into this category. Typical examples are quantum dot formation during epitaxial growth and formation of nanoparticles from colloidal dispersion, physical vapour deposition, chemical vapour deposition etc.

Bottom-up approach is based on the principle of molecular recognition (i.e., self assembly). The idea of self assembly is to gather precursors in random positions and orientations and supply energy to allow them to sample configuration space.

A bottom-up approach is capable of producing devices in parallel and is much cheaper than top-down methods but becomes difficult as the size and complexity of the desired assembly increases.



*Illustration 2: Schematic diagram of Top-down and Bottom-up approaches*

## **1.6. ADVANTAGES AND DISADVANTAGES OF NANOTECHNOLOGY**

While nanotechnology is seen as the way of the future and as a technology that people think will bring a lot of benefit for all who will be using it, nothing is ever perfect and there will always be pros and cons to everything. The advantages and disadvantages of nanotechnology can be easily enumerated and here are some of them:

### **1.6.1. ADVANTAGES**

- ❖ Nanotechnology can actually revolutionize a lot of electronic products, procedures and applications. The areas that benefit from the continued development of nanotechnology when it comes to electronic products include nano transistors, nano diodes, OLED, plasma displays, quantum computer sand many more.
- ❖ Nanotechnology can also benefit the energy sector. The development of more effective energy-producing, energy-absorbing and energy storage products in smaller and more efficient devices is possible with this technology. Such items like batteries, fuel cells and solar cells can be built smaller but can be made to be more effective with this technology.
- ❖ In the medical world, nanotechnology is also seen as a boon since these can help with creating what is called smart drugs. These help cure people faster and without the side effects that other traditional drugs have. The research of nanotechnology in medicine is now focusing on areas like tissue regeneration, bone repair, immunity and even cures for ailments like cancer, diabetes and other life threatening diseases.
- ❖ Nanotechnology pesticides for crops will directly attack the pathogens in agriculture fields without destroying or causing any harm to the crops. At the same time, it will help in increasing the efficiency of fertilizers.
- ❖ Nowadays manufacturing concerns require nano-products like nanotubes, nanoparticles, etc. which are durable, strong and lighter than the products which are not prepared with the help of nanotechnology. Therefore nanotechnology has changed the manufacturing scenario and made it much more advantageous to them.

### **1.6.2. DISADVANTAGES**

- ❖ Possible loss of jobs in the traditional farming and manufacturing industry.
- ❖ Atomic weapons can now be made to be more powerful and more destructive. These can also become more accessible with nanotechnology.

- ❖ Since these particles are very small, problems can actually arise from the inhalation of these minute particles, much like the problems a person gets from inhaling minute asbestos particles.
- ❖ The development of nanotechnology can also bring about the crash of certain markets due to the lowering of the price of oil and diamonds due to the possibility of developing alternative sources of energy that are more efficient and won't require the use of fossil fuels.
- ❖ There are possibilities that nanotechnology will be a hazard for the environment in a sense that these nanoparticles have the tendency to accumulate in the atmosphere and even in the food chain.
- ❖ Nanotechnology is very expensive and developing it can cost a lot of money. It is also pretty difficult to manufacture, which is probably why products made with nanotechnology are very expensive.

## **1.7. WATER POLLUTION**

Pollution has become a major environmental issue due to negligence and carelessness of man. Pollution is the introduction of harmful materials into the environment. All types of pollution are detrimental to human health and wildlife and contribute to climate change, which puts the entire planet in danger. The negative effects of pollution are serious and potentially fatal.

Water pollution is the release of substances into bodies of water which makes water unsafe for human use and disrupts aquatic ecosystems. Water bodies can be polluted by a wide variety of substances, including pathogenic microorganisms, organic waste, fertilizers and plant nutrients, toxic chemicals, sediments, heat, petroleum (oil) and radioactive substances.

Water pollution may cause diseases or they even act as poisons. Micro-organisms in poorly treated sewage may enter drinking water supplies and cause digestive problems such as cholera and diarrhoea. Hazardous chemicals, pesticides and herbicides from industries can cause acute toxicity and immediate death, or chronic toxicity that can lead to neurological problems or cancers. Hazardous chemicals in water bodies can also affect the animals and plants which live there. Sometimes these organisms will survive with the chemicals in their systems, only to be eaten by humans who may then become mildly ill or develop stronger toxic symptoms.

### **1.7.1. NEED OF WATER PURIFICATION**

Our earth is covered with water two-third of its surface which is almost 330 million cubic mile of water. Only 3% of water on our planet is fresh and only 1% is surface water and rest of it is frozen or underground. One in six people on the planet do not have access to clean drinking water. According to WHO report in 2019 cause of second most death is Diarrhoea which is mainly caused by water pollution. Cholera also falls under this category and every year 95,000 death occur according to WHO.

Different types of toxic containments are present in water which have adverse effect on consumption and lead to various water-borne diseases. Pollutants can be present in the form of organic and inorganic chemicals or physical, biological, radiological or heavy metal substances. Industry waste is the major cause of water pollution because they discard about 20% of the annual dye consumption into the water bodies. There are different water purification methods like chemical transformation, distillation, biological treatments, reverse osmosis, coagulation and flocculation, micro filtration, ultraviolet treatment, ultra filtration etc. Each of these methods has specific limitations and is not sufficient to remove the containments from water and to supply 100% pure drinking water. These methods are also expensive and cannot afford by developing countries. This points to the necessity of water purification technology which is efficient at the same time less expensive. The use of nanomaterials as photo-catalyst has been reported to produce efficient and environmental friendly results.

### **1.8. ROLE OF NANOTECHNOLOGY IN PHOTOCATALYSIS**

Accelerated photo-reaction in the presence of a catalyst is called photo-catalysis. In the reaction, light is absorbed by the substrate. Reaction rate of catalyst depends on the ability of catalyst in creating electron-hole pairs, which react with the substrate and produce the free radical. Secondary reactions take place and these radicals reacts with reactant to produce different useful products.

First Photo-catalysis was reported in 1911, by a German chemist Dr. Alexander Eibnor who used the technique to bleach dark blue pigment by using Zinc Oxide in the presence of sun light. In 1938, there was a major breakthrough in the photo-catalysis.

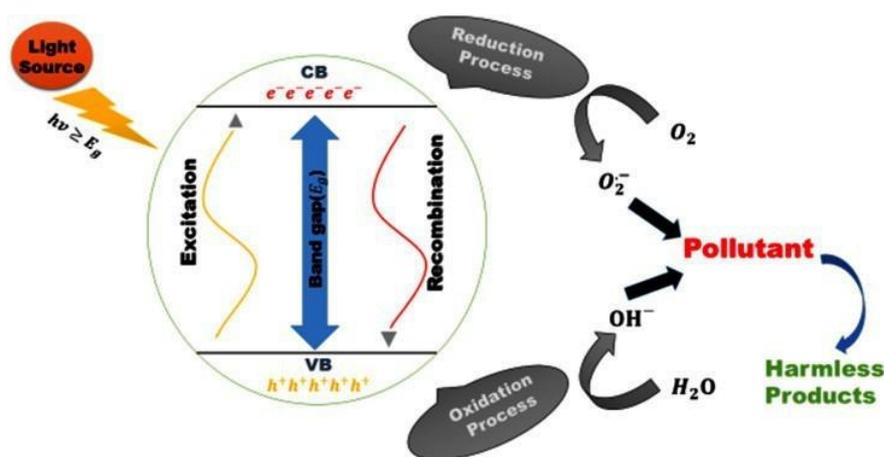
One of the most promising photocatalyst  $\text{TiO}_2$  was discovered. It was used as a photocatalyst for bleaching dyes. Another major breakthrough took place in 1972, when Akira Fujishima and Kenichi Honda reported the electrochemical photolysis of water using platinum and titanium dioxide electrodes.

Photo-catalysis is also very effective weapon against the water pollution. To increase the efficiency of photo catalytic reaction, instead of using bulk material as a catalyst we can use nanotechnology to improve the efficiency of photo catalytic reaction. The increased surface to volume ratio of nano materials increase catalyst efficiency as compared to bulk materials.

### 1.8.1. MECHANISM FOR PHOTOCATALYTIC REACTION

In photo-catalysis, reaction rate depends on crystal structure of catalyst and the energy of incoming photons of visible or UV light. Materials used as catalyst acts as a sensitizer for the irradiation of light-stimulated redox processes depending on their electronic structure which in turn, depends on filled valence and vacant conduction band.

If the band gap of the catalyst is equivalent or less than the energy of incident light, the electrons in valence band will absorb the photon and they will reach to the conduction band. Leaving holes in the valence band. Donor molecules are oxidized by these holes, also the hydroxyl is produced when  $\text{H}_2\text{O}$  react with these holes. Electron present in conduction band is absorbed by water to make superoxide ion, which is a reducing agent. This free electron is causes redox reactions to occur. These pairs of free electrons and holes can perform oxidation reduction reaction with any material which comes in contact with the catalyst and convert it into the desired products.



*Illustration 3: General reaction mechanism for photocatalytic process*

## **1.8.2 MATERIAL SELECTION FOR NANOMATERIALS AS PHOTOCATALYST**

In photocatalytic reaction, oxidation and reduction reaction occur simultaneously. Therefore, the catalyst for photocatalytic reaction should support both oxidation and reduction reaction. Materials are divided into three categories on the basis of electronic properties -conductor, insulator and semiconductor.

In conductors, valence and conduction bands overlap. For photocatalytic reaction, the necessary condition is oxidation and reduction simultaneously, but in conductors only free electron are available and hence can perform only oxidation reaction at a time. Best conductors like alkali, alkaline earth metals and transition metals have no suitable band gap and hence are not suitable for photocatalytic reaction.

Insulators have high band gap, therefore high energy is required to perform oxidation and reduction reaction. Insulator is deficient of free electron so no oxidation takes place and is why insulators are not suitable for photolytic reaction.

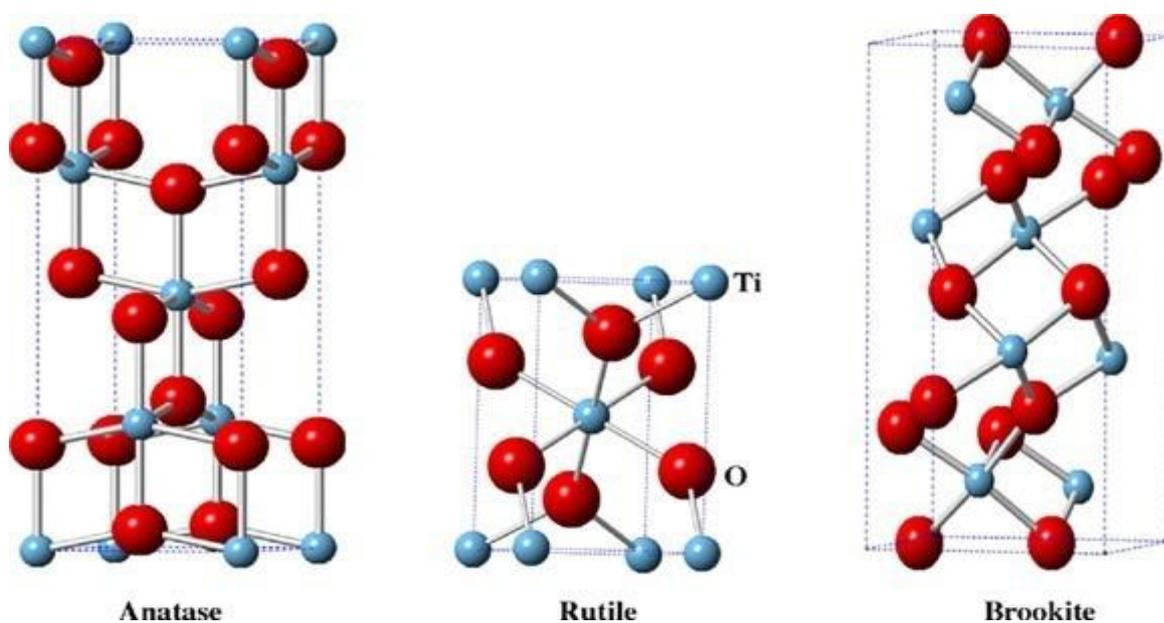
Semiconductors have moderate band gap and have the capabilities of oxidation and reduction reactions to occur simultaneously. When light falls, free electron hole pairs are generated. Necessary condition for a semiconductor to be a photocatalyst is the low recombination rate.

Semiconductors whose absorption wavelength (350–700 nm) in visible region or band gap in (1.5–3.5 eV) are suitable for photo catalytic activity. Generally semiconductors have a wide range of band gap but for a photo catalyst of UV visible region, we require only 1.5–3.5 eV band gap. Metal oxides generally fall in this category and they have many other properties which make them suitable as photo catalysts.

They include stability of the structure, morphology, reuse-ability, high surface area etc. Oxides of chromium, zinc, vanadium, cerium and titanium are used as photo-catalysts.

### 1.8.3. TITANIUM DIOXIDE ( TiO<sub>2</sub>)

Improvements in the performance of photo catalytic materials have been largely correlated with advances in nanotechnology. Many of the materials have been studied for photocatalysis in which titanium dioxide (TiO<sub>2</sub>; titania) has been extensively researched because it possesses many merits such as high photocatalytic activity, excellent physical and chemical stability, low cost, non-corrosive, nontoxicity and high availability. Titanium was first discovered in 1791 by William Gregor. It is white and a poorly soluble material. It consists of three crystalline phases; the anatase, rutile and brookite. The anatase phase is metastable and has a higher photocatalytic activity, while the rutile phase is more chemically stable but less active.



*Illustration 4: Different crystal structures of Titanium dioxide*

When titania is irradiated with light of sufficient energy, electrons from the valence band are promoted to the conduction band, leaving an electron deficiency or hole, h<sup>+</sup>, in the valence band and an excess of negative charge in the conduction band. The free electrons in the conduction band are good reducing agents while the resultant holes in the valence band are strong oxidizing agents and can participate in redox reactions.

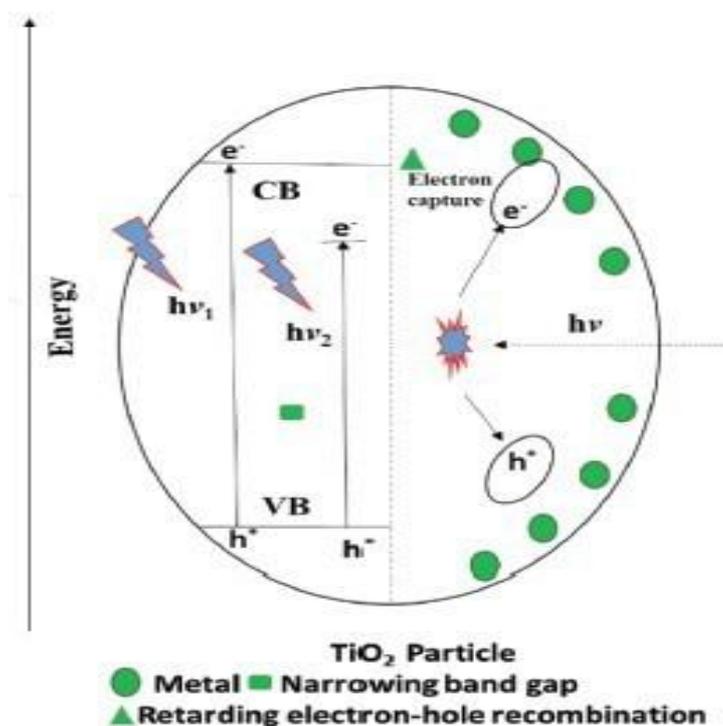
Titania suffers from a number of drawbacks that limit its practical applications in photocatalysis. The photo generated electrons and holes coexist in titania and the probability of their recombination is high. The relatively large bandgap energy ( $\sim 3.2$  eV) requires ultraviolet light for photo activation, resulting in a very low efficiency in utilizing solar light. UV light accounts for only about 5% of the solar spectrum compared to visible light (45%). There is also the challenge to recover nano-sized titania particles from treated water. Several strategies have been used to overcome these drawbacks. These strategies aim at extending the wavelength of photoactivation of  $\text{TiO}_2$  into the visible region of the spectrum thereby increasing the utilization of solar energy. ;preventing the electron/hole pair recombination and thus allowing more charge carriers to successfully diffuse to the surface.

#### **1.8.4. MODIFICATION OF $\text{TiO}_2$ PHOTO CATALYSTS**

The modifications have been done in many different ways which include metal and non-metal doping, dye sensitization, surface modification, fabrication of composites with other materials and immobilization and stabilization on support structures.

##### **1.8.4.a METAL DOPING**

Metal doping is used to modify  $\text{TiO}_2$  photo catalysts to operate efficiently under visible light. Doping  $\text{TiO}_2$  with metals results in an overlap of the Ti 3d orbitals with the d levels of the metals causing a shift in the absorption spectrum to longer wavelengths. This in turn favours the use of visible light to photo activate the material.



*Illustration 5: Metal doped TiO<sub>2</sub>*

Doping of TiO<sub>2</sub> nanoparticles with Li, Na, Mg, Fe and Co by high energy ball milling with The metal nitrates was found to widen the TiO<sub>2</sub> visible light response range. Noble metal nanoparticles such as Ag, Pt, Pd, Rh and Au have also been used to modify TiO<sub>2</sub> for photocatalysis and have been reported.

During the past few decades, transition metal dichalcogenides have been proved to be useful in many fields such as water splitting, optoelectronics, supercapacitors, solar cells, photocatalysis, hydrogen generation, sensors and lithium-ion batteries due to their admirable chemical, electrical, optical and mechanical properties. Among these, MoS<sub>2</sub> has been established as a significant material in sensitizing a wide band gap TiO<sub>2</sub> due to its potential properties like having a two-dimensional layered structure, good charge carrier transport capacity, and high surface area. The surface sensitization of TiO<sub>2</sub> by MoS<sub>2</sub> can systematically control the electron-hole pair recombination by acting as trapping centers of the electron.

### **1.8.5 MOLYBDENUM DISULFIDE (MoS<sub>2</sub>)**

Molybdenum is a Block D, Period 5 element, and sulfur is a Block P, Period 3 element. MoS<sub>2</sub> has a S–Mo–S sandwich layered structure seized together via weak Van der Waals interaction.

It is analogous to graphene, in which Mo is surrounded by the S atoms through covalent bonding. Molybdenum does not occur naturally as a free metal on Earth. Molybdenum disulfide has very good chemical and thermal stability. They can form a highly efficient dry lubricating film. Molybdenum disulfide nanoparticles possess a low friction coefficient, good catalytic activity and excellent physical properties. They also have a large active surface area, high reactivity, and increased adsorption capacity compared to the bulk material. Molybdenum disulfide nanoparticles appear in a black solid form.

### **1.8.5.a APPLICATIONS**

The key applications of molybdenum disulfide nanoparticles are as follows:

- ◆ In lubricant applications
- ◆ In difficult to maintain equipment, such as space vehicles, satellites and military fields
- ◆ In composite applications
- ◆ As a conductive filler
- ◆ As a catalyst for coal liquefaction
- ◆ Can be used to prepare special materials, catalytic materials and gas storage.

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## **CHAPTER 2**

### **EXPERIMENTAL METHODS**

#### **2.1. SYNTHESIS TECHNIQUES**

##### **2.1.1. HYDROTHERMAL METHOD**

Hydrothermal synthesis is one of the solution reaction based approach that can be used for synthesizing the nano materials. In hydrothermal method it is possible to set the parameters according to our requirement and it will result in different nano structures with wide variety of properties. To control the morphology of the materials to be prepared we can use high/low temperature or pressure conditions. The time of the synthesis can be also varied. Many types of nano materials have been successfully synthesized by the use of this approach.

Opportunity to control the parameters is itself the significant advantage of the hydrothermal synthesis method over others. Hydrothermal synthesis can generate nano materials which are not stable at elevated temperatures. Nano materials with high vapour pressures can be produced by the hydrothermal method with minimum loss of materials. The compositions of nano materials to be synthesized can be well controlled in hydrothermal synthesis through liquid phase or multiphase chemical reactions.

##### **2.1.1.a. HYDROTHERMAL SYNTHESIS OF TiO<sub>2</sub> NANO POWDER**

7 ml of Titanium Isopropoxide(0.65 M) in 25 ml of isoproponol was prepared. After vigorous stirring for 5 minute at room temperature a clear solution was obtained to which 50 ml of distilled water was added under the magnetic stirring, turning the clear solution into a milky suspension which is done at 50<sup>0</sup> C for one hour and autoclaved at 50<sup>0</sup> C for one hour. Finally on, cooling,the sample is obtained in liquid form, which is washed with distilled water and centrifuged a number of times. The settled product is separated and dried at 80<sup>0</sup>C for 1.5 hours. The obtained sample is then crushed into fine powder using mortar and pestle.

### **2.1.1.b. SYNTHESIS OF TiO<sub>2</sub> NANO TUBES**

0.6 g of TiO<sub>2</sub> nano powder was dispersed in 60 ml of 10M NaOH( 24 g of NaOH) solution and is vigorously stirred at room temperature for 2 hours. The sample is autoclaved at 130 °C for 26 hours. It is re dispersed in 400 ml of 0.1 M HCl for 3 hours, centrifuged and washed with distilled water to stabilize PH to 7 and is dried at 400 °C for 2 hours.

#### **Preparation of 0.1 M HCl**

To prepare HCl solution, 3.6ml of 35% HCl is taken in a beaker. The beaker is filled with distilled water up to 400 ml and the mixture from Teflon vessel was added into the above beaker. This is stirred for 3 hours.

### **2.1.1.c. HYDROTHERMAL SYNTHESIS OF MoS<sub>2</sub> NANOSHEET**

MoS<sub>2</sub> nano sheets were prepared by a hydrothermal route. In the typical synthesis process of MoS<sub>2</sub>, 1.21 g sodium molybdate (0.005 mol) and 1.56 g thiourea (0.02 mol) were mixed into 30 mL double distilled water. The resulting mixture was stirred constantly for 30 min and poured into 50 ml Teflon-lined stainless autoclave. Then, the autoclave was placed in a hot air oven at 180 °C for different time (8 hours, 10 hours,12 hours , 24 hours). Subsequently, the autoclave was allowed to cool and the obtained nano powder was centrifuged multiple times with double distilled water and ethanol. Finally, the resultant black powder was kept to dry under a vacuum oven at 80 °C.

### **2.1.1.d. SURFACE SENSITIZATION OF NANOSTRUCTURED TiO<sub>2</sub> BY MOS<sub>2</sub> NANOSHEET**

The surface sensitization of nano structured TiO<sub>2</sub> was carried out by using hydrothermally synthesized MoS<sub>2</sub> via the mechano-chemical method. The typical synthesis process is as follows: an appropriate amount of TiO<sub>2</sub> nano powder is mixed with a certain amount of MoS<sub>2</sub> (2, 5 wt %) in a minute quantity of ethanol. The above mixture was ground constantly in a mortar and pestle for 2 h. At the completion of grinding, the obtained powder was rinsed with double distilled water and allowed to dry at 80 °C for 12 h. The sensitized material could be labelled as x wt % MoS<sub>2</sub>-TiO<sub>2</sub>

Here, two different values were chosen for x; x=2 and 5 wt%.

For 2% wt MoS<sub>2</sub> in 0.25 g TiO<sub>2</sub> nanotube; the amount required can be calculated as:

$$x(2\%) = (100M_1)/(M_1+0.25)$$

$$50 M_1 = M_1+0.25$$

$$49 M_1 = 0.25$$

$$M_1 = \text{mass of MoS}_2 = 0.00510 \text{ g}$$

So, 0.00510 g of MoS<sub>2</sub> nano sheet is mixed with 0.25 g of TiO<sub>2</sub> nanotubes (NT). A small amount of ethanol is added and grounded for 30 minute in mortar and pestle. The mixture is then rinsed with distilled water and is kept in oven to dry at 80 degree Celsius for 5 hours. The obtained sample is kept in bottle as nanocomposite and termed as MT\*2%.

For 5% wt MoS<sub>2</sub> in 0.25 g TiO<sub>2</sub> nanotube:

$$x(5\%) = (100M_1)/(M_1+0.25)$$

$$20 M_1 = M_1+0.25$$

$$19 M_1 = 0.25$$

$$M_1 = \text{mass of MoS}_2 = 0.01316 \text{ g}$$

So, 0.01316 g of MoS<sub>2</sub> nano sheet is mixed with 0.25 g of TiO<sub>2</sub> NT. A small amount of ethanol is added and grounded for 2 hrs. in mortar and pestle. The mixture is then rinsed with distilled water and is kept in oven to dry at 80 degree Celsius for 5 hours. The obtained sample is kept in bottle as nanocomposite and termed as MT\*5%

The samples are named as follows:

### **2.1.1.e. SYNTHESIS OF TiO<sub>2</sub> @ MoS<sub>2</sub> HETEROSTRUCTURE**

TiO<sub>2</sub> @ MoS<sub>2</sub> heterostructure with different phases were synthesized by using hydrothermal and mixing method. 1.6 g of ammonium molybdate and 0.5 g of thiourea were dissolved in 80 ml of distilled water in a beaker. 0.37 g of TiO<sub>2</sub> nanotube was added to it and stirred until it forms a suspension. Solution was transferred in to the autoclave of Teflon lined stainless steel and was

heated at 200<sup>0</sup>C for 24 hours in the oven. The obtained powder was washed using distilled water, centrifuged a number of times and dried at 80<sup>0</sup>C for 4 hours to obtain a grey coloured TiO<sub>2</sub>@MoS<sub>2</sub> heterostructure.

SAMPLE	SYMBOL
2 wt% MoS <sub>2</sub> -TiO <sub>2</sub>	MT*2%
5 wt% MoS <sub>2</sub> -TiO <sub>2</sub>	MT*5%
MoS <sub>2</sub> @ TiO <sub>2</sub>	MT

**Table1:** Name of the sample and corresponding symbols used

## **2.1.2. PREPARATION OF DYE SOLUTION FOR PHOTO CATALYSIS**

### **2.1.2.a RHODAMINE B**

For photo catalytic study, 300 ml 0.00001 M Rhodamine B dye solution is prepared in distilled water. For this 300ml of distilled water and 0.00144 g of Rh B were added and stirred for 10 min in darkness.

From this 10 ml of the solution is taken and 2.5 mg of TiO<sub>2</sub> NT is added. And to another 10 ml solution 2.5mg of MoS<sub>2</sub>@TiO<sub>2</sub> is added which is kept in the presence of sun light and absorption spectra is taken at different interval of time. The same procedure is repeated at dark also.

Similarly, the nanocomposite MT, MT\*2%, MT\*5% was added into 10ml of the dye solution. It was kept under dark and also sunlight and the UV-Vis spectra was taken at different time intervals.

### **2.1.2.b. METHYLENE BLUE**

For photo catalytic study, 300 ml Methylene blue dye solution is prepared in distilled water. For this to 300ml of distilled water and 2.5mg of methylene blue was added and stirred for 10 min in darkness.

From this 10 ml of the solution is taken and 2 mg of TiO<sub>2</sub> nanotube is added. And to

another 10 ml solution 2mg of MoS<sub>2</sub>@TiO<sub>2</sub> (MT) is added. And kept in presence of sun light and absorption spectra is took at different interval of time. The same procedure is repeated at dark also.

Similarly, the 2 mg nanocomposite prepared MT, MT\*2%, MT\*5% was added into 10 ml of the dye solution. It was kept in dark and also sunlight. The UV spectra was taken at different time intervals. And the data was studied.

## **2.2. CHARACTERIZATION TECHNIQUES**

For exploring the features of the nano particles we can use two major domains. In one of the cases, we try to obtain the type of crystal group, determine lattice parameters and measure the average nano crystallite size. For such measurements, we generally perform X-ray diffraction experiments (XRD). The second domain is the microscopy/imaging in which we see the particles, lattice planes in the crystal and thus enabling direct measurement of the particle size, inter-planar distance and particle size distribution. We can use electron microscopy, atomic force microscopy; scanning tunnelling microscopy, field ion microscopy etc. for such informations.

The characterisation techniques employed in this study are discussed in detail in the following sections.

### **2.2.1. X-RAY DIFFRACTION**

Most of the nano particles exhibit crystalline structure and therefore characterization techniques for these particles should be able to identify the crystallographic structure and lattice parameters. From X-ray diffraction pattern we can obtain these details.

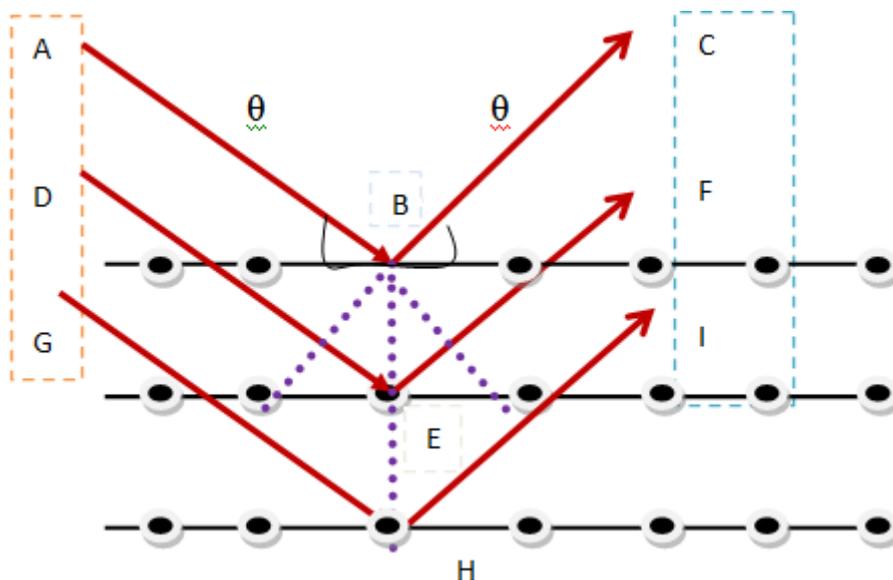
X-ray powder diffraction is primarily used for the identification of the crystalline material and thus can provide information regarding the unit cell dimension. For preparing the sample for XRD, it must be finely grounded and spread to the substrate. Therefore, the result we obtain will be averaged over several crystallites.

From the XRD pattern we compare the theta values of X-ray diffraction peaks to the standard values provided by the already known elements and obtain the best match.

### 2.2.1.a. BASIC PRINCIPLE

When the propagating beam wavelength is of the order of inter-planar distances for a particular crystal, the rays get reflected from different planes and these monochromatic reflected rays will constructively interfere resulting in the diffraction pattern.

Typically X-rays used for diffraction are electromagnetic waves with wavelength in the range 0.05 to 0.25 nm. X-ray beam should be monochromatic. So, it is filtered by graphite, and the collimated, focused and directed towards the sample. The interaction of the incident rays with the sample produces constructive interference and it will depend upon the angle of incidence.



*Illustration 6: X ray diffraction from parallel planes in a crystal.*

Consider the illustration 6, in which different parallel planes with same (h,k,l) values are given. The distance between the adjacent planes is the inter-planar distance is taken as d.

AB, DE, GH are the incident radiation incident on the plane at an angle theta that get reflected along BC, EF, HI. The ray DEF travels an extra distance of  $2d \sin\theta$  which is the path difference. For constructive interference of the reflected rays to occur path difference must be integral multiple of the wavelength of the X-ray ( $n\lambda$ )

The relation between the wavelengths of the electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample given as

$$n\lambda = 2d \sin\theta \dots\dots\dots (eq. 1)$$

This relation is what we call Bragg's law.

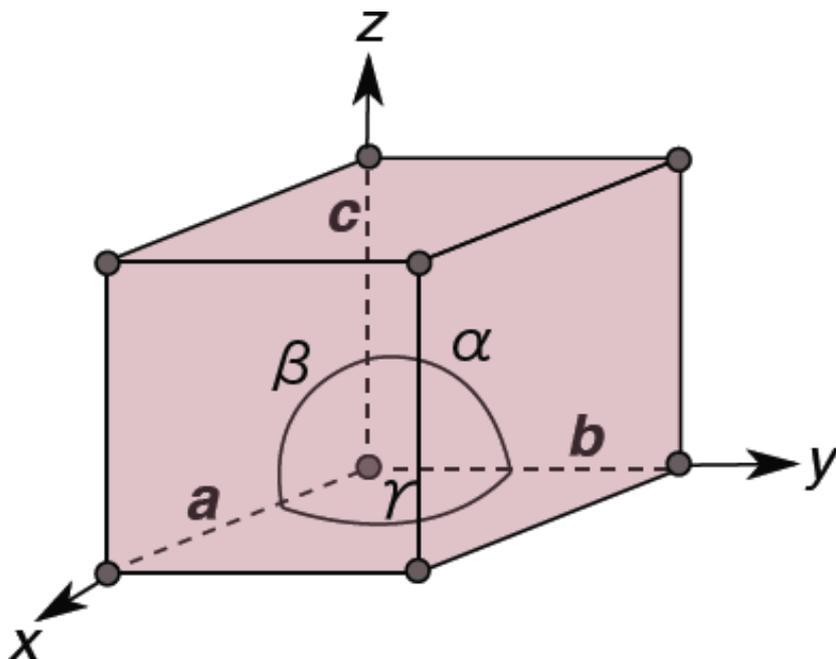
The inter-planar distance  $d$  in the Bragg's equation is decided by the lattice parameters  $a, b$  and  $c$

$$1/d^2 = (h/a)^2 + (k/b)^2 + (l/c)^2 \dots\dots\dots (eq 2)$$

If we find the value of  $d$  from the detected Bragg's angle, we can figure out the value of the lattice parameters which in turn provide vital information regarding the crystal.

**2.2.1.b. LATTICE PARAMETERS**

The lattice parameters are the quantities specifying a unit cell (smallest repeating unit of the crystal). Lattice parameters are represented by  $a, b, c$  as lengths of the unit cell in three dimensions, and " $\alpha, \beta, \gamma$ ," their mutual angles. The equations connecting lattice parameters ( $a, b, c$ ) and the inter planar distance ( $d$ ) different crystal structures are given below.



*Illustration 7: Crystal axis, lattice parameters a,b,c and angle between them*

*Cubic:* 
$$\frac{1}{d^2} = \frac{h^2 + k^2 + l^2}{a^2}$$

*Tetragonal:* 
$$\frac{1}{d^2} = \frac{h^2 + k^2}{a^2} + \frac{l^2}{c^2}$$

*Hexagonal:* 
$$\frac{1}{d^2} = \frac{4}{3} \left( \frac{h^2 + hk + k^2}{a^2} \right) + \frac{l^2}{c^2}$$

*Rhombohedral:*

$$\frac{1}{d^2} = \frac{(h^2 + k^2 + l^2)\sin^2 \alpha + 2(hk + kl + hl)\cos^2 \alpha - \cos \alpha}{a^2(1 - 3\cos^2 \alpha + 2\cos^3 \alpha)}$$

*Orthorhombic:* 
$$\frac{1}{d^2} = \frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}$$

*Monoclinic:* 
$$\frac{1}{d^2} = \frac{1}{\sin^2 \beta} \left( \frac{h^2}{a^2} + \frac{k^2 \sin^2 \beta}{b^2} + \frac{l^2}{c^2} - \frac{2hl \cos \beta}{ac} \right)$$

*Triclinic:* 
$$\frac{1}{d^2} = \frac{1}{V^2} (S_{11}h^2 + S_{22}k^2 + S_{33}l^2 + 2S_{12}hk + 2S_{23}kl + 2S_{13}hl)$$

In the equation for triclinic crystals,

$V$  = volume of unit cell (see below),

$$S_{11} = b^2c^2\sin^2 \alpha,$$

$$S_{22} = a^2c^2\sin^2 \beta,$$

$$S_{33} = a^2b^2\sin^2 \gamma,$$

$$S_{12} = abc^2(\cos \alpha \cos \beta - \cos \gamma),$$

$$S_{23} = a^2bc(\cos \beta \cos \gamma - \cos \alpha),$$

$$S_{13} = ab^2c(\cos \gamma \cos \alpha - \cos \beta).$$

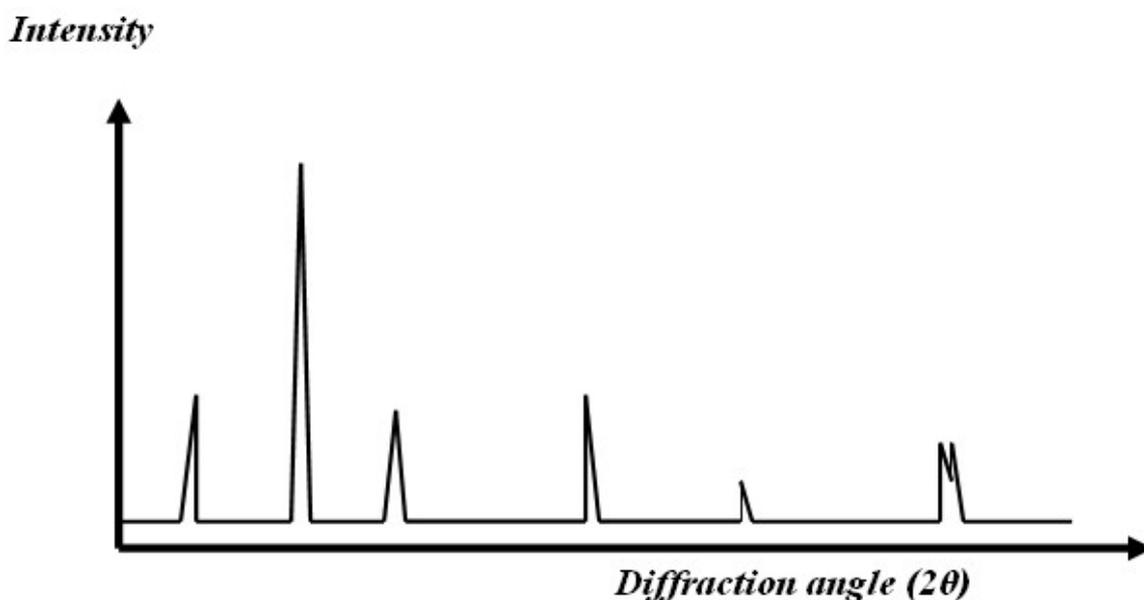
Where S represents constants relating lattice parameters.

### 2.2.1.c. XRD PATTERN

X ray pattern is a simple graph between intensity of diffracted X-rays and the angle of diffraction. To record this pattern, sample is needed to be scanned through a range of angles ( $2\theta$ ). Since the sample is in the form of powder, it presents all the diffraction direction of the beam. A single peak in the diffraction pattern will indicate a series of planes facing the X-ray beam at the correct angle to satisfy the Bragg's condition. So the peak can tag inter-planar distance ( $d$ ) and will help in the identification of the material element involved having a set of unique  $d$ - spacing. This can be typically obtained by comparing these values with the standard reference pattern.

All planes in the crystal may not produce reflected signal or satisfy Bragg's equations. For example, in body centred mono atomic lattice, only those plane with  $h+k+l = n$  will produce Bragg reflection only if  $n$  is an even integer. For face centred cubic lattice, constructive interference takes place when  $h$ ,  $k$  and  $l$  are either all even or all odd which arises because of the effect of structure factor. From simple cubic structure, reflections from all the planes are possible.

The pattern will consist of sharp peaks for crystallite nano particle. And for the nano sheets like structures it is seen that the peak extends and become broader. Given below is an example of XRD pattern.



*Illustration 8: XRD pattern with  $2\theta$  on x axis and intensity along y axis*

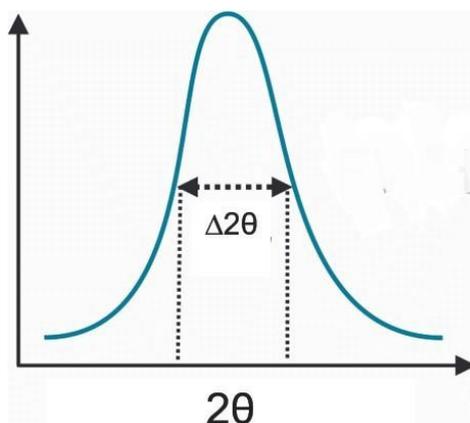
### **2.2.1.d. DETERMINATION OF THE PARTICLE SIZE FROM XRD PATTERN**

XRD gives account of the nano crystalline size from the width of the prominent diffraction pattern. It provides an easy and fast method for determining the size of nanocrystals using Debye-Scherrer's equation.

The coherence length of the particle/the particle size (L) is given by

$$L = \frac{0.94\lambda}{B \cos \theta} \dots\dots\dots(\text{eq 3})$$

Where  $\lambda$  is the wavelength of the X-ray, B is the full width half maximum, ie the width of the peak(radian) at the half of the maximum intensity,  $\theta$  is the angle of diffraction for that particular peak.



*Illustration 9: XRD peak indicating the full width half maximum.*

For spherical nanocrystals the coherence length (L) and the diameter (d) of the core of the nanocrystals/crystallite are related through the equations

$$d = (4L/3) \dots\dots\dots(\text{eq 4}).$$

And no contribution to the XRD pattern from an amorphous segment in the sample.

### **2.2.2. TRANSMISSION ELECTRON MICROSCOPY**

Electron microscopy is a powerful tool that can be used to measure the size and shape of the nanostructures. The image of the material can be obtained just like optical microscopy. The

resolution provided by electron microscope is in the order of nanometre and hence is very high. Electron microscope uses few thousand electron volt energized electron. The energy of such electron is very high and about 1000 times greater than that of the visible photon energy. So, a resolution of 0.01nm can be obtained.

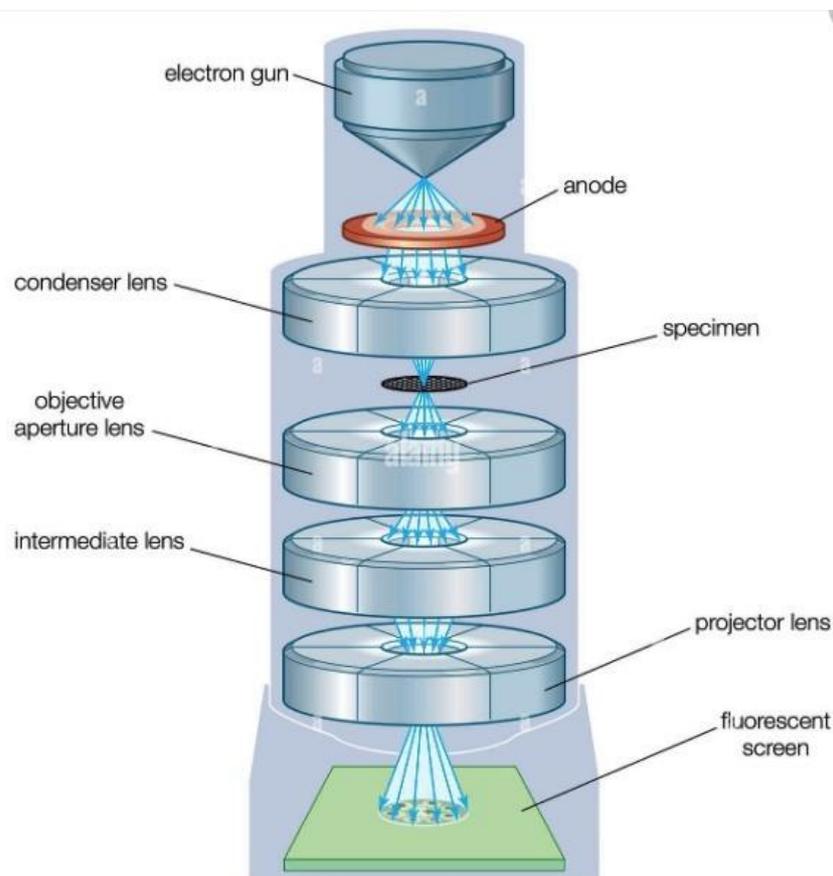
TEM or Transmission electron microscopy is a tool that can be utilized to analyse the structure of very thin specimen through which electron can transmit through. TEM is much identical to the optical electron microscopy in the transmission mode with only difference that here instead of light, electron is transmitted through the specimen. Hence, the specimen must be thin enough so the electron can penetrate through. This transmitted beam then can be recorded and processed to get an image of the specimen.

The components of the transmission electron microscope are similar to that of the optical microscope which are as follows:

1. Source of energized electron – electron gun
2. A monochromatic source.
3. To focus electron beam to particular spot in the specimen – electromagnetic condenser lens. The lens will have current carrying coil surrounded by iron.
4. To eliminate the high angle electron and to restrict the size of the beam – condenser aperture.
5. To hold the sample – A sample holder.
6. To focus the transmitted beam another lens can be used.
7. To block the high angle diffraction and thus to enhance the diffraction image – optical objective and selection area metal aperture.
8. To enlarge the image and allowing optical image recording projector lens is used.

The sample will be kept in extreme vacuum condition. It should be thin enough so that high energetic electron will penetrate. The electron get scattered at the points on the specimen and degrees of scattering which can be elastic/ inelastic depend on the constituent atom of the specimen . Heavier the atoms, more will be the scattering. If scattering is more, then the transmitted intensity will be less. For lighter atom, scattering will be less, transmitted intensity will be high. So the intensity of the electron reaching the detector will be determined by the no. of the transmitted

beams, which in turn depends on the nature of the specimen atoms. Heavy atoms produce dark spots and lighter atoms produce brighter spots. The transmitted beam is allowed to fall on the phosphor screen or is digitally processed with the help of a computer. From the TEM image we can obtain the information regarding the shape and size of the nano particle.



**Illustration 10:** Components of TEM

For obtaining atomic level image, one may use high resolution TEM (HRTEM) which is an improved version of TEM. It uses interference in image plane of electron wave itself instead of scattering by sample for image formation. Each imaging electron will interact with the sample and electron wave passes through the microscope system which will undergo a phase change and interferes with image wave in imaging plane. From such an image obtained even the inter planar distance  $d$  can be directly measured.

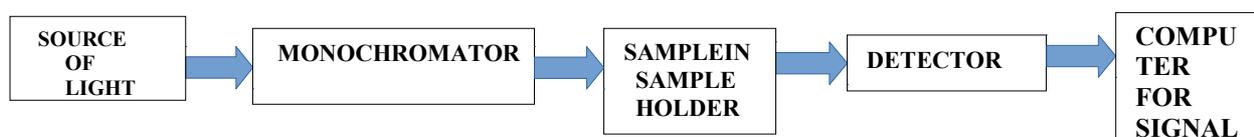
### **2.2.3. UV VISIBLE SPECTROSCOPY**

UV-Vis spectroscopy is basically an analytical technique that is used to measure the amount

of discrete wavelengths of UV or visible light that are absorbed by or transmitted through a sample in comparison to a reference or blank sample.

This absorption/transmission of light is influenced by the sample composition, thus potentially able to provide information regarding the sample and concentration.

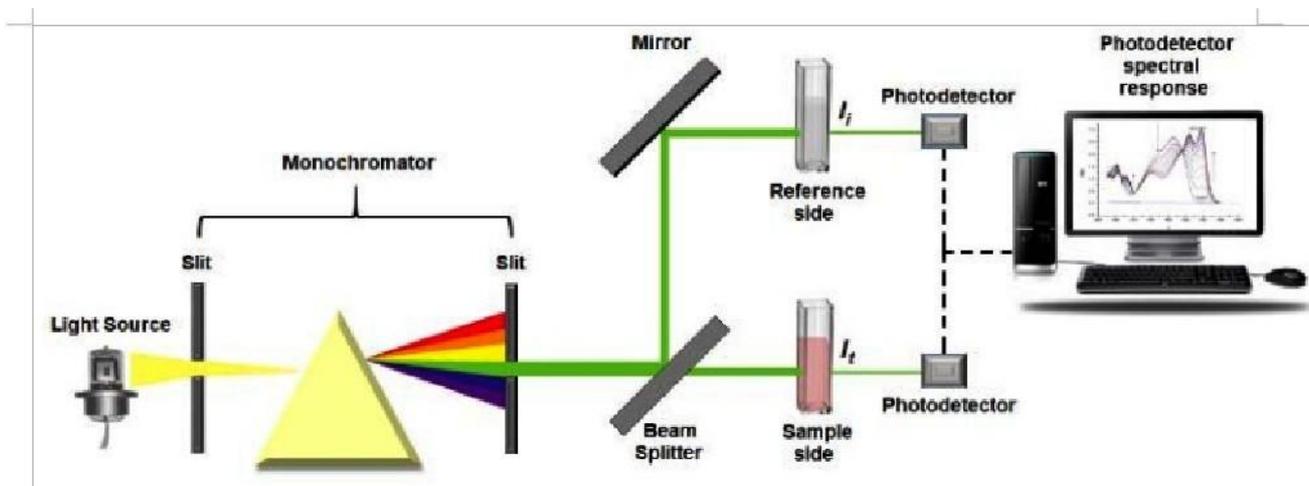
The energy of light/photon is inversely proportional to the wavelength of the light. Shorter wavelengths of light carry more energy and longer wavelengths carry less energy. Threshold energy is required to promote electrons in a substance to a higher energy state which we can detect as absorption. Electrons in different bonding environments in a substance require a different specific amount of energy to promote the electrons to a higher energy state. Thus, absorption of light for different substance occurs for different wavelengths. Humans can see the wavelength from approximately from 380 nm to 780 nm. UV light has wavelengths with shorter wavelength than visible light range. Thus light can be useful in UV-Vis spectroscopy to analyse or identify different substances by locating the specific wavelengths corresponding to maximum.



*Illustration 11: Components of UV-Visible spectrophotometer*

Tungsten lamp/xenon lamp are usually used as the source of light. The light will be polychromatic and hence they must be made monochromatic by allowing it to pass through the monochromator. For beam splitting one may use prism/diffraction grating. This monochromatic light is then allowed to fall on the sample which will be kept in the sample holder. We can use cuvette made up of glass for visible light range and quartz for UV light range as sample holders. For all analysis, measuring a reference sample, often referred to as the "blank sample", such as a cuvette filled with a similar solvent used to prepare the sample, is imperative. If an aqueous buffered solution containing the sample is used for measurements, then the aqueous buffered solution without the substance of interest is used as the reference. The reference sample signal is later used automatically by the instrument to help obtain the true absorbance values of the analytes. The light incident on the sample, some of its part is absorbed by the sample and the rest is transmitted. This

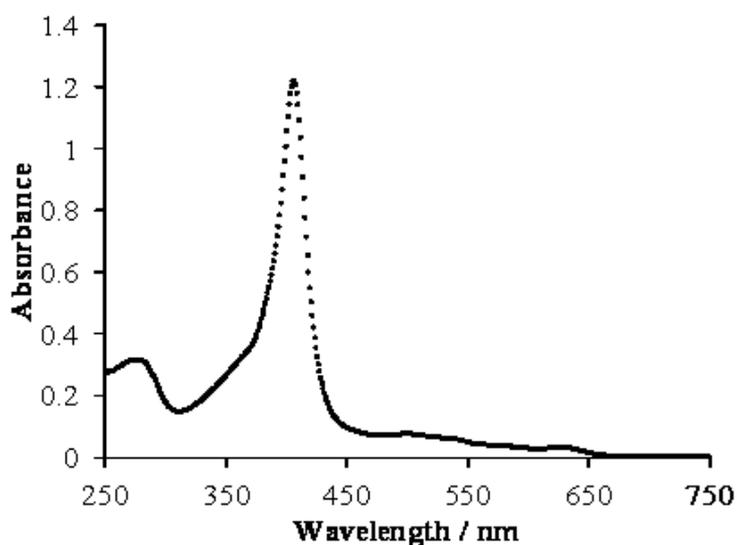
light is then detected by the detector. The electric signal is fed in to the computer to get the output.



*Illustration 12: Schematic diagram of dual beam UV-VIS Spectrometer.*

### **2.2.3.a. UV- VISIBLE ABSORPTION SPECTRUM**

UV-Vis spectroscopy information may be presented as a graph of absorbance/optical density /transmittance as a function of wavelength. However, the information is more often presented as a graph of absorbance on the vertical  $y$  axis and wavelength on the horizontal  $x$  axis.



*Illustration 13: Absorption spectra*

The absorbance ( $A$ ) is equal to the logarithm of a fraction involving the intensity of light before passing through the sample ( $I_0$ ) divided by the intensity of light after passing through the sample ( $I$ ). The fraction  $I$  divided by  $I_0$  is also called transmittance ( $T$ ), which expresses how much light has passed through a sample. Absorbance is the logarithm of the ratio of incident to transmitted radiant power through a sample. However, Beer–Lambert's law is often applied to obtain the concentration of the sample ( $c$ ) after measuring the absorbance ( $A$ ) when the molar absorptivity ( $\epsilon$ ) and the path length ( $L$ ) are known. Typically,  $\epsilon$  is expressed with units of  $\text{L mol}^{-1} \text{cm}^{-1}$ ,  $L$  has units of  $\text{cm}$ , and  $c$  is expressed with units of  $\text{mol L}^{-1}$ . As a consequence,  $A$  has no units.

Beer–Lambert's law is especially useful for obtaining the concentration of a substance if a linear relationship exists using a measured set of standard solutions containing the same substance. Equation 6, shows the mathematical relationships between absorbance, Beer–Lambert's law, the light intensities measured in the instrument, and transmittance.

$$A = \epsilon L c = \log_{10} \left( \frac{I_0}{I} \right) = \log_{10} \left( \frac{1}{T} \right) = -\log_{10}(T) \quad \text{---(eq 5)}$$

## ADVANTAGES

- The technique is **inexpensive and non destructive**, allowing the sample to be reused or proceed to further processing or analysis.
- Measurements can be made **quickly**, allowing easy integration into experimental protocols and its easy to use.
- Data analysis generally requires **minimal processing**; again meaning little user training is required.

## DISADVANTAGES

- Possibility of presence of stray light since in practical instrumentation, wavelength selector may not be perfect.

- Light scattering caused by suspended solids in liquid samples, which may cause serious measurement errors. The presence of bubbles in the cuvette or sample will scatter light, resulting in irreproducible results.
- **Interference from multiple absorbing species** – if sample has multiple types of the species overlapping of the spectra may occur. For a proper quantitative analysis, each chemical species should be separated from the sample and examined individually.
- **Geometrical considerations** - Misaligned positioning of any one of the instrument's components, especially the cuvette holding the sample, may yield irreproducible and inaccurate results. Therefore, it is important that every component in the instrument is aligned in the same orientation and is placed in the same position for every measurement. Some basic user training is therefore generally recommended to avoid misuse.

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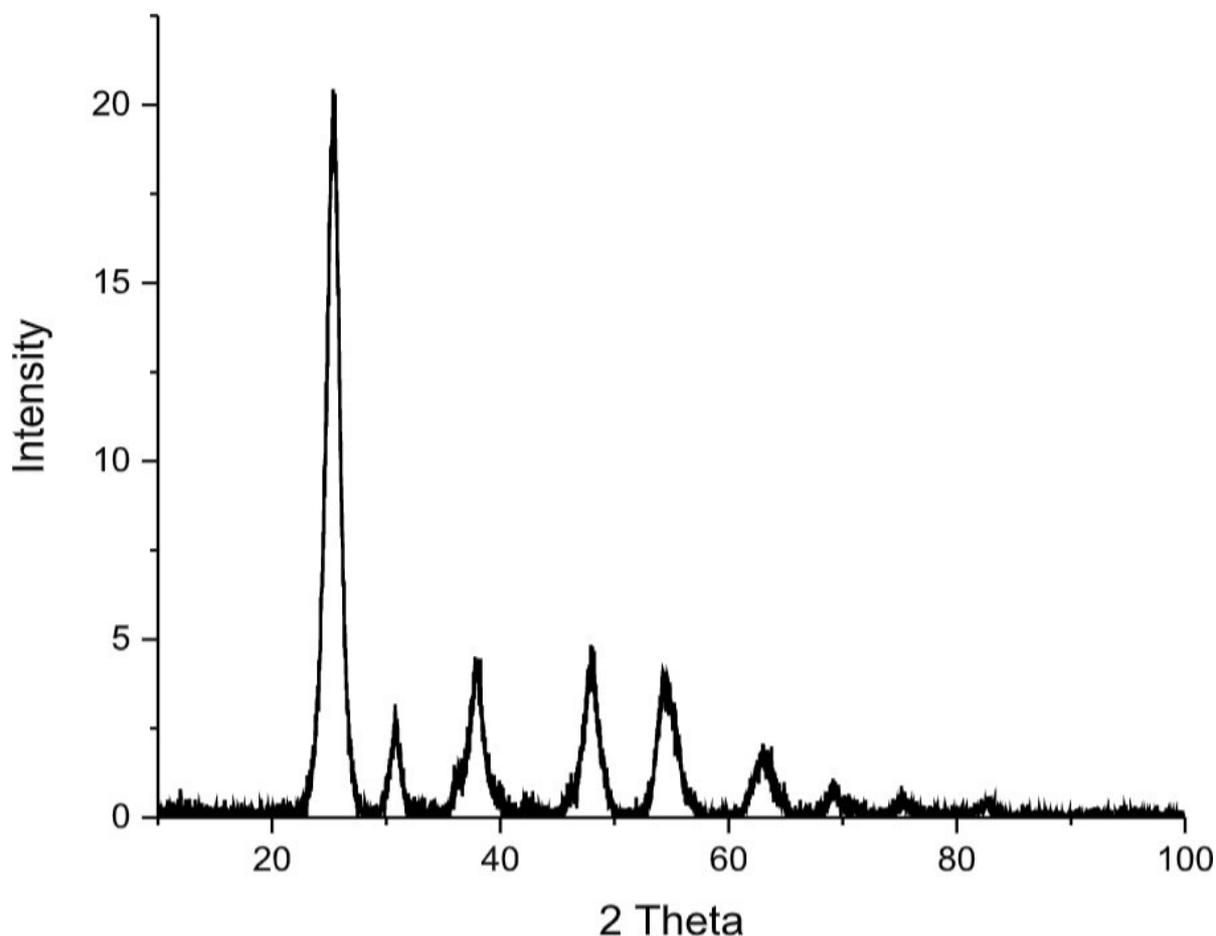
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## CHAPTER 3

### RESULT AND DISCUSSION

#### 3.1. XRD ANALYSIS

##### 3.1.1. XRD SPECTRUM OF SYNTHESIZED TiO<sub>2</sub> NANOPOWDER



*Illustration 14: XRD pattern of the TiO<sub>2</sub> nanopowder*

The X Ray diffraction spectrum of synthesized TiO<sub>2</sub> nano powder is shown in illustration 15. The peaks in the spectrum match with the standard peaks of TiO<sub>2</sub> anatase phase. There is a major peak centered at 25.39<sup>0</sup>, which is of (101) plane of anatase TiO<sub>2</sub>. Also, the peaks around 37.96<sup>0</sup>, 47.93<sup>0</sup>, 54.34<sup>0</sup>, 62.66<sup>0</sup> are compatible with the standard peaks of anatase TiO<sub>2</sub>. The corresponding crystal planes are (004), (200), (105) and (204) respectively. Other than these peaks, an additional peak of TiO<sub>2</sub> Brookite phase is present around 30.77<sup>0</sup>.

Particle size is calculated using the formula,

$$\text{Particle size } L = \frac{0.94\lambda}{B \cos \theta} \dots\dots\dots (\text{eq. 6})$$

Where  $\lambda$  is the wavelength of x ray, B is the full width at half maximum of the xrd peak obtained and theta is the diffraction angle.

The particle sizes of the synthesized TiO<sub>2</sub> are tabulated below:

<b>2<math>\Theta</math></b> <b>(DEGREE)</b>	<b><math>\Theta</math></b> <b>(DEGREE)</b>	<b><math>\Theta</math></b> <b>(RADIAN)</b>	<b>FWHM</b> <b>(DEGREE)</b>	<b>FWHM</b> <b>(RADIAN)</b>	<b>PARTICLE</b> <b>SIZE(NM)</b>
25.33819	12.6691	0.221005	1.31089	0.022868	6.21445
37.87463	18.93732	0.330351	1.54064	0.026876	5.454008
47.96137	23.98069	0.41833	1.45075	0.025308	5.99579
54.62099	27.3105	0.476416	1.67964	0.0293	5.325142
63.1131	31.55655	0.550486	1.74207	0.030389	5.35343

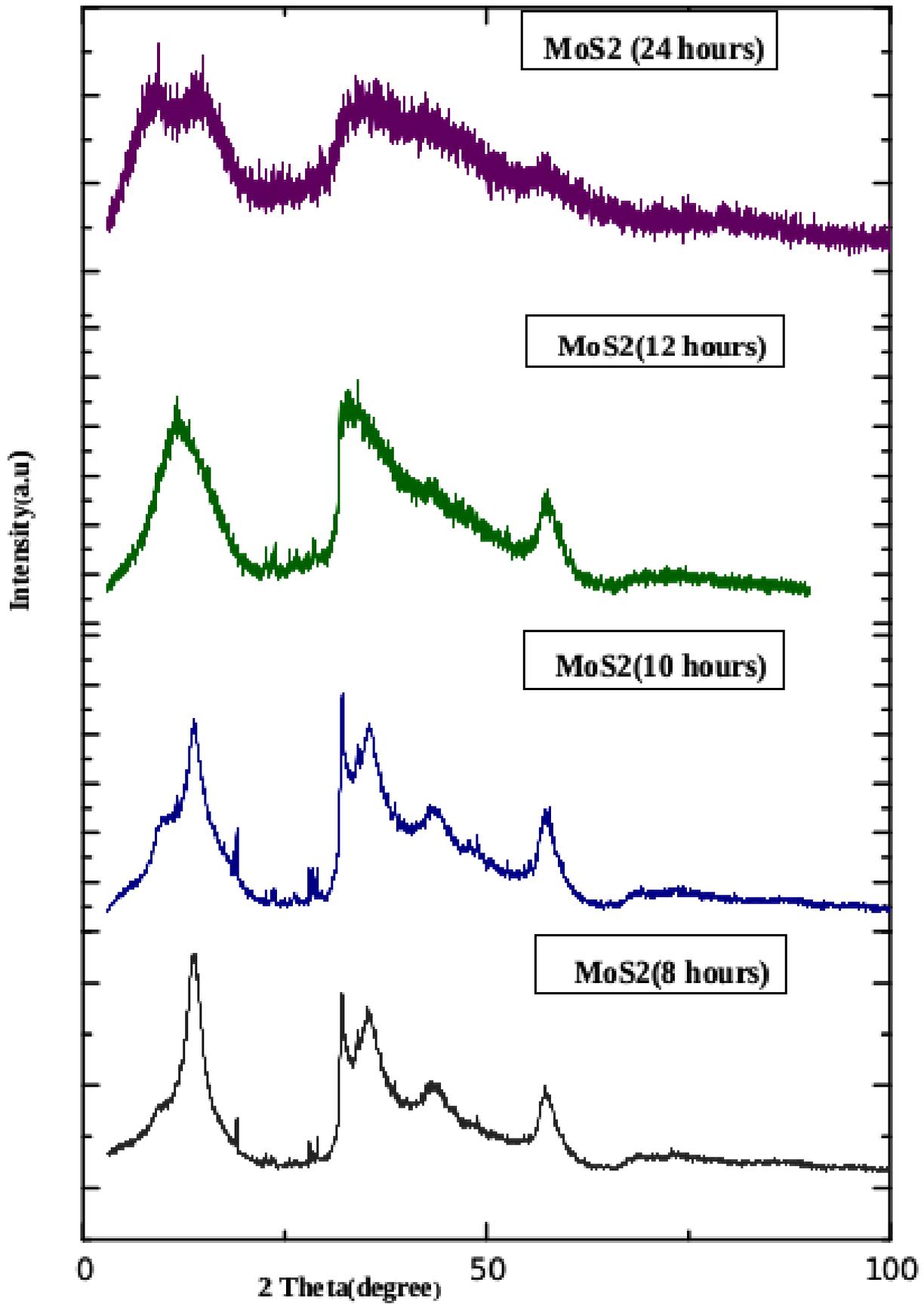
*Table 2. Particle size determination*

Average Particle size = **5.66856453nm**.

### **3.1.2. XRD SPECTRA OF SYNTHESIZED MoS<sub>2</sub> NANO STRUCTURES OBTAINED AT DIFFERENT AUTOCLAVED TIME PERIODS**

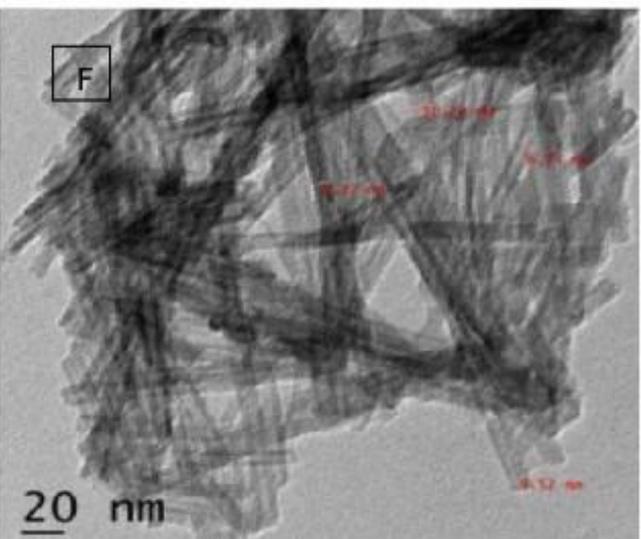
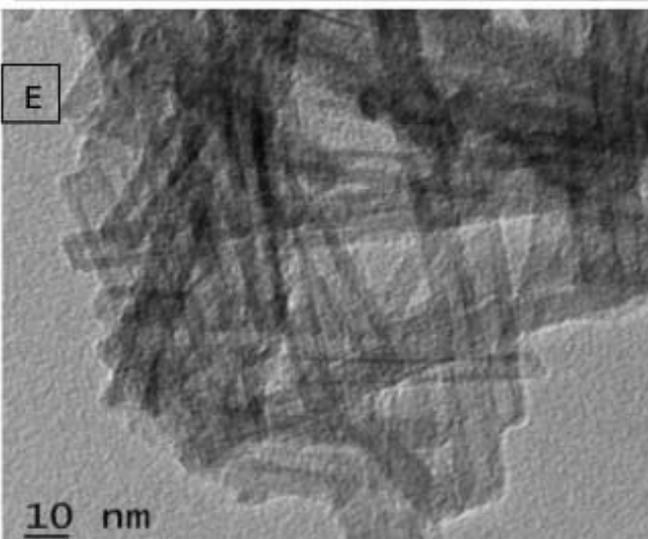
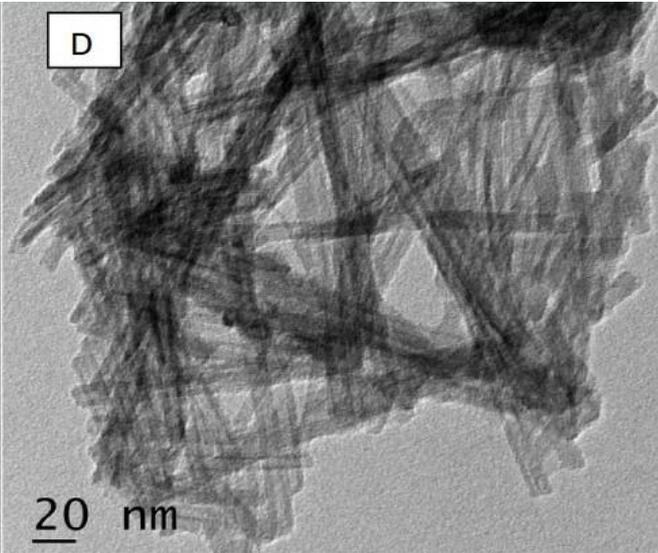
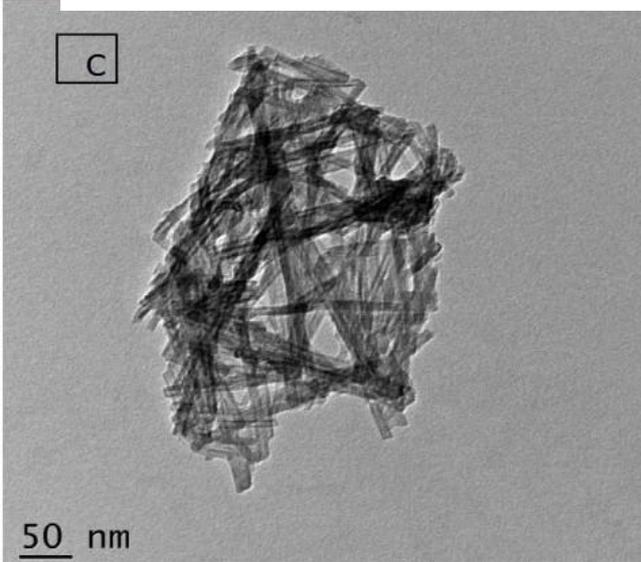
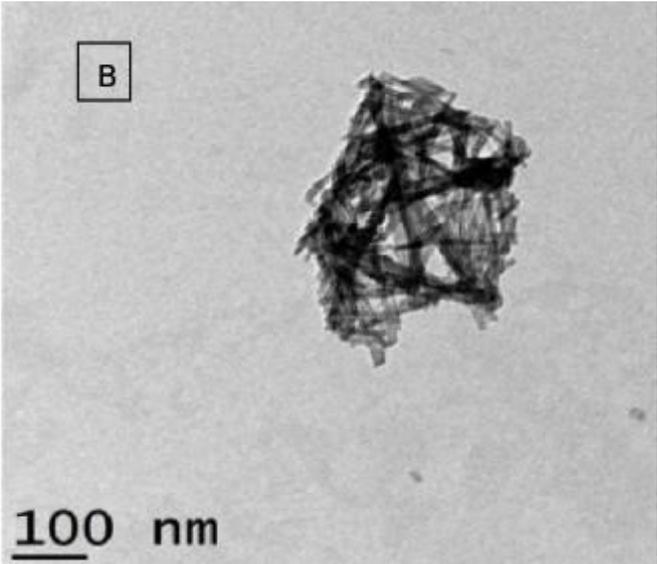
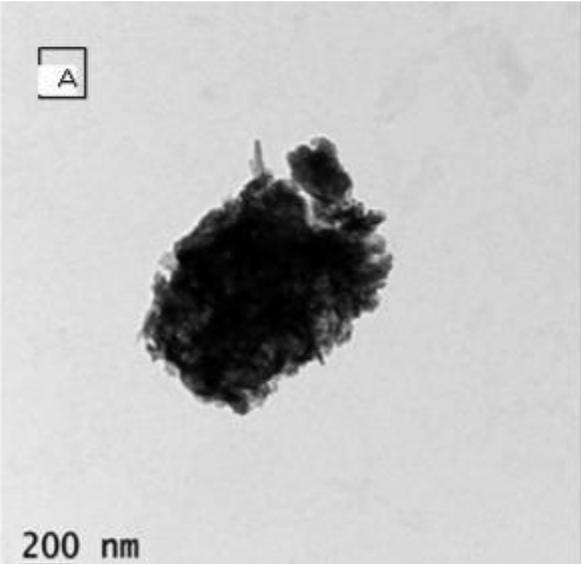
The X ray diffraction spectrum of synthesized MoS<sub>2</sub> nano structures at various autoclaved time periods are shown below. It is seen that, as the time duration increased the ex foliation of MoS<sub>2</sub> nano structures have taken place and finally after 24 hours we have got nanosheets of MoS<sub>2</sub>. Also, the obtained peaks in the spectra are in agreement with the standard peaks of MoS<sub>2</sub>. The detected peaks around 13.58<sup>o</sup>, 32.2<sup>o</sup>, 39.69<sup>o</sup>, 43.8<sup>o</sup> and 57.77<sup>o</sup> respectively correspond to (002), (100), (103), (006) and (110) planes of Hexagonal MoS<sub>2</sub>.

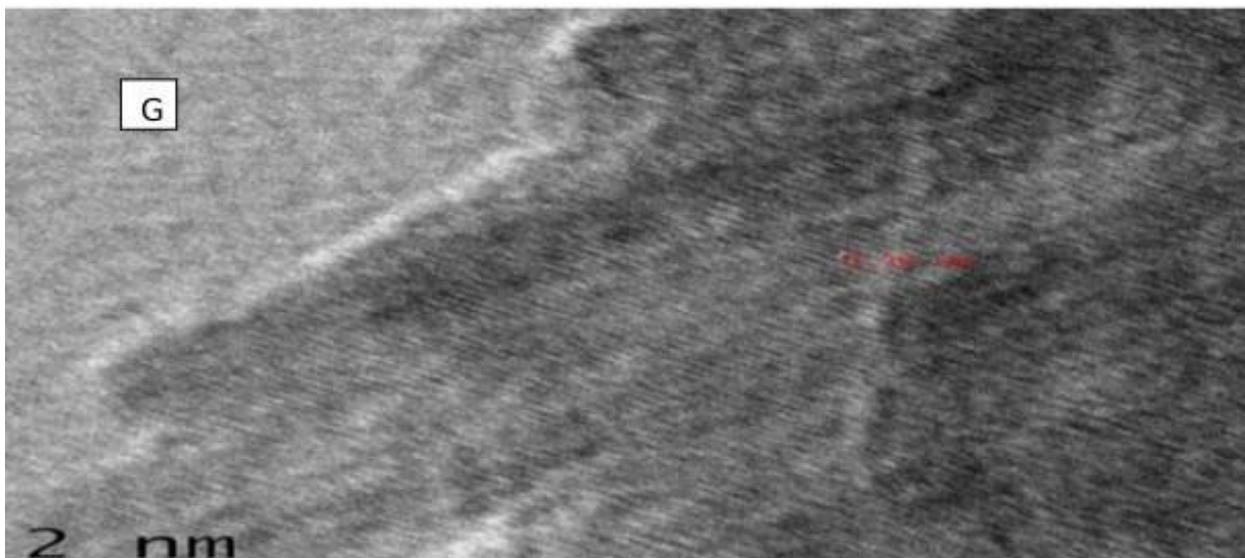
It is seen that as time duration increases, the peaks decrease in intensity except the prominent ones. The peaks become less and less sharper as the time period increase from 8 to 24 hours. At 8 and 10 hours the peaks are sufficiently sharp but as the time increased to 24 hours it becomes more broadened which indicate the finite small size of the nanosheet developed.



*Illustration 15: Stack of the XRD pattern of the MoS<sub>2</sub> synthesised by varying time*

**3.2. TEM IMAGES OF THE SYNTHESIZED TiO<sub>2</sub> NANOTUBES**





*Illustration 16:A,B,C,D,E,F,G : HRTEM image of TiO<sub>2</sub> nanotube at different resolutions*

Illustrations marked from A to G are the obtained TEM images of the synthesized nanotubes. Figure B reveals that the nanotubes are almost clustered in nature and randomly oriented. But, nanoparticles are not seen which indicates that the nanopowder has totally transformed into nanotubes. Illustration 21.F shows that the nano tubes are of thickness less than 10nm. We could synthesize nanotubes of average thickness 9.19 nm (marked in the image). From the HR TEM image of illustration 21 G, it can be understood that the inter planar spacing (d) is 0.30nm which is perfectly agreeing with the (101) plane of TiO<sub>2</sub>.

### **3.3. PHOTO CATALYTIC STUDIES**

#### **3.3.1 DEGRADATION OF METHYLENE BLUE DYE(MB)**

##### **3.3.1.a DEGRADATION OF MB WITH TiO<sub>2</sub> NANOTUBE**

Methylene blue is a salt that is used as a dye and as medication. It is a thiazine dye. It is often used to treat condition called methemoglobinemia which is condition that occur when blood cannot deliver oxygen where it is needed in the body. It is a safe drug when used in therapeutic doses (<2 mg/kg). But it can cause toxicity at high level. Overdose symptoms include vomiting, stomach pain, feeling like you might pass out, confusion, numbness, blue coloured skin or lips etc.

Degradation of MB dye was studied by varying the amount of the TiO<sub>2</sub> nanotube added to the solution at 40 min.

The percentage of degradation of the dye can be calculated by the equation

$$\% \text{ of degradation} = \frac{A_0 - A_t}{A_0} \times 100 \dots\dots\dots (\text{eq. 7})$$

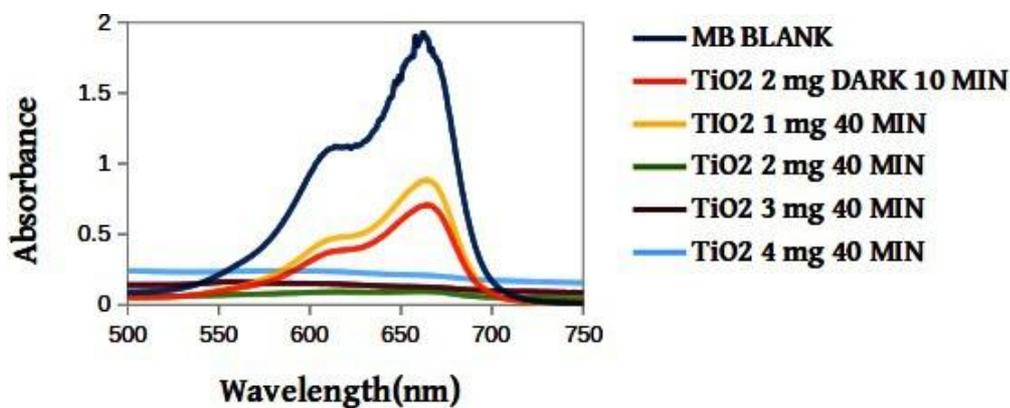
where ,

A<sub>0</sub> – Absorbance of initial methylene blue

A<sub>t</sub> – Absorbance after illumination at time t

MB dye shows absorbance peak at 609 nm and 668 nm and the corresponding absorbance were 1.088552 and 1.761653 respectively.

The table below shows the % of degradation of MB dye as amount of TiO<sub>2</sub> NT added to solution increase from 1 mg to 5 mg.



*Illustration 17: Absorption spectra of MB dye with TiO<sub>2</sub> nanotube added.*

<b>TiO<sub>2</sub> NT</b>				
<b>PEAK CORRESPONDING TO WAVELENGTH</b>	<b>TIME</b>	<b>A<sub>t</sub></b>	<b>A<sub>0</sub></b>	<b>% OF DEGRADATION</b>
668 nm	Dark 10 min- 2 mg	0.689198	1.761653	60.88
	40 min - 1 mg	0.857952		51.30
	40 min- 2 mg	0.095542		94.5
	40 min-3 mg	0.123523		92.99
	40 min-4 mg	0.20724		88.24
609 nm	Dark 10 min- 2 mg	0.365905	1.088552	66.39
	40 min - 1 mg	0.456166		58.09
	40 min- 2 mg	0.091345		91.61
	40 min-3 mg	0.149912		86.23
	40 min-4 mg	0.237715		78.16

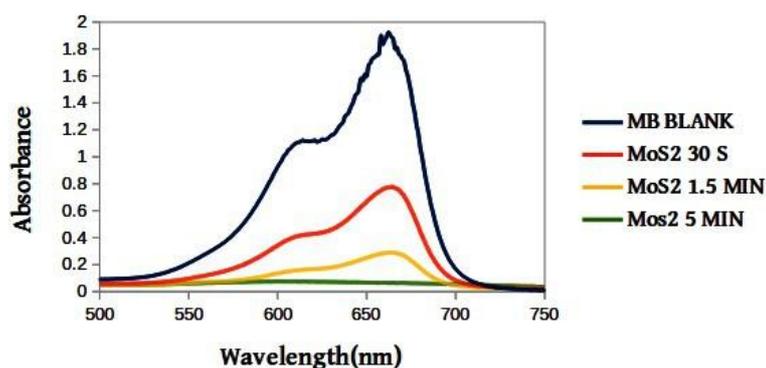
**Table 3.** Percentage of degradation for various amount of TiO<sub>2</sub> nanotube added.

Comparing the percentage of degradation one can conclude that the degradation is maximum when 2 mg of TiO<sub>2</sub> NT added to the solution. At this amount the degradation reaches 94.58 and 91.61 percentage respectively at 40 min exposure to visible light. On adding further amount of TiO<sub>2</sub> NT the degradation efficiency is seen to decrease. This happened because photo catalysis happens only for optimum amount of photo catalyst. If the amount of photo catalyst is excessive, it reduces the capture of photons ( a screening effect). In order to speed up the photo degradation TiO<sub>2</sub> NT is doped with MoS<sub>2</sub>.

### **3.3.1.b. DEGRADATION OF MB WITH MoS<sub>2</sub> NANOSHEET**

2 mg of MoS<sub>2</sub> nano sheet was added to 10 ml of the MB dye solution. The photo degradation of MB dye was studied at different times. The comparison of the absorption spectra

of MB when MoS<sub>2</sub> nano sheet is added at different time period is given below.



*Illustration 18: Absorption spectra of MB dye with MoS<sub>2</sub> nanosheet*

MoS <sub>2</sub> NANO SHEET				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
668 nm	30 s	0.757522	1.761653	56.999
	1.5 min	0.281769		84.005
	5 min	0.063579		96.391
609 nm	30 S	0.402923	1.088552	62.985
	1.5 min	0.155858		86.682
	5 min	0.075074		93.103

*Table 4. Percentage of degradation of MB with 2 mg of MoS<sub>2</sub> nano sheet.*

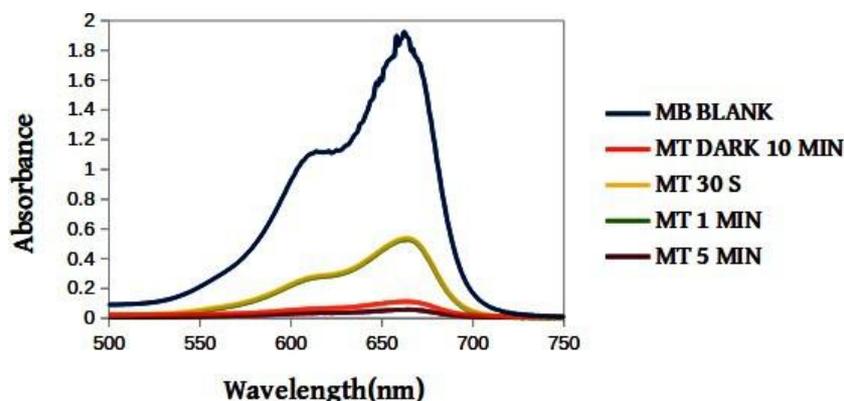
From the data, we may conclude that MoS<sub>2</sub> nano sheet prepared can cause dye degradation up to 96.391 and 93.103 respectively within 5 min.

### **3.3.1.c. DEGRADATION OF MB DYE WITH MoS<sub>2</sub> NANOSHEET**

#### **DOPED TiO<sub>2</sub> NANOTUBE (MT)**

2 mg of the nanocomposite (MT) was added to the dye solution and photo degradation

was studied at different time. The absorption spectra was taken and the comparison plot is given below.



*Illustration 19: Absorption spectra of MB dyewith MoS<sub>2</sub>@TiO<sub>2</sub>*

NANOCOMPOSITE(MT)				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
668 nm	Dark 10 min	0.107152	1.761653	93.92
	30 s	0.523016		70.311
	1 min	0.51326		70.865
	5 min	0.056759		96.778
609 nm	Dark 10 min	0.062385	1.088552	94.269
	30 s	0.72019		75.011
	1 min	0.261978		75.933
	5 min	0.03354		96.919

*Table 5. Percentage of photo catalytic degradation of MB dye with MoS<sub>2</sub>@TiO<sub>2</sub>*

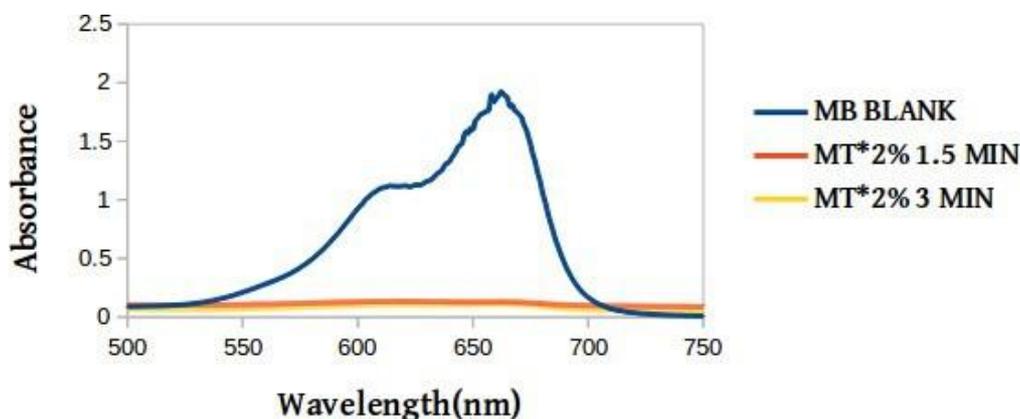
From the data we may conclude that the synthesized nanocomposite has high efficiency and the percentage of photo degradation increase as the time increased from approximately 70 to

97 percentage as the time increase from 30s to 5 min.

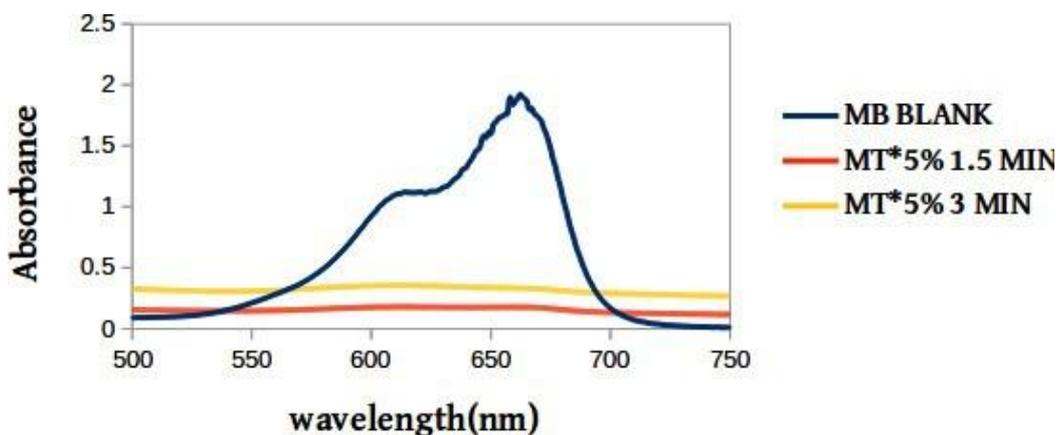
Also it is seen that the synthesized nanocomposite shows good degradation of the MB dye in darkness. In a time duration 10 min, the dye was degraded to approximately 94%.

### **3.3.1.d. DEGRADATION OF MB WITH MoS<sub>2</sub> NANOSHEET DOPED TiO<sub>2</sub> NANOTUBE PREPARED BY MECHANO CHEMICAL METHOD**

Doping of TiO<sub>2</sub> NT with MoS<sub>2</sub> nanosheet was also done by physical method. They were respectively labelled as MT\*2wt% (2 wt% MoS<sub>2</sub> in TiO<sub>2</sub>) and MT\*5wt%(5 wt% MoS<sub>2</sub> in TiO<sub>2</sub>). The photo degradation of MB dye was studied for these composites at different times. The obtained absorption spectra and the tabulated percentage of the degradation of the dye are given below.



*Illustration 20: Absorption spectra of MB with 2 wt% MoS<sub>2</sub>@ TiO<sub>2</sub>*



*Illustration 21 Absorption spectra of MB with 5 wt% MoS<sub>2</sub>@ TiO<sub>2</sub>*

<b>MT*2%</b>				
<b>PEAK CORRESPONDING TO WAVELENGTH</b>	<b>TIME</b>	<b>A<sub>t</sub></b>	<b>A<sub>0</sub></b>	<b>% OF DEGRADATION</b>
668 nm	2 mg – 1.5 min	0.127689	1.761653	92.752
	2 mg-3 min	0.111401		93.676
609 nm	2 mg – 1.5 min	0.106708	1.088552	85.577
	2 mg-3 min	0.214923		90.197

**Table 6.** Percentage of photo catalytic degradation of MB dye with 2 wt% MoS<sub>2</sub>@TiO<sub>2</sub>

<b>MT*5%</b>				
<b>PEAK CORRESPONDING TO WAVELENGTH</b>	<b>TIME</b>	<b>A<sub>t</sub></b>	<b>A<sub>0</sub></b>	<b>% OF DEGRADATION</b>
668 nm	2 mg – 1.5 min	0.17527	1.761653	90.051
	2 mg-3 min	0.328939		81.328
	2 mg – 5 min	0.208773		88.149
609 nm	2 mg – 1.5 min	0.179249	1.088552	83.533
	2 mg-3 min	0.355191		67.370
	2 mg – 5 min	0.206867		80.996

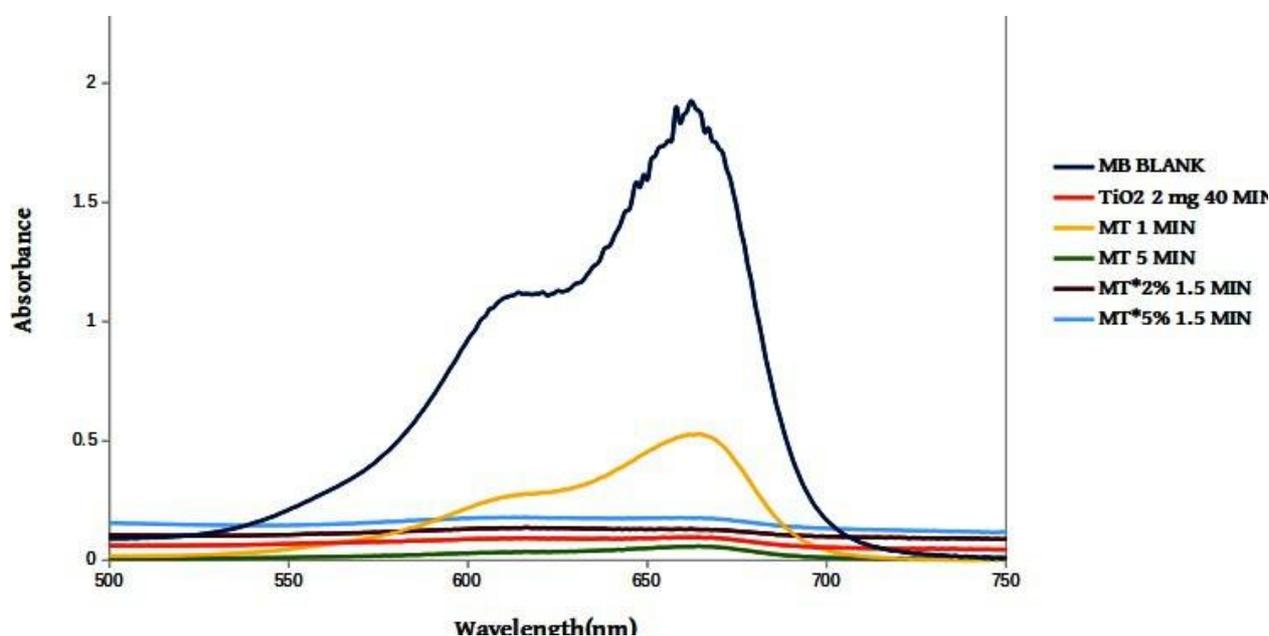
**Table 7.** Percentage of photo catalytic degradation of MB dye with MoS<sub>2</sub>@TiO<sub>2</sub>

MT\*2wt% degraded the dye up to 93.676 % within 3 min while the MT\*5% could degrade only 81.328 %. Further more MT\*5% is showing a decrease in the percentage of the degradation when time increased from 1.5 to 3 min and an increase in the interval 3 to 5 min. From the degradation data, we confirm 2 wt% of MoS<sub>2</sub> in TiO<sub>2</sub> is more efficient when compared to the 5 wt% MoS<sub>2</sub> in TiO<sub>2</sub>.

### 3.3.1.e. COMPARISON OF THE DOPED TiO<sub>2</sub> NANOTUBE (MT) WITH UN DOPED TiO<sub>2</sub> NANOTUBE

A comparison of the photo-catalytic degradation of the MB dye was done by comparing the absorption spectra of the MoS<sub>2</sub> doped TiO<sub>2</sub> nanotube and undoped TiO<sub>2</sub> nanotube

From the absorption spectra we may interpret that the photo-catalytic activity of the TiO<sub>2</sub> is improved when doped with MoS<sub>2</sub> nano sheet. TiO<sub>2</sub> undoped sample could degrade MB dye to 94.58% . but, it took almost 40 min. while the doped forms MT, MT\*2%, MT\*5% could degrade the dye up to 97 % , 93 % , 90% within 5, 1.5,1.5 minutes respectively. MT\*2% is more efficient as a photo catalyst in the photo degradation of MB dye.



**Illustration 22:** Absorption spectra of undoped TiO<sub>2</sub> nanotube (NT) and doped composites MoS<sub>2</sub>@TiO<sub>2</sub> NT, 2 wt% MoS<sub>2</sub>@TiO<sub>2</sub> NT, 5wt% MoS<sub>2</sub> @ TiO<sub>2</sub> NT

TiO<sub>2</sub> and MoS<sub>2</sub> are semiconductors and hence falls into the category of heterogeneous photo catalyst. They possess forbidden energy gap which needs photon to excite an electron from valence band to conduction band thus producing electron hole pair. The generated holes react with redundant producing oxidised product and excited electron react with oxidant to produce reduced product. These oxidation-reduction reactions take place on the surface of photo catalyst. The positive holes, will react with the moisture on the surface to produce hydroxyl radicals. Hence adsorption of the dye on the surface of the photocatalyst is the first step towards photo

catalysis.

It is observed that, the dye was degraded upto 61% on stirring with 2 mg of  $\text{TiO}_2$  nanotube for 10min in darkness. This is due to the adsorption of the molecule on the surface of the photo catalyst( $\text{TiO}_2$  NT). Thus, an amount of dye is removed along with the nanotube once we centrifuge it out. All other solutions with MB and  $\text{TiO}_2$  nanotube(added in different quantity say 1 mg, 2 mg,3 mg,4 mg) were first stirred in darkness for 10 minute, so that the methylene blue dye get adsorbed on the surface of the nanotube and then exposed to light. When exposed to light, free radicals produced on the surface of the nanotube, will continuously react with the dye reducing it until it became harmless. From the comparative study, it is seen that the degradation reach the highest percentage (94. 58%) for 2 mg of  $\text{TiO}_2$  nanotube added. For small amount of catalyst added, the degradation will increase as the amount of photo-catalyst added and reaches a maximum at the optimum quantity of photo catalyst. As the quantity of  $\text{TiO}_2$  nanotube added to dye solution increase from 1 mg to 2 mg the the degradation has increased from 51.3% to 94.58 %. But, when we added 3 mg and 4 mg of  $\text{TiO}_2$  nanotube, the percentage of degradation decreased from 94.58% to 93% and 88.24% respectively. This happens because, as the amount of photo catalyst increases, the photon density that can be absorbed by the photo catalyst will decrease. Thus production of reactive oxygen species will decrease. But, this high percentage of degradation was reached after 40 min.

Similarly, the comparison study of the photo degradation of the MB dye with  $\text{MoS}_2$  nanosheet was done. Nano sheet being one of the quantum structure having high surface area, highly reactive and has high adsorbing capability. It was seen that the MB dye get reduced instantly, on adding 2 mg of  $\text{MoS}_2$  nanosheet agreeing with the high adsorption efficiency of  $\text{MoS}_2$  nanosheet. The adsorbed dye get further reduced on exposure to light. In this case, it is seen that dye get degraded 57%, 84%, 96.4% on exposure to visible light for 30s, 1.5 min and 5 min respectively.

The nanocomposite also shows better result in MB, as compared to un doped  $\text{TiO}_2$  nanotube. On doping  $\text{TiO}_2$  nanotube with  $\text{MoS}_2$  nanosheet, the surface area increases thus providing more surface area for the dye to get adsorbed. More over, surface sensitization of  $\text{TiO}_2$  nanotube with  $\text{MoS}_2$  nanosheet can control the electron hole pair recombination by acting as trapping centres for electron, thus increasing the visible light driven photo-catalytic activity of

TiO<sub>2</sub>. This is clear from the observation. On doping with MoS<sub>2</sub> nano sheet, the percentage of degradation has enhanced from 94.58 % in 40 min to 97% (MT), 93% (MT\*2%), 90%(MT\*2%) within 5, 1.5, 1.5 minutes respectively. These result indicate that the nano composite developed are much better photocatalyst than un doped TiO<sub>2</sub> NT in degradation of MB dye.

It is observed that as MoS<sub>2</sub> nano sheet doped with TiO<sub>2</sub> nanotube, MoS<sub>2</sub> will trap the photo excited electron of TiO<sub>2</sub>. From the study of photo degradation of MB it was observed that 2 wt% MoS<sub>2</sub>-TiO<sub>2</sub> nanocomposite is more efficient than 5wt% MoS<sub>2</sub>-TiO<sub>2</sub>. The appropriate amount of MoS<sub>2</sub> would permit maximum photoelectrons trapping. Excessive amount of MoS<sub>2</sub> can hinder the efficient absorption of light by TiO<sub>2</sub> and screen the TiO<sub>2</sub> surface from catalytic reaction.

### **3.3.2. ANALYSIS OF DEGRADATION OF RHODAMINE B DYE(Rh B)**

Rhodamine B is an organic chloride salt. It is a chemical compound and a dye which is most often used as tracer dye to determine the direction and rate of the water flow. Rh B dye is also used for dyeing purposes. It finds application in many other field like fluorescence microscopy, Fluorescence correlation spectroscopy and flow cytometry. But, the high doses of Rh B can cause several health issues, more over it is suspected to be carcinogenic.

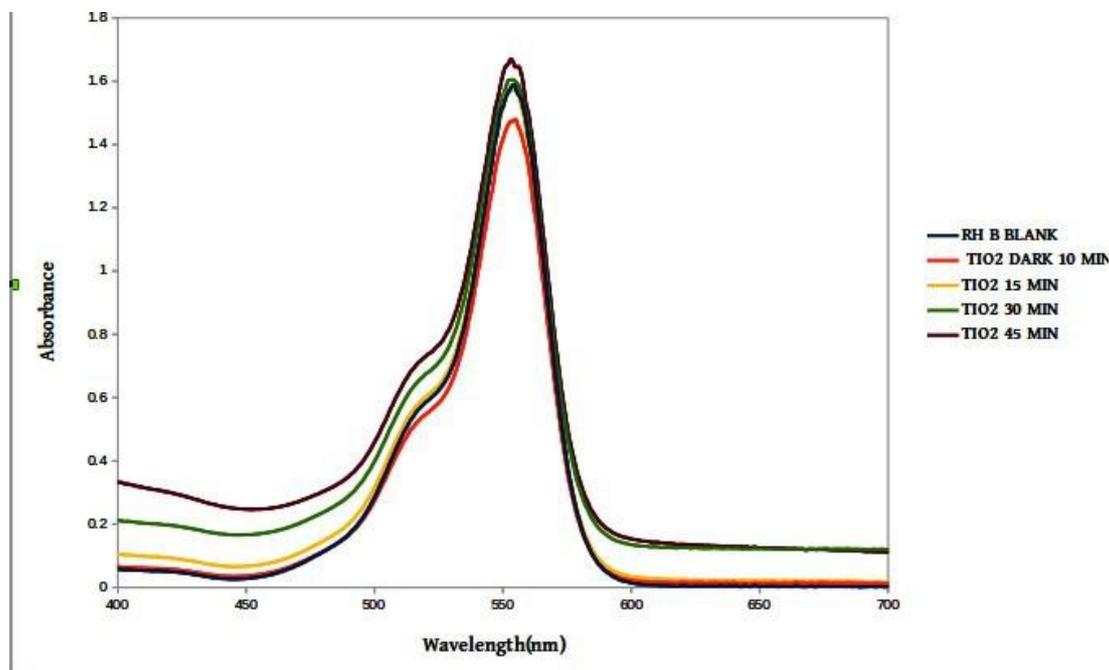
#### **3.3.2.a DEGRADATION OF Rh B WITH TiO<sub>2</sub> NANOTUBE**

Degradation of Rhodamine B dye was studied by adding 2.5 mg of TiO<sub>2</sub> nanotube at different time Rh B dye shows absorbance peak at 554 nm and the corresponding absorbance is 1.5894. The table below shows the % of degradation of Rh B dye 2.5 mg TiO<sub>2</sub> NT added to solution at different times.

<b>TiO<sub>2</sub> NT</b>				
<b>PEAK CORRESPONDING TO WAVELENGTH</b>	<b>TIME</b>	<b>A<sub>t</sub></b>	<b>A<sub>0</sub></b>	<b>% OF DEGRADATION</b>
554 nm	2.5 mg Dark 10 min	1.4732	1.5894	7.3090
	2.5 mg – 15 min	1.5772		0.7671

	2.5 mg – 30 min	1.6055		-1.0123
	2.5 mg – 45 min	1.6600		-4.4438

**Table 8.** Percentage of degradation of Rh B dye with un doped TiO<sub>2</sub>



**Illustration 23:** Absorption spectra of Rh B dye with un doped TiO<sub>2</sub> nanotube

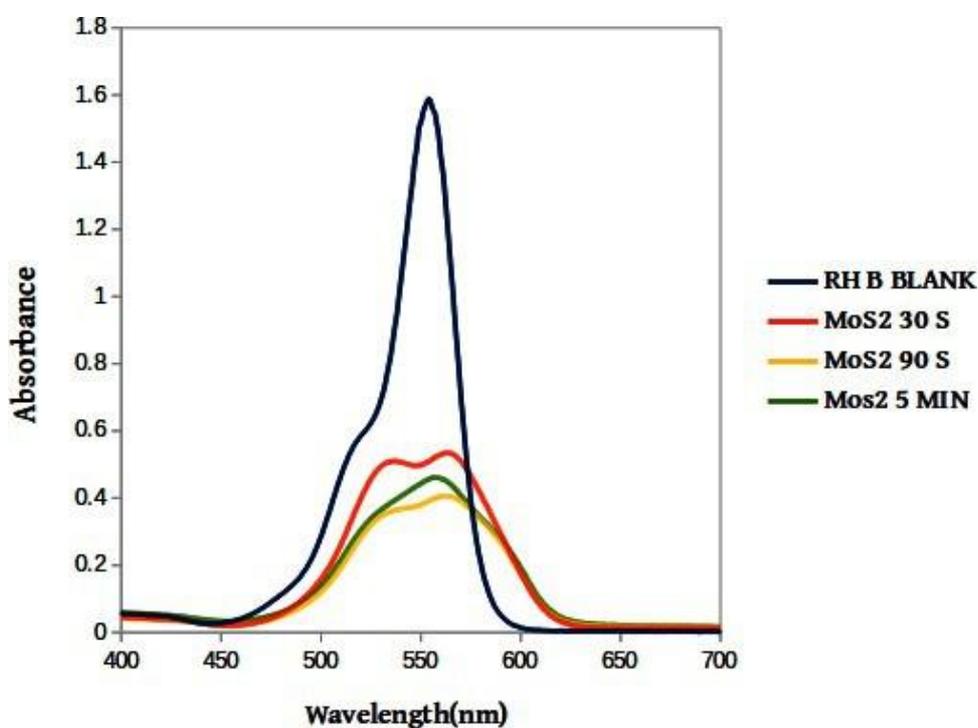
Comparing the percentage of degradation one can conclude that the degradation is maximum when 2.5 mg of TiO<sub>2</sub> NT added to the solution in dark. In the presence of light, TiO<sub>2</sub> does not have much effect on Rh B dye.

### **3.3.2.b . DEGRADATION OF Rh B WITH MoS<sub>2</sub> NANOSHEET**

2.5 mg of MoS<sub>2</sub> nanosheet was added to 10 ml of Rh B dye solution. The photo degradation of Rh B dye was studied at different time intervals. The comparison of the absorption spectra of Rh B dye when MoS<sub>2</sub> nanosheet is given below.

MoS <sub>2</sub> NANO SHEET				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
554 nm	30 s	0.5089	1.5894	67.9980
	1.5 min	0.3913		75.3795
	5 min	0.4558		71.3207

*Table 9. Percentage of degradation of Rh B dye with un MoS<sub>2</sub> nanosheet*



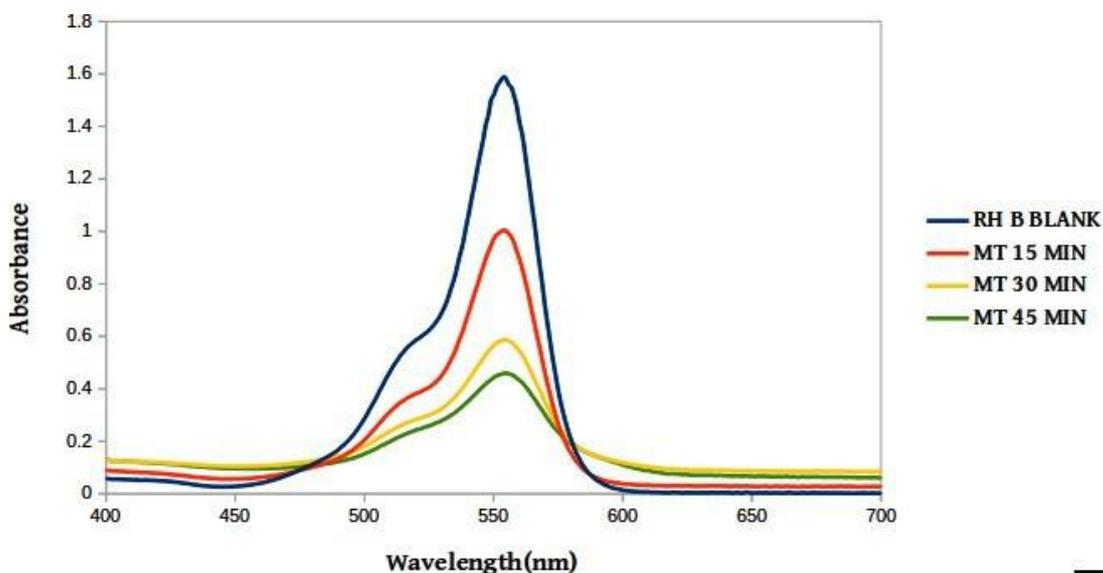
*Illustration 24: Absorption spectra of Rh B dye with 2.5mg MoS<sub>2</sub> nanosheet*

From the data, we may conclude that MoS<sub>2</sub> nanosheet prepared can cause dye degradation up to 75.3795% within 1.5 min.

**3.3.2.c. DEGRADATION OF Rh B DYE WITH MoS<sub>2</sub> NANOSHEET DOPED TiO<sub>2</sub> NANOTUBE (MT)**

2.5 mg of the nanocomposite(MT) was added to the dye solution and photo degradation was studied at different different time. The absorption spectra was taken and the comparison plot is given below.

The percentage of dye degradation are tabulated in the table given below.



*Illustration 25: Absorption spectra of Rh B with 2.5 mg of MoS<sub>2</sub> @TiO<sub>2</sub>*

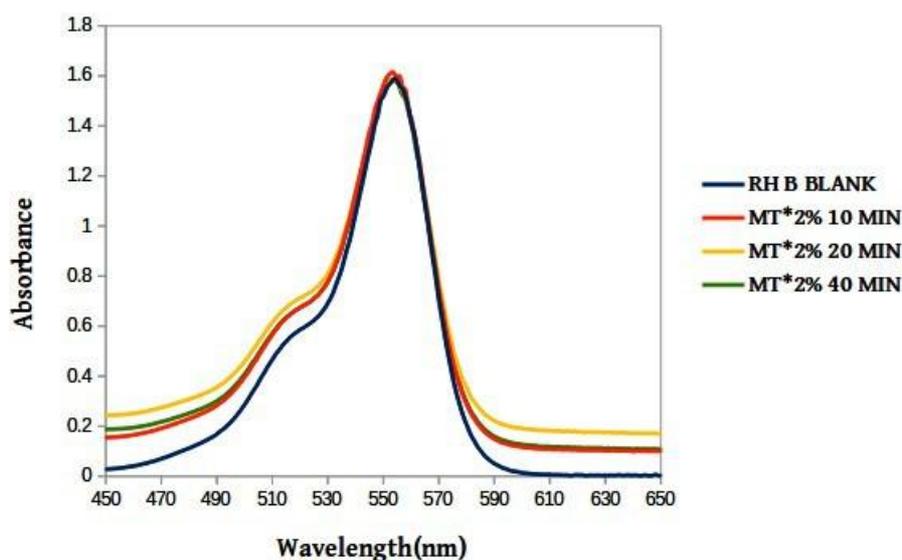
NANOCOMPOSITE(MT)				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
554 nm	15 min	1.0031	1.5894	36.8855
	30 min	0.5861		63.1243
	45 min	0.4585		71.1497

*Table 10. Percentage of degradation of RH B dye with un doped MoS<sub>2</sub> @TiO<sub>2</sub>*

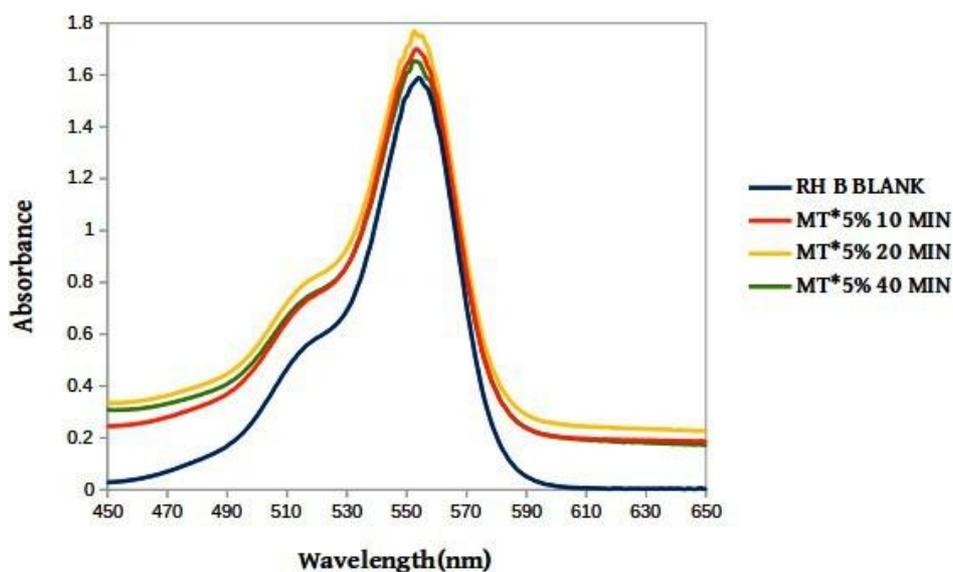
From the data we may conclude that the synthesized 2.5 mg nanocomposite can cause degradation of Rh B dye up to 71.145% within 45 minutes. Its seen that the photo degradation percentage increase from 36.885 % to 71.1497 % on increasing the time of exposure to light from 15 to 45 minutes.

### **3.3.2.d. DEGRADATION OF Rh B DYE WITH MoS<sub>2</sub> NANOSHEET DOPED TiO<sub>2</sub> NANOTUBE PREPARED BY MECHANO CHEMICAL METHOD**

The photo degradation of Rh B dye was studied for nanocomposites(MT\*2%,MT\*5%) at different time. The obtained absorption spectra and the tabulated percentage of the degradation of the dye are given below.



*Illustration 26: Absorption spectra of Rh B with 2.5 mg of 2wt% MoS<sub>2</sub> @TiO<sub>2</sub>*



*Illustration 27: Absorption spectra of Rh B with 2.5 mg of 5wt% MoS<sub>2</sub> @TiO<sub>2</sub>*

MT*2%				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
554 nm	2.5 mg – 10 min	1.6087	1.5894	-1.2146
	2.5 mg – 20 min	1.5783		0.6942
	2.5 mg – 40 min	1.5782		0.7024

*Table 11. Percentage of degradation of Rh B dye with 2 wt% MoS<sub>2</sub> @TiO<sub>2</sub>*

MT*5%				
PEAK CORRESPONDING TO WAVELENGTH	TIME	A <sub>t</sub>	A <sub>0</sub>	% OF DEGRADATION
554 nm	2.5 mg – 10 min	1.6946	1.5894	-6.6185
	2.5 mg – 20 min	1.7475		-9.9490
	2.5 mg – 40 min	1.6500		-3.8148

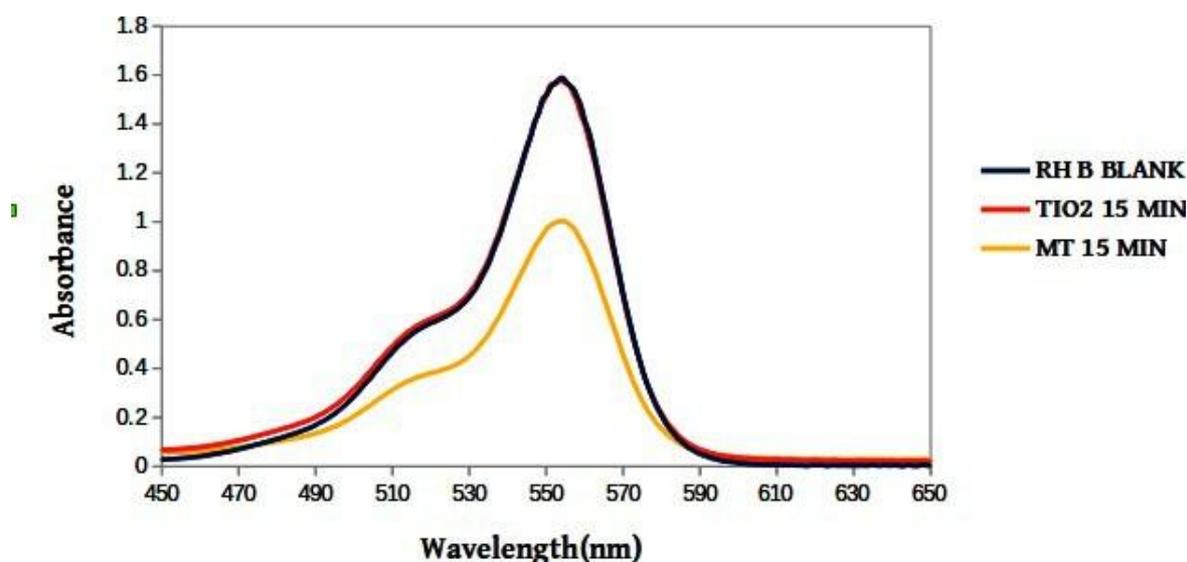
*Table 12. Percentage of degradation of Rh B dye with 5 wt% MoS<sub>2</sub> @TiO<sub>2</sub>*

From the spectra we can see that, the nanocomposite does not work in Rh B dye.

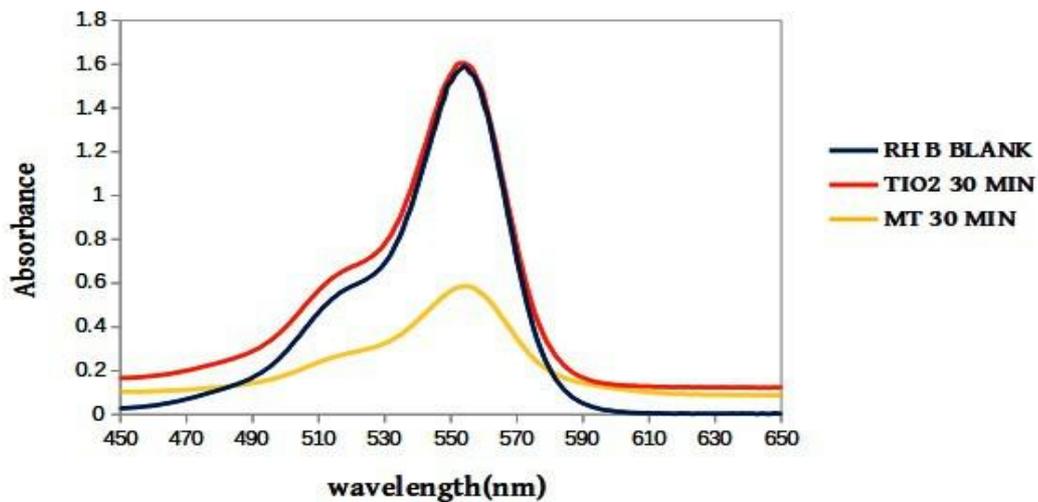
### **3.3.2.e. COMPARISON OF DOPED TiO<sub>2</sub> NT(MT) WITH UN DOPED TiO<sub>2</sub> NANOTUBE**

A comparison of the photo-catalytic degradation of the Rh B dye may be done by comparing the absorption spectra of the MoS<sub>2</sub> doped TiO<sub>2</sub> NT and un doped TiO<sub>2</sub> NT. Since MT is more efficient in causing degradation of Rh B dye than MT\*2% and MT\*5% we may compare the absorption spectra of MT and un doped TiO<sub>2</sub> NT.

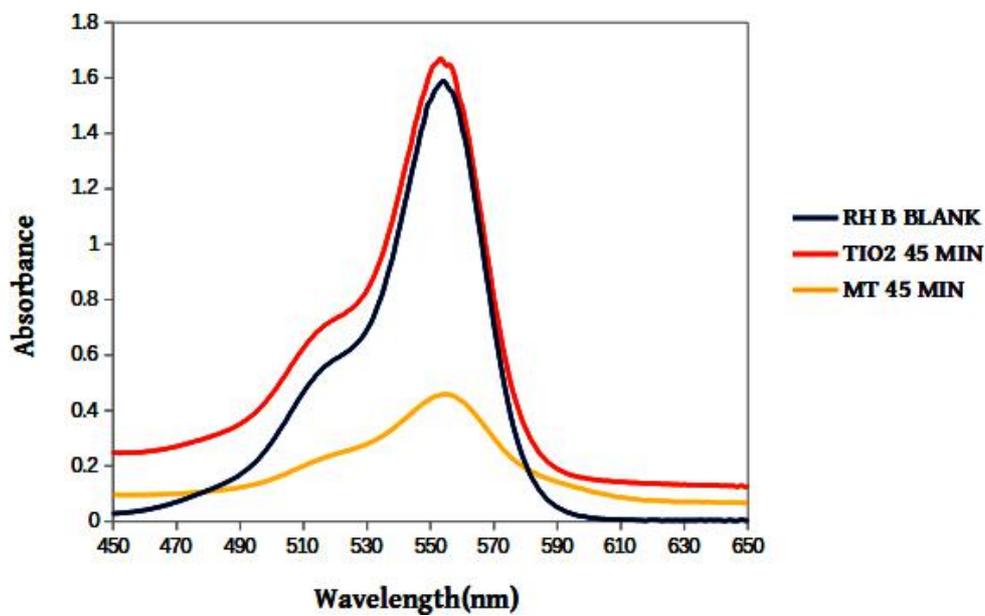
It is seen that as for TiO<sub>2</sub> NT alone, degradation was very less( below 1%). But, for the nanocomposite MT, the degradation was seen to increase with time and reached up to 71%.



*Illustration 28: Absorption spectra of Rh B with undoped TiO<sub>2</sub> nanotube and MoS<sub>2</sub>@TiO<sub>2</sub> nanotube composite at 15 min.*



*Illustration 29: Absorption spectra of Rh B with undoped TiO<sub>2</sub> nanotube and MoS<sub>2</sub>@TiO<sub>2</sub> nanotube composite at 30 min.*



*Illustration 30: Absorption spectra of Rh B with undoped TiO<sub>2</sub> nanotube and MoS<sub>2</sub>@TiO<sub>2</sub> nanotube composite at 45 min.*

From the absorption spectra, we may interpret that the photocatalytic activity of the TiO<sub>2</sub> nanotube is improved when doped with MoS<sub>2</sub> nano sheet. TiO<sub>2</sub> NT alone could degrade Rh B dye to less than 1% even kept under light up to 45 minute. MT\*2% and MT\*5% in which 2 wt% and 5wt % of MoS<sub>2</sub> nanosheet was doped to TiO<sub>2</sub> nanotube, no effect was observed. In this context Rh B adsorption on TiO<sub>2</sub> NT is less than that of Methylene blue dye. While the doped form MT could degrade the dye up to 71 % within the same time span. It is observed that, as the amount of MoS<sub>2</sub> increases photo catalytic degradation of Rh B increase. In comparison with TiO<sub>2</sub> NT, MT is more efficient as a photo catalyst in the photo degradation of Rh B dye.

When comparing the degradation, the nanocomposite MT\*2% work in Methylene blue and nanocomposite MT work in Rhodamine B. This happens because Rh B is having stable structure. Hence, it is very difficult to degrade Rh B than MB. More over, MB adsorb more to TiO<sub>2</sub> nanotube owing to its cationic nature than Rh B which is anionic. MoS<sub>2</sub> shows affinity to anionic dyes. So, as the percentage of MoS<sub>2</sub> increases in nanocomposite, adsorption of Rh B increases. This is the reason why the less MoS<sub>2</sub> doping more efficient in the case of MB, while the nanocomposite with highest doping efficient in Rh B.

### **3.4 . RE-USABILITY STUDIES**

The nanocomposite of TiO<sub>2</sub> nanotube and MoS<sub>2</sub> nano sheet synthesised by hydrothermal mixing does not dissolve in water. Because of this reason, it is possible to separate the nanocomposite from the solution by centrifuging a number of times and drying. Hence, it is a good photo catalyst for degradation of dyes since it increases the rate of degradation without getting dissolved itself.

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## CHAPTER 4

### CONCLUSION AND FUTURE SCOPE

Water pollution has become a global challenge to both nature and human beings. Our water resources are getting polluted because of the improper discharge of waste from industries and households. The organic contaminants like synthetic dyes, heavy metals, pesticides, phenols etc. Present in waste water are toxic/carcinogenic. Effluents from the textile industries are important sources of water pollution, because dyes in waste water undergo chemical as well as biological changes, consume dissolved oxygen, destroy aquatic life and endanger human health.

Synthetic dyes are employed extensively in a variety of industries, including textiles, leather, cosmetics, and paint industries. They are difficult to degrade due to its complex structure. For instance, methylene blue (MB, a thiazine cationic dye) has adverse health effects, which include breathing difficulties, vomiting, eye burns, diarrhoea, and nausea when MB is accumulated in waste water. Due to its non biodegradability, it is highly persistent in the environment. Another pollutant that is extensively used for dyeing purpose is Rhodamine B (Rh B). It is a water-soluble fluorescent xanthene dye used to dye various substances. It is highly toxic to various organisms and may cause long-term undesirable effects when improperly disposed of. The traditional physical methods like filtration, adsorption, filtration, ozonation, coagulation etc. are nondestructive, but instead of eradicating pollutants, they only transfer pollutants to other media, generating secondary pollution. Therefore, there are intensive demands for advanced technologies for the complete degradation of dye from the aquatic environment.

Photocatalysis has been recognised as an effective and economic method for dye degradation. This method is used for the removal of refractory pollutants from waste water and for the complete mineralization of organic dyes. It has the ability to convert pollutants into harmless end products like CO<sub>2</sub>, H<sub>2</sub>O and mineral acids. TiO<sub>2</sub> is one of the most promising catalysts for the removal of toxic organic pollutants, because of its chemically inertness, cost-effectiveness, excellent durability, non-toxicity and environment-friendly characteristics. On the other hand, TiO<sub>2</sub> can only be absorbing UV light, because of its 3.2 eV bandgap, resulting in the faster electron–hole pair recombination, which restricts its activity for the photocatalysis process. Surface sensitization of TiO<sub>2</sub> is an effective approach to enhance photocatalytic performance;

additionally, surface sensitization contributes to shrinking the crystallite size and band gap of  $\text{TiO}_2$

Among transition metal dichalcogenides,  $\text{MoS}_2$  has been established as a significant interest in sensitizing a wide band gap  $\text{TiO}_2$  due to its potential properties like having a two-dimensional layered structure, good charge carrier transport capacity, and high surface area. The present work focused on the surface sensitization of nanostructured  $\text{TiO}_2$  surface by  $\text{MoS}_2$ .

Transmission electron microscopy (TEM), X-ray diffraction (XRD) and Fourier transform infra red (FTIR) were used for structural analysis. The photocatalytic performance of surface-sensitized  $\text{TiO}_2$  was tested for rhodamine B (Rh B) and methylene blue (MB) under UV-vis light, and its degradation mechanism are discussed.

The thesis has been divided into four chapters including summary. First chapter contains the introduction regarding the research and the second chapter elaborates details of experimental set up, materials used and the methods adopted. The third chapter contains the result and discussion followed by the summary in the fourth chapter.

$\text{TiO}_2$  nanotubes and  $\text{MoS}_2$  nanosheet were synthesized by a facile hydrothermal technique. The surface sensitization of nano structured  $\text{TiO}_2$  by  $\text{MoS}_2$  was carried out via mechano - chemical method.  $\text{MoS}_2$ - $\text{TiO}_2$  nanocomposite of different x wt% (x = 2.0, 5.0 wt%) are obtained. The peaks in the X-ray diffraction spectrum of synthesized  $\text{TiO}_2$  match with the standard peaks of  $\text{TiO}_2$  anatase phase. The average particle size of the synthesized  $\text{TiO}_2$  was found to be 5.668 nm. The X-ray diffraction spectrums of synthesized  $\text{MoS}_2$  nano structures autoclaved for different time periods are obtained. The detected peaks corresponds to hexagonal  $\text{MoS}_2$ . As the time duration increases the ex foliation of  $\text{MoS}_2$  nano structures have taken place and we have got  $\text{MoS}_2$  nano sheets.

The morphological investigations of  $\text{TiO}_2$  nanotube were performed via TEM and HR-TEM analysis. Nano particles are not observed in the TEM image which implies that the nano powder has completely transformed into nanotubes. The obtained TEM images of the synthesized  $\text{TiO}_2$  nano tubes reveals that the nano tubes are randomly oriented and are almost clustered in nature. The HR-TEM image shows that it has got an inter planar spacing (d) of 0.30nm, which is in perfect agreement with the (101) plane of  $\text{TiO}_2$ .

The photodegradation efficiencies of MB and Rh B using TiO<sub>2</sub> NT, MoS<sub>2</sub> and MoS<sub>2</sub>-TiO<sub>2</sub> nanocomposites were determined under UV-vis light irradiation. The absorption spectra shows that the photo-catalytic activity of the TiO<sub>2</sub> is improved when doped with MoS<sub>2</sub> nano sheet/nano flower TiO<sub>2</sub>. Undoped TiO<sub>2</sub> could degrade MB dye to 94.58% which took almost 40 min, while the doped forms MT, MT\*2%(2 wt% MoS<sub>2</sub> in TiO<sub>2</sub>), MT\*5%(5 wt% MoS<sub>2</sub> in TiO<sub>2</sub>) could degrade the dye up to 97 % , 93 % , 90% within 5, 1.5,1.5 minutes respectively. MT\*2% is more efficient as a photo catalyst in the photo degradation of MB dye. MT is more efficient in causing degradation of Rh B dye than MT\*2% and MT\*5%. TiO<sub>2</sub> NT alone could degrade Rh B dye to less than 1% even kept under light up to 45 minute, while the doped forms of MT could degrade the dye up to 71 % within the same time span. This concludes that the photocatalytic activity of the synthesized nanocomposite is admirable toward Rh B and MB degradation.

## **FUTURE SCOPE**

For efficient photocatalytic performance, the nanoparticles should have good adsorption capacity. There are various strategies to improve the photocatalytic efficiency of MoS<sub>2</sub>-TiO<sub>2</sub> nanocomposite. The photocatalytic performance can be increased, by increasing the intensity of light source. The usage of xenon lamp having high intensity is efficient to increase the percentage of degradation.

By optimising the factors like effect of time, effect of temperature, nature of pollutant and nature of light source the photocatalyst can be commercialized. For practical applications, the uv light source must be replaced with sunlight in order to save energy and money. The increase in band gap hinders the widespread use of photocatalyst using sunlight. Surface modification of the photocatalyst can enhance the utilization of solar energy. The band gap of MoS<sub>2</sub>-TiO<sub>2</sub> samples can be reduced by introducing co-catalysts.

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MAHATMA GANDHI UNIVERSITY  
PROJECT REPORT

**EFFECTS OF SOLAR WIND TRANSIENTS**  
**ON OUR EARTH**

Year: 2020-2022

**In partial fulfilment of the requirement of the award of  
Master of Science Degree in Physics**

By

**BERSHEBA ELSA BENNY**

**M.Sc. PHYSICS**

**REG NO. AM20PHY004**

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Date: 13.06.2022

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**CERTIFICATE**

This is to certify that the project entitled **“EFFECTS OF SOLAR WIND TRANSIENTS ON OUR EARTH”** is a bonafied work carried out by **BERSHEBA ELSA BENNY**, in partial fulfilment of the requirements for the award of the degree of Master of Science in Physics during the academic year 2020-2022 and has not been included in any other works submitted previously for the award of any degree.

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## CERTIFICATE

This is to certify that the work incorporated in the thesis entitled "EFFECTS OF SOLAR WIND TRANSIENTS ON OUR EARTH", submitted by 'BERSHEBA ELSA BENNY', towards the partial fulfilment of the requirements for the award of the degree, Master of Science in Physics is a bonafied record of the work carried out by the candidate, under my supervision. The work presented here or any part of it has not been included in any other thesis submitted previously for the award of any degree or diploma from any other University or institution.

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## **DECLARATION**

I, BERSHEBA ELSA BENNY, hereby declare that the project report entitled “**EFFECTS OF SOLAR WIND TRANSIENTS ON OUR EARTH**” is an authentic record of the work carried out by me under the guidance of **Dr. K P ARUN BABU**, Assistant Professor, Department of Physics, St. Albert’s College, Ernakulam, and **Dr. PRIYA PARVATHI AMEENA JOSE**, Assistant Professor, Department of Physics, St. Teresa’s College, Ernakulam.

The data and conclusions drawn are based on the calculations done by myself. This is my original work and the report submitted has not been duplicated from any other source.

BERSHEBA ELSA BENNY  
AM20PHY004

Date: 10 June 2022

Place: Ernakulam

## AKNOWLEDGEMENT

First of all, I would like to thank the Almighty God for being able to complete this project with success.

I take this opportunity to express my profound gratitude and deep regards to my guide **Dr. K P Arun Babu**, Assistant Professor, St. Albert's College, Ernakulam, and **Dr. Priya Parvathi Ameena Jose**, Assistant Professor, St. Teresa's College, Ernakulam, for their exemplary guidance, monitoring, support and constant encouragement without which this project would not be able to exist in the present shape. The blessings, help and guidance given by them time to time shall carry us a long way in the journey of life on which we are about to embark. They have taken pain to go through the project and make necessary corrections as when needed. I am extremely thankful to all other faculties of the department of physics, for their constant support.

I would like to express my thanks to all respondents and colleagues in developing the project. I'm grateful to my parents for their blessings and constant encouragement throughout the project.

## **ABSTRACT**

Our Earth is experiencing a continuous stream of charged particles released from the upper atmosphere of the Sun known as the solar wind. The dynamic pressure and magnetic field of solar wind are compressing the magnetosphere in the day-side to bow-shock-nose. During a solar transient event, an enhancement in the solar wind parameter such as density, magnetic field, and flow speed was observed, causing a significant change in our magnetosphere, also known as geomagnetic storms. In this work we are analysing the relationship of the ram pressure and magnetic field of solar transient events to the geomagnetic storms. We are analysing the solar transient events during the period from 2001 to 2020 with a four year gap.

# **CONTENT**

1. INTRODUCTION.....	2
1.1 Sun.....	2
1.1.1. Solar interior.....	3
1.1.2. Solar atmosphere.....	4
1.1.3. Corona.....	5
1.2 Solar cycle.....	7
1.3 Solar wind.....	9
1.4 Coronal Mass Ejection.....	11
1.5 Geomagnetic storms.....	14
1.6 Sun-Earth connections.....	16
2. DATA ANALYSIS AND INTERPRETATION.....	18
2.1 Solar wind parameters.....	19
2.2 Variation of flow pressure and magnetic field with DST.....	21
2.3 Dependency of dynamic pressure and magnetic field on SymH.....	22
2.4 Data analysis by integration.....	24
2.5 Observations.....	38
3. CONCLUSION.....	40
4. FUTURE WORKS.....	44
5. BIBLOGRAPHY.....	45

# 1. INTRODUCTION

Our Earth is experiencing a continuous stream of charged particles released from the upper atmosphere of the Sun known as the solar wind. The dynamic pressure and magnetic field of solar wind are compressing the magnetosphere in the day-side to bow-shock-nose. During a solar-transient event the solar wind cause a significant change in our magnetosphere known as geomagnetic storms.

We are analysing the solar transient events during the period from 2001 to 2020 with a four year gap.

## 1.1. SUN

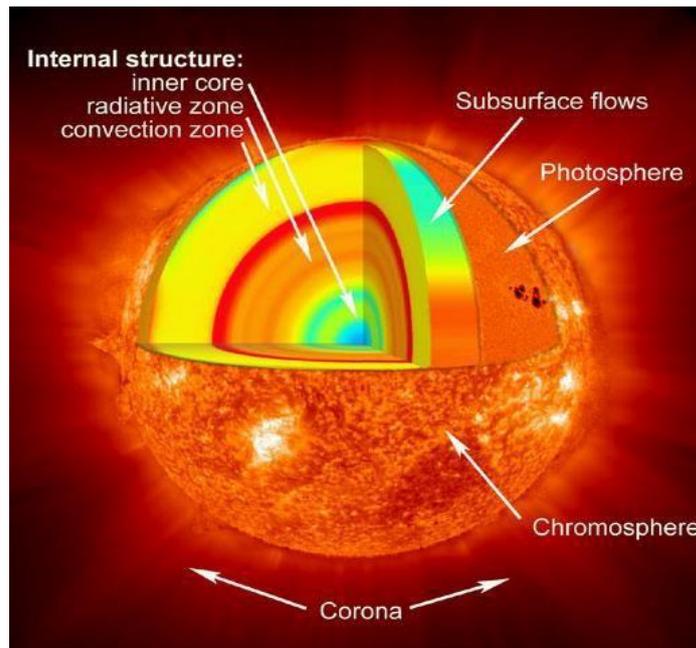
The Sun is the star at the centre of the Solar System. It is nearly perfect ball of hot plasma heated to incandescence by nuclear fusion reactions in its core, radiating the energy mainly as visible light, ultraviolet light, and infrared radiation. The sun was born from a giant molecular cloud which began to gravitationally collapse and fragment. This process of collapse and fragment continued until one of these fragments attained a central temperature large enough to start hydrogen fusion. It is the most important source of energy for life on Earth. Currently the Sun is in a stable configuration, where it is hydrostatic equilibrium ( $\nabla P = -\rho g$ ). The sun will continue to maintain in this stable state for about 100 times its current size and begin to shedding its outer layer due to successive nuclear burning and resulting total loss of outer layer, in which all nuclear burning has stopped, called a white dwarf. According to spectral class, the Sun is a main sequence star of spectral type G2V. The Sun has a total luminosity,  $L = (3.84 \pm 0.04) \times 10^{26}$  W, Mass,  $M = (1.9889 \pm 0.0003) \times 10^{30}$  kg and Radius,  $R = (6.959 \pm 0.007) \times 10^8$  m.

### 1.1.1. SOLAR INTERIOR

This is usually divided into three main regions: the sun's interior, the solar atmosphere, and the visible surface which lies between the interior and the atmosphere.

There are three main parts to solar interior: the core, the radiative zone and the convective zone. The core is at the centre. It is the hottest region, where the nuclear fusion that power the sun occur. The temperature in the core is about  $1.5 \times 10^7$  K and the pressure exceeds  $2.5 \times 10^{11}$  atm and extends up to  $0.25R_{\odot}$ . Moving outward, next comes the radiative zone ( $0.25-0.70R_{\odot}$ ). Its name derived from the way energy is carried by photons as thermal radiation. The temperature drops from about  $7 \times 10^6$  K at bottom of the radiative zone to  $2 \times 10^6$  K just below the convective zone. Due to high densities in the radiative zone the mean free path of photons is very small. Hence it can take tens to hundreds of thousands of years for photon to escape. The third and final region of solar interior is the convective zone ( $0.7-1.0R_{\odot}$ ). It is also named after the dominant mode of energy flow in this layer, heat move upward via rolling convection. The temperature of convective zone is lower than that of radiative zone and heavier atoms are not fully ionized. As a result, radiative heat transport is less effective. Thermal convection carries the majority of the heat outward to the Sun's photosphere, the boundary between sun's interior and the solar atmosphere. It is what we see as the visible "surface" of the Sun. The material cools off at the photosphere, which increases its density and causes it to sink to the base of the convection zone. Above the photosphere visible sunlight is free to propagate into space, and its energy escapes the Sun entirely.

The thin interface between radiative zone and convective zone is known as



*Fig1: shows the different layers of Sun. At the centre is the corona where fusion takes place. The energy generated at corona is transmitted to radiative zone where solar plasma is cool enough to form ionized atoms and becomes optically thick. Hence it is convectively unstable and energy is transported through mass motion in convection zone. (Image courtesy: Geysler land observatory)*

tachocline. The fluid motions found in the convection zone slowly disappear from the top of this layer to its bottom where the conditions match those of the calm radiative zone. It is believed that the Sun's magnetic field is generated by a magnetic dynamo in this layer. The changes in fluid velocities across the layer (shear flow) can stretch magnetic field lines of force and make them stronger. This change in flow velocity gives this layer its alternative name-the tachocline. There also appears to be sudden change in chemical composition across this layer.

### **1.1.2. SOLAR ATMOSPHERE**

The atmosphere of the Sun comprises chromosphere, solar transition region, corona, and heliosphere. The solar atmosphere is an inhomogeneous mix of different plasma properties due to up-flows, down-flows, heating, cooling and other dynamic process. The temperature decreases in the photosphere, reaching a minimum in the chromosphere,

then slowly rises until there is a rapid increase at the transition region which continues into the corona. This rapid increase in temperature is called 'coronal heating problem'. [1]

### **1.1.3. CORONA**

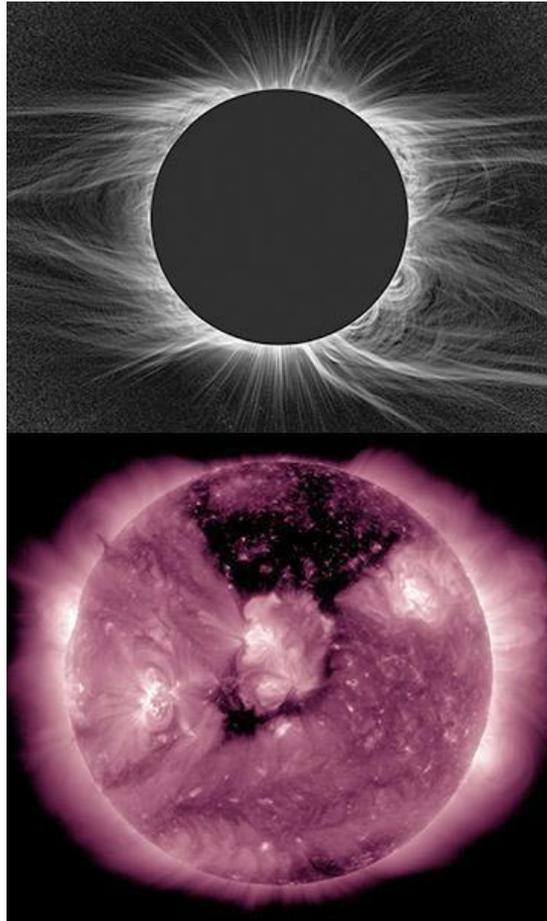
The corona is the outer atmosphere of the Sun. It extends many thousands of kilometres above the visible surface of the Sun, gradually transforming into the solar wind that flows outward through our Solar System.

The material in the corona is an extremely hot but very tenuous plasma. The temperature in the corona is more than a million degrees, much hotter than the temperature at the Sun's surface which is around 5,500°C. The pressure and density in the corona are much, much lower than in Earth's atmosphere.

The corona is above the Sun's lower atmosphere, which is called the chromosphere. A relatively narrow area called the transition region, from thousands of degrees in the chromosphere to more than a million degrees in the corona. The density of plasma falls rapidly through the transition region moving upward from the chromosphere to corona.

We normally cannot see the solar atmosphere, including the corona. The surface of the Sun is far too bright to allow a glimpse of the much fainter corona. During a total solar eclipse, the corona briefly comes into view as the Moon blocks out the solar surface. A special instrument called coronagraph allows astronomers to view the corona at other times. Some coronagraphs are used with ground-based telescope, others are carried on satellites. [4]

The electron density of the solar corona ranges from  $\sim 10^{14} \text{ m}^{-3}$  at its base, 2500 km above the photosphere. The temperature in corona is generally above  $1 \times 10^6 \text{ K}$ . The high temperature reached in the corona gives rise to



*Fig 2: Two views of corona: during an eclipse (top) and ultraviolet light (bottom)*

*(Credit: NASA)*

extreme ultraviolet (EUV) and X-ray emission, which have highly ionized ion lines as a prominent feature. The visible corona during eclipse is due to Thomson scattering of photospheric light from free electrons in the coronal plasma. The corona has a number of components:

1. K-corona (kontinuierliches) is composed of Thomson-scattered photospheric radiation and dominates below  $\sim 2R_{\odot}$ . As a result of the Thomson scattering mechanism, the scattered light is strongly polarized parallel to the solar limb. The high temperatures mean the electrons have high thermal velocities. This will wash out the Fraunhofer lines, producing a white-light continuum. The intensity of the K-corona is proportional to the density summed along the line-of-sight.

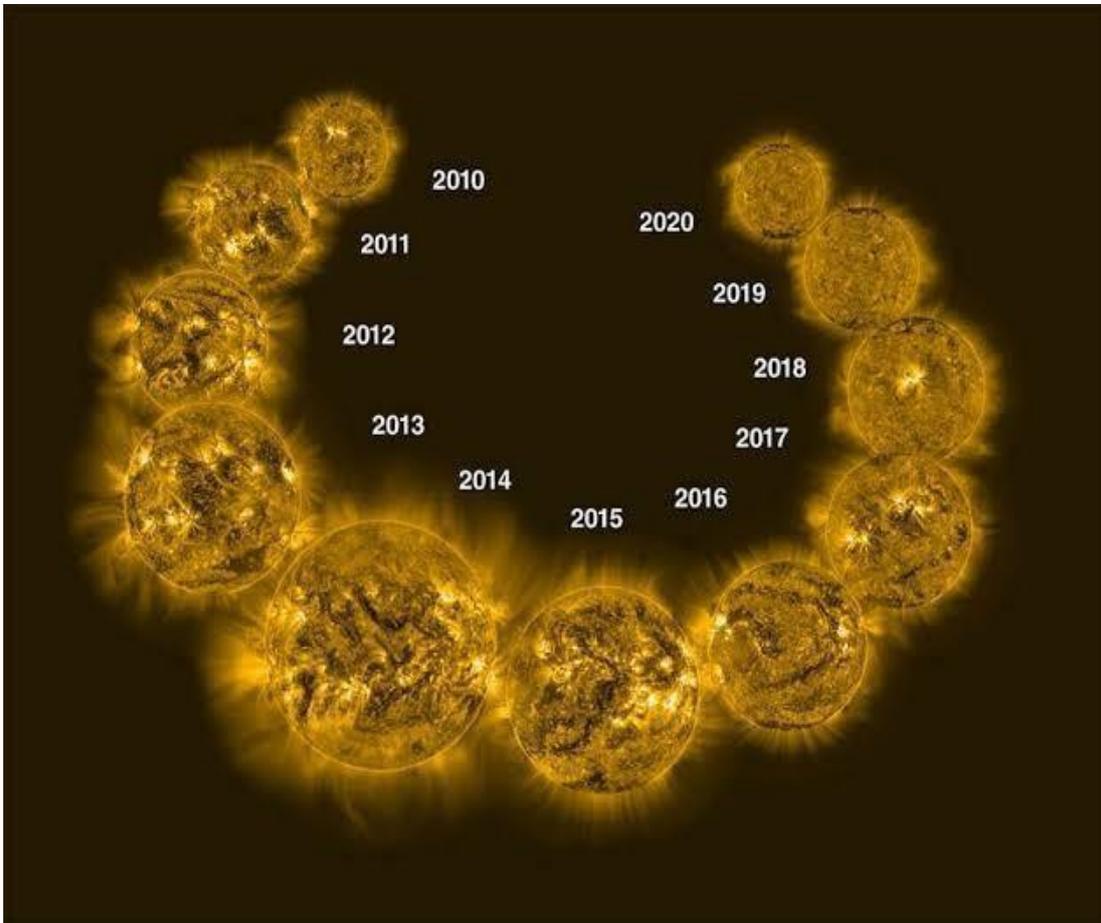
2. F-corona (Fraunhofer) is composed of Rayleigh-scattered photospheric radiation by dust particles and dominates above  $\sim 2R_{\odot}$ . It forms a continuous spectrum with superimposed Fraunhofer absorption lines. The radiation has a very low degree of polarization. The F-corona is also known as Zodiacal light, it can be seen with the naked eye at dawn or dusk under favourable conditions.
3. E-corona (Emission) is composed of line emission from visible to EUV due to various atoms and ions in the corona. It contains many forbidden line transitions; thus, it contains many polarization states.
4. T-corona (Thermal) is composed of thermal radiation from heated dust particles. It is a continuous spectrum according to the temperature and colour of the dust particles. [1]

## **1.2. SOLAR CYCLE**

Our sun is a huge ball of electrically-charged hot gas. This charged gas moves, generating a powerful magnetic field. The sun's magnetic field goes through a cycle, called the solar cycle. Every 11 years, the sun's magnetic field completely flips. This means that the sun's north and south poles switch places. Then it takes about another 11 years for the sun's north and south poles to flip back again. The 11-year cycle in which the sun's magnetic field goes through result in formation of sunspots. As the magnetic field changes, so does the amount of activity on the sun's surface. The point of highest solar activity during a cycle is known as solar maximum and point of lowest solar activity is solar minimum. [6]

One way to track the solar cycle is by counting the number of sunspots. The beginning of a solar cycle is a solar minimum or when the sun has the least sunspots. Overtime, the solar activity and the number of sunspots increases. The middle of the solar cycle is the solar maximum or when the sun has the most sunspots. As the cycle ends, it fades back to the solar

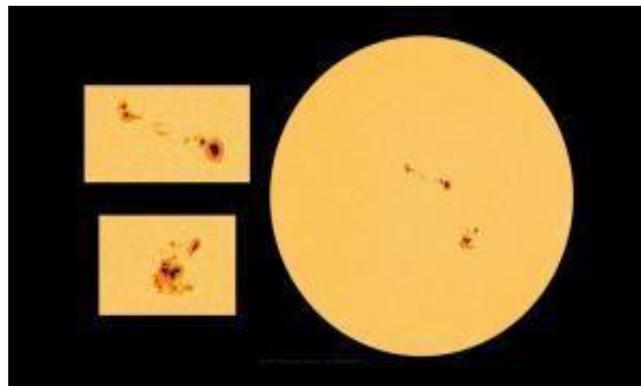
minimum and a new cycle begins. Giant eruptions on the sun, such as solar flares and coronal mass ejections, also increases during the solar cycle. [6]



*Fig 3: Evolution of the Sun in extreme ultraviolet light from 2010 through 2020, as seen from the telescope aboard Europe's PROBA2 spacecraft. (Credit: Dan Seaton/European Space Agency (Collage by NOAA/JPL-Caltech))*

The 11-year-old cycles are numbered sequentially starting with observations made in 1750s. Ellery Hale first linked magnetic fields and sunspots in 1908. Although sunspots were known as early as 1600, no one noticed that their number changed with time until the German amateur astronomer Samuel Heinrich Schwabe announced the 11-year cycle in 1843. It was 15 years later that an English amateur astronomer, Richard Christopher Carrington, recognised the latitude drift of the sunspots. The most important result of Carrington's observations was the establishment of a zone leap: after both sunspot belts during one 11-year cycle have

approached the equator from north and south, just at the beginning of the next cycle, the zone leap takes place. While the last few spots of the old cycle dissolve close to the equator, new spots start to appear at high latitudes in two belts north and south of the equator from about 25° and 35°. These belts then drift towards the equator as did the belts of the old cycle. Swiss astronomer Rudolf Wolf studied historical sunspot records and proposed the scheme still used for numbering solar cycles, with solar cycle 1 beginning in 1755, the earliest year for which he found reliable sunspot numbers. The 22-year magnetic cycle was discovered in 1925 by the American astronomer George Ellery Hale. [8]



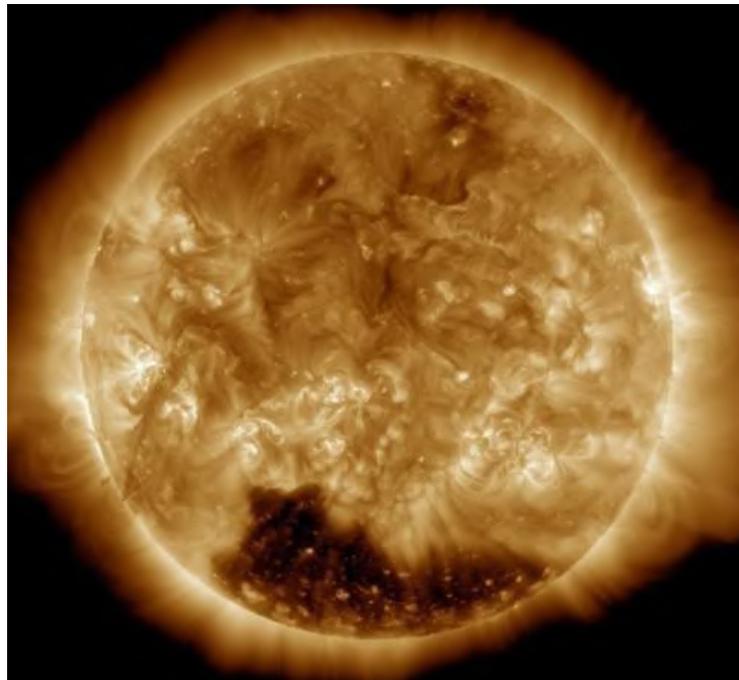
*Fig 4: Sunspots*

### **1.3. SOLAR WIND**

One of the most remarkable discoveries about the Sun's atmosphere is that it produces a stream of charged particles (protons and electrons) that we call the solar wind. These particles flow outward from the sun into the solar system with a speed of about 400 km per second. The solar wind exists because the gasses in the corona are so hot and moving so rapidly that they cannot be held back by solar gravity.

Although the solar wind materials are very, very rarefied, the sun has an enormous surface area. Astronomers estimate that the sun is losing about 10 million tons of materials each year through this wind. In visible photographs, the solar corona appears fairly uniform and smooth. X-ray

and EUV pictures show that the corona has loops, plumes and both bright and dark regions. Large dark regions of corona that are relatively cool and quiet are called coronal holes. In these regions, magnetic field lines stretch far out into space away from the sun, rather than looping back to the surface. The solar wind comes predominantly from coronal holes, where gas can stream away from the sun into space unhindered by magnetic fields. Hot coronal gas, on the other hand, is present mainly where magnetic fields have trapped and concentrated it.

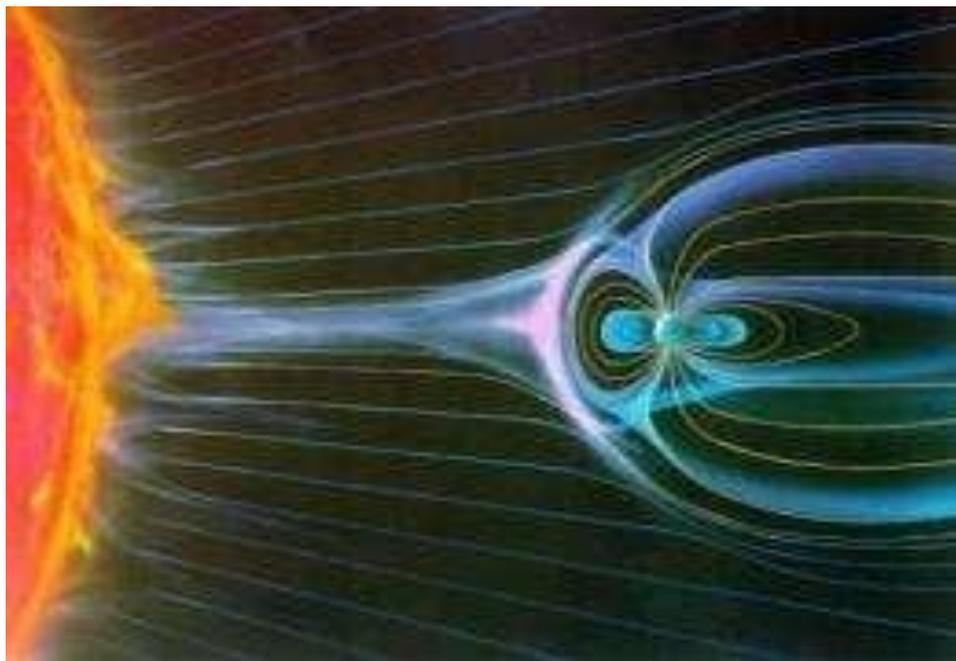


*Fig 5: Coronal hole: the dark area visible near the Sun's South pole on this Solar Dynamics Observer spacecraft image is a coronal hole (credit: modification of work by NASA/ SDO)*

At the surface of the Earth, we are protected to some degree from the solar wind by our atmosphere and earth's magnetic field. However, the magnetic field lines come into earth at the north and south magnetic poles. Here, charged particles accelerated by the solar wind can follow the field down into our atmosphere. As the particles strike molecules of air, they cause them to glow, producing beautiful curtains of light called the auroras or the northern and southern lights.[7]



*Fig 6: Aurora: the colourful glow in the sky results from charged particles in solar wind interacting with Earth's magnetic fields. The stunning display captured here occurred over Jokularison lake in Iceland in 2013 (credit: Moyan Brenn)*



*Fig 7: An artistic view of solar wind and Earth's magnetosphere. It shows how the solar wind rearranges the Earth's magnetosphere. It is compressing the magnetic field in the side facing sun and elongates same in other end (credit: NASA)*

#### **1.4. CORONAL MASS EJECTION (CME)**

CMEs are large expulsion of plasma and magnetic field from the sun's corona. They can eject billions of tons of coronal material and carry an

embedded magnetic field (frozen in flux) that is stronger than the background solar wind interplanetary magnetic field (IMF) strength. CMEs travel outward from the Sun at a speed ranging from lower than 250 km/s to as fast as near 3000 km/s. The fastest Earth directed CMEs can reach our planet in as little as 15-18 hours. Slower CMEs can take several days to arrive. They expand in size as they propagate away from the Sun and larger CMEs can reach a size nearly a quarter of the space between Earth and Sun by the time it reaches our planet.

The more explosive CMEs generally begin when highly twisted magnetic field structure contained in the Sun's lower corona become too stressed and realign into a less tense configuration - a process called magnetic reconnection. This can result in the sudden release of electromagnetic energy in the form of a solar flare: which typically accompanies the explosive acceleration of plasma away from the Sun - the CME. These types of CMEs usually take place from areas of the Sun with localized fields of strong and stressed magnetic flux: such as active region associated with sunspot groups. CMEs can also occur from location where relatively cool and denser plasma is trapped and suspended by magnetic flux extending up to the inner corona - filaments and prominences. When these flux ropes reconfigure, the denser filament or prominence can collapse back to the Solar surface and be quietly reabsorbed, or CME may result. CMEs traveling faster than the background solar wind speed can generate a shock wave. These shock waves can accelerate charged particles ahead of them; causing increased radiation storm potential or intensity.

Important CME parameters used in analysis are size, speed and direction. These properties are inferred from orbital satellite's coronagraph imagery by Space Weather Prediction Center (SWPC) forecast to determine any Earth-impact likelihood. The NASA Solar and Heliospheric Observatory

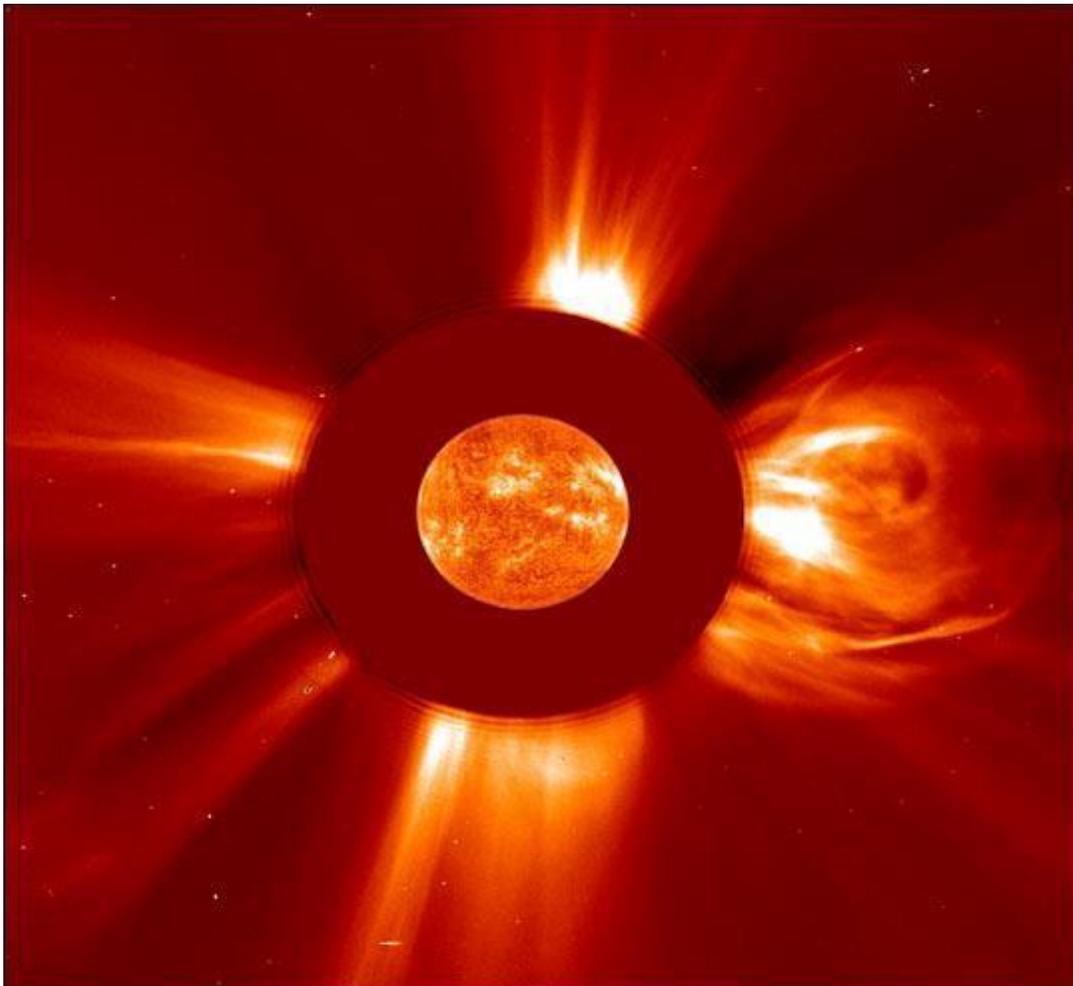
(SOHO) carries a coronagraph known as the Large Angle and Spectrometric Coronagraph (LASO). This instrument has two ranges for optical imaging of the Sun's corona: C2(covers distance range of 1.5 to 6 solar radii) and C3(range of 3 to 32 solar radii). The LASO instrument is currently the primary means used by forecasters to analyse and categorize CMEs; However, another coronagraph is on the NASA STEREO-A spacecraft as an additional source.

Imminent CME arrival is first observed by the Deep Space Climate Observatory (DSCOVR) satellite, located at the L1 orbital area. Sudden increases in density, total IMF strength, and solar wind speed at the DSCOVR spacecraft indicate arrival of CME associated interplanetary shock ahead of magnetic cloud.

Important aspects of an arriving CME and its likelihood for causing more intense geomagnetic storming include the strength and direction of IMF beginning with shock arrival, followed by arrival and passage of the plasma cloud and frozen in flux magnetic field. More intense level of geomagnetic storming is favoured when the CME enhanced IMF becomes more pronounced and prolonged in south direct orientation. Some CMEs show predominantly one direction of magnetic field during its passage, while most exhibit changing field directions as the CME passes over earth. Generally, CMEs that impact earth's magnetosphere will at some point have an IMF orientation that favours generation of geomagnetic storming.[2]

In coronagraphic images, a CME can be recognised as bright features moving to progressively larger heliocentric distances. The CME occupies a portion of the coronal images indicating a finite angular extent and hence defines a finite quantity of matter expelled from the sun. CMEs are ejected

into the ambient medium, which expands as solar wind. The CMEs and the solar wind are exchange momentum. If a CME moves faster than the characteristics speed of the ambient medium it can drive a shock which have additional consequences. [10]

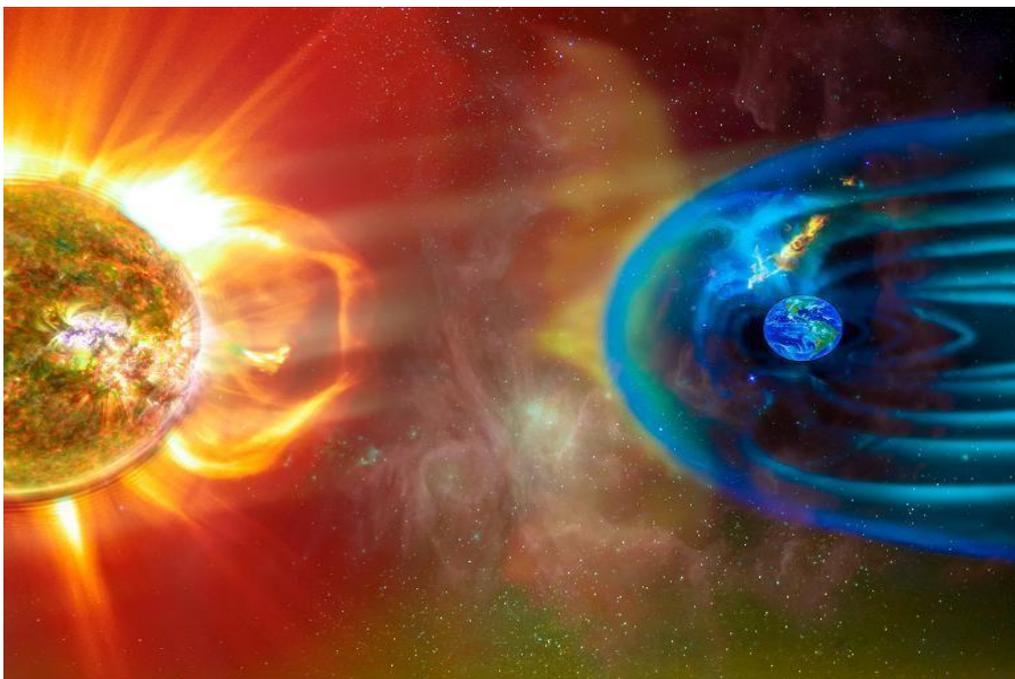


*Fig 8: An image of a coronal mass ejection observed by NASA's Solar and Heliospheric Observatory, or SOHO, satellite in 2001.( Credit: ESA/NASA/SOHO)*

## **1.5. GEOMAGNETIC STORMS**

A geomagnetic storm is a major disturbance of earth's magnetosphere that occurs when there is very efficient exchange of energy from the solar wind into the space environment surrounding the earth. These storms results from variations in the solar wind that produces major changes in the currents, plasmas, and fields in earth's magnetosphere. The solar wind conditions that are effective for creating geomagnetic storms are sustained

periods of high-speed solar wind, and most importantly, a southward directed solar wind magnetic field (opposite to the direction of earth's field) at the dayside of the magnetosphere. This condition is effective for transferring energy from solar wind to the earth's magnetic field.[5] The largest storms that result from these conditions are associated with solar coronal mass ejections (CMEs) where billion tons or so of plasma from the sun, with its embedded magnetic field, arrive at earth. CMEs typically take several days to arrive at earth, but have been observed, for some of the most intense storms, to arrive in as short as eighteen hours. Another solar wind disturbance that creates conditions favourable to geomagnetic storms is a high-speed solar wind stream (HSS). The high-speed solar wind stream overtakes the slow solar wind streams as they propagate outward creating co-rotating interaction regions (CIRs). These regions are often related to geomagnetic storms that while less intense than CME storms, often can deposit more energy in earth's magnetosphere over a long interval.[5]



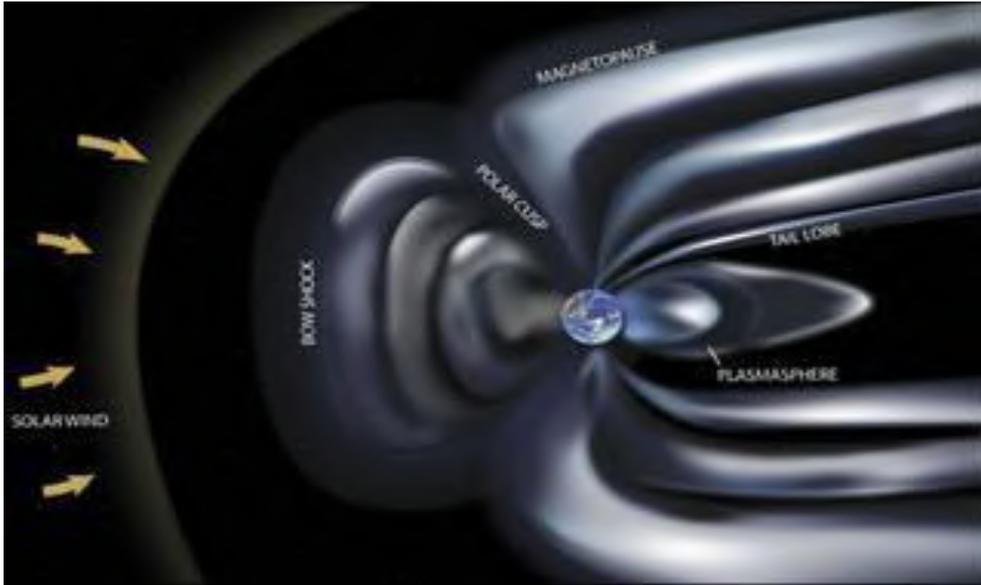
*Fig 9: Geomagnetic storms*

The frequency of geomagnetic storms increases and decreases with the sunspot cycle. During solar maximum, geomagnetic storms occur more often, with the majority driven by CMEs. The increase in the solar wind pressure initially compresses the magnetosphere. The solar wind's magnetic field interacts with the earth's magnetic field and transfers an increased energy into the magnetosphere. Both interactions cause an increase in plasma movement through the magnetosphere and an increase in electric current in the magnetosphere and ionosphere. During the main phase of a geomagnetic storm, electric current in the magnetosphere creates a magnetic force that pushes out the boundary between the magnetosphere and the solar wind.[9]

The largest recorded geomagnetic storm, the Carrington event in September 1859, took down parts of the recently created US telegraph network, starting fires and shocking some telegraph operators. In 1989, a geomagnetic storm energized ground induced currents that disrupted electric power distribution throughout most of Quebec and cause aurorae as far south as Texas.[9]

## **1.6. SUN-EARTH CONNECTIONS**

When the solar wind travels with the IMF, the charged particles and magnetic fields interact with the Earth's magnetic field. The Earth's magnetic field, as it stretches out in space, is known as its magnetosphere. The solar wind pushes on the side of the magnetosphere facing the sun, and pulls it out on the side facing away from the sun. The pulling forms a long tail moving away from the sun, and thus the magnetosphere resembles a wind-sock blowing in the wind. Electrical current flows in the magnetosphere, and generates the light in the sky known as the Northern and Southern lights. Together these lights are known as aurora.[11]



*Fig 10: Earth's magnetosphere as it would look if we had "magnetic field glasses". The shape is created by the interaction of the solar wind with Earth's intrinsic magnetic field.  
(Credits: UC Regents)*

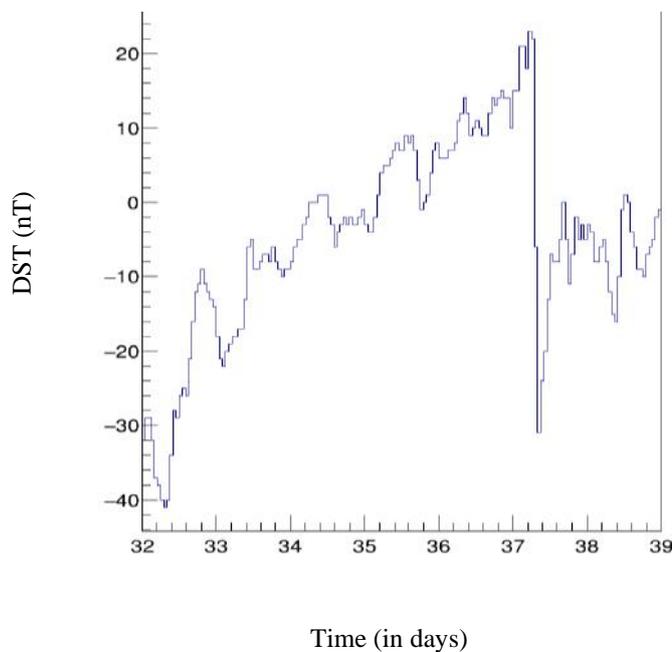
The term space weather refers to conditions on the sun and in the solar wind, magnetosphere, ionosphere and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and that can affect human life and earth. Our society has become increasingly vulnerable to disturbances in near-earth space weather, in particular to those initiated by explosive events on the sun like solar flares, solar energetic particles (SEPs), and coronal mass ejections (CMEs).[1]

Solar flares release flashes of radiation covering an immense wavelength range (from radio waves to Gamma-rays) that can, heat up the terrestrial atmosphere within minutes such that satellites drop into lower orbits. SEPs accelerated to near-relativistic energies during major solar storms arrive at the Earth's orbit within minutes and may, among other things, severely endanger astronauts travelling through interplanetary space - that is outside the Earth's protective magnetosphere. CMEs ejected into interplanetary space as gigantic clouds of ionized gas, that after a few hours or days may eventually hit the Earth and cause geomagnetic storms.[3]

## 2. DATA ANALYSIS AND INTERPRETATION

In this project we have analysed the effects of solar wind transients on our Earth. The program codes were written in Root software, which enables statistically sound scientific analysis and visualization of large amount of data. We are analysing the solar wind parameter data such as dynamic pressure, scalar magnetic field, and magnetic field components along with SymH and DST index data for a period from 2001 to 2020 with a four year gap. The one-minute resolution solar wind parameters were obtained from the OMNI Data service (<https://omniweb.gsfc.nasa.gov/>) developed and supported by NASA.

As a first step, we observed the events of flow pressure. We are using the threshold of  $3\sigma$  level of dynamic pressure and identifying events above this level. Then the corresponding values of B total, V total and the DST values of each year were noted. With the data obtained we plotted graphs and found that they didn't show a good correlation.



*Fig 11. DST index for the days from 32 to 39 of 2001*

As a second step, smoothening of flow pressure for each year was done using coded program. Then we integrated the flow pressure, magnetic field and the product of flow pressure and magnetic field. The DST values corresponding to each onset and offset time for all the years were noted. Then graphs were plotted with each integrated values and the corresponding DST values for each year.

## **2.1. Solar Wind Parameters**

1. *Magnetic field*- The magnetic field in the solar wind is relatively weak and is carried along by the solar wind. The rotation of the Sun results in the lines of magnetic flux in the solar wind being drawn into Archimedean spirals. This occurs because the Sun revolves once every  $\sim 25.5$  days while, it takes solar wind several days to reach 1 AU. Therefore, the Sun revolves through a significant angle during the time it takes the solar wind to reach the Earth. The magnetic field in the solar wind, called the interplanetary magnetic field, or IMF, is attached to the Sun at the point where the solar wind began. Thus, the point on the field line attached to the Sun is turned through an angle of  $60^\circ$  relative to the point on the magnetic field line that is at 1 AU. [12] It gives one minute resolution.
2. *Dynamic pressure*- The dynamic pressure of the solar wind and the interplanetary magnetic field (IMF) are important for the interaction of the solar wind with the earth's magnetosphere, and both of these are generally quite variable. The dynamic pressure of the flowing solar wind is  $C\rho V^2$ . Here C is a constant, V and  $\rho$  are the solar wind velocity and ion number density respectively. [12] It gives one minute resolution.
3. *Disturbance storm time index (DST)*- Disturbance Storm Time index measures the variation of magnetic field associated with

magnetosphere. It is used to analyse the strength and duration of geomagnetic storms. DST is a measure of the decrease in the horizontal component of the Earth's magnetic field near the magnetic equator due to increases in the magnetospheric ring current. Values less than  $-50$  nanotesla indicate high geomagnetic activity. [13] It gives one hour resolution.

4. *SymH*- SymH is the symmetric horizontal component of the magnetic field. The SYM - index represents the global Earth's magnetic field variations. The magnetic observatories to derive this index are located in low latitude and mid-latitude which are far from equator and auroral region to avoid any contamination of auroral and equatorial electrojet currents. The SymH-index gives the magnetic typical signature during geomagnetic storm. For instance, when there is connection between the magnetospheric ring current and Earth's magnetic field during the storm main phase, the SymH variation decrease. While during the magnetospheric compression, the SymH variation increase, the signature of the eastward magnetopause current. The SymH-index pattern also indicates the different phases of geomagnetic storm phases from initial, main and recovery storm phases. [14]

It gives one minute resolution. SymH is essentially the same as the DST index with a different time resolution.

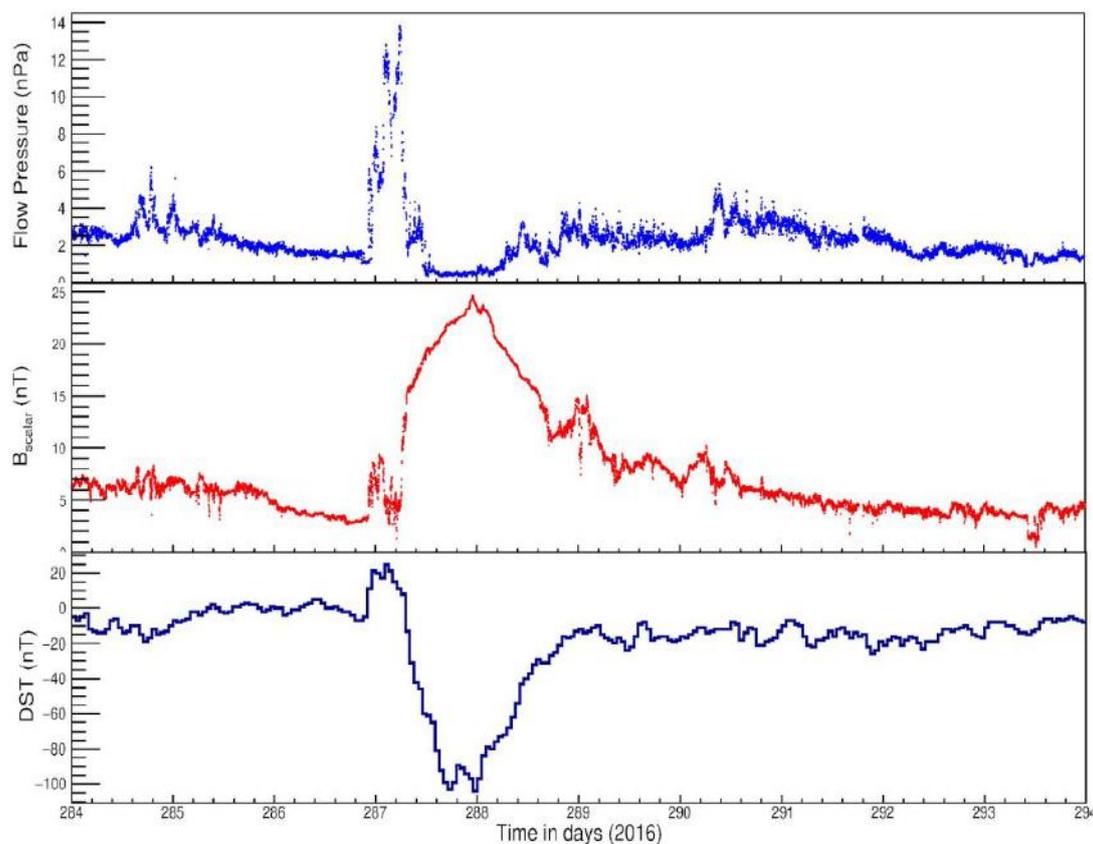
## ● TProfile

All the histograms used for data analysis were made using TProfile function provided in Root. Profile histograms are used to display the mean value of Y and its error for each bin in X. The displayed error is by default the standard error on the mean (that is, the standard deviation divided by the  $\sqrt{n}$ ). Profile histograms are elegant

replacement of two-dimensional histograms. The inter-relation of two measured quantities X and Y can always be visualized by a two-dimensional histogram or scatter plot, but if Y is an unknown (but single-valued) approximate function of X, this function is displayed by a profile histogram with much better precision than by a scatter plot.

## 2.2. Variation of Flow pressure and Magnetic field with DST

We have analysed the solar wind parameter data such as dynamic pressure, scalar magnetic field, and magnetic field components along with the SymH and DST index data for a period from 2001 to 2020. We are using the threshold of  $3\sigma$  level of dynamic pressure and identifying events above this level.



*Fig 12: First panel shows the variation of dynamic pressure for the period of 10 days from day number 284 of 2016, second panel shows the variation of scalar magnetic field and the third panel shows the DST index for the same period of time.*

In fig 12, the first panel shows the plot of variation of dynamic pressure for the period of ten days from day number 284 of 2016. The time in days is in x-axis and the dynamic pressure is in the y-axis. The second panel indicates the plot of the variation of scalar magnetic field for the same period of time. The time in days is taken along the x-axis and the scalar magnetic field is taken along the y-axis. The third panel shows the DST index for the same period of time. Here DST values are taken along the y-axis and time in days along the x-axis. From the figure we can see an enhancement in flow pressure. With respect to the flow pressure there is an increase in the magnetic field and a decrease in DST. Because of this pressure enhancement, the magnetosphere is compressing and we can see a peak in DST. Then with respect to the increase in magnetic field, the DST is decreasing.

### **2.3.Dependency of Dynamic pressure and Magnetic field on SymH**

We have seen in the fig 12 that, there is an enhancement in the flow pressure and relative to it a change in magnetic field and DST is also observed. So, we are going to analyse the dependency of dynamic pressure and magnetic field on DST. For this, we have analysed all the events from 2001 to 2020 with a four year gap. From them 1650 events were studied to observe their dependency on DST. These events are linked with TProfile. In the case of magnetic field, we use a range of 0 to 40 nT with a bin width of 0.5 nT. Similarly, for dynamic pressure we use a range of 0 to 40 nPa with the same bin width.

Fig 13 indicates the dependency of dynamic pressure on SymH. Dynamic pressure is taken along the x-axis and the SymH is taken along the y-axis. Similarly, fig 14 shows the dependency of scalar magnetic field along the x-axis and SymH along the y-axis. We found a good correlation of SymH

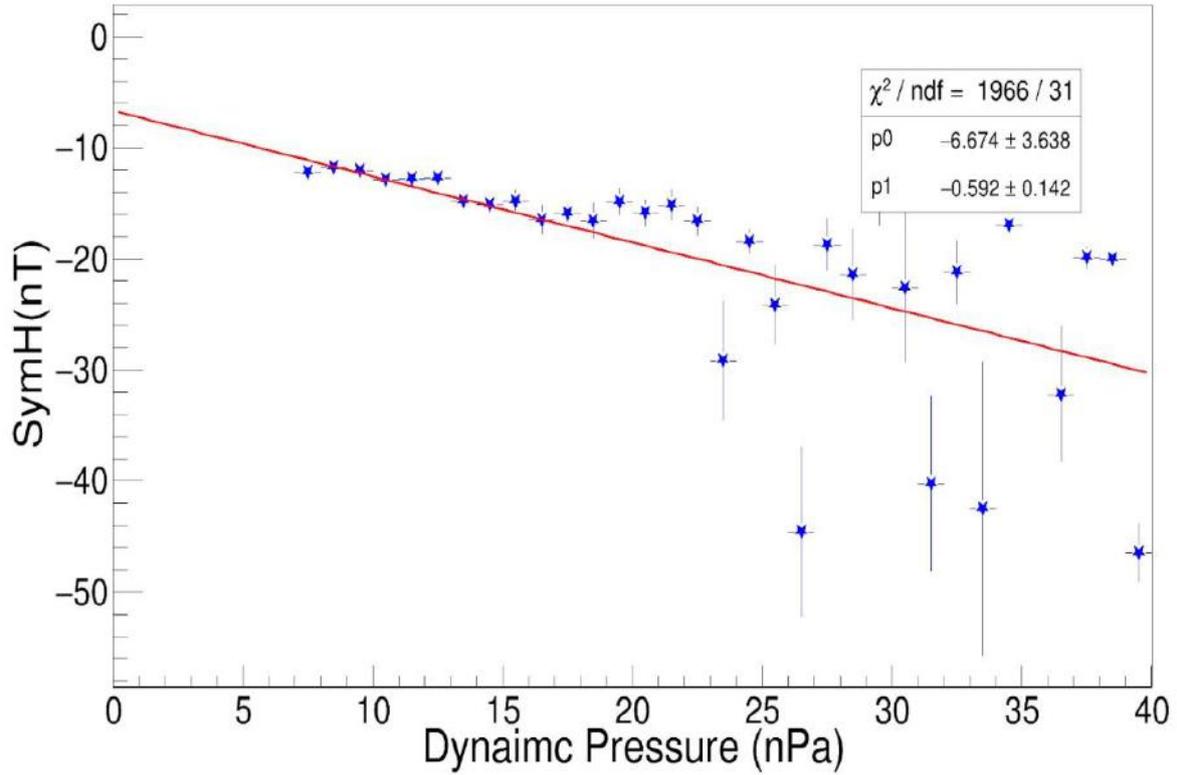


Fig 13: Dependency of dynamic pressure on the SymH

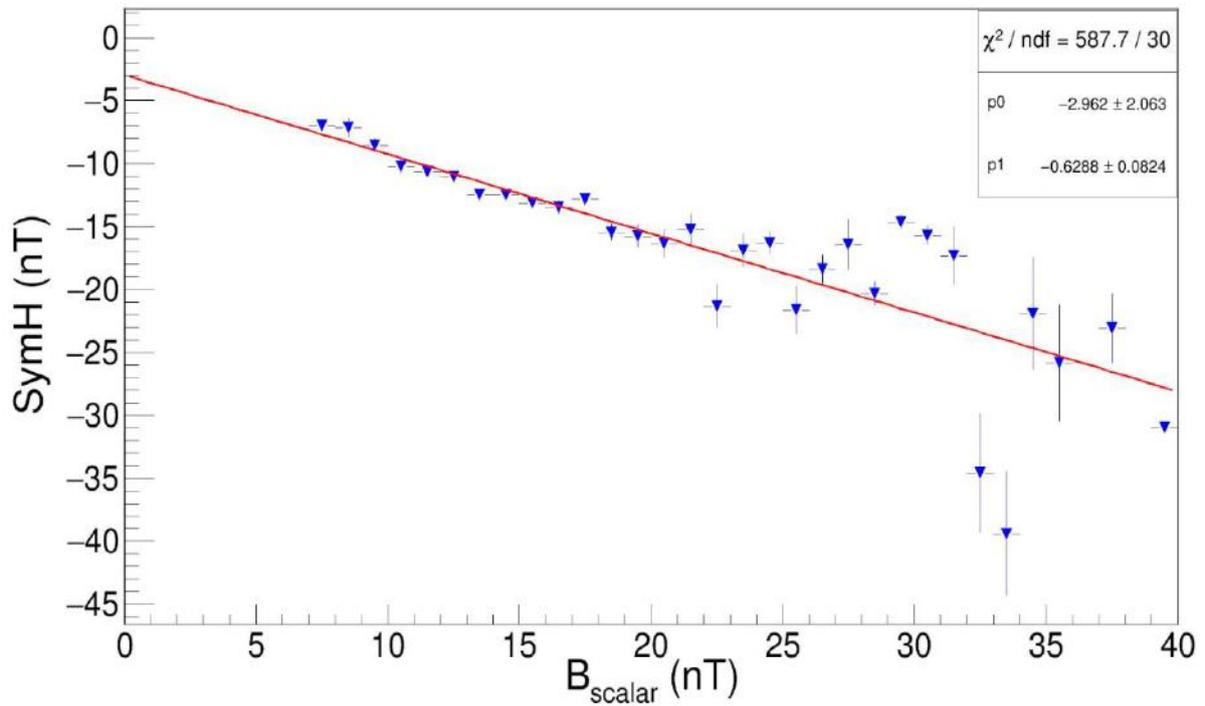


Fig 14: Dependency of scalar magnetic field on SymH

decrease with both magnetic field and dynamic pressure strengths. The dependency of dynamic pressure of SymH is  $\sim 0.592 \pm 0.142$  nT/nPa and that of magnetic field on SymH is  $\sim 0.6288 \pm 0.0824$ .

## 2.4. Data Analysis by Integration

The integration was done to find the total influence of pressure energy and magnetic energy and also the combined energy with the geomagnetic storm. We have used a threshold of  $3 \sigma$  level of dynamic pressure and magnetic field and the integration was done for events above this level. On integrating, we get a proxy value of pressure and magnetic field which indicates the total dynamic pressure and total magnetic pressure applied on the Earth's magnetosphere.

❖ 2001

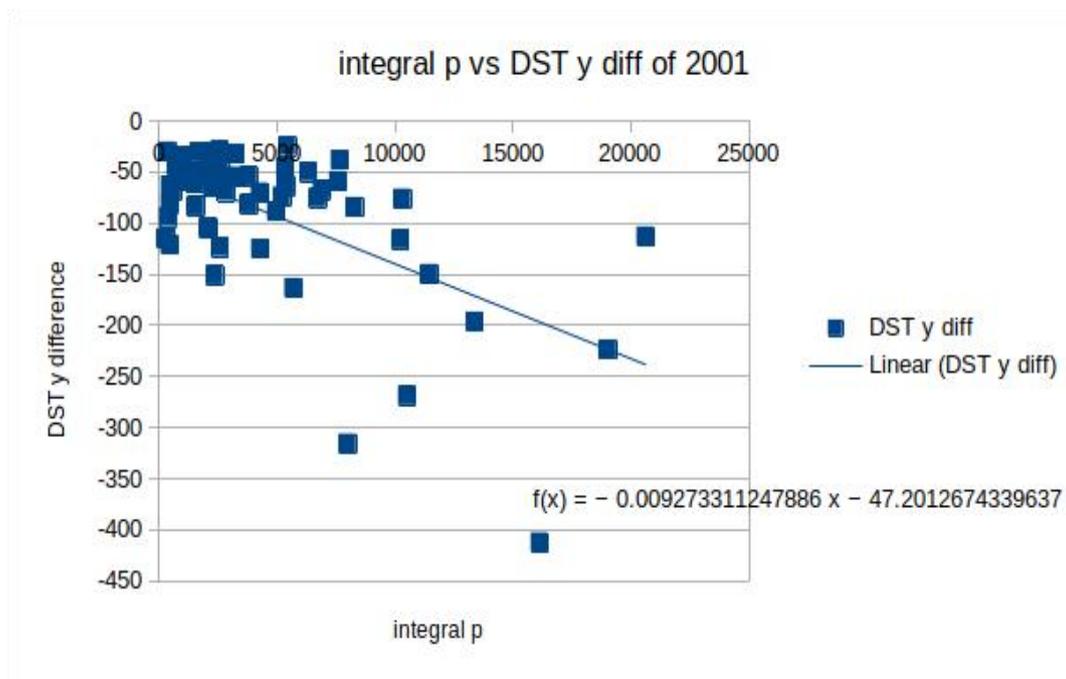


Fig 15: A plot of integrated values of pressure and events in DST profile

The figures 15 and 16 show the plots of integrated values of pressure and magnetic field with the events in DST profile for the year 2001. Each point indicates events. Pressure is measured in nano Pascal, while DST and

magnetic field are measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered.

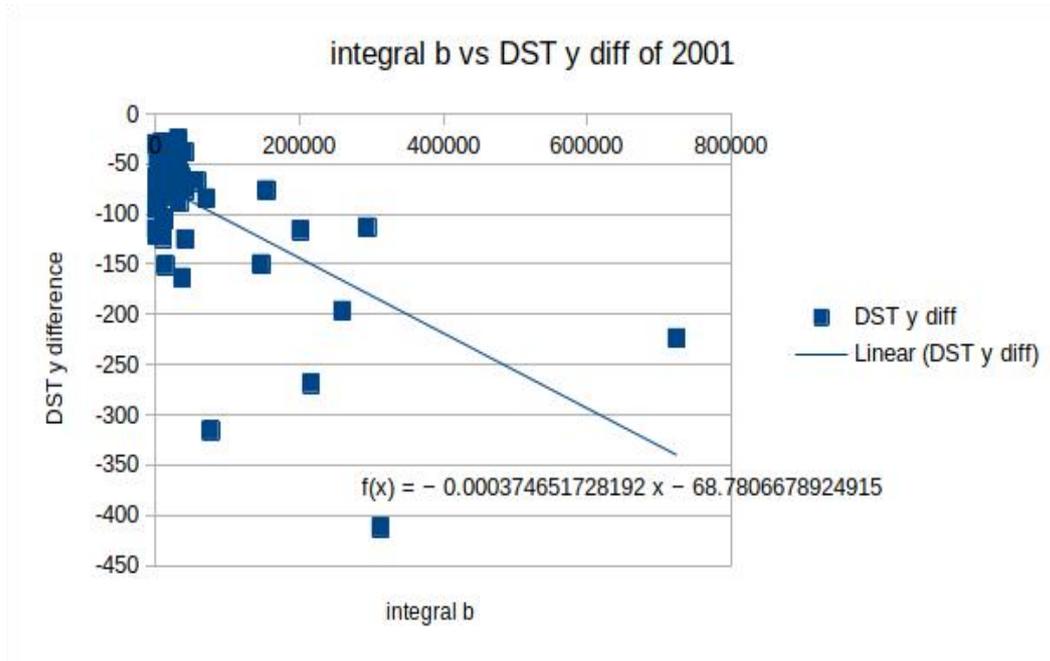


Fig 16: A plot of integrated values of magnetic field and events in DST profile

A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 15, the integrated values of pressure are taken along the x-axis and the events in DST profile along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.009273$ . The correlation is  $\sim -0.592607$ . In fig 16, the integrated values of magnetic field are taken along the x-axis and events in DST profile are taken along the y-axis. The trend line shows an increase with its slope  $\sim -0.0003746$ . Its correlation is  $\sim -0.603751$ .

The figures 17 and 18 show the plots of integrated values of pressure and magnetic field with the onset time for the year 2001. Each point indicates events. Pressure is measured in nano Pascal and magnetic field is measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered.

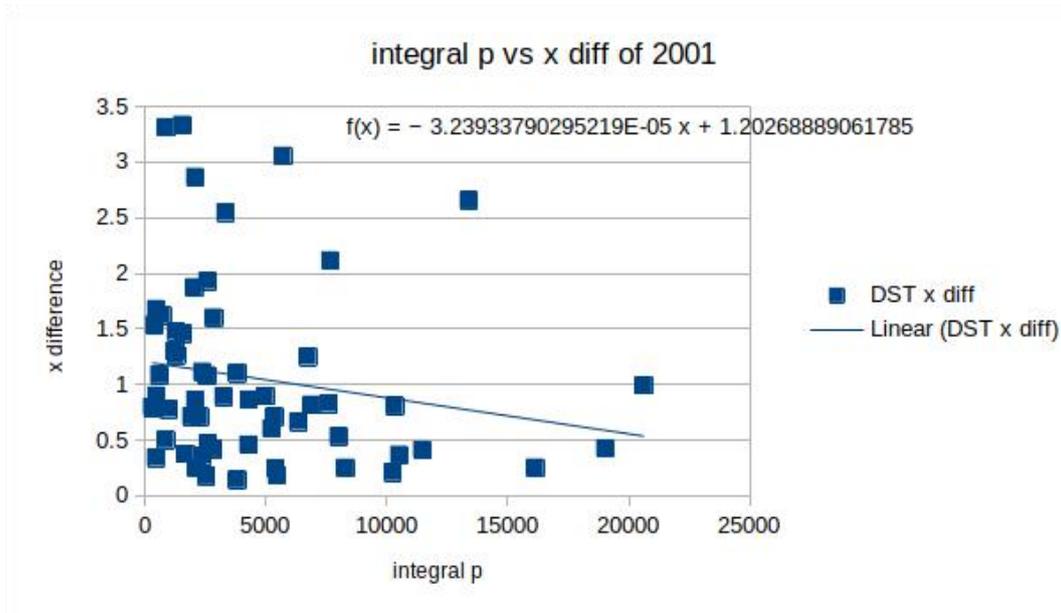


Fig 17: A plot of integrated values of pressure onset time

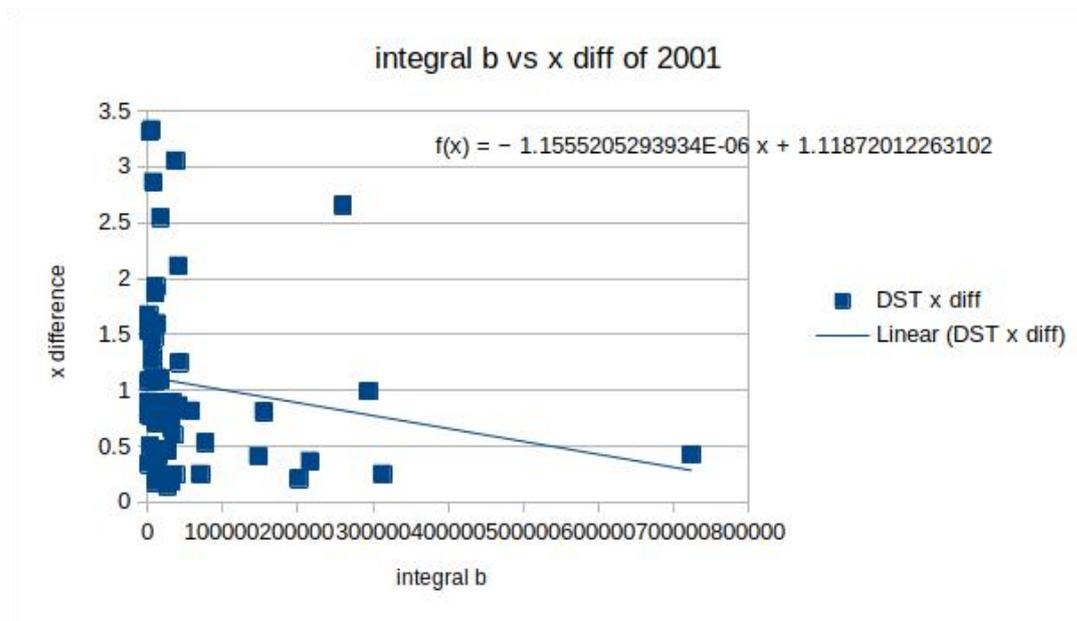


Fig 18: A plot of integrated values of magnetic field and onset time

A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 17, the integrated values of pressure are taken along the x-axis and the onset time along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -3.24E-05$ . Its correlation is  $\sim -0.18174$ . In fig 18, the integrated values of magnetic field are taken along the x-axis and

the onset time is taken along the y-axis. The trend line shows a decrease with its slope  $\sim -1.16E-06$ . Its correlation is  $\sim -0.163482$ .

❖ 2005

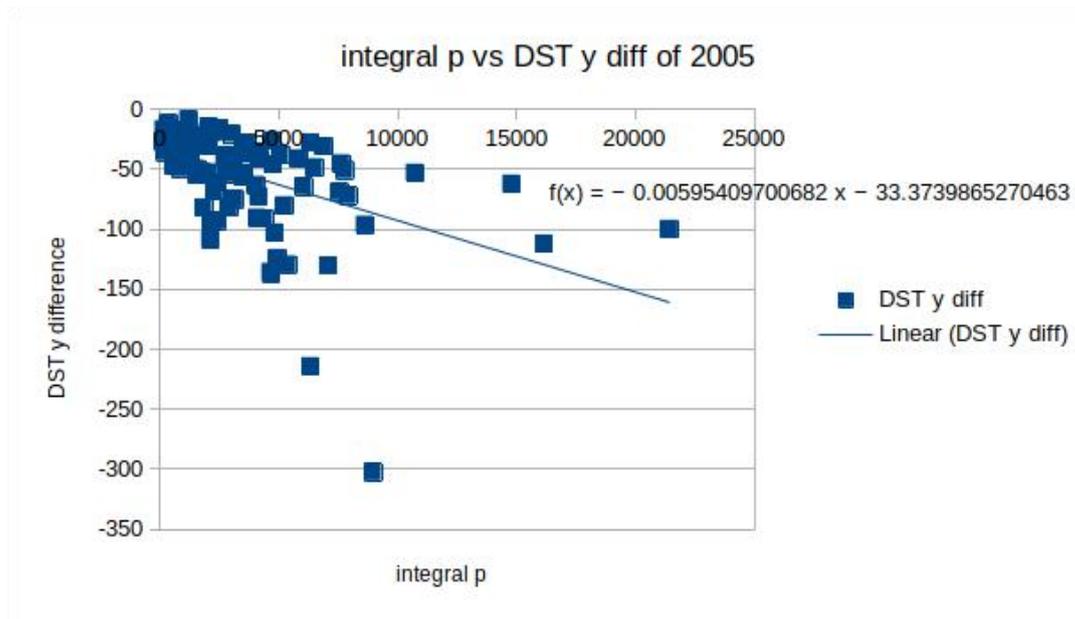


Fig 19: A plot of integrated values of pressure and events in DST profile

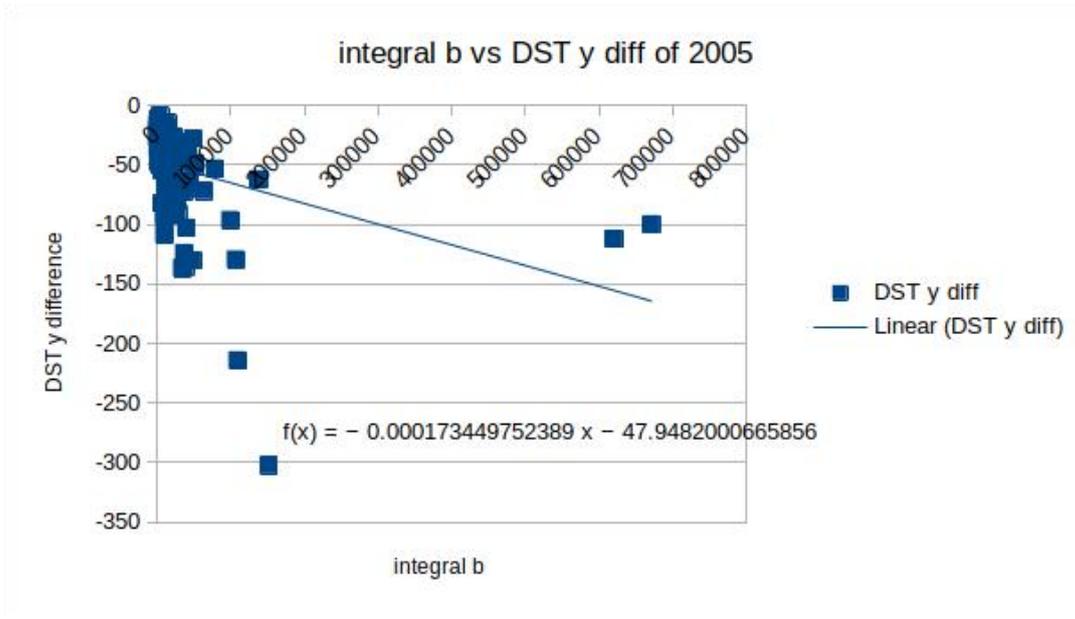
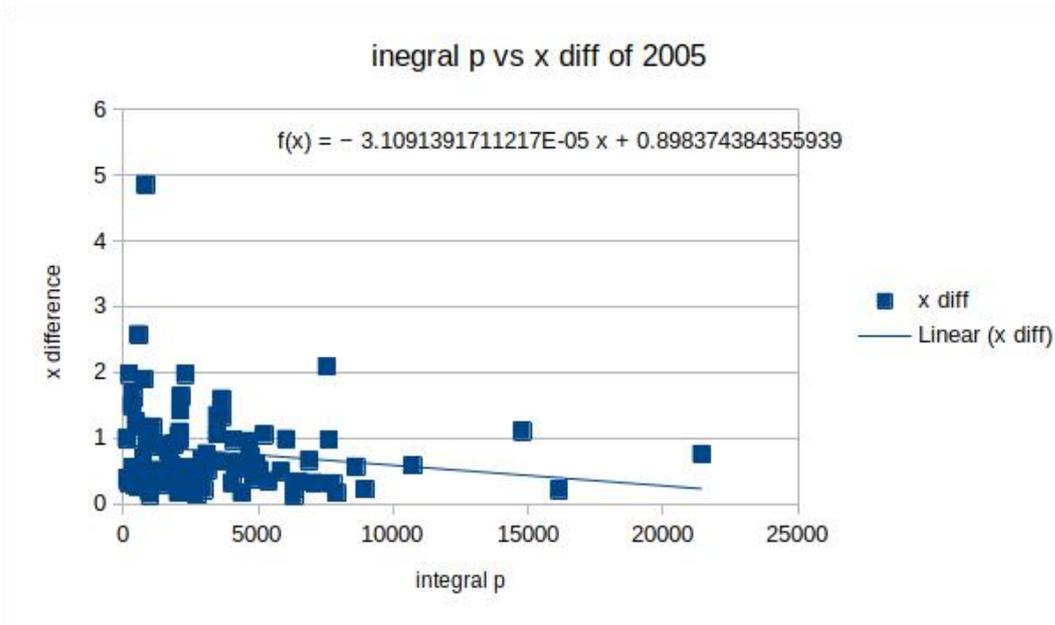


Fig 20: A plot of integrated values of magnetic field and events in DST profile

The figures 19 and 20 show the plots of integrated values of pressure and magnetic field with the events in DST profile for the year 2005. Each point indicates events. Pressure is measured in nano Pascal, while DST and

magnetic field are measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 19, the integrated values of pressure are taken along the x-axis and the events in DST profile along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.005954$ . Its correlation is  $\sim -0.476016$ . In fig 20, the integrated values of magnetic field are taken along the x-axis and events in DST profile are taken along the y-axis. The trend line shows an increase with its slope  $\sim -0.0001734$ . Its correlation is  $\sim -0.374054$ .



*Fig 21: A plot of integrated values of pressure and onset time*

The figures 21 and 22 show the plots of integrated values of pressure and magnetic field with the onset time for the year 2005. Each point indicates events. Pressure is measured in nano Pascal and magnetic field is measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated.

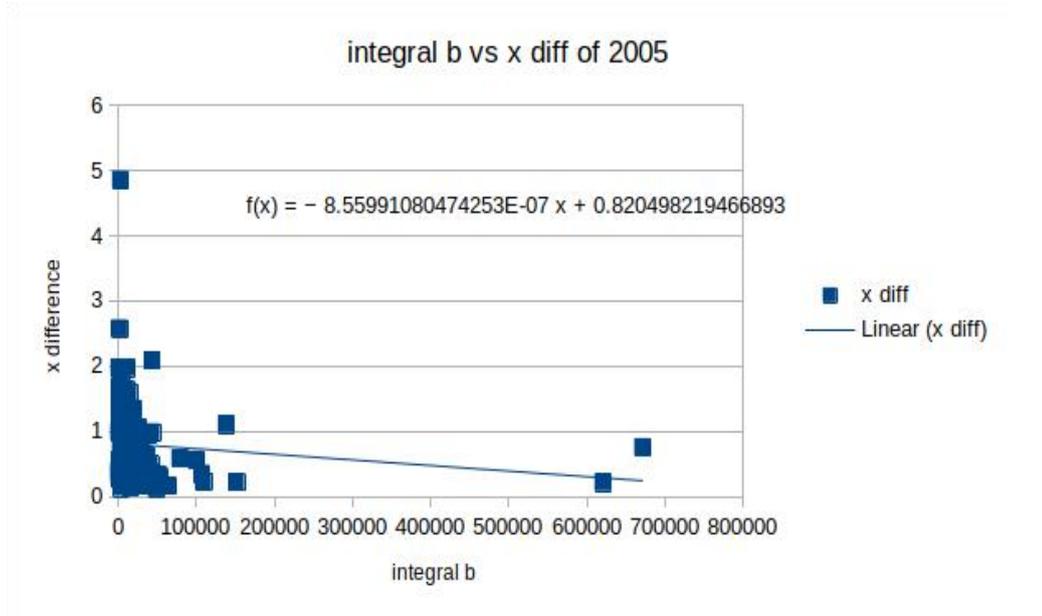


Fig 22: A plot of integrated values of magnetic field and onset time

In fig 21, the integrated values of pressure are taken along the x-axis and the onset time along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -3.11E-05$ . Its correlation is  $\sim -0.166861$ . In fig 22, the integrated values of magnetic field are taken along the x-axis and the onset time is taken along the y-axis. The trend line shows a decrease with its slope  $\sim -8.56E-07$ . Its correlation is  $\sim -0.123919$ .

❖ 2009

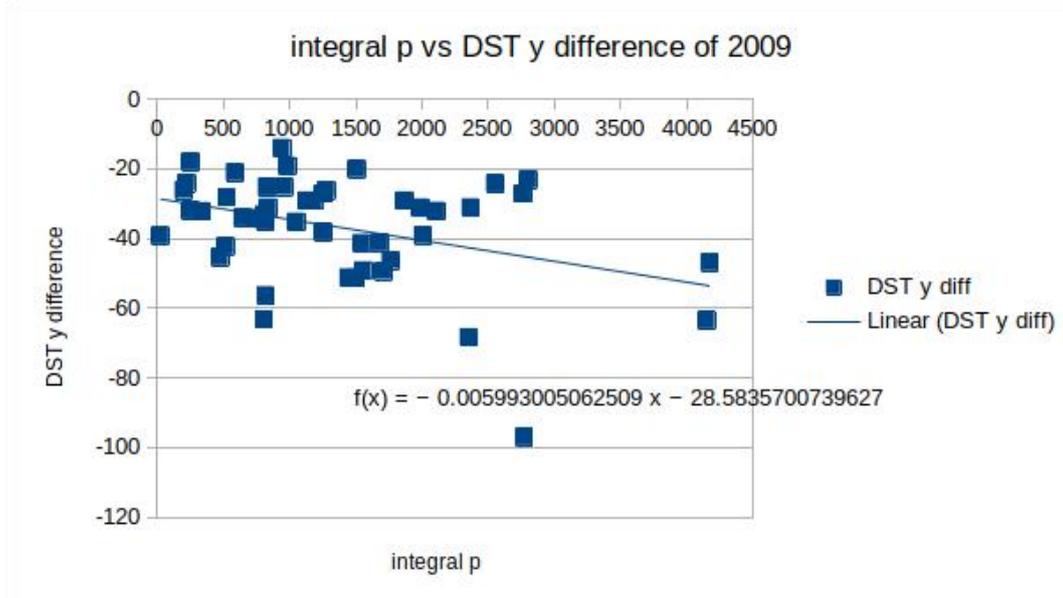


Fig 23: A plot of integrated values of pressure and events in DST profile

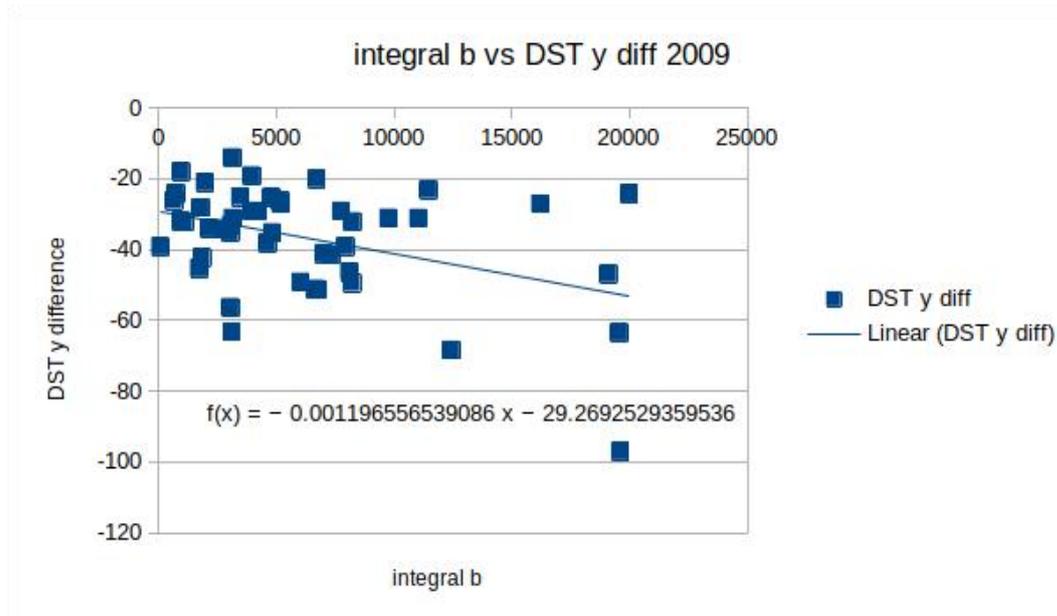


Fig 24: A plot of integrated values of magnetic field and events in DST profile

The figures 23 and 24 show the plots of integrated values of pressure and magnetic field with the events in DST profile for the year 2009. Each point indicates events. Pressure is measured in nano Pascal, while DST and magnetic field are measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 23, the integrated values of pressure are taken along the x-axis and the events in DST profile along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.005993$ . Its correlation is  $\sim -0.37024$ . In fig 24, the integrated values of magnetic field are taken along the x-axis and events in DST profile are taken along the y-axis. The trend line shows an increase with its slope  $\sim -0.0011966$ . Its correlation is  $\sim -0.416004$ .

The figures 25 and 26 show the plots of integrated values of pressure and magnetic field with the onset time for the year 2009. Each point indicates events. Pressure is measured in nano Pascal and magnetic field is measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered.

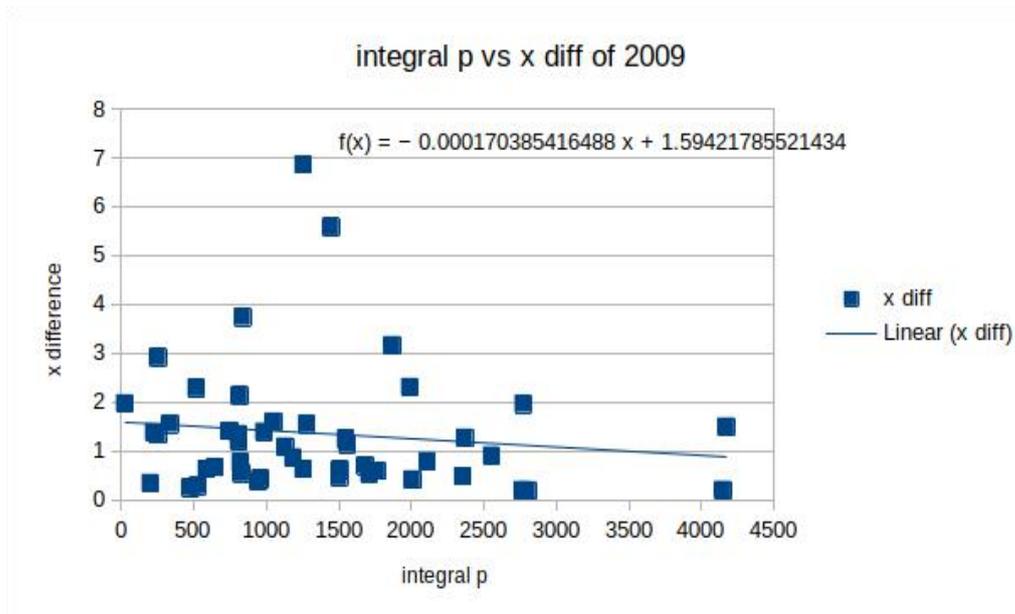


Fig 25: A plot of integrated values of pressure and onset time

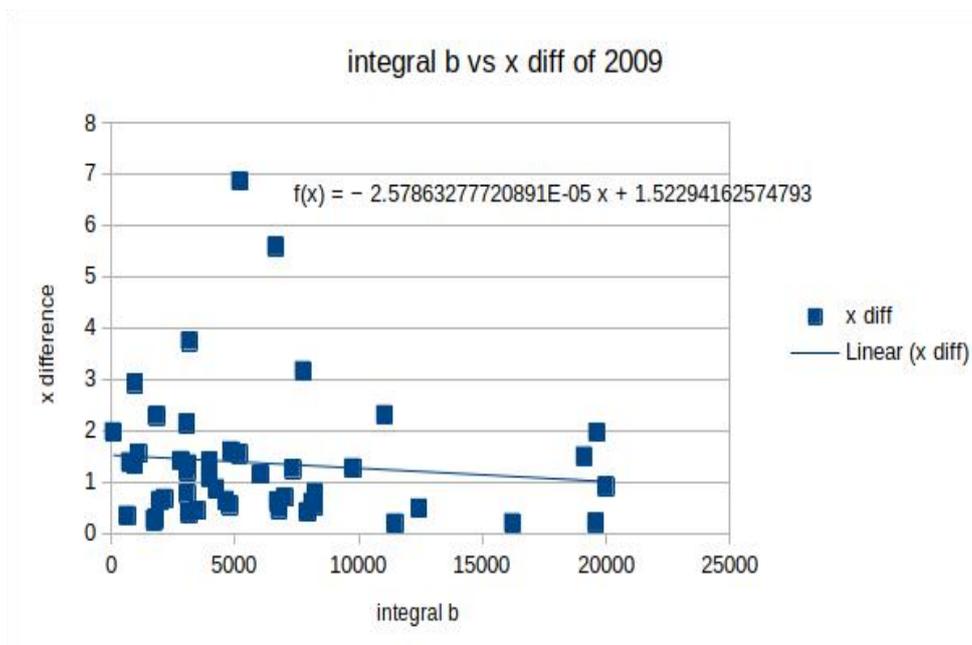


Fig 26: A plot of integrated values of magnetic field and onset time

A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 25, the integrated values of pressure are taken along the x-axis and the onset time along the y-axis. The trend line shows a decrease and its equation gives a slope of  $\sim -0.0001704$ . Its correlation is  $\sim -0.122395$ . In fig

26, the integrated values of magnetic field are taken along the x-axis and the onset time is taken along the y-axis. The trend line shows a decrease with its slope  $\sim -2.58E-05$ . Its correlation is  $\sim -0.104243$ .

❖ 2013

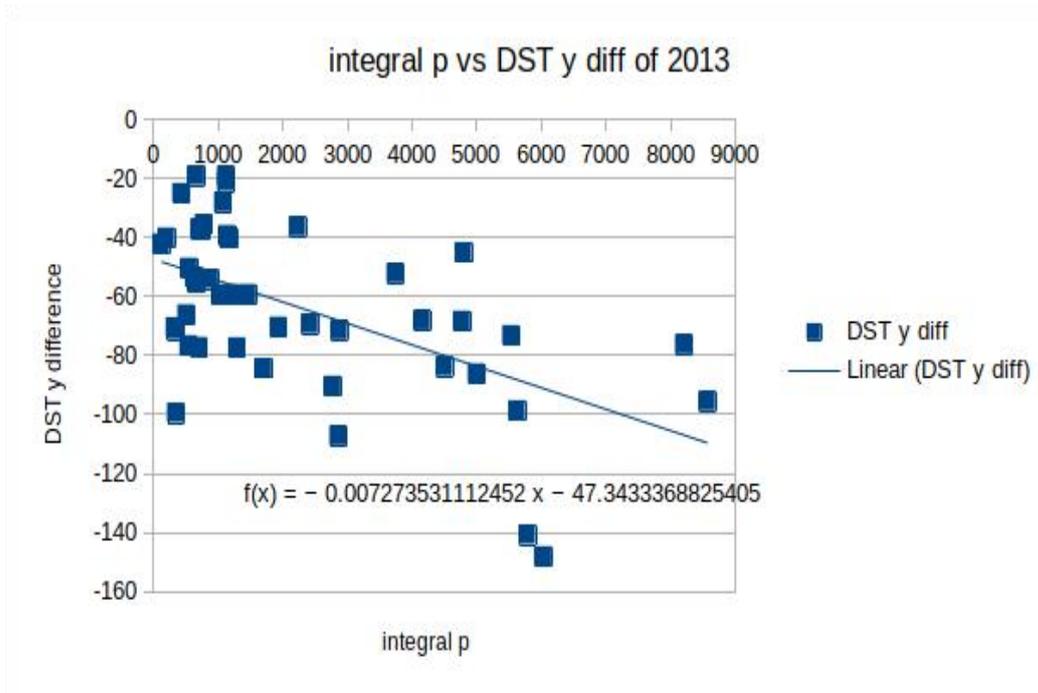


Fig 27: A plot of integrated values of pressure and events in DST profile

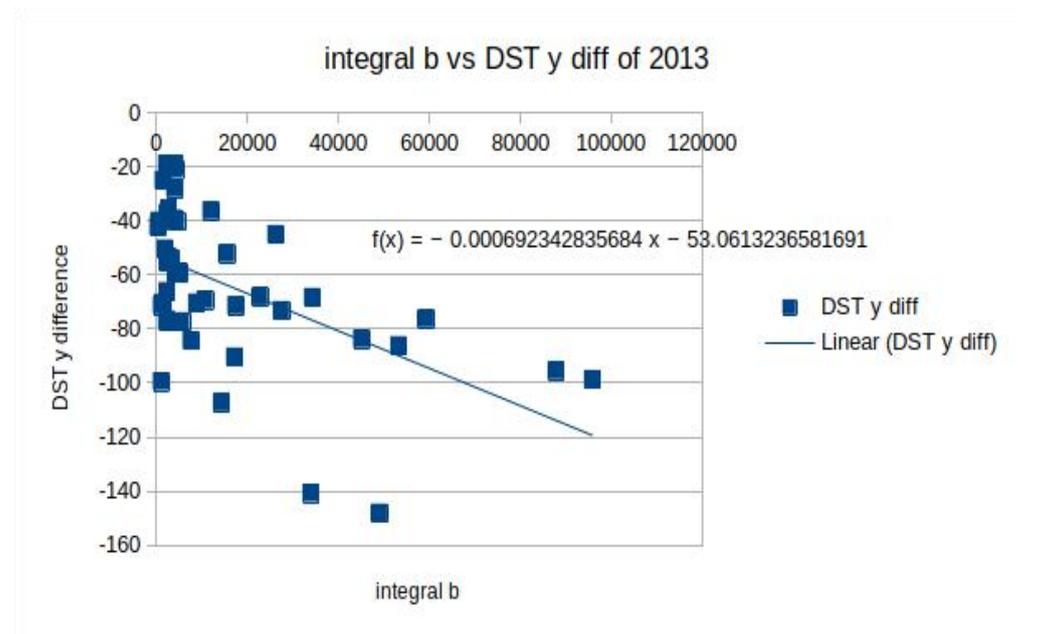


Fig 28: A plot of integrated values of magnetic field and events in DST profile

The figures 27 and 28 show the plots of integrated values of pressure and magnetic field with the events in DST profile for the year 2013. Each point indicates events. Pressure is measured in nano Pascal, while DST and magnetic field are measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 27, the integrated values of pressure are taken along the x-axis and the events in DST profile along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.007273$ . Its correlation is  $\sim -0.564138$ . In fig 28, the integrated values of magnetic field are taken along the x-axis and events in DST profile are taken along the y-axis. The trend line shows an increase with its slope  $\sim -0.0006923$ . Its correlation is  $\sim -0.544068$ .

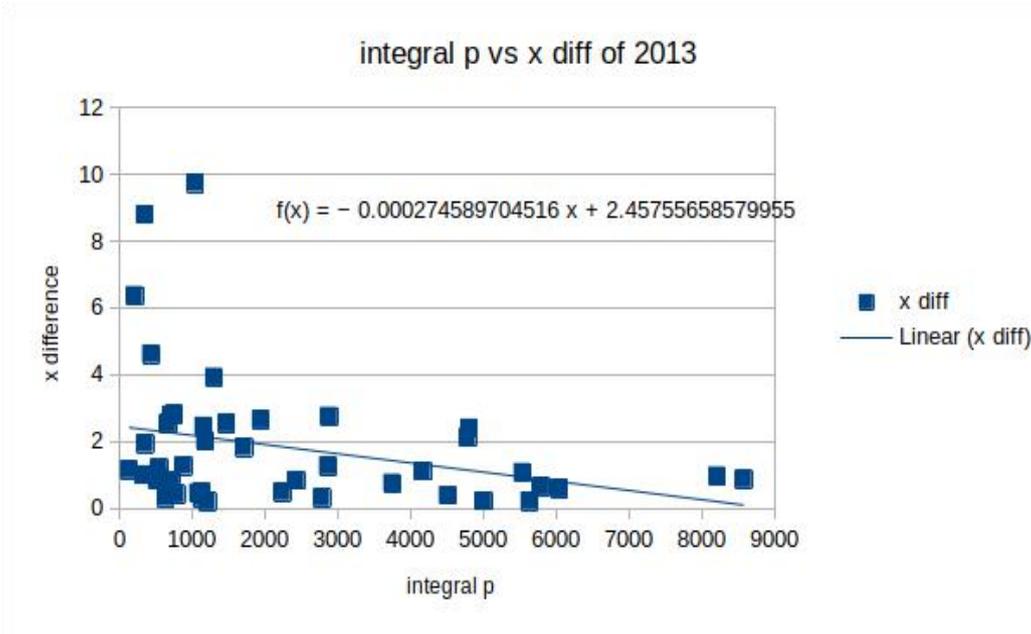


Fig 29: A plot of integrated values of pressure and onset time

The figures 29 and 30 show the plots of integrated values of pressure and magnetic field with the onset time for the year 2013. Each point indicates events. Pressure is measured in nano Pascal and magnetic field is measured

in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered.

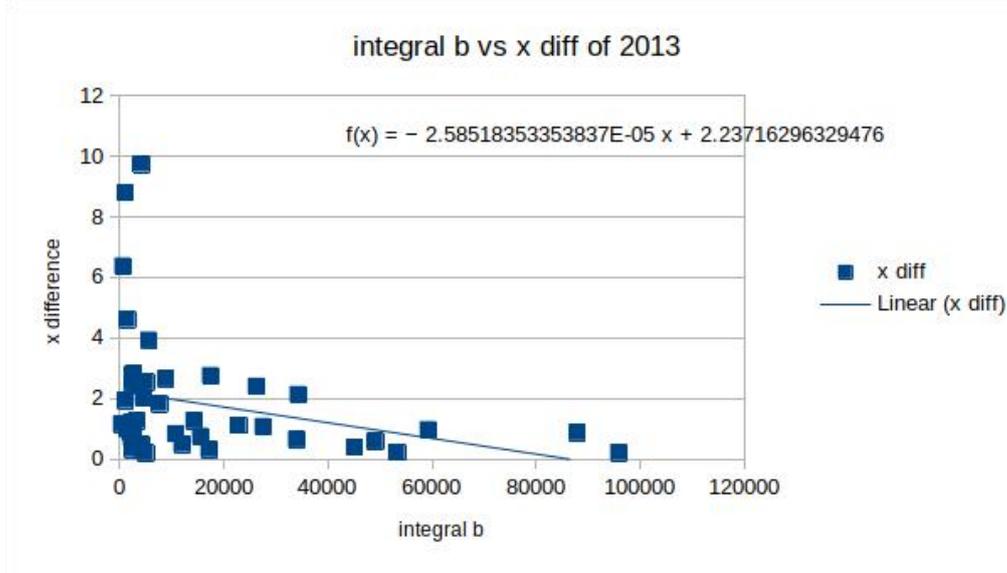


Fig 30: A plot of integrated values of magnetic field and onset time

A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 29, the integrated values of pressure are taken along the x-axis and the onset time along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.0002746$ . Its correlation is  $\sim -0.296414$ . In fig 30, the integrated values of magnetic field are taken along the x-axis and the onset time is taken along the y-axis. The trend line shows an increase with its slope  $\sim -2.59E-05$ . Its correlation is  $\sim -0.282747$ .

❖ 2017

The figures 31 and 32 show the plots of integrated values of pressure and magnetic field with the events in DST profile for the year 2017. Each point indicates events. Pressure is measured in nano Pascal, while DST and magnetic field are measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend

line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated.

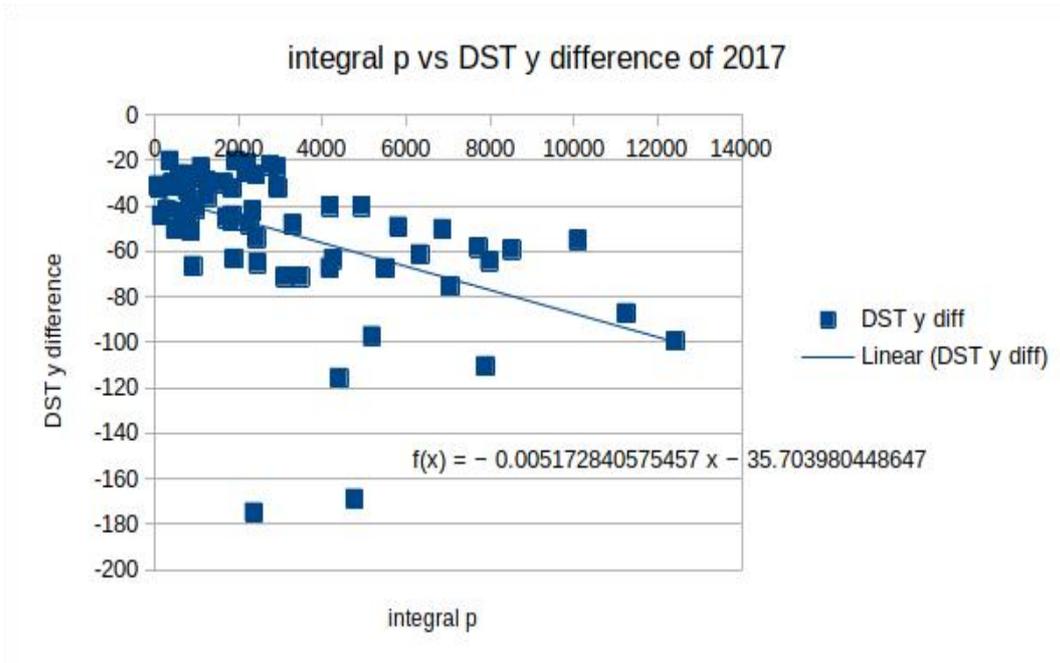


Fig 31: A plot of integrated values of pressure and events in DST profile

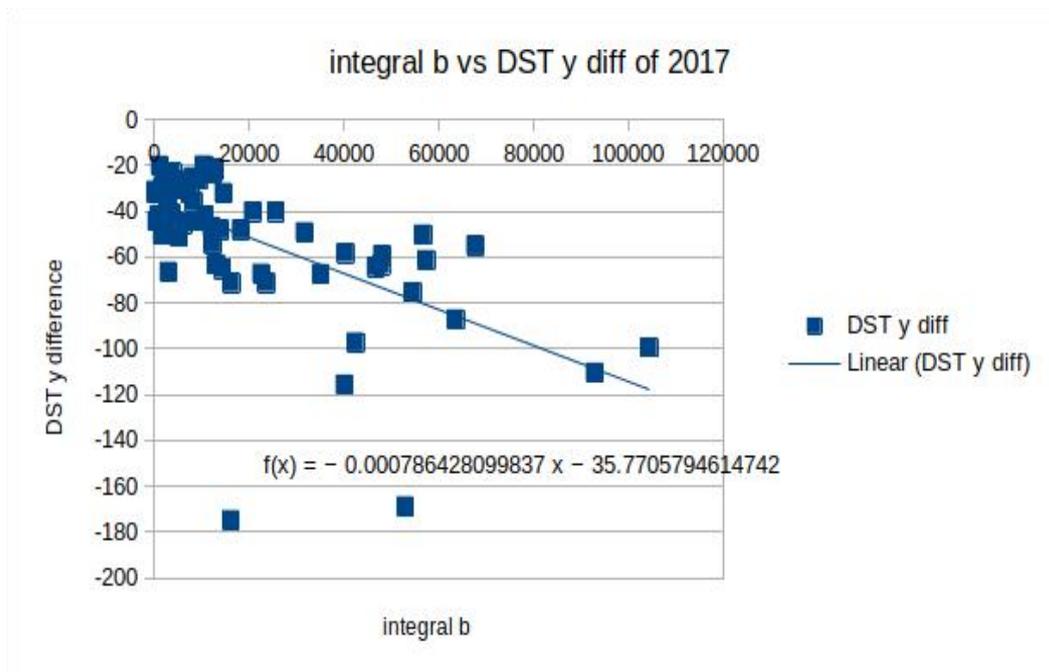


Fig 32: A plot of integrated values of magnetic field and events in DST profile

In fig 31, the integrated values of pressure are taken along the x-axis and the events in DST profile along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -0.005173$ . Its correlation is  $\sim$

0.486168. In fig 32, the integrated values of magnetic field are taken along the x-axis and events in DST profile are taken along the y-axis. The trend line shows an increase with its slope  $\sim -0.0007864$ . Its correlation is  $\sim 0.594531$ .

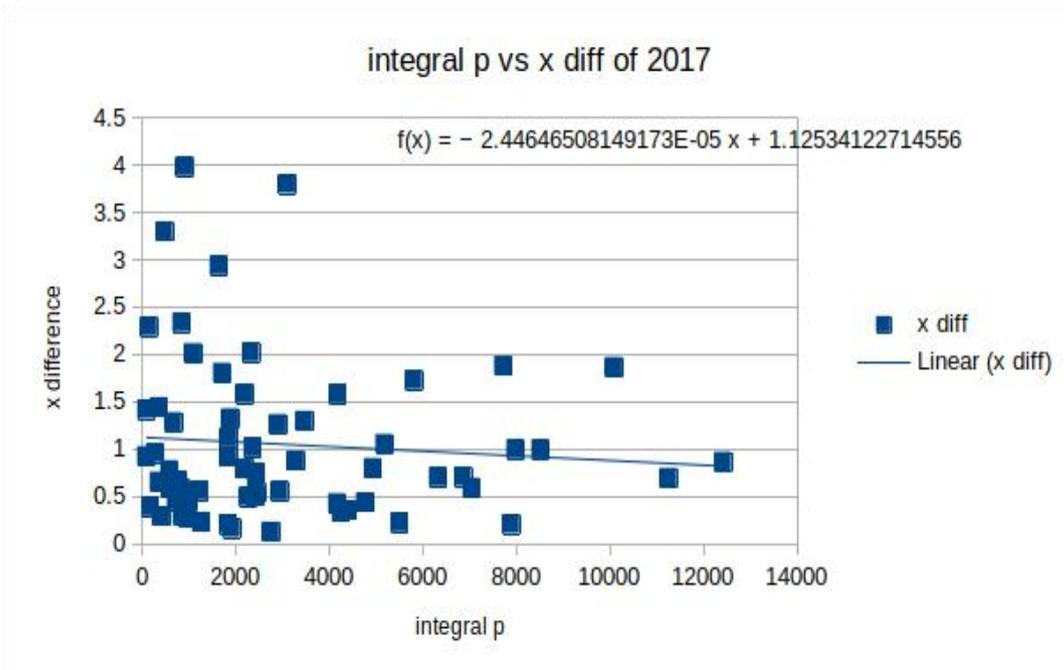


Fig 33: A plot of integrated values of pressure and onset time

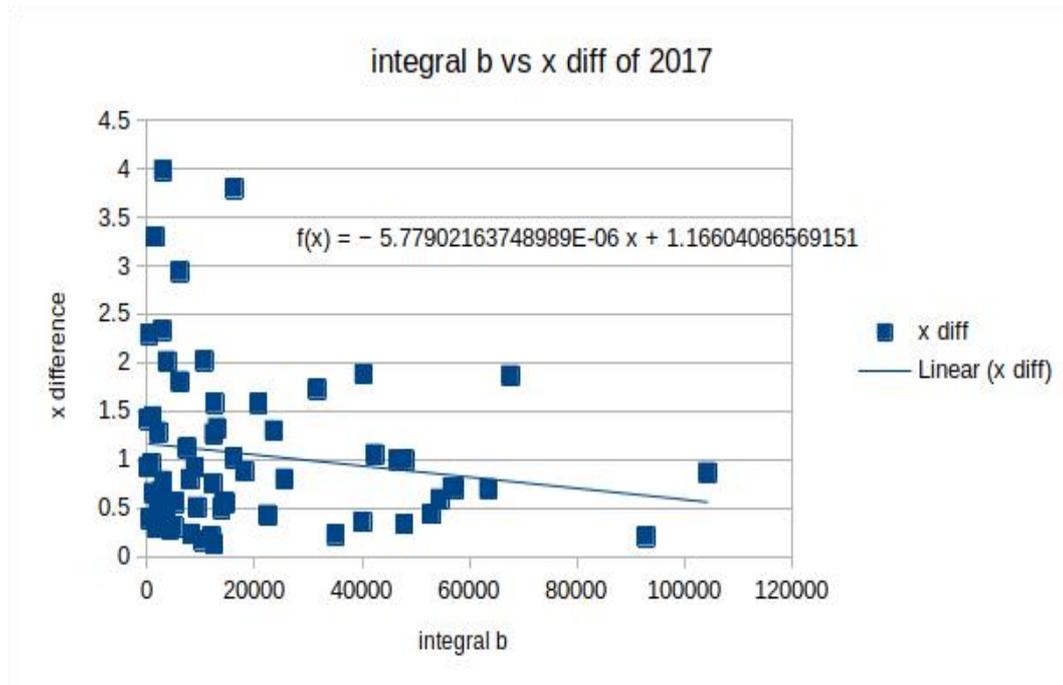


Fig 34: A plot of integrated values of magnetic field and onset time

The figures 33 and 34 show the plots of integrated values of pressure and magnetic field with the onset time for the year 2017. Each point indicates events. Pressure is measured in nano Pascal and magnetic field is measured in nano Tesla. We have obtained a plot with clustered points at the starting and further the values get scattered. A trend line was set for each plot showing its equation. Also in each case, the correlation between the corresponding quantities were calculated. In fig 33, the integrated values of pressure are taken along the x-axis and the onset time along the y-axis. The trend line shows an increase and its equation gives a slope of  $\sim -2.45E-05$ . Its correlation is  $\sim -0.083602$ . In fig 34, the integrated values of magnetic field are taken along the x-axis and the onset time is taken along the y-axis. The trend line shows an increase with its slope  $\sim -5.78E-06$ . Its correlation is  $\sim -0.158851$ .

## 2.5. Observations

### 1. Table 1:- DST

YEAR	SLOPE		CORRELATION	
	<i>Integral p with DST</i>	<i>Integral b with DST</i>	<i>Integral p with DST</i>	<i>Integral b with DST</i>
2001	-0.009273	-0.0003746	-0.592607	-0.603751
2005	-0.005954	-0.0001734	-0.476016	-0.374054
2009	-0.005993	-0.0011966	-0.37024	-0.416004
2013	-0.007273	-0.0006923	-0.564138	-0.544068
2017	-0.005173	-0.0007864	-0.486168	-0.594531

## 2. Table 2:- ONSET TIME

YEAR	SLOPE		CORRELATION	
	<i>Integral p with onset time</i>	<i>Integral b with onset time</i>	<i>Integral p with onset time</i>	<i>Integral b with onset time</i>
2001	-3.24E-05	-1.16E-06	-0.18174	-0.163482
2005	-3.11E-05	-8.56E-07	-0.166861	-0.123919
2009	-0.0001704	-2.58E-05	-0.122395	-0.104243
2013	-0.0002746	-2.59E-05	-0.296414	-0.282747
2017	-2.45E-05	-5.78E-06	-0.083602	-0.158851

Table 1 shows the slope and correlation of the pressure and magnetic field with the events in the DST profile for five years 2001, 2005, 2009, 2013 and 2017. Table 2 shows the slope and correlation of pressure and magnetic field with the onset time for the same years.

### 3. CONCLUSION

We have analysed the dependency of dynamic pressure and magnetic field with DST and onset values. Here, we have considered the events of five years and combining the results, we obtained the following plots. Then a straight line is fitted which is shown in red in the plots and in each case the slope and correlation are calculated.

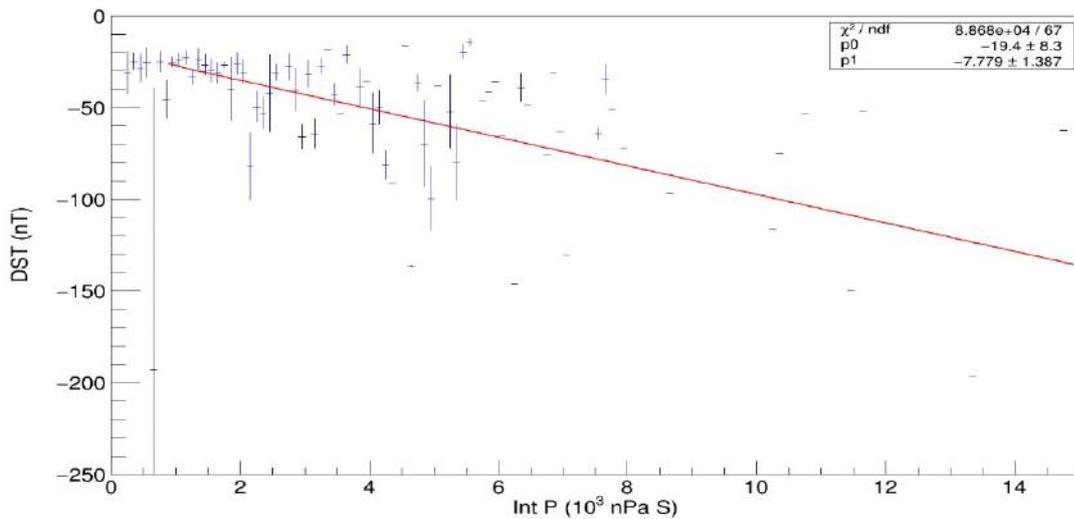


Fig 35: Dependency of dynamic pressure on DST

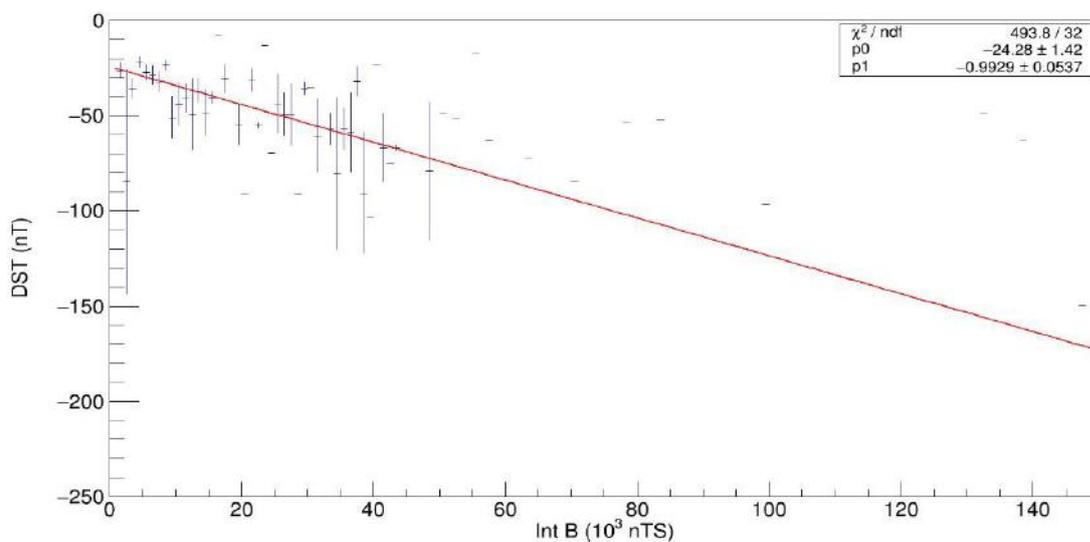


Fig 36: Dependency of magnetic field on DST

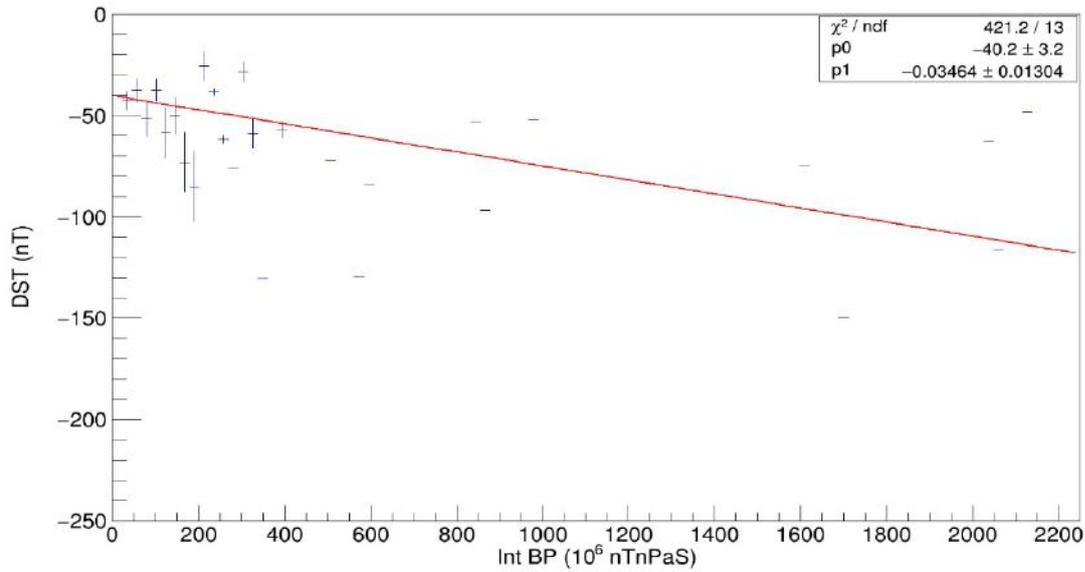


Fig 37: Dependency of B\*P on DST

The fig 35 indicates the dependency of dynamic pressure on DST. Dynamic pressure is taken along the x-axis and DST along the y-axis. We have fitted a straight line and found that it shows a good correlation of DST increase with dynamic pressure with a slope  $\sim -7.779 \pm 1.387$ . The fig 36 shows the dependency of magnetic field on DST. Magnetic field is taken along the x-axis and DST along the y-axis. On fitting a straight line, we found a good correlation of DST increase with magnetic field with a slope of  $\sim -0.9929 \pm 0.0537$ . Similarly, the fig 37 indicates the dependency of B\*P on DST. B\*P is taken along the x-axis and DST along the y-axis. Fitting of a straight line shows a good correlation of DST increase with B\*P with a slope of  $\sim -0.03464 \pm 0.01304$ .

The fig 38 indicates the dependency of dynamic pressure on onset values. Dynamic pressure is taken along the x-axis and onset along the y-axis. We have fitted a straight line and found that the onset doesn't show a good correlation with dynamic pressure and its slope is  $\sim -0.01577 \pm 0.01297$ . The

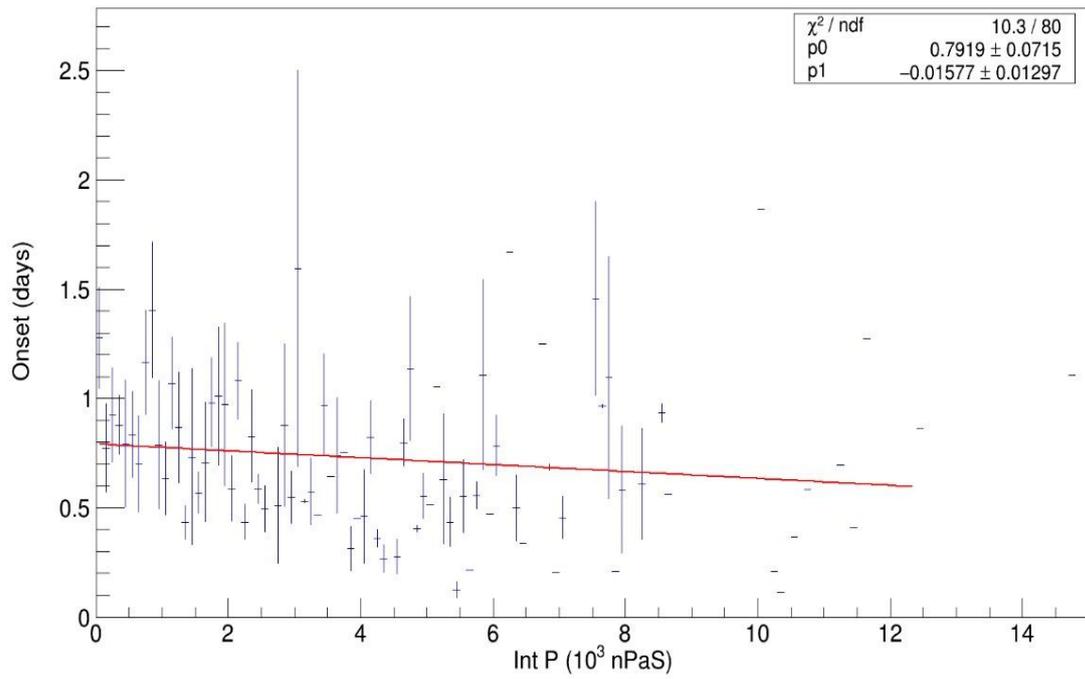


Fig 38: Dependency of dynamic pressure on onset

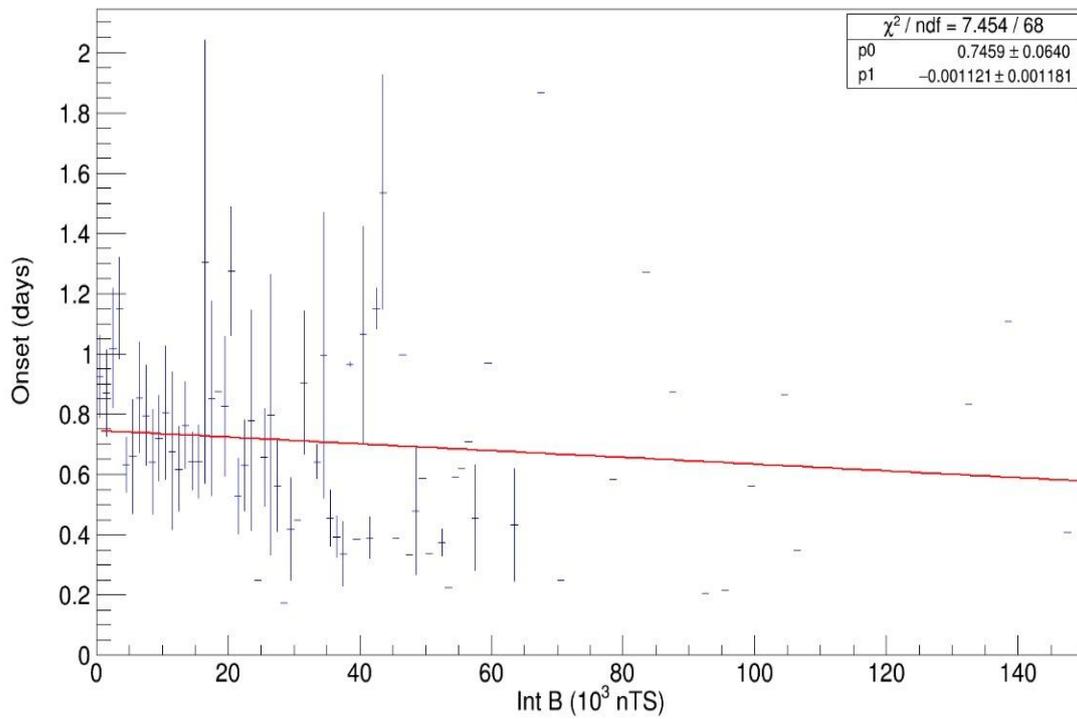
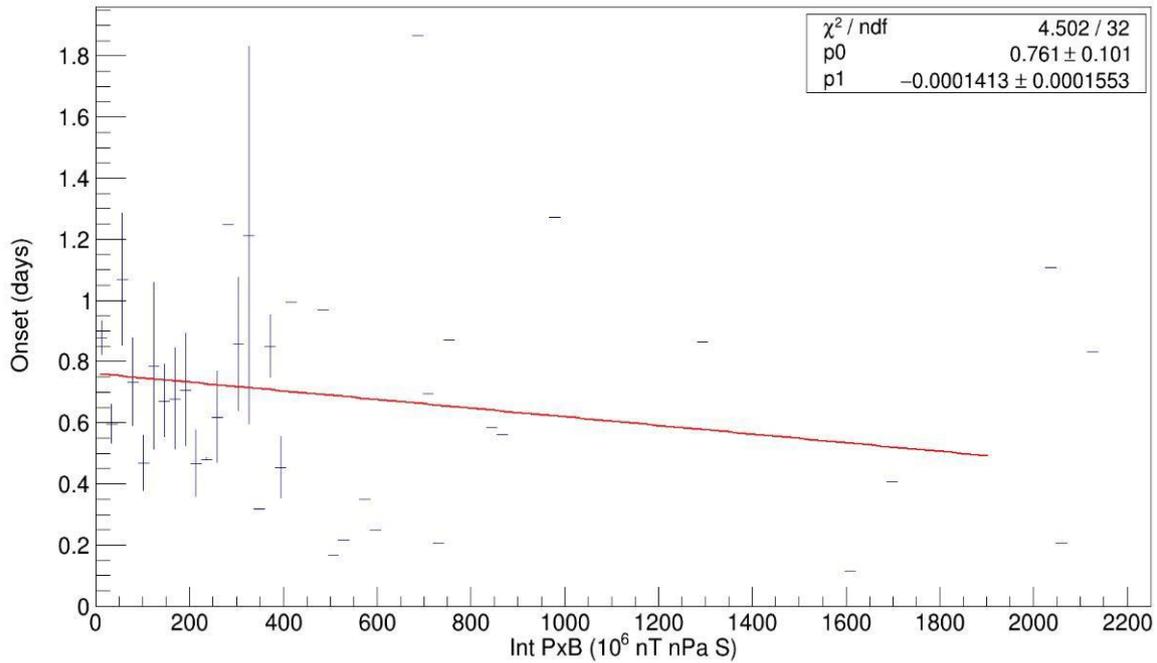


Fig 39: Dependency of magnetic field on onset



*Fig 40: Dependency of B\*P on onset*

fig 39 shows the dependency of magnetic field on onset along the y-axis. On fitting a straight line, we can see that it doesn't show a good correlation with magnetic field and its slope is  $\sim -0.001121 \pm 0.001181$ . Similarly, the fig 40 indicates the dependency of B\*P on onset values. B\*P is taken along the x-axis and onset along the y-axis. Fitting of a straight line shows that the onset values doesn't show a good correlation with B\*P and its slope is  $\sim -0.0001413 \pm 0.0001553$ .

From the above results, we can see a good correlation of DST with solar wind parameters that are considered here. A good correlation indicates the major contribution of these parameters on the Earth's magnetosphere. On the other hand, the onset values don't show a good correlation with these parameters. The onset time decreases with strength of the magnetic field.

## **4. FUTURE WORKS**

Due to lack of time, we had to stop our work in between and based on our analysis, we have arrived up to the above conclusions. Here, only dynamic pressure and magnetic field are considered. We plan to expand our work in a more detailed way by considering the other parameters of solar wind. All the results until now are made irrespective of the  $B_z$  component of the magnetic field. In further study we will include them.

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**DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM**  
**PROJECT REPORT**

Submitted by

LINU GEORGE

Register No: AM20PHY009

Under the guidance of

DR. MARY VINAYA

In partial fulfillment of the requirement for the award

Of

**MASTERS DEGREE OF SCIENCE IN**  
**PHYSICS**



**ST.TERESA'S COLLEGE (AUTONOMOUS),**  
**ERNAKULAM, KOCHI-682011**

# ST. TERESAS COLLEGE, ERNAKULAM



## MSc PHYSICS PROJECT REPORT

Name : LINU GEORGE  
Register No. : AM20PHY009  
Year of work : 2020-2022

This is to certify that the project "DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM" was done by LINU GEORGE.

*Mary Vunaja*  
Staff member in charge

*Dr. Mary Vunaja*



*Pooja*  
Head of the Department

Submitted for the university examination held in St. Teresa's College  
(Autonomous), Ernakulam.

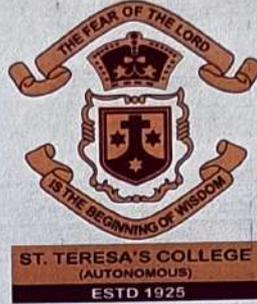
Examiners

1) *Dr. Issac Paul*

2) *Dr. Visham Mathew*

*[Signature]*  
Date: 14.06.2022

**ST.TERESA'S COLLEGE**  
**(AUTONOMOUS)**  
**ERNAKULAM**



**CERTIFICATE**

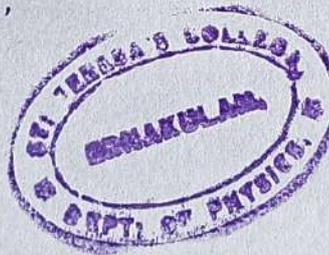
This is to certify that the project report title “**DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM**” submitted by **LINU GEORGE**, towards partial fulfillment of the requirements for the award of the degree of Master of Physics is a record of bonafide work carried out by them during the academic year 2020-2022.

**Supervising guide**

**Dr. Mary Vinaya**

**Assistant professor**

**Department of Physics**



**Head of the department**

**Dr. Priya Parvathi Ameena Jose**

**Associate Professor**

**Department of Physics**

**PLACE: Ernakulam**

**DATE: 14.06.2022**

## **DECLARATION**

I, LINU GEORGE, Register No. AM20PHY009, Department of Physics, St. Teresa's College (Autonomous), Ernakulam do hereby declare that this project work entitled **"DBS DYNAMICS OF MEMRISTIVE LIF NEURON SYSTEM"** submitted to Mahatma Gandhi University, Kottayam in partial fulfillment of the requirements for the award of the degree of Master of Science in Physics is a record of original work done by us under the supervision of Dr. Mary Vinaya, Assistant Professor, St. Teresa's College (Autonomous), Ernakulam.

Place: Ernakulam

Date:14/06/2022

## **ACKNOWLEDGEMENT**

Every project big or small is successful largely due to the effort of a number of wonderful people who have always given their valuable or extensive cooperation.

First and foremost we would like to thank God Almighty for showering his blessings on us in this endeavor.

We express our sincere gratitude to Dr. Mary Vinaya, Assistant Professor, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, under whose able guidance and supervision, we could complete our project. Her extensive cooperation and valuable guidance were the light in the dark for us in the course of this project.

We take this opportunity to thank Dr. Priya Parvathy Ameena Jose, Head of the Physics Department for the generous concern and support given to us. We express our sincere sense of gratitude to both teaching and non-teaching staffs of Department of Physics, St. Teresa's College (Autonomous), Ernakulam, for extending facilities required from time to time.

We would like to thank each and every one who has contributed to this work by their unfailing support throughout the preparation of the project.

**DBS DYNAMICS OF MEMRISTIVE LIF  
NEURON SYSTEM**

# CONTENTS

Abstract.....	1
<b>Chapter 1: NON LINEAR DYNAMICS</b>	
1.1 Dynamical systems.....	2
1.2 Linearity versus Non linearity .....	3
1.3 Nonlinear systems.....	4
1.4 Characteristics of nonlinear systems.....	5
1.5 Characterization of nonlinear systems.....	9
<b>Chapter 2: NEURAL NETWORK</b>	
2.1 What is a Neuron?.....	10
2.2 Structure of a Neuron.....	11
2.3 What is Synapse?.....	12
2.4 Neurotransmitters and Action potential.....	14
2.5 Communication of Neurons.....	15
<b>Chapter 3: REVIEW OF BRAIN STIMULATION ON TM MODEL</b>	
3.1 Deep Brain Stimulation.....	17
3.2 Tsodyks-Markram (TM) model.....	19
3.3 Synaptic response to DBS.....	21

## Chapter 4: THE LIF SPIKING NEURON MODEL

4.1 Introduction.....	24
4.2 Post-synaptic neuron firing.....	26
4.3 Result.....	27

## Chapter 5: DYNAMICS OF MEMRISTIVE LIF MODEL UNDER DEEP BRAIN STIMULATION

5.1 Introduction.....	38
5.2 Memristor properties.....	40
5.3 The Memristive LIF (MLIF) spiking neuron model.....	44
5.4 Result.....	46

## Chapter 6: DISCUSSION.....67

MATLAB code for TM Model.....	69
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MATLAB code for LIF Neuron Model.....	73
---------------------------------------	----

MATLAB code for MLIF Neuron Model.....	78
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REFERENCES.....	84
-----------------	----

## ABSTRACT

Deep brain stimulation (DBS) is a successful clinical therapy for a wide range of neurological disorders; however, the physiological mechanisms of DBS remain unresolved. While many different hypotheses currently exist, our analyses suggest that high frequency (130 Hz) stimulation-induced synaptic suppression represents the most basic concept that can be directly reconciled with experimental recordings of spiking activity in neurons that are being driven by DBS inputs.

The goal of this project was to develop a simple model system to characterize the excitatory post-synaptic currents (EPSCs) and action potential signaling generated in a neuron that is strongly connected to pre-synaptic glutamatergic inputs that are being directly activated by DBS.

We used the Tsodyks-Markram (TM) phenomenological synapse model to represent depressing, facilitating, and pseudo-linear synapses driven by DBS over a wide range of stimulation frequencies. The EPSCs were then used as inputs to a leaky integrate-and-fire neuron model (LIF) and later to a memristor leaky integrate-and-fire neuron model (MLIF) in order to measure the DBS-triggered post-synaptic spiking activity.

The result we obtained is that the synaptic suppression was a robust feature of high frequency stimulation, independent of the synapse type and MLIF neuron model exhibits greater spiking activity than LIF neuron model.

# CHAPTER 1

## NON-LINEAR DYNAMICS

### 1.1 Dynamical systems

Dynamical systems are found all around us. A dynamical system is a system whose state is distinctively specified by a set of variables and whose behavior is outlined by certain predefined rules. Some examples of dynamical systems are population growth, a swinging pendulum, the motions of celestial bodies, and the behavior of “rational” individuals playing a negotiation game, to name a few. If you assume that individuals make decisions always perfectly rationally, then the decision making process becomes deterministic, and therefore the interactions among them may be modeled as a deterministic dynamical system. Of course, this doesn't guarantee whether it is a good model or not [1]. The main reason behind studying dynamic systems is to predict system behavior and to control it.

Dynamical systems first developed from the geometry of Newton's equations and the question of the stability of the solar system motivated further researches inspired by celestial mechanics. Then dynamical systems developed intensively from stability theory (Lyapunov's theory) to generic properties (based on functional analysis techniques,) hyperbolic structures and to perturbation theory [2].

Dynamical systems are deterministic mathematical models, where time can be either a continuous or a discrete variable. Both qualitative and quantitative properties of such models are of interest to researchers [3]. Dynamical systems are usually studied in order to figure out their complex behaviors such as chaos, hyperchaos, transient chaos, bursting oscillations, mixed mode oscillations, multistability and extreme multistability [4].

The equations representing a dynamical system describe the change in time of variables taken to adequately describe the target system and these equations are referred to as dynamical or evolution equations. A complete specification of the initial state of such equations is referred to as the initial conditions for the model, while a characterization of the boundaries for the model domain are

known as the boundary conditions. A simple example of a dynamical system would be the equations modelling a particular chemical reaction, where a set of equations relates the temperature, pressure, amounts of the various compounds and their reaction rates. The boundary condition might be that the container walls are maintained at a fixed temperature. The initial conditions would be the starting concentrations of the chemical compounds. The dynamical system would then be taken to describe the behavior of the chemical mixture over time [3].

The variables that completely describe the state of the dynamical system are called the state variables. The set of all the possible values of the state variables is the state space. An instantaneous state is taken to be characterized by the instantaneous values of the variables considered crucial for a complete description of the state. The state space can be discrete, consisting of isolated points, such as if the state variables could only take on integer values. It could be continuous, consisting of a smooth set of points, such as if the state variables could take on any real value. The number of state variables is the dimension of the dynamical system. The state space can also be infinite-dimensional. When the state of the system is fully characterized by position and momentum variables, the resulting space is often called a phase space. A model can be studied in state space by following its trajectory, which is a history of the model's behavior in terms of its state transitions from the initial state to some chosen final state [3, 4].

## **1.2 Linearity Versus Non linearity**

Linear systems are rare in nature. A linear system is one in which the cause produces a constant proportionality effect. The dynamics of a linear system can be reconstructed by summing up the individual causes acting on a single component. Small initial errors in prediction or from a random measurement grow linearly over time. Linear phenomena are concerned with inter relationship between cause and effect, which can be determined with great accuracy.

A linear system can be characterized in several different ways. Its dynamics can be represented by a system of linear differential equations (for continuous-time systems) or linear difference equations (for discrete-time systems). It has a

transfer function and obeys the law of superposition. A sinusoidal input produces a sinusoidal output of the same frequency. One of the most common ways to test for a system's linearity is by verifying if it follows the law of superposition. Superposition is composed of two parts, scaling and additively.

Nonlinear systems are ubiquitous in nature. A nonlinear system is simply one that is not linear. However, there are several reasons why a system might be nonlinear, and different classes of nonlinearities come about because of different physical reasons.

### **1.3 Nonlinear systems**

A nonlinear system is a system in which the variation in the output is not proportional to the variations occurring in the input. As most real physical systems are inherently nonlinear in nature, nonlinear systems are of great interest to physicists, engineers and mathematicians [5]. For a nonlinear system a small change in a parameter may cause sudden and dramatic changes, resulting in a complex and unpredictable trajectory. A curve for a nonlinear system consists of a smooth curve, wiggles, an abrupt cut-off or any number of different types of lines. That is a nonlinear system can be considered as a sum of its parts. A small initial error in prediction or from a random measurement grows exponentially over time. A large scale deviation and huge unpredictable effects can take place from small initial changes.

The behavior of a nonlinear system is described in mathematics by a nonlinear system of equations. In a nonlinear system of equations, the equation(s) to be solved cannot be written as a linear combination of the unknown variables or functions that appear in them. Non-linear dynamic systems do not obey superposition principle. They have multiple isolated equilibrium points. The state of an unstable nonlinear system can reach up to infinity in finite time [6]. Nonlinear equations are difficult to be solved by analytical methods and give rise to interesting phenomena such as bifurcation, limit cycle and chaos.

The purpose of nonlinear dynamic systems is twofold. To begin with, it serves as an instrument to analyze information (e.g., EEG rhythms, eye developments, and so on). Second, it is utilized to show the various areas being scrutinized

(from neuroscience to imagination). Time and change are the two factors behind the strength of the nonlinear dynamic systems approach [7]. Nonlinearity might stay inactive or, lead to subjective changes of conduct contingent upon the values of the control parameters portraying the manner in which a framework has been at first ready or is being permanently requested by the external world [8].

## **1.4 Characteristics of nonlinear systems**

### **1.4.1 Limit cycle**

One peculiar behavior exhibited by nonlinear systems is a limit cycle. Although linear systems may oscillate, this oscillatory behavior cannot be explained in terms of linear theory. It is characterized by a constant amplitude and frequency determined by the nonlinear properties of the system irrespective of the initial conditions, external data inputs, or perturbations [9, 10].

A limit cycle is a closed trajectory in phase space exhibiting the property that at least one other trajectory spirals into it either as time approaches infinity or as time approaches negative infinity [10]. A limit cycle is said to be asymptotic stable if all trajectories nearby the limit cycle converge to it as  $t \rightarrow \infty$ . Otherwise the limit cycle is said semi-stable or unstable, that is, all neighboring trajectories approach it as time approaches negative infinity [11].

Stable limit cycles are vital scientifically, since they model systems that display self-sustained oscillations, for example systems which oscillate even without any external driving force (e.g. thumping of a heart, rhythms in body heat level, chemical discharge). In the event that the system is perturbed marginally, it always gets back to the stable limit cycle. If a system has a stable limit cycle, the system will tend to fall into the limit cycle, with the output approaching the amplitude of that limit cycle regardless of the initial condition and forcing function.

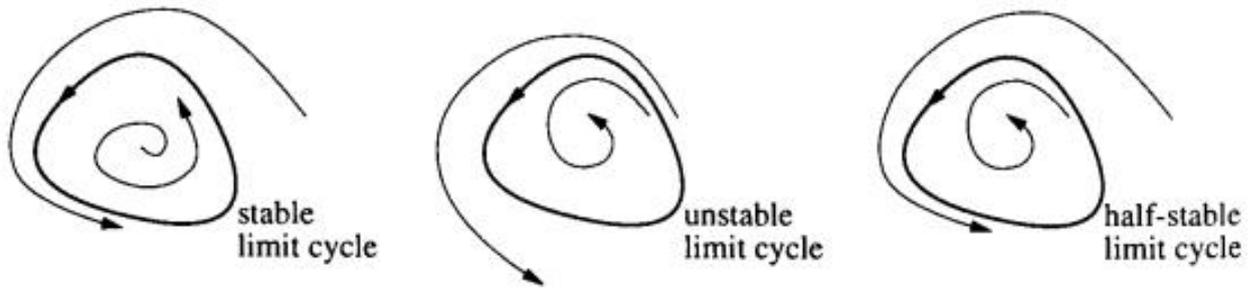


Fig. 1.1 Different types of Limit cycles

### 1.4.2 Bifurcation

As we mentioned earlier, a system's nonlinearities are not awakened gradually rather it involves a succession of explosive events in the form of instabilities. When the constraints exerted by environment reach certain threshold, small perturbation or small spontaneously arising fluctuations become amplified the system moves out from its basic state and is pushed toward a new regime called bifurcation.

Bifurcation in a nonlinear system can be defined as a change in behavior resulting from a small change in a parameter. By behavior, we mean a change in the number equilibrium points, a change in the type of equilibrium points (stable or unstable), or the emergence of a limit cycle. By small change in a parameter, we mean that there is a threshold above which the system exhibits one type of behavior and below it exhibits another [9].

When the initial state become unstable, it is replaced by a multitude of stable regimes that are accessible simultaneously. To decide which particular branch will be followed is decided by chance in the form of critical variation at that moment. This makes the system sensitive to parameters which controls the position of bifurcation point since two macroscopically indiscernible systems at same constraints follow entirely different path.

As system undergoes not just a single transition but a whole sequence of transition as the constraints are varied and its characteristics depend on the nature of nonlinearities present. One such phenomenon is deterministic chaos, where the transition eliminates in regime which is characterized by as irregular evolution of the variables in space and time.

### 1.4.3 Chaos

Chaos is the phenomenon of occurrence of bounded non periodic evolution, deterministic but not predictable, nonlinear dynamical systems with very high sensitive dependence on initial conditions. If we begin a system at two different initial conditions then the trajectories resulting from each initial condition may be extremely different from each other. Whereas in linear systems, two initial conditions that start close to each other will have trajectories that behave similarly and stay relatively close to each other.

The idea of Chaos theory was acquainted with the cutting edge world by Edward Lorenz in 1972 with conceptualization of “Butterfly Effect”. A butterfly flapping its wings causes a hurricane on the other side of the world. The relatively small amplitude of butterfly wings is equivalent to a small change in initial condition. Surely a butterfly can't have much of an effect on atmospheric conditions. But even this small change is enough to make the difference between a nice sunny day and a storm (weather trajectory) in another part of the world. Knowledge of this hypothesis will assist with making a complex system more predictable [9].

In theoretical physics, chaos is a kind of moderated randomness that, unlike true randomness, contains complex patterns that are mostly unknown. The first evidence for an underlying design in chaos was observed by American physicist Mitchell Feigenbaum, who in 1976 discovered that when an ordered system begins to break down into chaos, a consistent pattern of rate doubling occurs [1]. In 1975, Yorke and Li showed a sustained periodic behavior could be found in 1-D maps. They coined the term chaos for the various phenomena that showed a periodicity along with sensitive dependence on initial conditions. In addition to showing that the existence of a periodic three orbit in 1-D continuous map implies sensitive dependence, they showed another remarkable consequence: the existence of infinitely many other periodic orbits.

If the equations governing a chaotic system and the initial conditions are known, then the behavior can be predicted by simple iteration. In practice, however, the initial condition can never be specified to 100% accuracy. This initial uncertainty, coupled with the sensitive dependence, means that such attempts at prediction are futile.

Other hallmarks of chaos include the existence of a dense set of unstable periodic orbits in its regime[12], positive Lyapunov exponents or finite Kolmogorov-Sinai entropy[13], continuous power spectrum, non-ergodicity, mixing (Arnold's cat map), as well as some other limiting properties [1].

Chaos is "ubiquitous". Interesting chaotic dynamical systems include:

- Hamiltonian systems of many different kinds,
- Digital filters, electrical and electronics systems,
- Celestial mechanics (the three-body problem),
- Laser, plasmas, solid state, and quantum mechanics,
- Nonlinear optics,
- Chemical reactions,
- Power systems,
- Neural networks,
- Economic behaviour, and
- Biological systems (heart, brain, population, etc.).

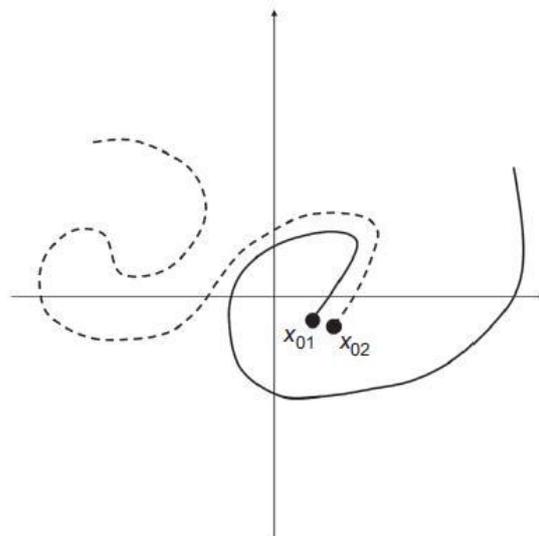


Fig.1.2 Trajectories in a chaotic system may diverge from each other even if the initial conditions are close.

## **1.5 Characterization of nonlinear systems**

Consider a system with finite set of observables such as temperature, chemical composition, flow velocity, pressure etc. The evolution into the abstract space spanned by all these variables is phase space. In this space, an instantaneous state of the system is represented by a point. As the time goes on, the point follows a curve called phase trajectory. By following these trajectories from different initial states, a phase portrait is obtained which provides a valuable qualitative idea of system potentialities. For every natural system the phase trajectory will converge to an object in phase space which is referred to as the attractor.

In recent years, it has been realized that ordinary systems obeying nonlinear laws leads to complexity associated with abrupt transitions, multiplicity of states referred to as deterministic chaos. Thermal convection in a fluid layer heated from below, turbulence etc. provide well established example of property of nonlinear systems which is referred to as self-organization. The self-organization become a powerful tool for analyzing complex systems, mainly biological systems and systems encountered in environmental science.

## CHAPTER - 2

### NEURAL NETWORK

#### 2.1 What is a neuron?

Human brain consists of neurons or nerve cells which transmit and process the information received from our senses. They use electrical impulses and chemical signals to transmit information between different areas of the brain, and between the brain and the rest of the nervous system. Everything we think and feel and do would be impossible without the work of neurons and their support cells, the glial cells [14]. Many such nerve cells are arranged together in our brain and they form a network of nerves. They pass electrical impulses i.e. the excitation from one neuron to the other.

The dendrites receive the impulse from synapse of an adjoining neuron. These dendrites carry the impulse to the nucleus of the nerve cells which is called as soma. The electrical impulse is processed here and the passed on to the axon. The axon is the longer branch among the dendrites which carries the impulse from the soma to the synapse. The synapse then passes the impulse to dendrites of the second neuron. A complex network of neuron is thus created in the human brain.

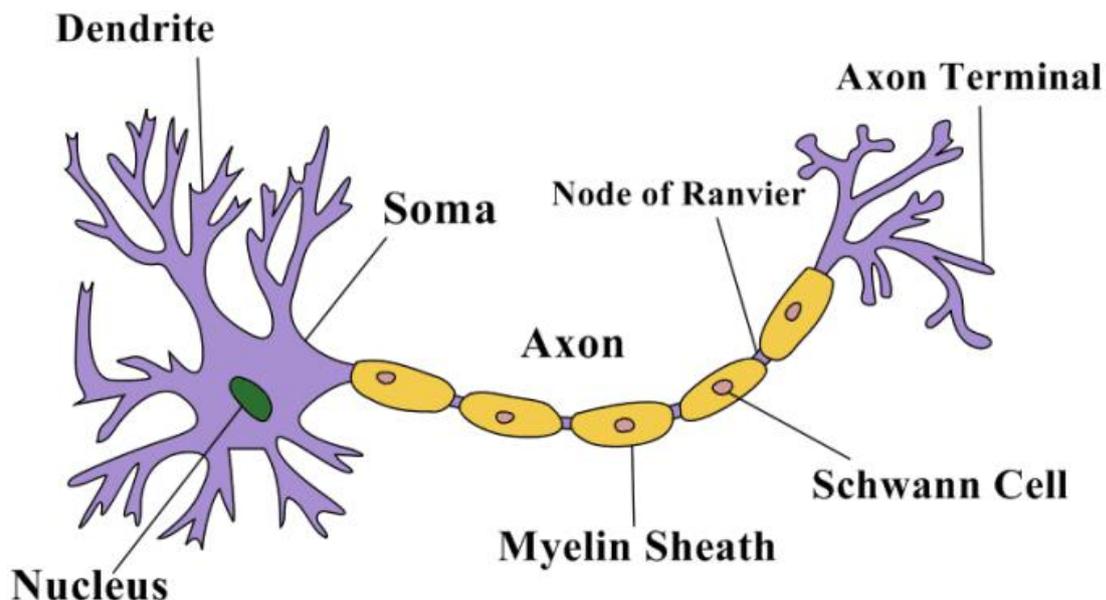


Fig. 2.1 Structure of a Neuron

The basic building block of the brain and central nervous system is the neuron. They are specialized cells that transmit chemical and electrical signals. The brain is made up of neurons and glial cells. Glial cells are non-neuronal cells which provide structure and support for the neurons. Nearly there are 86 billion neurons work together within the nervous system to communicate with the rest of the body. They control everything from consciousness and thought to pain and hunger. There are three primary types of neuron: sensory neurons, motor neurons and inter-neurons.

*Sensory neurons* respond to stimuli such as touch, sound, or light that affect the cells of the sensory organs, and they send signals to the spinal cord or brain.

*Motor neurons* receive signals from the brain and spinal cord to control everything from muscle contractions to glandular output.

*Inter-neurons* connect neurons to other neurons within the same region of the brain or spinal cord. When multiple neurons are connected together they form what is called a neural circuit.

## **2.2 Structure of neuron**

Neurons contain unique structure for receiving and sending the electrical signals that make neuronal communication possible. They consist of a nucleus, cell body, axon, dendrite and a myelin sheath.

### **Dendrite**

Dendrites are branch-like structure extending away from the cell body. Their job is to receive message from other neurons and allow those messages to travel to the cell body. Although some neurons do not have any dendrites, other types of neurons have multiple dendrites.

### **Cell Body**

Each neuron has a cell body (or soma) that contains a nucleus, smooth and endoplasmic reticulum, Golgi apparatus, mitochondria, and other cellular components. They control the functions of a cell. They contain different organelles which help them to do its job.

## **Axon**

An axon is a tube like structure that carries an electrical impulse from the cell body (or from another cell's dendrites) to the structure at opposite end of the neuron i.e. axon terminals, which then pass the impulse to another neuron.

## **Synapse**

The synapse is a chemical junction between the axon terminals of one neuron and the dendrites of the next. It is a gap where chemical interactions can occur. Its function is to transfer electrical activity (information) from one cell to another.

### **2.3 What is synapse?**

"Coming together" is the meaning of the word synapse. A synapse is formed when two structures or entities come together. Although the term synapse can refer to any cellular junction, it is most commonly used in physiology to refer to the junction of two neurons, the junction of a neuron and a target cell (ex. the neuromuscular junction), or the interface between adjacent cardiac muscle cells or adjacent smooth muscle cells. A synapse is a structure in the nervous system that permits a neuron to send an electrical or chemical signal to another cell.

#### Synapse cell

The presynaptic cell is the cell that sends the signal to the synapse. The postsynaptic cell is the cell that receives the signal after it crosses the synapse. A postsynaptic neuron at one synapse may become the presynaptic neuron for another cell downstream since most brain pathways contain several neurons.

With a postsynaptic neuron, a presynaptic neuron can make one of three types of synapses. The axon of the presynaptic neuron synapses with a dendrite of the postsynaptic neuron in an axodendritic synapse, which is the most frequent form of synapse. An axosomatic synapse occurs when the presynaptic neuron synapses with the postsynaptic neuron's soma, while an axoaxonic synapse occurs when it synapses with the postsynaptic cell's axon.

## Synapse Transmission

In your body, there are two types of synapses: electrical and chemical. Electrical synapses allow ions and signalling molecules to move directly from one cell to the next. Chemical synapses, on the other hand, do not transmit signals directly from the presynaptic cell to the postsynaptic cell. An action potential in the presynaptic neuron causes the release of a chemical message known as a neurotransmitter in a chemical synapse. The neurotransmitter then diffuses across the synapse and binds to postsynaptic cell receptors. When a neurotransmitter binds to a receptor, an electrical signal is produced in the postsynaptic cell. Each type of synapse has functional advantages and disadvantages.

### *Electrical synapse:*

The signal is passed through electrical synapse very fast, allowing groups of cells to act in unison. The direct flow of electrical current at gap junctions transmits action potentials in electrical synapses. When the trans-membrane pores of two neighboring cells align, a gap junction is produced. The two cells' membranes are joined together, and the matched pores create a pathway between them. As a result, various chemicals and ions are permitted to flow between the cells. Electrical synapses facilitate bidirectional information flow between cells due to the direct passage of ions and molecules from one cell to another. The function of cardiac myocytes and smooth muscles is dependent on gap junctions.

### *Chemical synapse:*

Chemical synapses allow neurons to integrate information from many presynaptic neurons, determining whether or not the postsynaptic cell will continue to propagate the signal. Multiple chemical synapses send information to neurons, which causes them to respond differently. The majority of synapses in your body are chemical synapses. A synaptic gap or cleft separates the pre- and postsynaptic cells in a chemical synapse. When an action potential is transmitted to the axon terminal, the axon terminals secrete chemical messengers known as neurotransmitters. Neurotransmitter molecules go across the synaptic cleft and bind to receptor proteins on the postsynaptic cell's cell membrane. The neurotransmitter binds to the receptors on the postsynaptic cell, causing a brief shift in the membrane potential of the postsynaptic cell [15].

## 2.4 Neurotransmitters and Action potential

### Neurotransmitters

The chemical messengers of the body are typically referred to as neurotransmitters. They are the chemicals that the nervous system uses to send and receive messages between neurons and between neurons and muscles.

The synaptic cleft is where two neurons communicate with one another (the small gap between the synapses of neurons). The release of neurotransmitters converts electrical messages that have travelled along the axon into chemical signals, generating a specific reaction in the receiving neuron. A neurotransmitter can have one of three effects on a neuron: excitatory, inhibitory, or modulatory.

In the receiving neuron, an excitatory transmitter encourages the formation of an electrical signal known as an action potential, whereas an inhibitory transmitter prevents it. The receptor to which a neurotransmitter binds determines whether it is excitatory or inhibitory.

Neuromodulators are unique in that they are not limited to the synaptic cleft between two neurons and can therefore affect a large number of neurons simultaneously. Neuromodulators, in contrast to excitatory and inhibitory transmitters, influence populations of neurons while functioning at a slower rate [16].

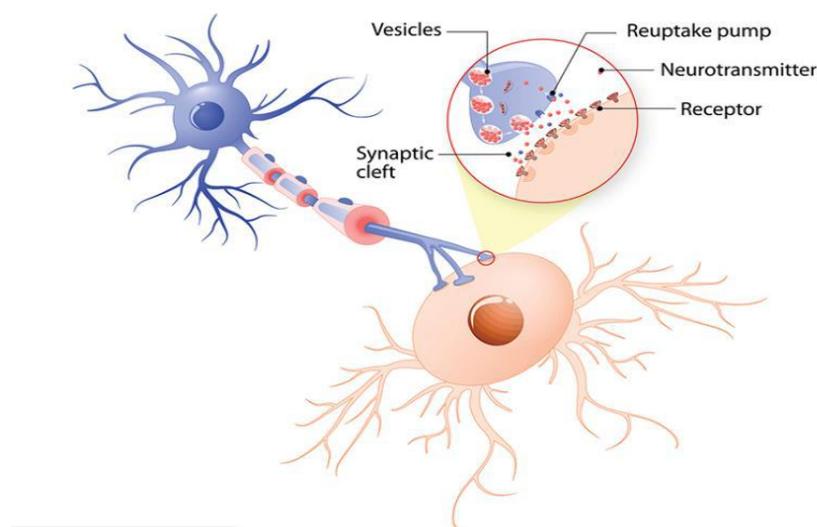


Fig. 2.2 Synapse model

## Action Potential

The cell membrane (the border between the interior and outside of a cell) contains many channels that allow positive and negative ions to flow into and out of the cell. The inside of a cell is normally more negative than the exterior; neuroscientists estimate that the inside is roughly -70 mV in comparison to the outside, or that the cell's resting membrane potential is -70 mV. The potential of the membrane isn't constant. It fluctuates regularly, primarily because to inputs from other neurons' axons. Some inputs cause the membrane potential of the neuron to become more positive (or less negative, for example, from -70 mV to -65 mV), whereas others have the reverse effect.

Because they encourage or inhibit the formation of action potentials, these are referred to as excitatory and inhibitory inputs, respectively (the reason some inputs are excitatory and others inhibitory is that different types of neuron release different neurotransmitters; the neurotransmitter used by a neuron determines its effect). The sum total of all excitatory and inhibitory inputs causes the neuron's membrane potential to hit roughly -50 mV (see diagram), which is known as the action potential threshold.

Action potentials are commonly referred to as 'spikes' by neuroscientists, who also remark that a neuron has 'fired a spike' or 'spiked.' The shape of an action potential as recorded with sensitive electrical equipment is referred to by this word [17].

## **2.5 Communication of Neurons**

Neurons communicate with one another via synapses. Neurotransmitter is released from the neuron into the synaptic cleft, a 20–40nm space between the presynaptic axon terminal and the postsynaptic dendrite, when an action potential reaches the presynaptic terminal (often a spine).

The transmitter will attach to neurotransmitter receptors on the postsynaptic side after crossing the synaptic cleft, and depending on the neurotransmitter released (which is dependent on the type of neuron releasing it), specific positive (e.g. Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>+</sup>) or negative ions (e.g. Cl<sup>-</sup>) will travel through membrane channels.

Synapses can be thought of as converting an electrical signal (the action potential) into a chemical signal in the form of neurotransmitter release, and then switching the signal back into an electrical form as charged ions flow into or out of the postsynaptic neuron after the transmitter binds to the postsynaptic receptor [17].

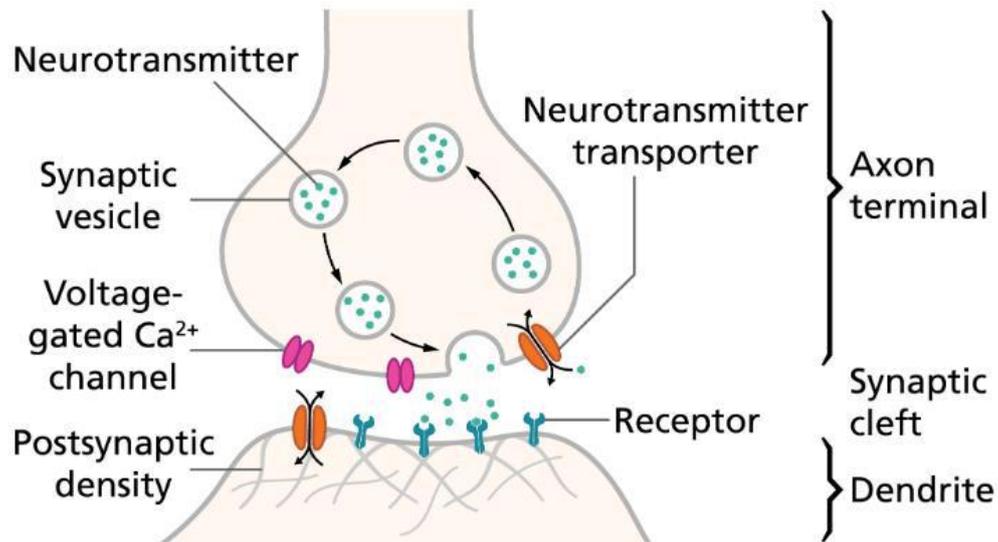


Fig. 2.3 An action potential, or spike, causes neurotransmitters to be released across the synaptic cleft, causing an electrical signal in the postsynaptic neuron

## **CHAPTER 3**

### **REVIEW OF BRAIN STIMULATION**

#### **3.1 Deep Brain Stimulation**

Deep brain stimulation (DBS) is a neurosurgical operation that employs electrical stimulation and implanted electrodes to treat movement disorders such as Parkinson's disease (PD), essential tremor, dystonia, and other neurological illnesses. It can also be used to manage obsessive-compulsive disorder and epilepsy symptoms [18]. When drugs are no longer effective or their negative effects interfere with a person's everyday activities, doctors may utilize DBS to treat movement disorders or neuropsychiatric diseases.

- During a surgical operation, surgeons implant one or more small wires (called leads or electrodes) in the brain.
- A tiny pulse generator implanted in the chest provides gentle electrical stimulation to the leads.
- Successful DBS surgery necessitates careful patient selection, precise electrode insertion, and pulse generator modification.
- DBS cannot completely alleviate the symptoms of Parkinson's disease or other illnesses, but it can help patients take fewer medications and have a better quality of life.

Deep brain stimulation (DBS) has changed the treatment of late-stage Parkinson's disease and has shown promise in the treatment of other intractable neuropsychiatric illnesses. Despite over 25 years of clinical experience, many concerns about the neurophysiological basis for therapeutic mechanisms of action remain unanswered. Electrical stimulation therapies in the nervous system are designed to manipulate the opening and closing of voltage-gated sodium channels on neurons, generate stimulation induced action potentials, and then control the release of neurotransmitters in targeted pathways using an applied electric field.

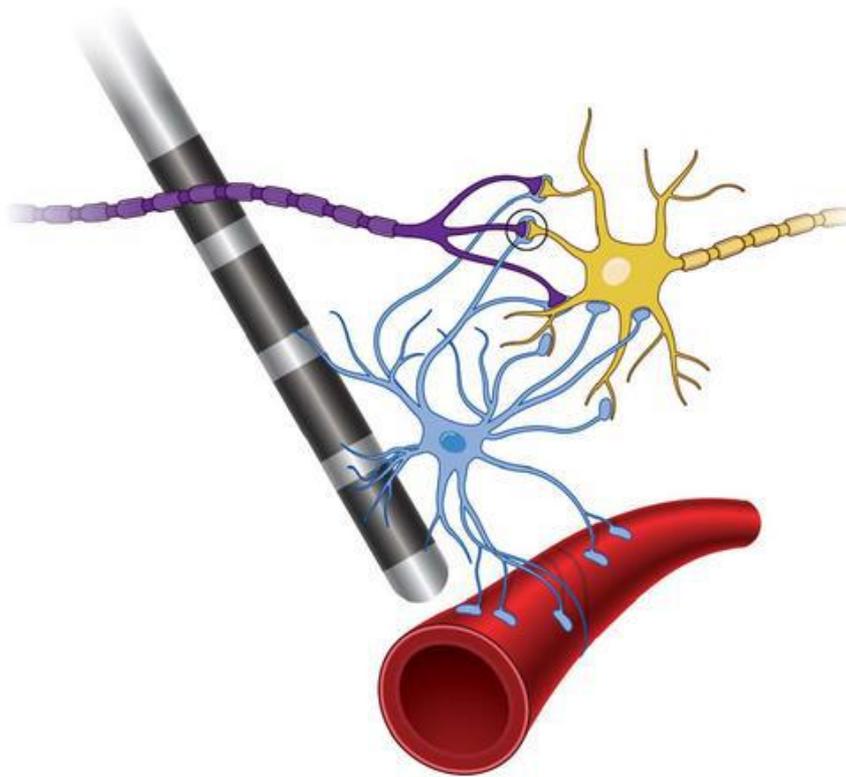


Fig. 3.1 Structural representation of DBS

Deep brain stimulation is a useful clinical tool, although the precise treatment mechanisms are unknown. The most basic concept that can be directly reconciled with experimental recordings of spiking activity in neurons driven by DBS inputs is that high frequency (100 Hz) stimulation-induced synaptic suppression represents the most basic concept that can be directly reconciled with high frequency (100 Hz) stimulation-induced synaptic suppression [19].

Given that therapeutic stimulation methods typically use a constant stimulation frequency, the steady-state PSC generated at the synapse as a function of stimulation frequency is a significant parameter of interest. Low stimulation frequencies (e.g., 10 Hz) can maintain high amplitude PSCs for lengthy periods of time, whereas high stimulation frequencies (e.g., 100 Hz) reduce PSCs immediately after the stimulus train begins.

In most in DBS experiments, communication between the directly stimulated pre-synaptic neuron and a tightly linked post-synaptic neuron does not completely stop. Instead, with high frequency stimulation, signal transmission, which is strong during low frequency stimulation, becomes sporadic and low

fidelity, despite remaining time-locked to the stimulus train. This shows that DBS changes the dynamics of these synaptic connections, and that 100 Hz stimulation acts as a filter, preventing low-frequency oscillatory activity of pre-synaptic neurons from impacting their post-synaptic neurons [20].

The general phenomena of DBS-induced synaptic suppression may be studied most easily at glutamatergic synapses [21, 22], where there is a wealth of experimental data to parameterize synaptic models and post-synaptic neurons can be monitored for synaptically generated APs time-locked to the stimuli. There are several types of glutamatergic synapses, including depressing, facilitating, and pseudo-linear. As a result, we set out to determine how these various synapse types respond to DBS.

Here, Tsodyks-Markram (TM) phenomenological synapse model to represent depressing (D), facilitating (F), and pseudo-linear (P) glutamatergic synapses driven by DBS over a wide range of stimulation frequencies.

### **3.2 Tsodyks-Markram (TM) model**

Short-term synaptic plasticity strongly affects the neural dynamics of cortical networks. The Tsodyks and Markram (TM) model for short-term synaptic plasticity accurately accounts for a wide range of physiological responses at different types of cortical synapses.

To quantify the dynamic behaviour of glutamatergic synapses driven by DBS-induced action potentials, here employed the Tsodyks-Markram (TM) phenomenological model of short-term synaptic plasticity. Short-term depression (related with neurotransmitter depletion) and short-term facilitation (associated with calcium influx into the pre-synaptic terminal) can both be simulated using TM models. The dynamics of the TM model arise from the combination of a depression effect, denoted by normalized variable  $x$ , which represents the fraction of neurotransmitter resources that remain available after synaptic transmission, and a facilitation effect modeled by utilization parameter  $u$  that represents the fraction of available neurotransmitter resources ready to be used (Fig. 2). As such,  $u$  is consumed to produce the postsynaptic current,  $I$ . The combination of the depression and facilitation effects, as well as the time delay,  $D$ , yields the following differential equations:

$$\dot{u} = -\frac{u}{\tau_f} + U(1 - u^-)\delta(t - t_s - \Delta) \quad (1)$$

$$\dot{x} = -\frac{1 - x}{\tau_d} - u^+x^-\delta(t - t_s - \Delta) \quad (2)$$

$$\dot{I} = -\frac{I}{\tau_s} + Au^+x^-\delta(t - t_s - \Delta) \quad (3)$$

where;

- $t_s$  – spike time
- $\delta$  – Dirac delta function
- $U$  – Increment of  $u$  produced by an incoming spike
- $\tau_f$  – decay time constant of variable  $u$
- $\tau_d$  – recovery time constant of variable  $x$
- $\tau_s$  – decay time constant of variable of  $I$
- $A$  – denotes the synaptic response amplitude that would be produced with the release of all neurotransmitter resources

The specific parameter values for the D, F, and P synapses are listed below, which were previously defined to match the experimentally measured characteristics of intracortical glutamatergic EPSCs.

Synapse	$\tau_f(ms)$	$\tau_d(ms)$	$\tau_s(ms)$	U	$A(\mu s)$
F	670	138	3	0.09	2.5
D	17	671	3	0.5	2.5
P	326	329	3	0.29	2.5

### 3.3 Obtained synaptic response to DBS

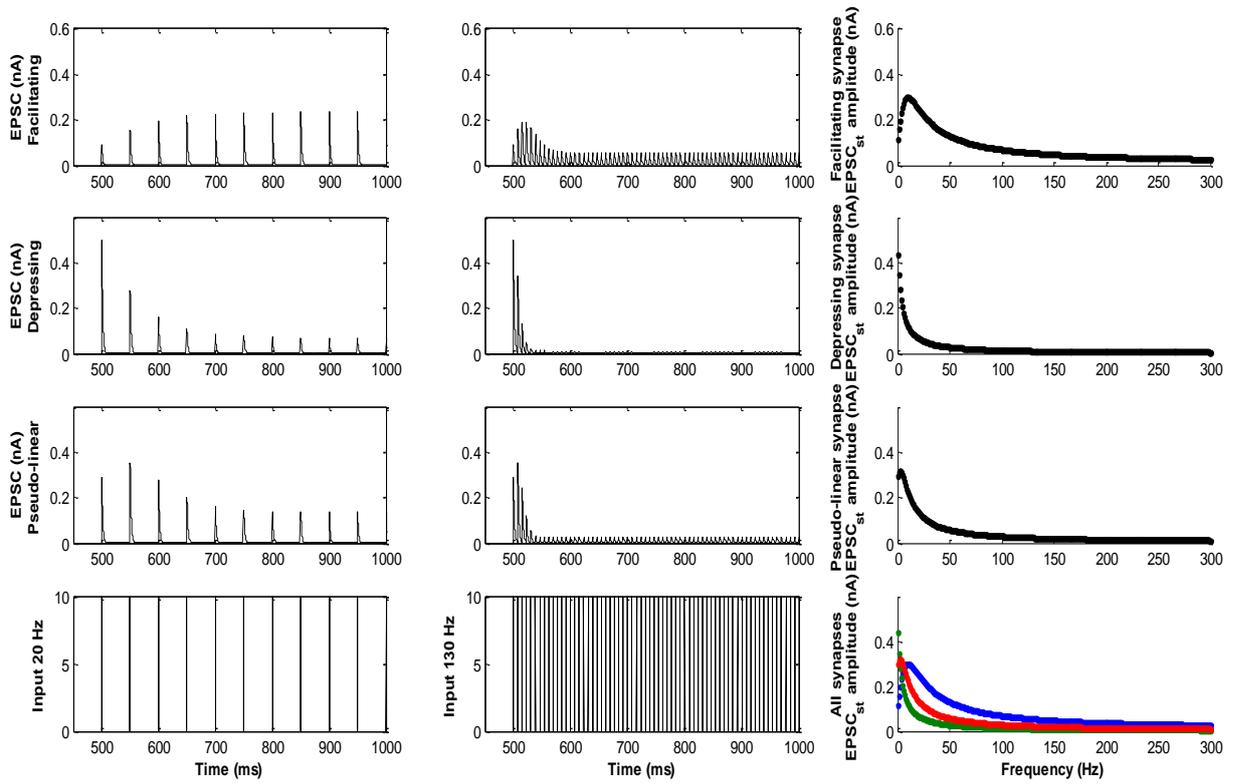


Fig 3.2 shows the EPSC generated by each of the F,D and P synapses for 20HZ and 130Hz.

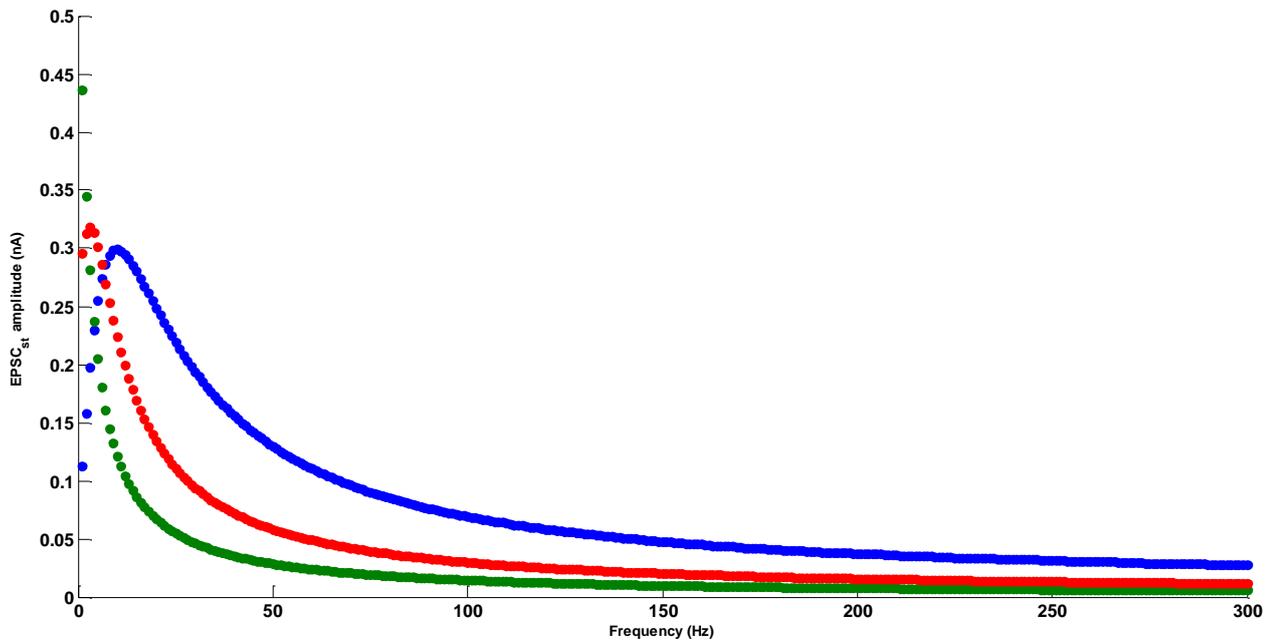


Fig 3.3 EPSC amplitude Vs Frequency plot

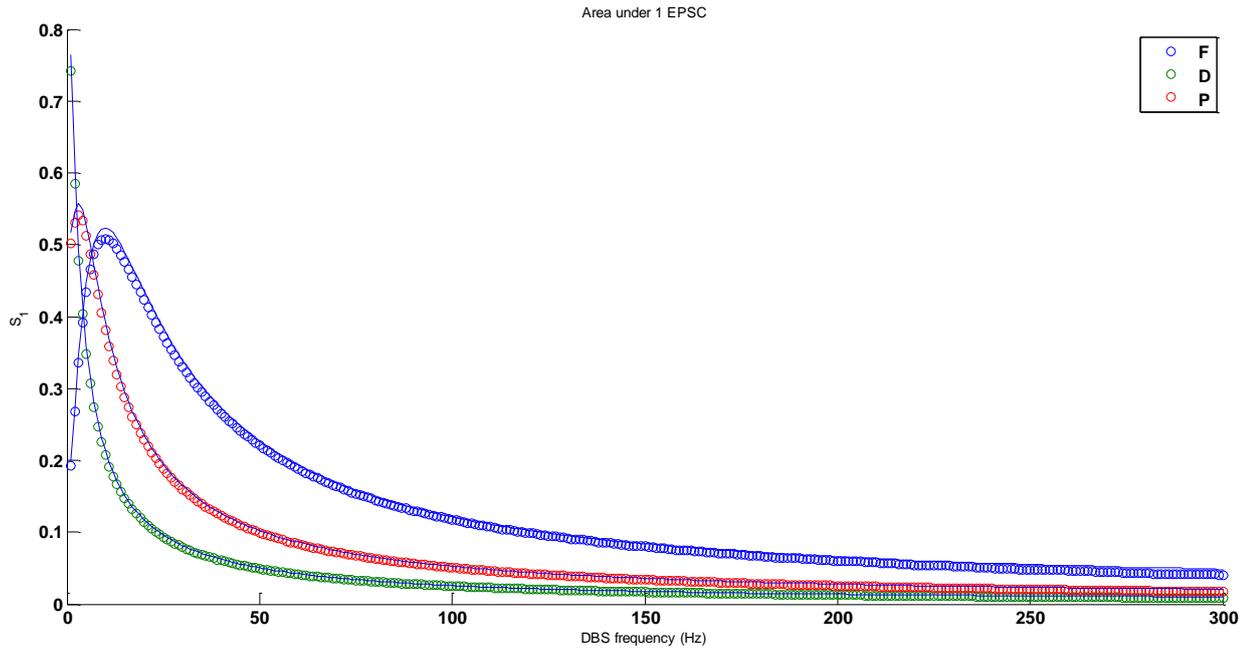


Fig 3.4 Area under 1EPSC

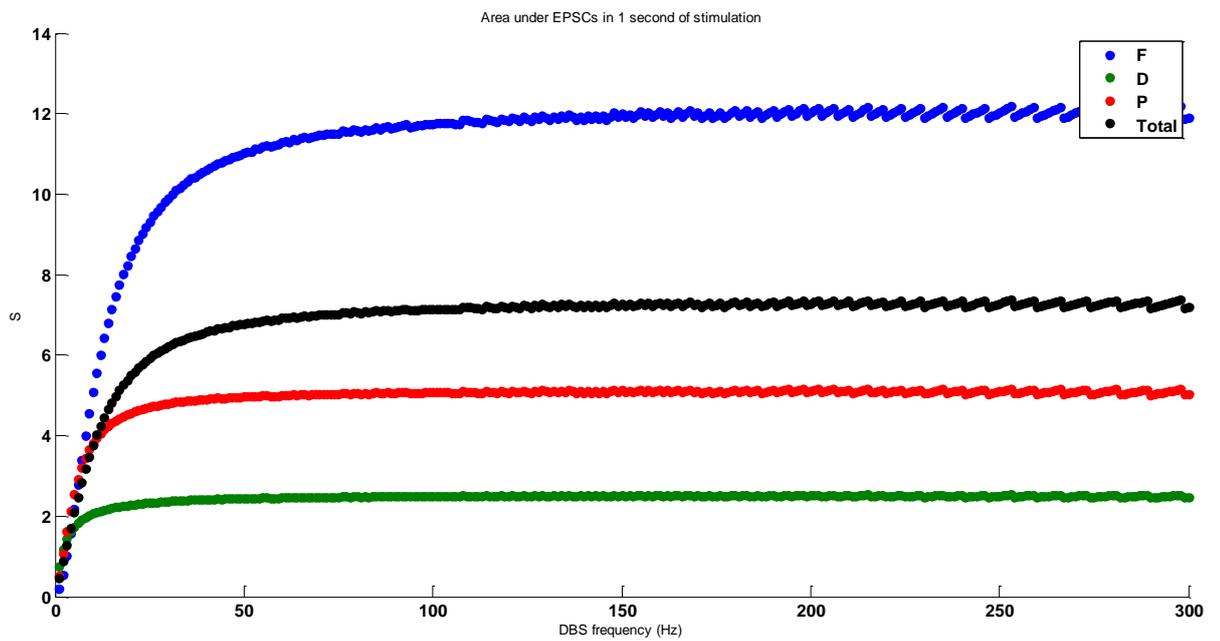


Fig 3.5 Area under EPSCs in 1 second of stimulation

Low frequency stimulation can produce a wide range of EPSCs, depending on the type of synapse (depressing (D), facilitating (F), or pseudo-linear (P)), as well as the timing of when the EPSC is evaluated throughout the stimulus train,

according to simulations of the TM synaptic model. The number of available transmission resources,  $x$ , for a D synapse stimulated at 20 Hz decays with a fast time constant. EPSCs are initially very strong, but in the steady-state, they degrade to a modest amplitude.

F synapses stimulated at 20 Hz, on the other hand, have an  $x$  that does not decrease rapidly because the utilisation fractions,  $u$ , are less. As a result, EPSCs start out small but grow in size with time to reach a larger amplitude in the steady-state. Under high frequency driving, however, both the F and D synapses show a similar tendency of steady-state EPSC suppression. During 130 Hz driving, F synapses have tiny EPSC amplitudes while D synapse EPSCs are essentially zero.

Thus we can conclude that Independent of the synapse type (D, F, P), high frequency driving of the synapse models generates marked EPSC suppression.

## **CHAPTER 4**

### **THE LIF SPIKING NEURON MODEL**

#### **4.1 Introduction**

Many neuron models emerged to mimic the functions of a biological neuron, especially the LIF spiking model. It is a simplified and much easier model for hardware implementation and large-scale integration. The primary purpose of an artificial neuron is to mimic the functions of biological neurons in an energy effectiveness and scalability way. The typical LIF model consists of a capacitor and a resistor. The external stimulus is applied to the LIF model until a threshold is reached, and then the action potential is produced. Although the LIF model can reproduce the firing behaviors of neurons after each activation, the previous pulse cannot be retained, and the biological spiking frequency adaptability does not perform very well. To solve these deficiencies, we need to find a new device to promote the LIF neuron model. A memristor is a potential element to emulate the function and behavior of a biological synapse or neuron gets a lot of attention. The non-volatile memristor modulates its conductance due to ion motion, similar to the phenomena in biological neurons and synapses. Therefore, these advantages enable the memristor to become an inevitable choice as a building block between artificial neural networks and biological neural networks.

Even though the LIF neuron model with a memristor had achieved lots of progress in emulating biological neurons, the implementation of retaining the previous pulse and performing the biological spiking frequency adaptability has not been yet explored in the MLIF neuron model.

The LIF spiking circuit model is put forward which is closer to the real biological neuron, as shown in Figure 4.7

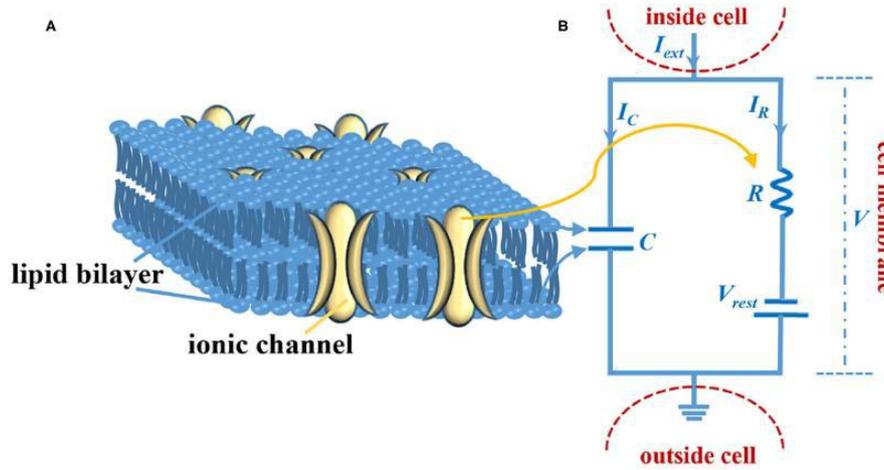


Fig 4.7 The LIF circuit model of the axon membrane. (A) The sketch of the cell membrane. (B) The circuit model of the cell membrane.

The cell membrane consists of the lipid bilayer and the ionic channel (Fig 4.7 A). The lipid bilayer can be represented by a capacitor, and the ionic channel can be characterized by a resistor (Fig 4.7 B).  $I_{ext}$  is external stimulus,  $C$  is the membrane capacitor,  $R$  is the membrane resistor (leaky resistor),  $V_{rest}$  is the resting voltage,  $V - V_{rest}$  is the resistive voltage,  $I_C$  is the current that passes through membrane capacitor,  $I_R$  is the current that passes through the membrane resistor, and  $V$  is the membrane voltage. Current passes through the membrane capacitor:

$$q = CV \tag{1}$$

$$I_C = \frac{dq}{dt} = Cdv/dt \tag{2}$$

Current passes through the membrane resistor:

$$I_R = (V - V_{rest})/R \tag{3}$$

According to Kirchhoff's current law:

$$I_{ext} = I_C + I_R \tag{4}$$

The time constant:

$$\tau = RC \tag{5}$$

The differential equation of the LIF model, which represents the leaky integration process:

$$dt = -(V - V_{rest}) + RI_{ext} \quad (6)$$

Using the finite differential method to solve (6) and compute the membrane potential at a time step of duration  $\Delta t$ :

$$V(t + \Delta t) - V(t) = \frac{\Delta t}{\tau} (-V(t) + V_{rest} + RI_{ext}) \quad (7)$$

## 4.2 Post-synaptic neuron firing

We used a noisy leaky-integrate-and-fire (LIF) neuron model to evaluate the post-synaptic response to the DBS-driven synaptic inputs. The LIF neuron was parameterized to exhibit an intrinsic tonic firing pattern at 20 Hz. This was achieved by incorporating a bias current,  $I_e$  (0.56 nA), background synaptic inputs that arrived stochastically at  $t_k$  via a Poissonian process with rate  $\omega_k$ , and white Gaussian noise,  $n(t)$ , that had a mean of 0 and variance ( $\sigma^2$ ) of 2.5. The LIF neuron also received glutamatergic inputs from DBS-driven synapses, where TM models simulated EPSCs that could also be modulated by a synaptic fidelity coefficient ( $\omega_{sf}$ ). Therefore, the transmembrane potential,  $v$ , of the LIF neuron model was defined by the following differential equation:

$$C_m \dot{v} = \frac{E_l - v}{R_m} + I_e + \omega_{sf} EPSC + \sum_{k, t_k} \omega_k \delta(t - t_k) + n(t) \quad (8)$$

Where  $C_m$  ( $1 \mu F$ ) and  $R_m$  ( $100 M\Omega$ ) are the membrane capacitance and resistance respectively, and  $E_l$  ( $-70 mV$ ) is the leak voltage. In eq. (8) EPSC represents the summated post-synaptic currents from all DBS-driven inputs [31].

## 4.3 Results

### Varying DBS frequency

**fdbs=60Hz**

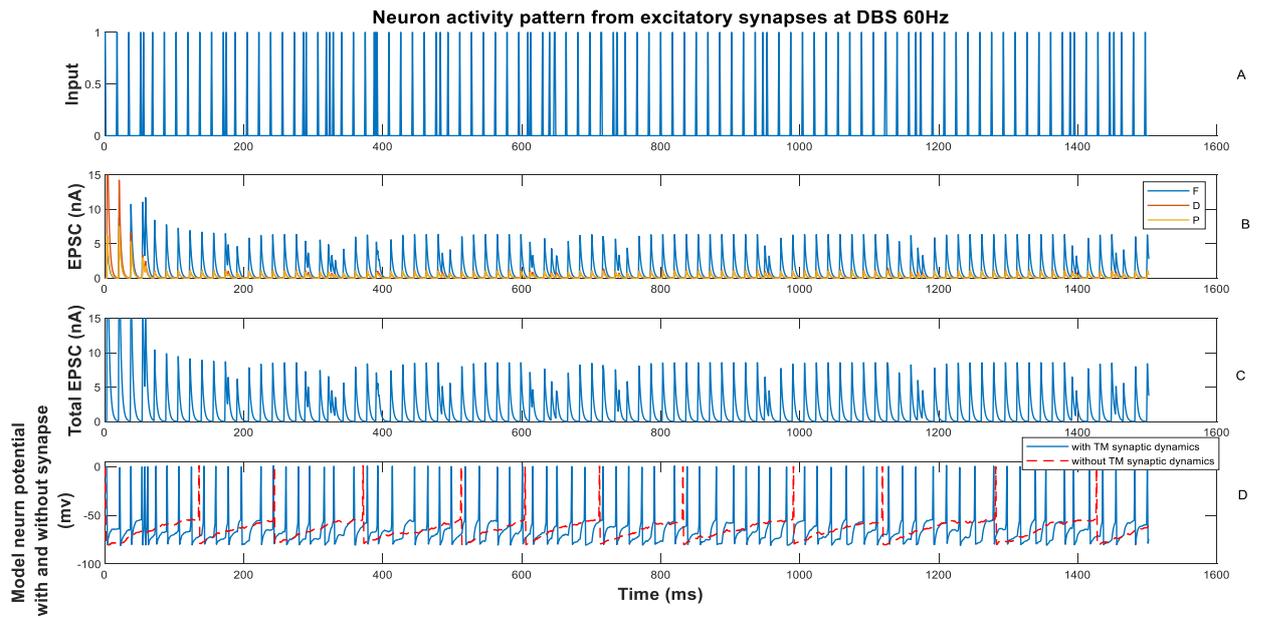


Fig.4.8

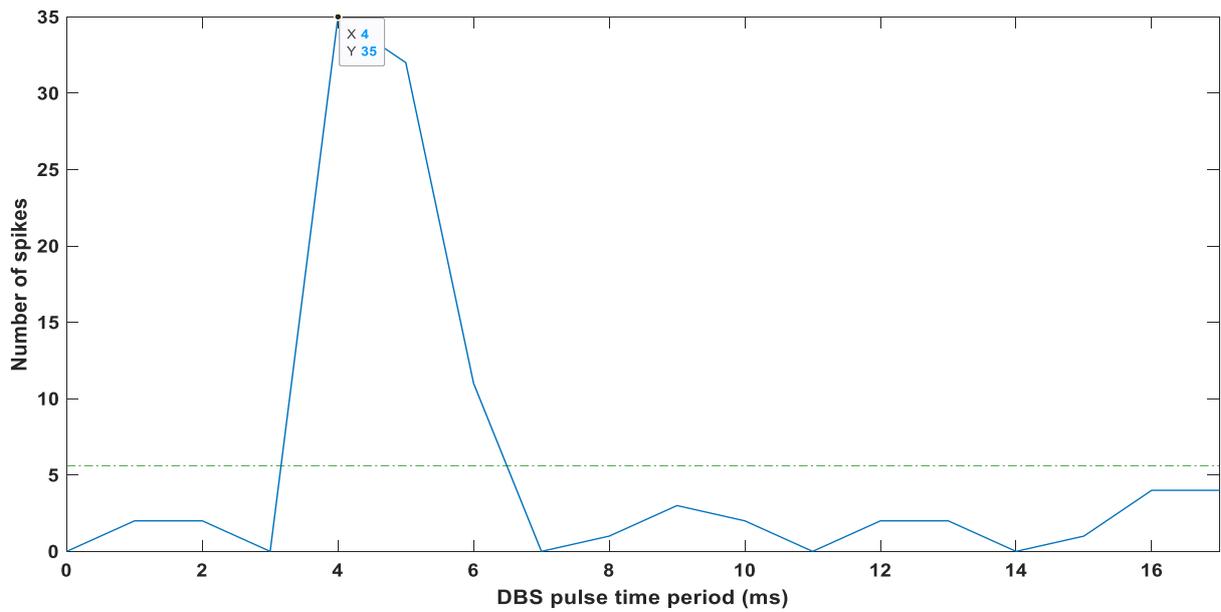


Fig.4.9

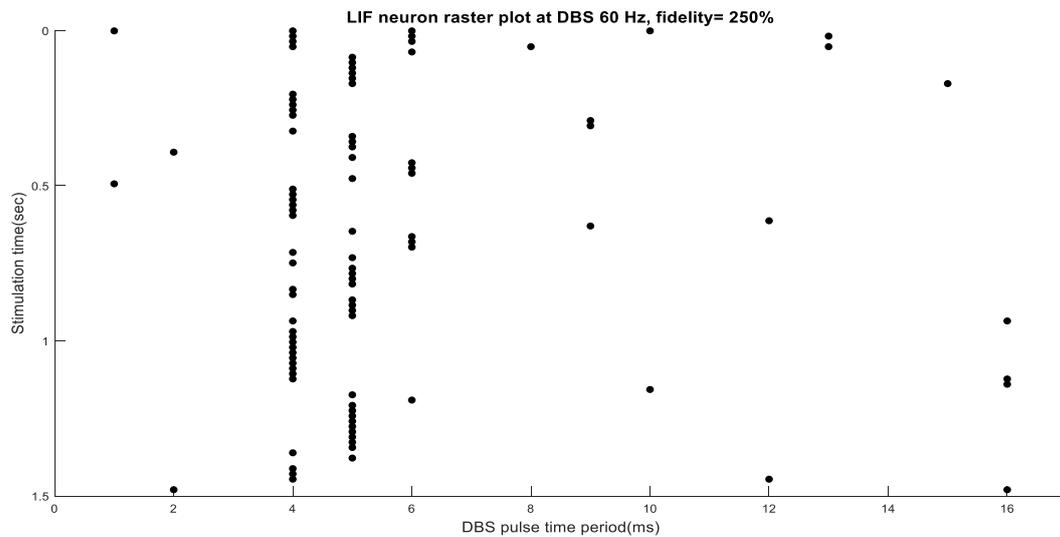


Fig.4.10

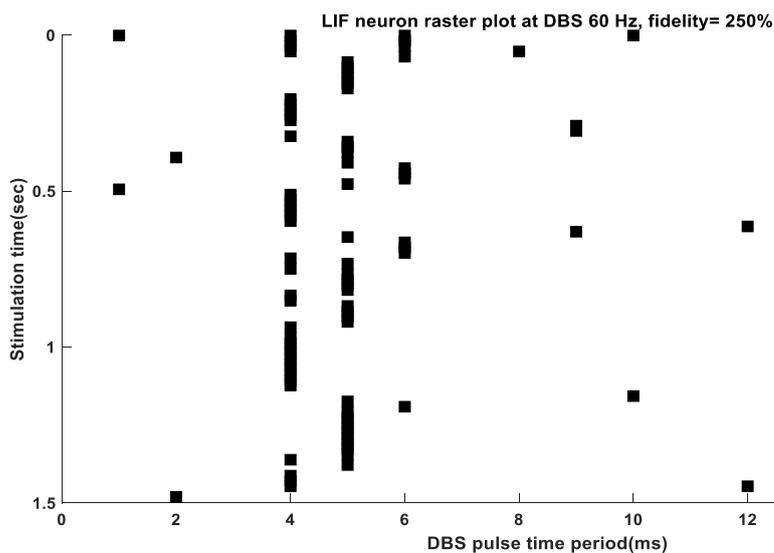


Fig.4.11

Fig. 4.8(A) shows the input frequency, i.e. 60Hz. Fig.4.8(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.8(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.8(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.9 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 35 at 4ms, whereas the average no. of spikes generated is 5.6.

Fig.4.10 and Fig.4.11 shows stimulus triggered action potentials during DBS. Fig.4.10 shows raster plot of the LIF neuron model without TM synaptic dynamics and Fig. 4.11 with TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 53.3689 (Hz)

LIF rate with all synapses during DBS10Hz = 66.7111 Hz

Elapsed time is 12.924753 seconds.

### fdbs=80Hz

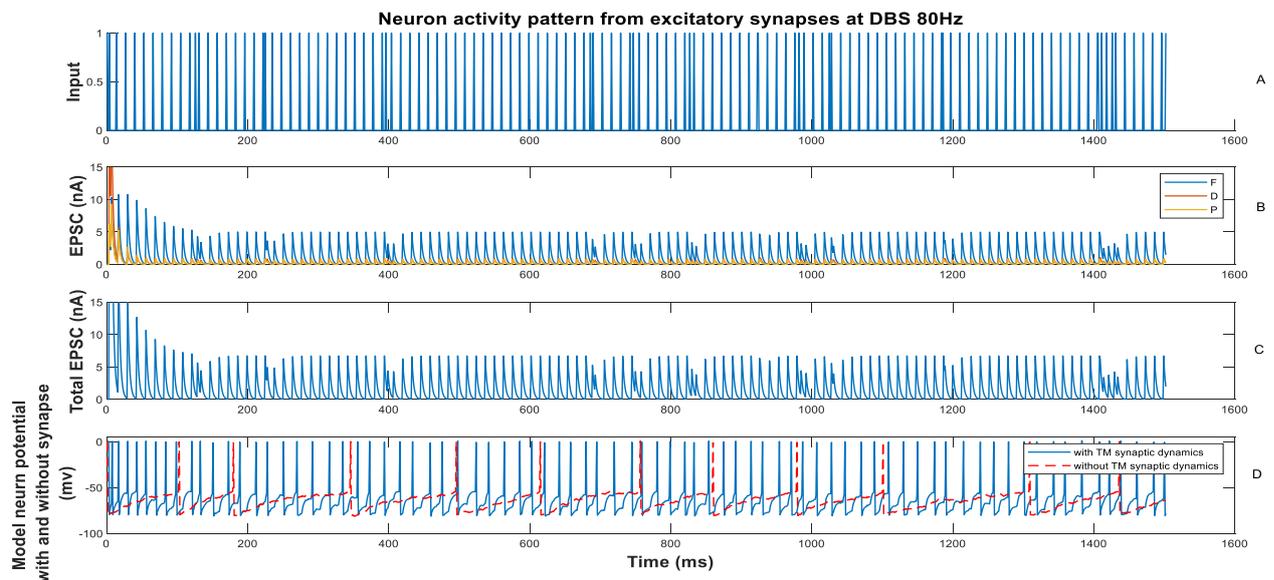


Fig.4.12

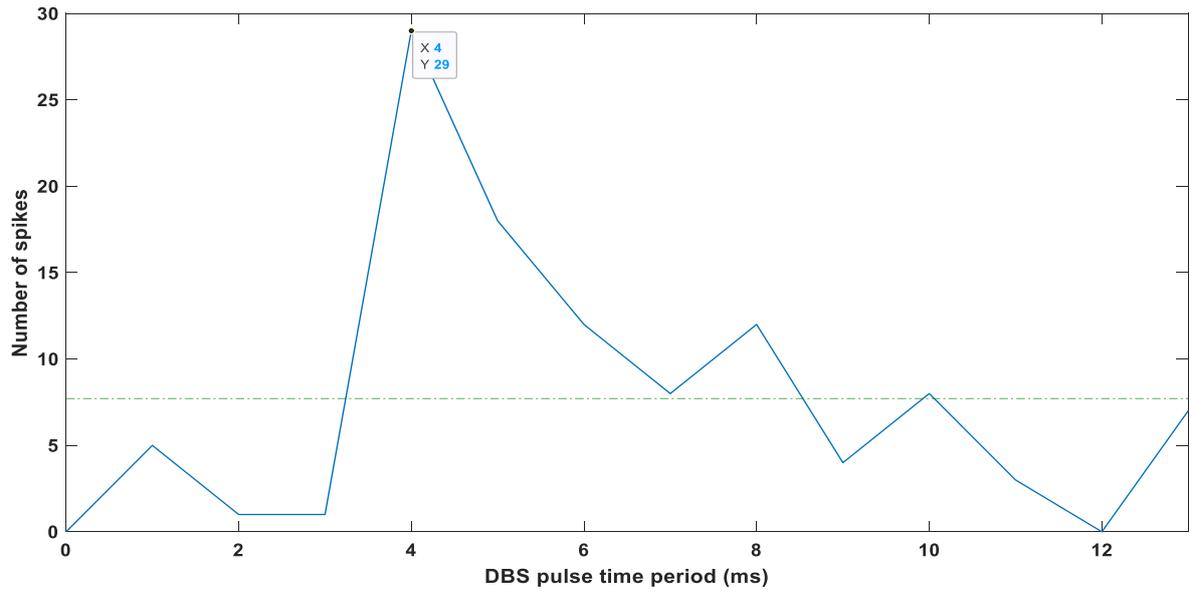


Fig.4.13

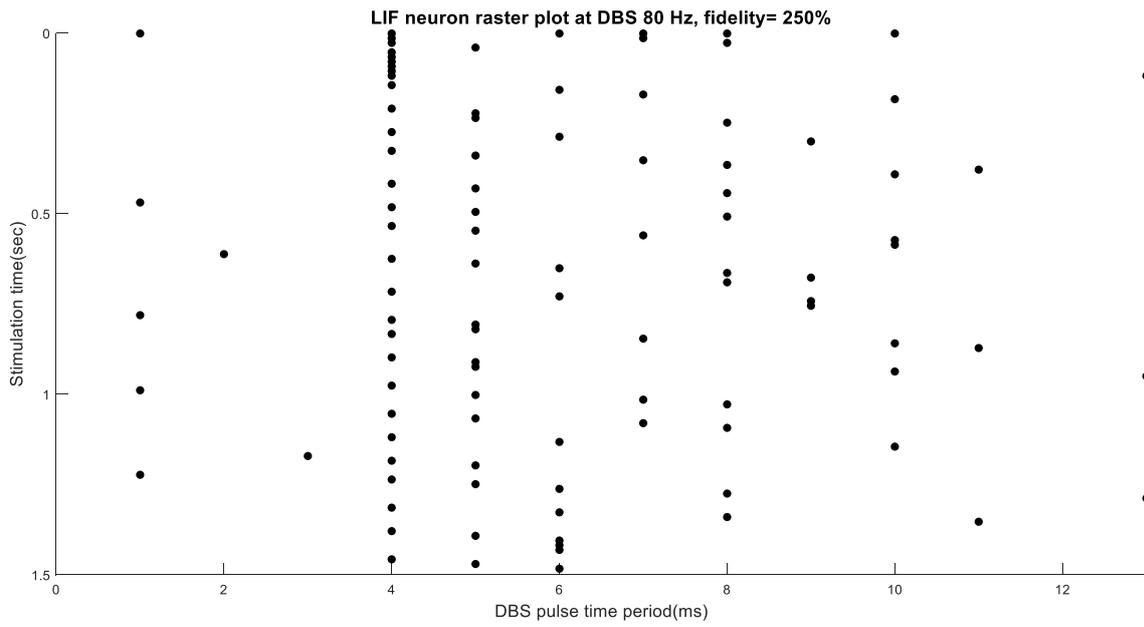


Fig.4.14

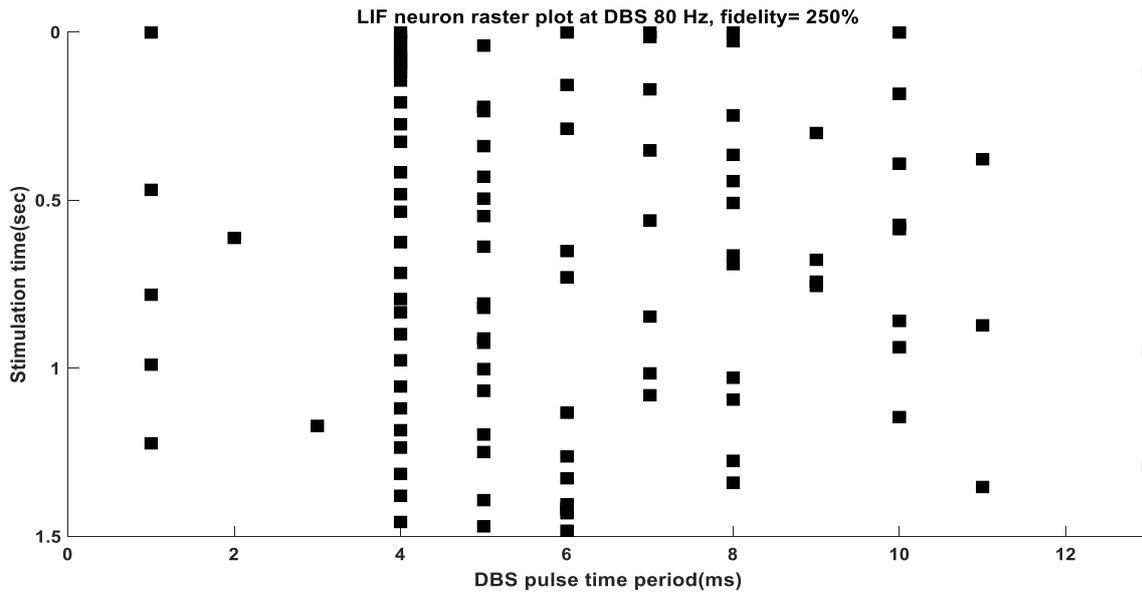


Fig. 4.15

Fig. 4.12(A) shows the input frequency, i.e. 80Hz. Fig.4.12(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.12(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.12(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.13 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 29 at 4ms, whereas the average no. of spikes generated is 7.7.

Fig.4.14 and Fig.4.15 shows stimulus triggered action potentials during DBS. Fig.4.14 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.15 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 5ms.

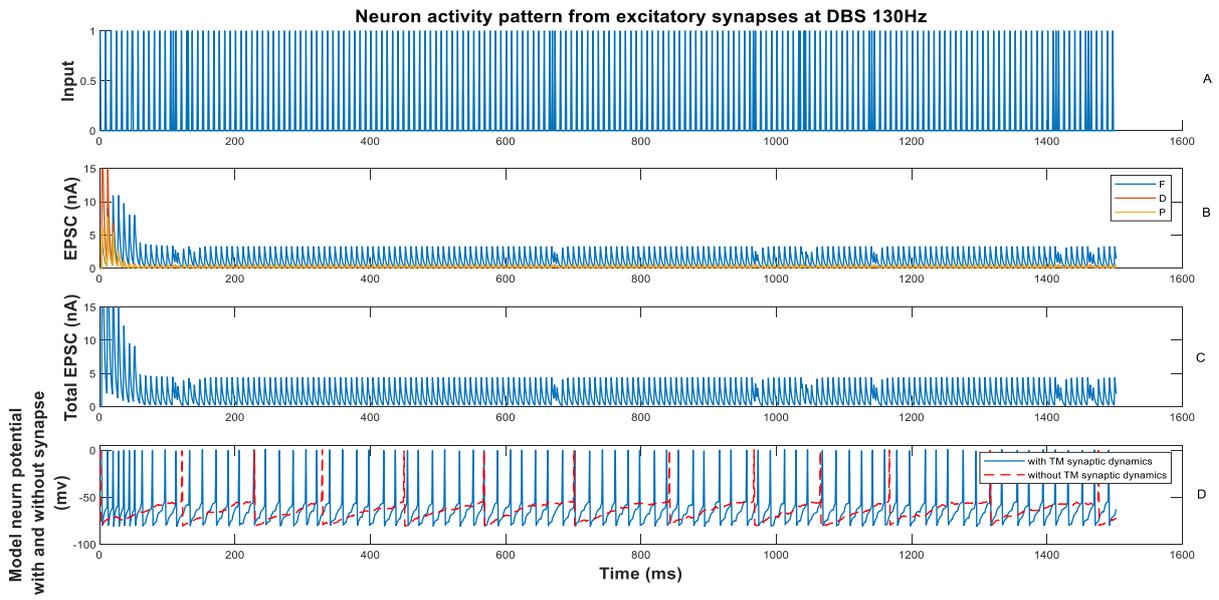
LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 54.036 (Hz)

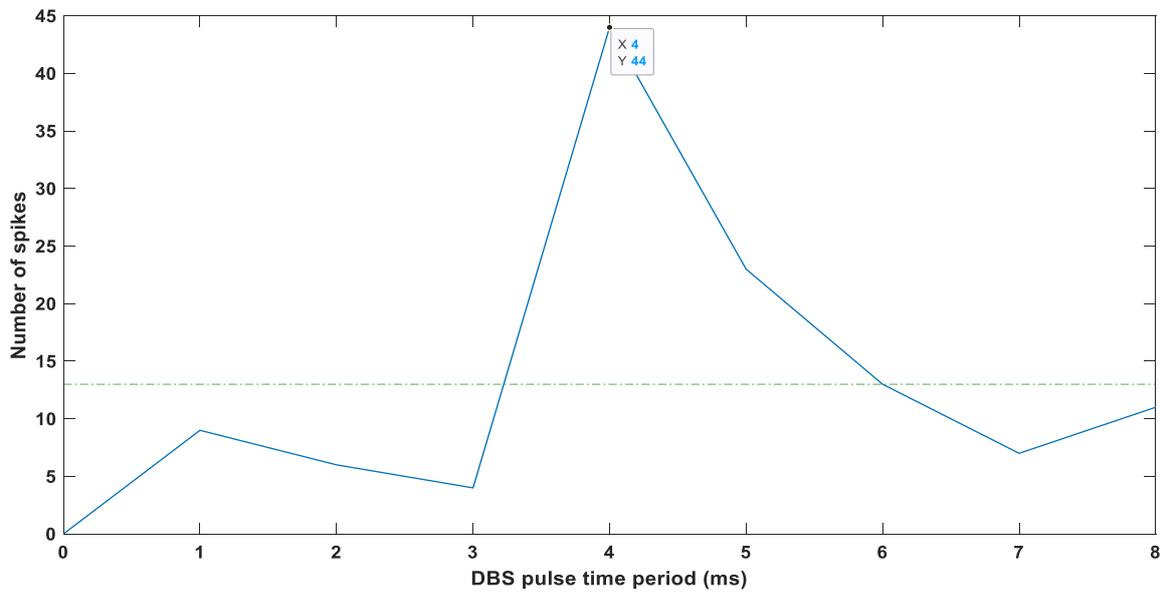
LIF rate with all synapses during DBS10Hz = 69.3796 Hz

Elapsed time is 10.173028 seconds.

**fdfs=130Hz**



**Fig. 4.16**



**Fig.4.17**

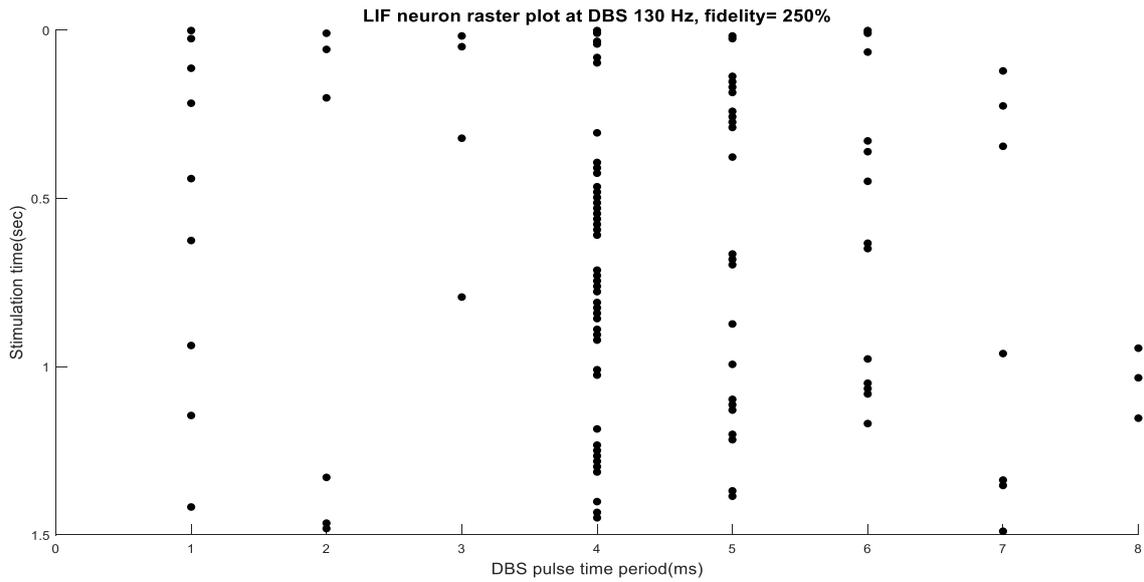


Fig.4.18

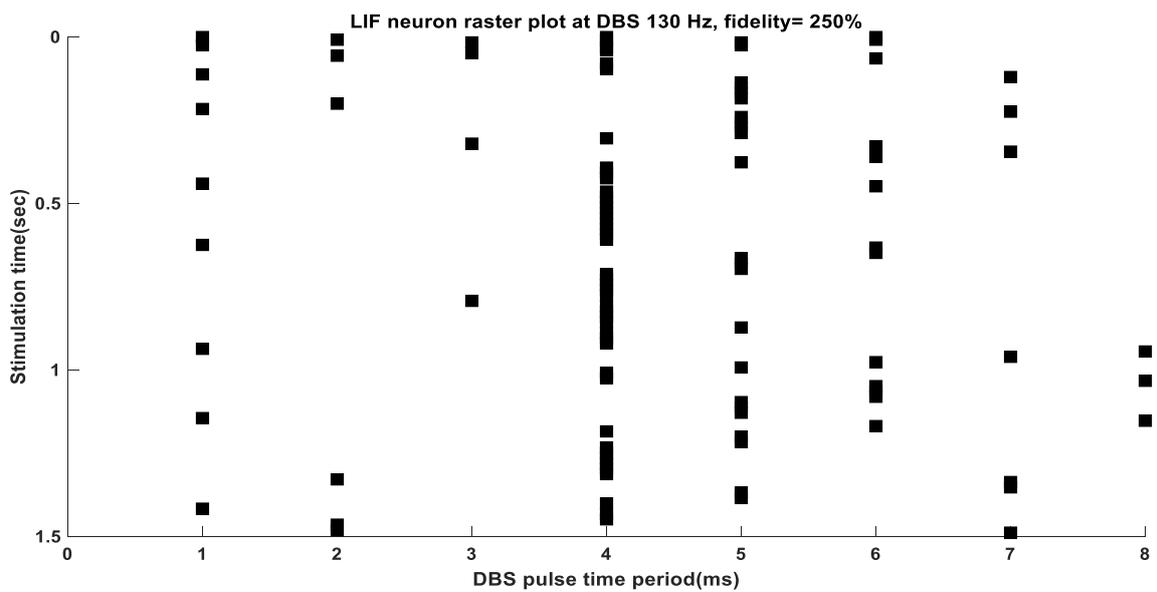


Fig.4.19

Fig. 4.16(A) shows the input frequency, i.e. 130Hz. Fig.4.16(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.16(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.16 (D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.17 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 44 at 4ms, whereas the average no. of spikes generated is 13.

Fig.4.18 and Fig.4.19 shows stimulus triggered action potentials during DBS. Fig.4.18 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.19 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.6724 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 56.7045 (Hz)

LIF rate with all synapses during DBS10Hz = 72.7151 Hz

Elapsed time is 15.008347 seconds.

### fdbs=150Hz

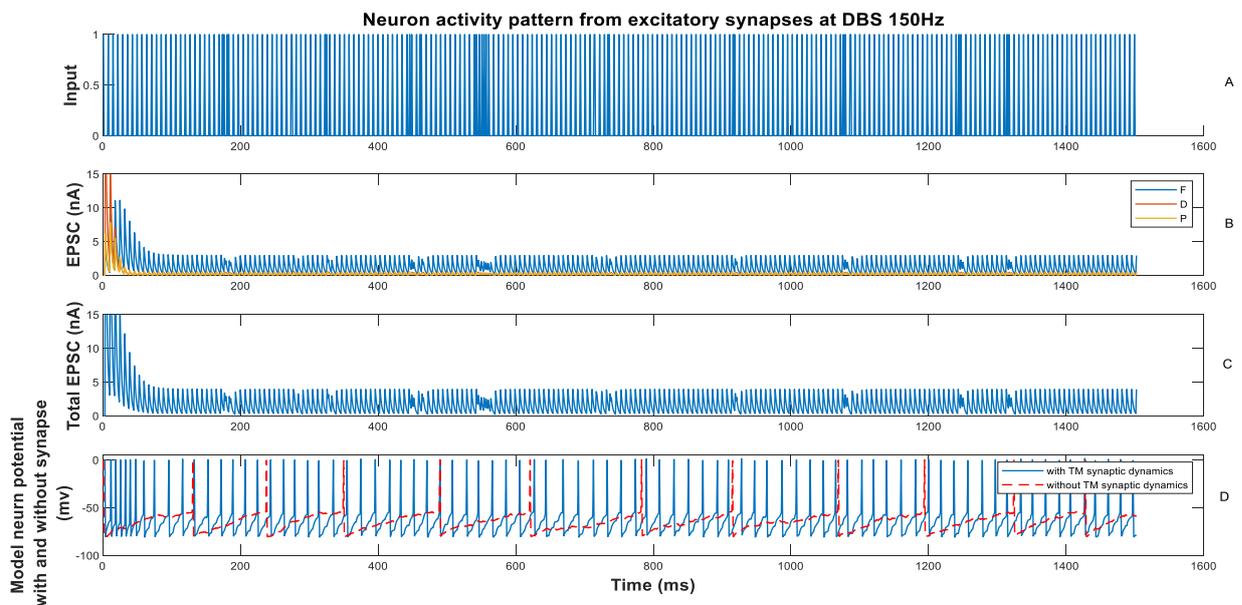


Fig.4.20

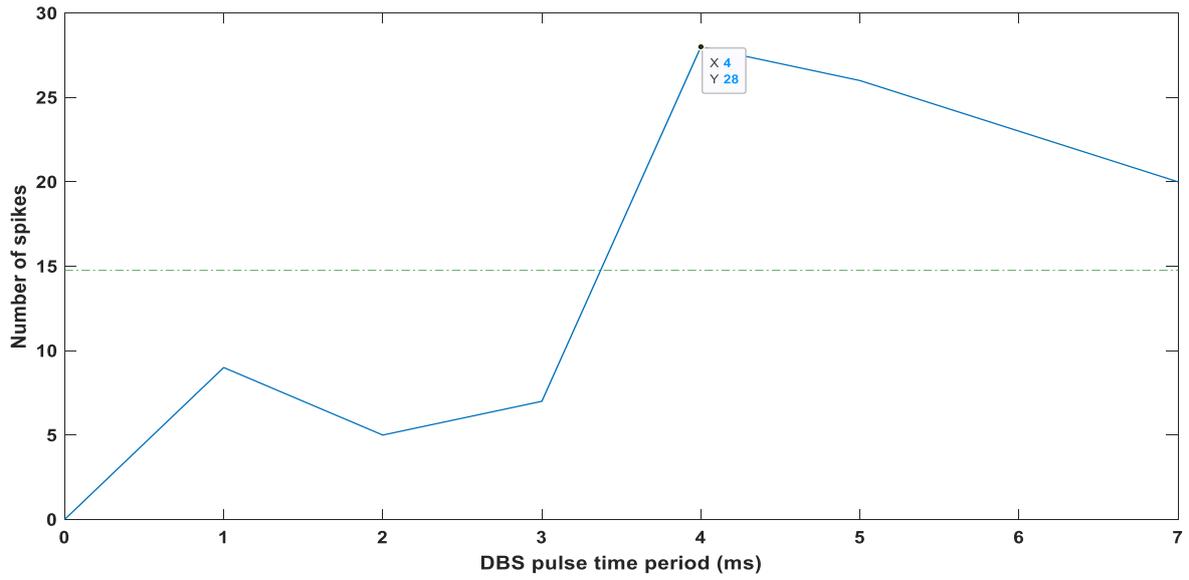


Fig.4.21

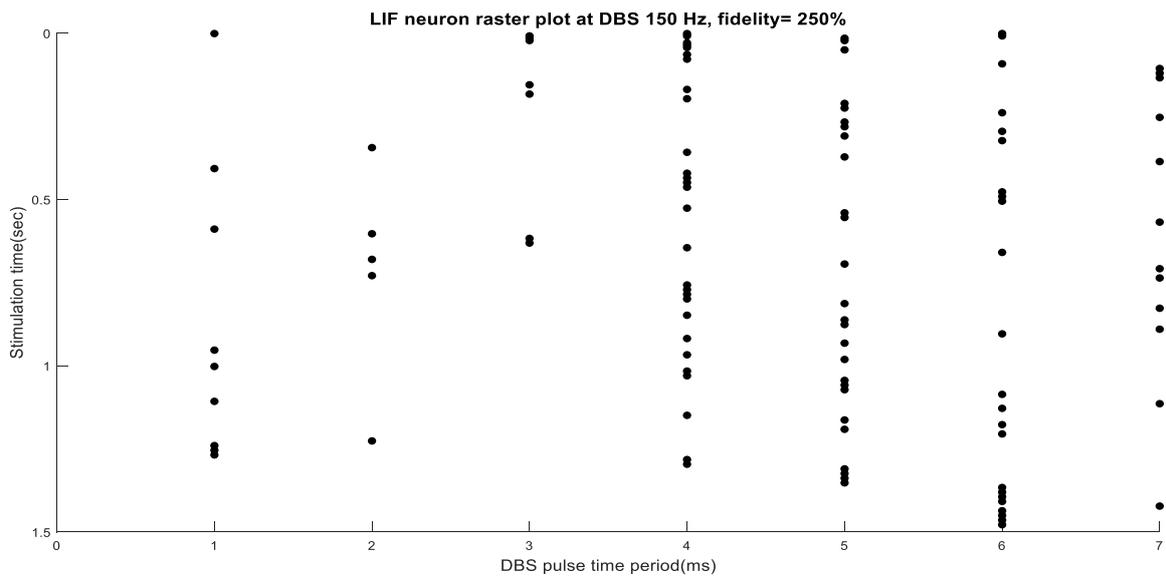


Fig.4.22

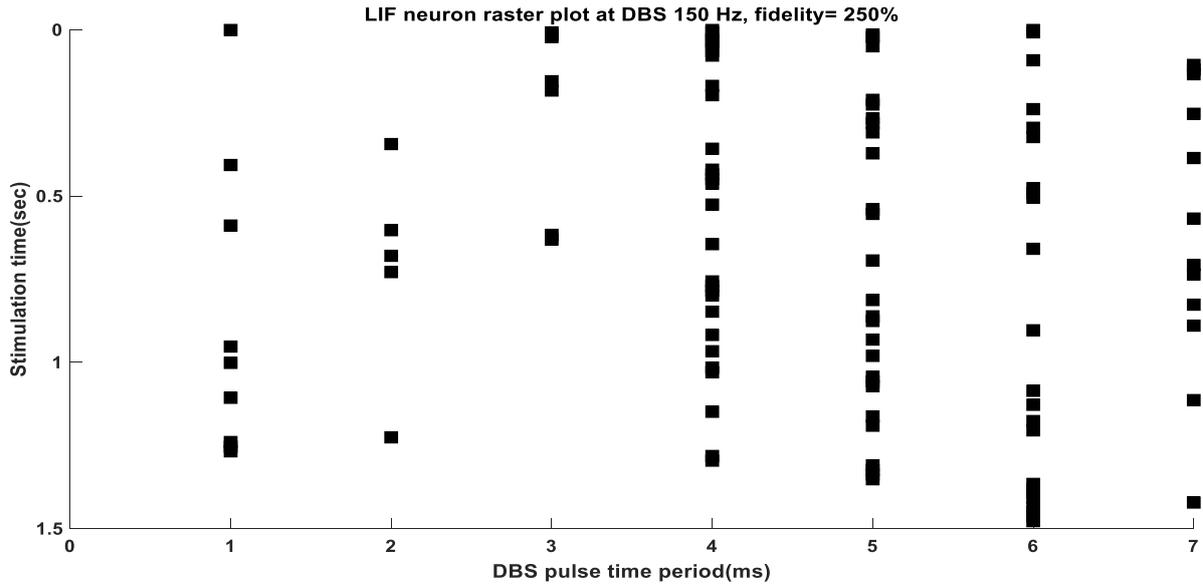


Fig.4.23

Fig. 4.20(A) shows the input frequency, i.e. 150Hz. Fig.4.20(B) depicts EPSC from F, D and P synapses distinctly. Fig. 4.20(C) shows the total EPSC generated from all the synapses F, D and P. Fig.4.20(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 4.21 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 28 at 4ms, whereas the average no. of spikes generated is 14.75.

Fig.4.22 and Fig.4.23 shows stimulus triggered action potentials during DBS. Fig.4.22 shows raster plot of the LIF neuron model with TM synaptic dynamics and Fig. 4.23 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

LIF rate without any synaptic connection = 8.0053 (Hz)

LIF rate with a fraction of synapses during DBS10Hz = 56.7045 (Hz)

LIF rate with all synapses during DBS10Hz = 74.0494 Hz

Elapsed time is 16.477522 seconds.

Fig.4.8 to Fig.4.23 depicts the post synaptic spiking activity of the F, D and P synapses triggered by DBS. It is found that the average number of spikes generated increased as the applied DBS frequency was increased. This implies that as the DBS frequency increases, the spiking activity also increases.

Glutamatergic synaptic inputs were sent to the LIF neuron model, all of which were explicitly triggered by our DBS signal (with a 2 ms AP transmission delay from thalamus). Based on physiologically realistic distributions of synapse types, the various synaptic inputs were classified as F (45), D (38), or P (17). EPSCs were generated simultaneously in the LIF neuron when a single DBS pulse was initiated in these synaptic inputs, thus resulting in a total DBS EPSC that was a mix of F, D, and P components. A single DBS EPSC, generated with the initial conditions of the synapse models, was suprathreshold for the generation of a stimulus evoked AP in the LIF neuron. High frequency driving (130 Hz) of the DBS synaptic input generated an initial burst of APs in the LIF neuron and then as the total DBS EPSC reduced in amplitude to a steady-state value, the inputs provided subthreshold excitatory inputs to the LIF neuron. The overall result of this DBS-driven excitatory current was an increased average firing rate.

## CHAPTER 5

# DYNAMICS OF MEMRISTIVE LIF MODEL UNDER DEEP BRAIN STIMULATION

### 5.1 Introduction

A memristor is a two-terminal passive electrical component that serves as a fundamental non-linear circuit element that links charge and magnetic flux. The memristor is a promising device in many analogue and digital applications, particularly memory chips, logic circuits, and neural networks [23].



Fig 5.1 Memristor

Three fundamental passive elements such as resistor, capacitor, and inductor are currently used to build electronic circuits. The fourth fundamental element called memristor has recently emerged [24]. Professor Leon O. Chua of the University of California at Berkeley initially described a basic circuit that connects flux to charge in 1971, and it was successfully discovered in 2008 by a team led by Stanley Williams of HP Labs. Members of an HP Lab submitted a paper describing the successful realisation of a nanoscale electronic component whose measured physical attributes can be described by the memristor theory. As illustrated in the figure 2, the HP memristor is a solid state device made up of a nanometer-scale  $\text{TiO}_2$  thin film with a doped and undoped region sandwiched between two Platinum electrodes.

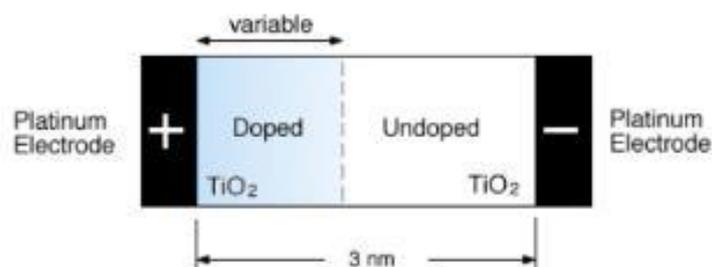


Fig 5.2 Titanium Dioxide Memristor

The new two-terminal passive element is named memristor as it combines the behavior of a memory and a resistor (i.e. memory+resistor). Memristors have shown various outstanding properties, such as good compatibility with CMOS technology, small device area for high-density on-chip integration, non-volatility, fast speed, low power dissipation, and high scalability [25]. One of the basic properties, resistance, of a memristor depends on the magnitude, direction, and duration of the voltage applied across its terminals. Memristor remembers its most recent resistance value when applied voltage was turned off and until the next time when applied voltage is turn on. And has other properties including pinched hysteresis and dynamical-negative resistance that can have significant impact on nanoelectronics.

Many uses for the memristor have been proposed since 2008. Memristors can be utilized in Resistive Random Access Memory (RRAM) cell architectures and Memristor-based Content Addressable Memories (MCAMs) that use a combination of memristor and MOS devices in memory chips. The capacity of the memristor to "memorise" the current pass through it and its direction can be employed efficiently in neural networks to minimize the area and complexity of neuromorphic circuits. A novel form of memristor-based IMPLY logic circuit was developed in the field of logic circuits. Memristor-based logic has the unique capability of being manufactured on the same chip as memory cells. Crossbar-arrays, which are employed in the switching blocks of Field Programmable Gate Arrays, are also designed with memristors (FPGAs) [26]. Thus, although memristors took many years to transform from a purely theoretical derivation into a feasible implementation, these devices has been widely used in applications such as machine learning and neuromorphic computing, as well as non-volatile random-access memory.

Ion motion controls the conductance of the non-volatile memristor, which is analogous to what happens in organic neurons and synapses. As a result of these advantages, the memristor has become an unavoidable choice as a building block for both artificial and organic neural networks.

## 5.2 Memristor properties

### 5.2.1 Flux-Charge relation

A charge-controlled memristor is one in which the flux and charge relationship is expressed as a function of charge, whereas a flux-controlled memristor is one in which the flux and charge relationship is expressed as a function of flux [27]. A linear (constant) memristor acts like resistance. If relation is nonlinear, the device behaviour is more complex, thus the memristor's parameter that relates  $q$  and  $\varphi$  is not a constant [28].

Memristance  $M$  is the missing link between flux and charge. The memristor is said to be charge-controlled with a memristance ' $M(q)$ ' given by:

$$M(q) = \frac{d\varphi}{dq}$$

The memristor is said to be flux-controlled with a memductance ' $W(\varphi)$ ' given by:

$$W(\varphi) = \frac{dq}{d\varphi}$$

Therefore it can be derived that:

$$v = M(q).i$$

$$i = W(\varphi).v$$

Memristance has the same unit (Ohm) as resistance, and  $M(q)$  is logically a charge controlled resistance. Similarly, the memductance has the unit of conductance [29]. The inverse of memductance is memristance,

$$M = 1/W(\varphi)$$

The  $q$ - $\varphi$  curve is characterised by a monotonically increasing trend. The memristance  $M$  is the slope of this curve ( $q$ ). As a result, the memristance is

always positive  $M(q) \geq 0$ . A memristor is a passive element if and only if the memristance has a non-negative value, according to the passivity requirement. The instantaneous power dissipated by the memristor is given by:

$$P(i) = M(q)i(t)^2$$

Since  $M(q) \geq 0$ , the wasted power is always positive. As a result, the memristor is a passive device. This means it can't produce or store energy; it can only consume power. A memristor, like a resistor, is entirely dissipative [23].

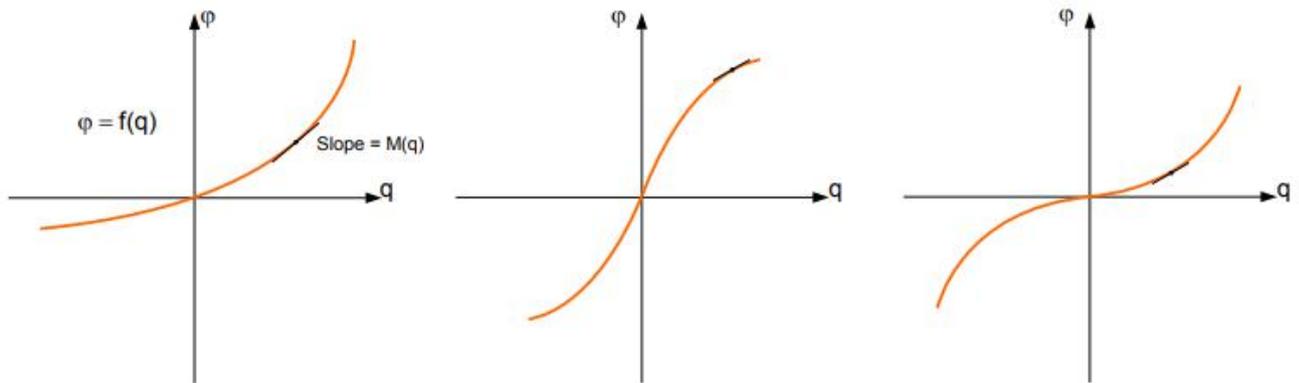


Fig. 5.3 Three examples of charge-flux characteristics of the memristor, which all have monotonically increasing characteristics.

### 5.2.2 Current-Voltage relation

The current-voltage characteristic of a memristor, which exhibits a pinched hysteresis loop, is its most important feature. The I-V characteristic of the memristor cannot be achieved using any combination of the other three basic components, therefore the memristor is considered a basic component [26]. By applying a periodic signal to a memristor, if the voltage is zero, the current will be zero and vice-versa. So, both voltage  $v(t)$  and current  $i(t)$  curves always cross the origin curve. The pinched hysteresis loop's shape will fluctuate with frequency. The hysteresis loop shrinks when the frequency is increased. The memristor will behave like a conventional resistor if the frequency is increased to infinity [23].

The I-V characteristic's slope changes, indicating a changeover between distinct resistance states, with the resistance becoming positive as the applied voltage rises and negative as it falls. Double-loop I-V hysteresis is produced by the symmetrical voltage bias, which can collapse to a straight line at high frequencies [24].

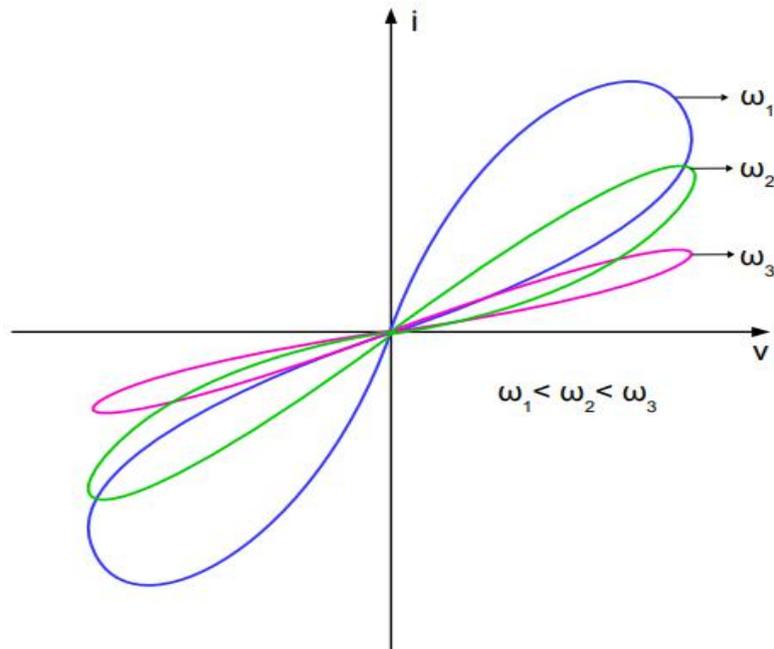


Fig. 5.4 Current-voltage characteristics of the memristor.

### 5.2.3 Resistance – Time Relation

The resistance versus time characteristic of the memristor is depicted in Fig. 4.5. The instantaneous resistance is in the range  $[R_{ON}, R_{OFF}]$ . The resistance values depend on the applied voltage. For a sine-wave voltage with period  $T$ , the memristance has its extreme (maximum or minimum) values at the following time instances:  $t = (2n + 1)T/2$  [30].

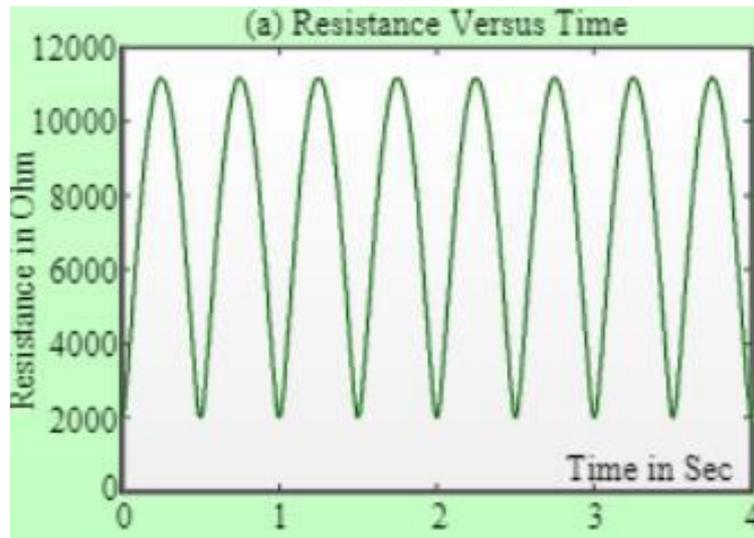


Fig. 5.5 Resistance Versus Time plot of the memristor

#### 5.2.4 Resistance – Voltage Relation

The resistance versus voltage characteristic is depicted in Fig. 4.6. The voltage across the memristor is initially 0 Volt, with a current of 0 Amp and a resistance of  $R_i$  [30].

The memristance value also depends on the sign of  $v(t)$ ; in other words, resistance  $[R_i, R_{OFF}]$  for  $v(t) < 0$  and  $[R_{ON}, R_i]$  for  $v(t) > 0$ . This is because current follows voltage, whereas resistance rises as voltage rises. When the voltage drops to zero, the resistance reaches its maximum,  $R_{OFF}$  [24].

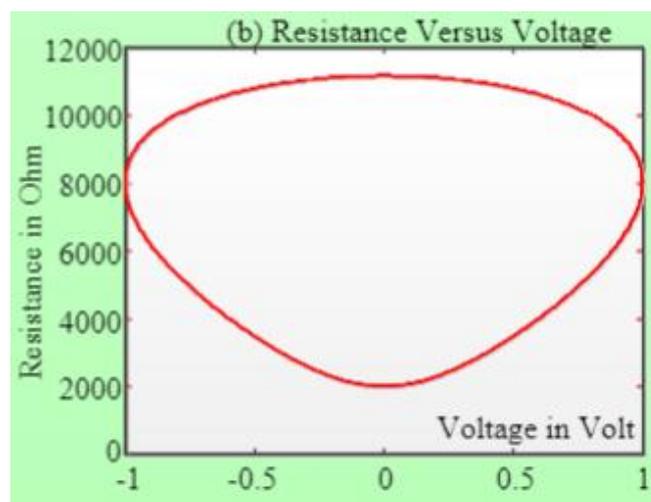


Fig. 5.6 Resistance Versus Voltage plot of the memristor.

### 5.3 The Memristive LIF (MLIF) spiking neuron model

Considering the LIF spiking model has no memory of the previous spike and the memory advantage of the memristor (can “remember” the charges pass through itself, and it is called non-volatile characteristics) we introduce a memristor to the LIF spiking model, as shown in Figure 4.8.

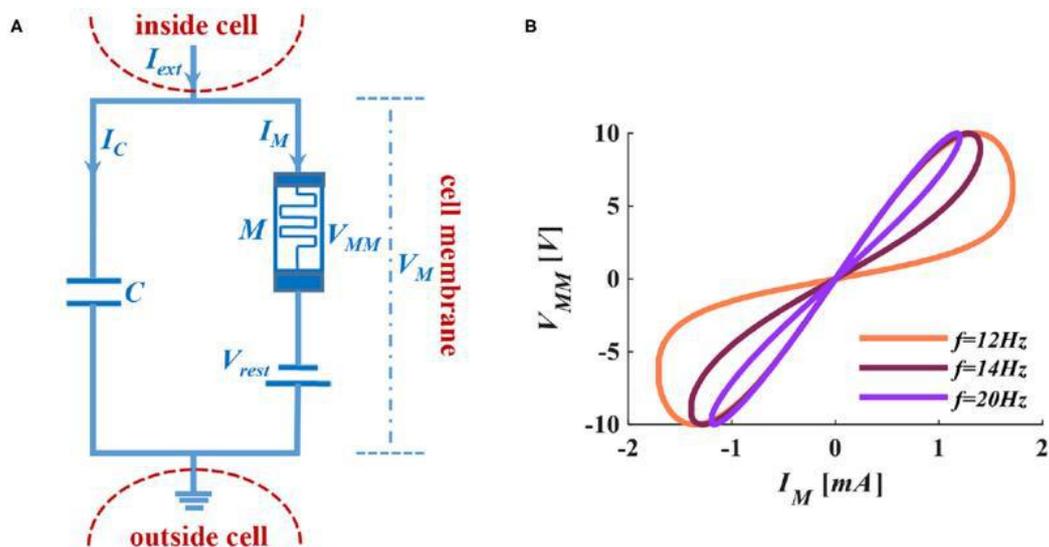


Fig 5.7 The MLIF circuit model and the I-V curve of the memristor. (A) MC membrane circuit of the MLIF model. (B) The pinched hysteresis curve and frequency characteristics of ion channel memristor.

When we apply a sinusoidal voltage to the ion channel memristor, it performs a zero-crossing pinched hysteresis curve. When we adjust the voltage frequency to 100 Hz, the electrical characteristics of the memristor are close to a straight line. The memristor performs the feature of pure resistance. In Figure 4.8 B, the distribution of the curve is in the first and third quadrants, which indicates that the device is passive. The curve has two prominent switching states and keeps a memristance constant without a power supply. It shows that the device is non-volatile.

In the MLIF membrane circuit, the  $\tau$  is not a constant anymore, and it becomes a function of time. Therefore,  $\tau = RC$  is transformed into  $\tau_M(t) = M(t)C$ . The memristor  $M(t)$  is divided into charge-controlled memristor and flux-controlled memristor, and they are the functions of time. According to  $q = CV$ , we get  $q(t) = C(t)V_M$  ( $V_M$  is the membrane voltage of the MLIF model, as shown in

Figure 4.8 A), thereby we can rewrite C as  $C(t) = q(t)/V_M$ , and  $\tau_M(t) = M(t)q(t)/V_M$ . The charge or discharge time of the capacitor always relates to the accumulation of charge [32].

*The charge-controlled memristor:*

$$M(q(t)) = \left\{ \begin{array}{ll} 20000, & q(t) < -0.5 \times 10^{-4} \\ 10^4 + (-1.99) \times 10^8 \times q(t), & q(t) \geq -0.5 \times 10^{-4} \text{ and } q(t) < 0.5 \times 10^{-4} \\ 100, & q(t) \geq 0.5 \times 10^{-4} \end{array} \right\} \quad (9)$$

And then, we get:

$$\tau_M(t) = \left\{ \begin{array}{ll} \frac{20000q(t)}{V_M}, & \varphi(t) < -0.75 \\ \frac{10^4 q(t)}{V_M} + (-1.99) \times 10^8 \times \frac{q(t)^2}{V_M}, & \varphi(t) \geq -0.75 \text{ and } \varphi(t) < 0.25 \\ \frac{100q(t)}{V_M}, & \varphi(t) \geq 0.25 \end{array} \right\} \quad (10)$$

From the above equations, we can get the time constants of charge-controlled memristor.

According to the MLIF membrane circuit and (7), the mathematic expression of the MLIF model can be rewritten as follows:

$$V_M(t + \Delta t) - V_M(t) = \frac{\Delta t}{\tau(t)} (-V_M(t) + V_{rest} + M(t)I_{ext}) \quad (11)$$

In the following experiments, the different stimuli are applied to the MLIF model, and the values of parameters will be set as  $C = 2 \times 10^{-9}F$ ,  $R = 10^6 \Omega$ ,  $V_{rest} = -60 \text{ mV}$ ,  $V_{th} = -50 \text{ mV}$ ,  $V_{rest} = -80 \text{ mV}$

## 5.4 Results

### Varying DBS frequency

$f_{DBS}=60\text{Hz}$

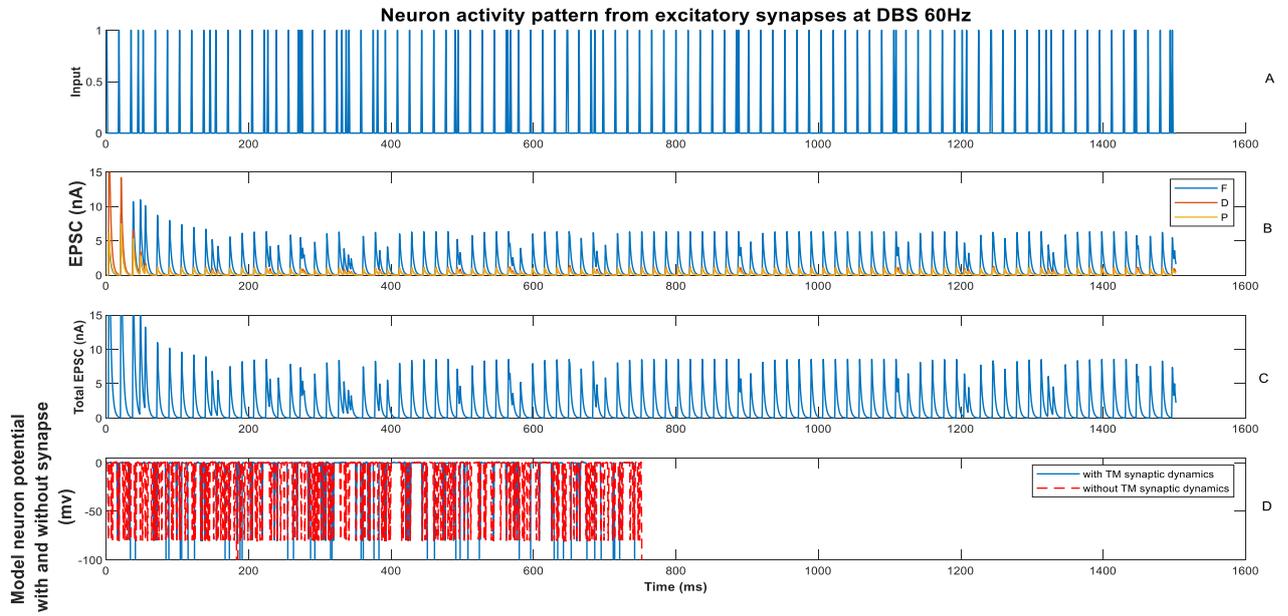


Fig.5.8

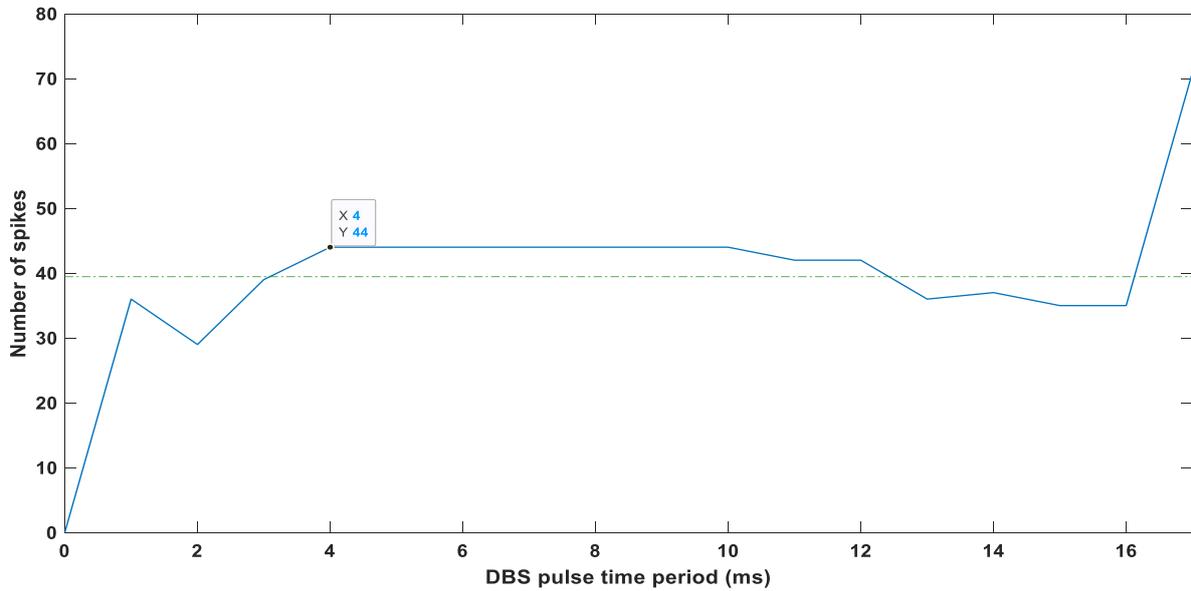


Fig.5.9

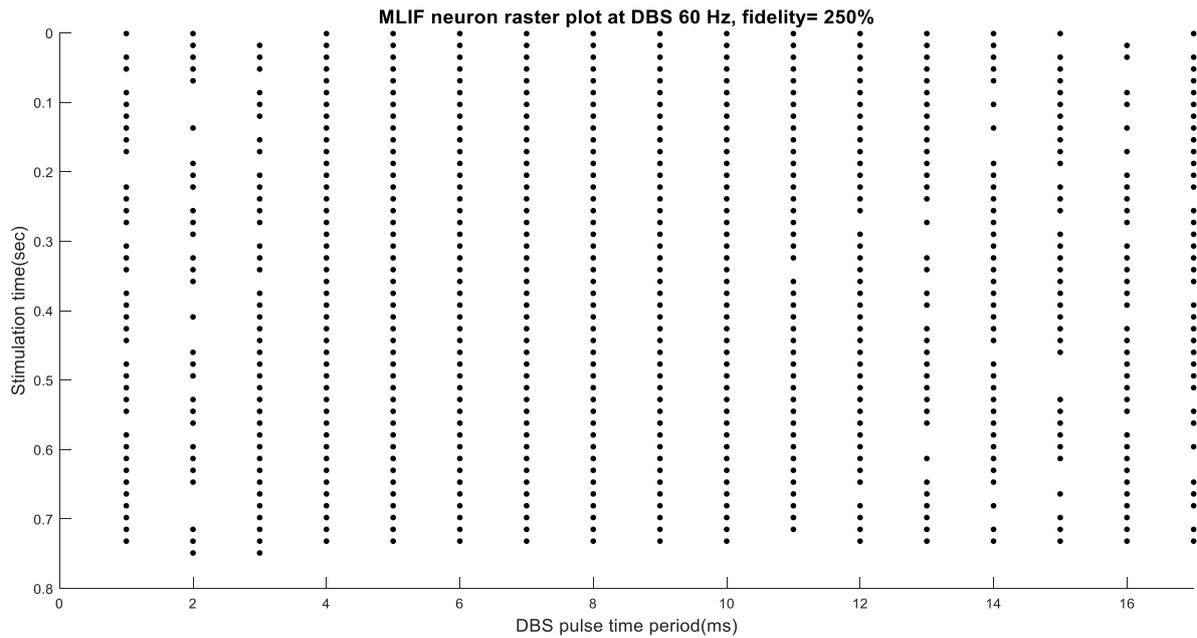


Fig.5.10

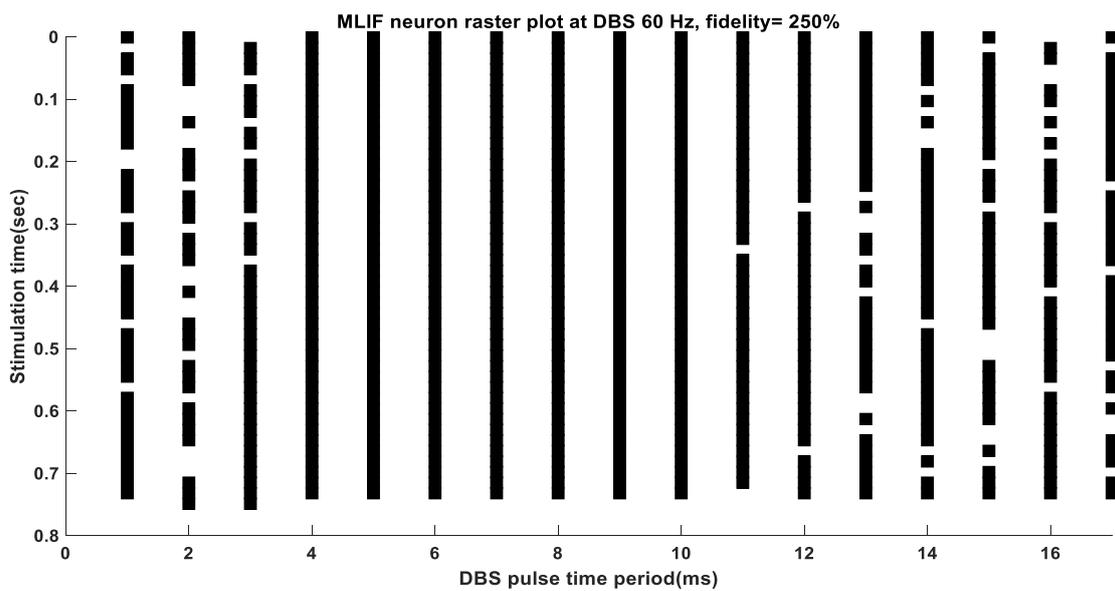


Fig.5.11

Fig.5.8(A) shows the input frequency, i.e. 60Hz. Fig.5.8(B) depicts EPSC from F, D and P synapses distinctly. Fig. 5.8(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.8(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.9 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 44 at 4ms, whereas the average no. of spikes generated is 39.44.

Fig.5.10 and Fig.5.11 shows stimulus triggered action potentials during DBS. Fig.5.10 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.11 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

MLIF rate without any synaptic connection = 381.5877 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 360.2402 (Hz)

MLIF rate with all synapses during DBS10Hz = 450.3002 Hz

Elapsed time is 8.107420 seconds.

**fdbs=80Hz**

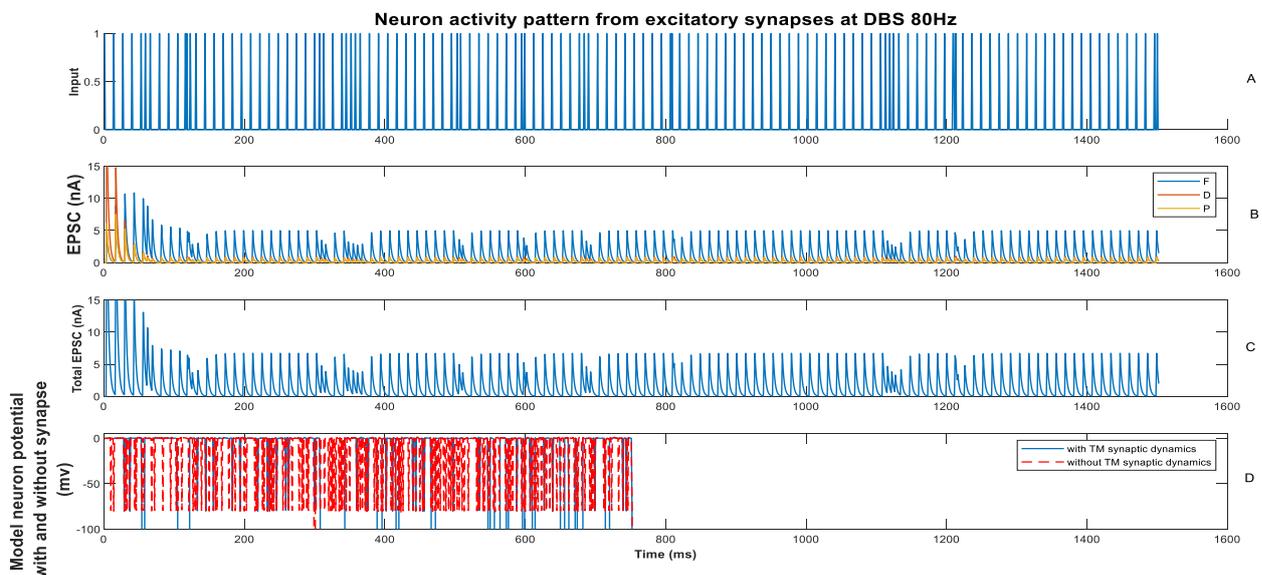


Fig.5.12

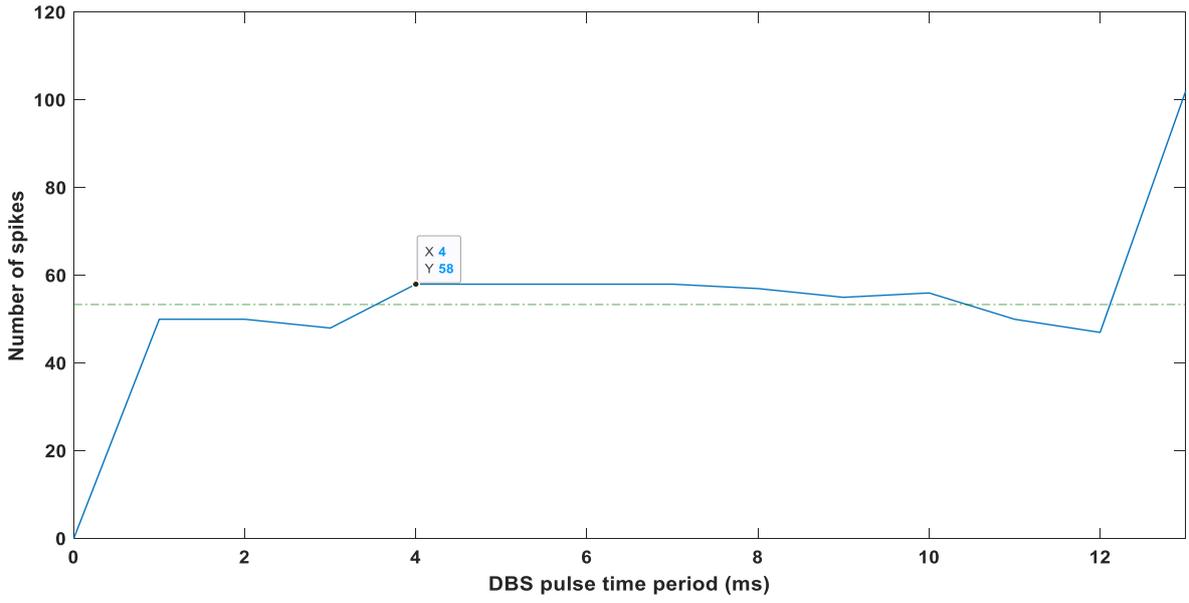


Fig.5.13

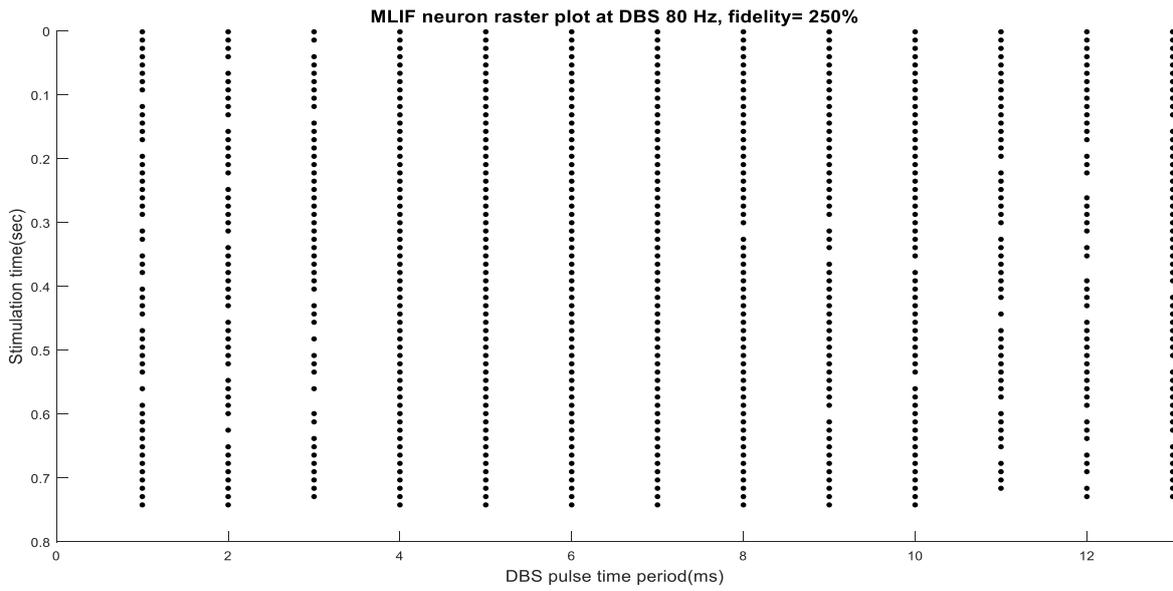


Fig.5.14

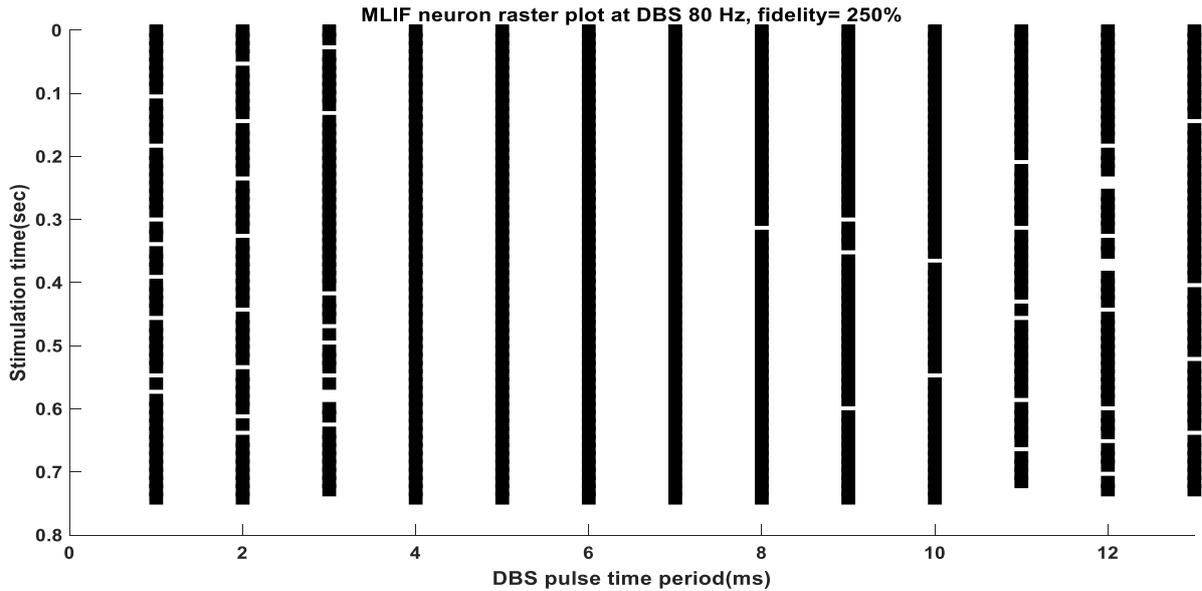


Fig.5.15

Fig.5.12(A) shows the input frequency, i.e. 80Hz. Fig.5.8(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.12(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.12(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.13 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 58 at 4ms, whereas the average no. of spikes generated is 53.36

Fig.5.14 and Fig.5.15 shows stimulus triggered action potentials during DBS. Fig.5.14 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.15 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

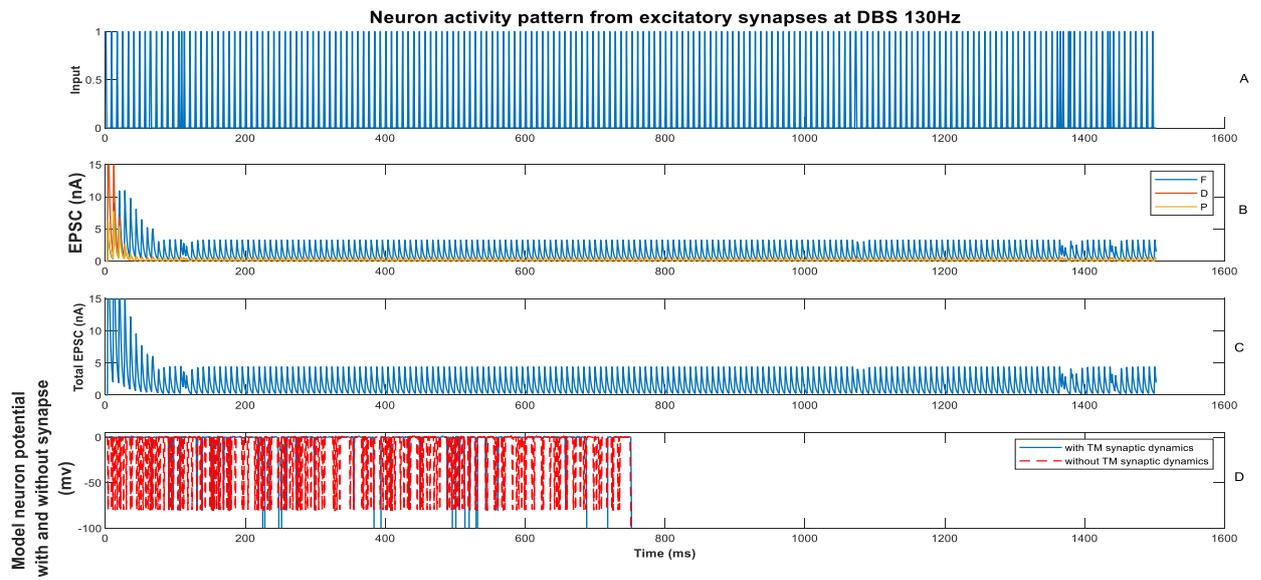
MLIF rate without any synaptic connection = 392.2615 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 396.9313 (Hz)

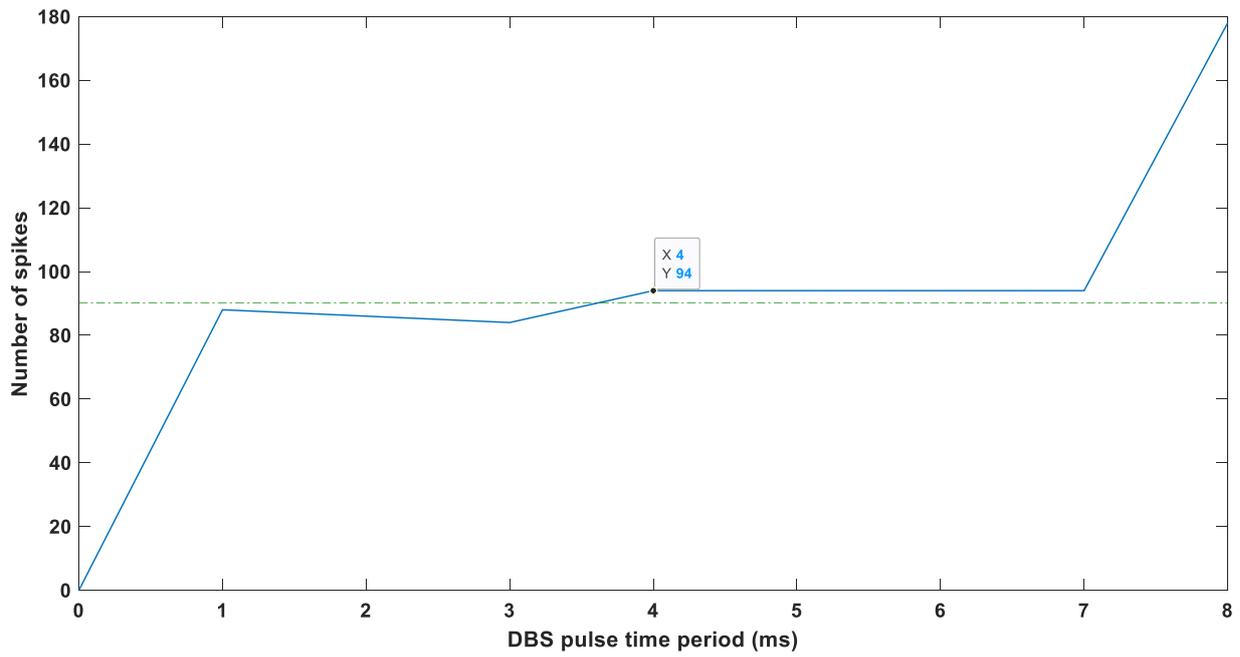
MLIF rate with all synapses during DBS10Hz = 465.6438 Hz

Elapsed time is 9.892783 seconds.

**f<sub>DBS</sub>=130Hz**



**Fig.5.16**



**Fig.5.17**

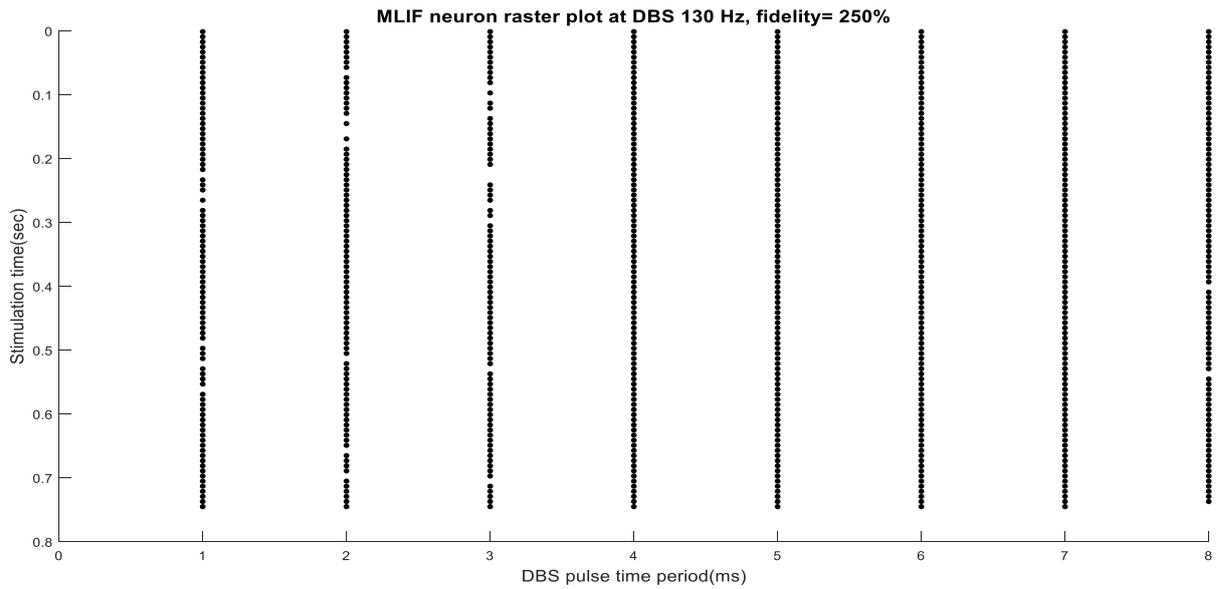


Fig.5.18

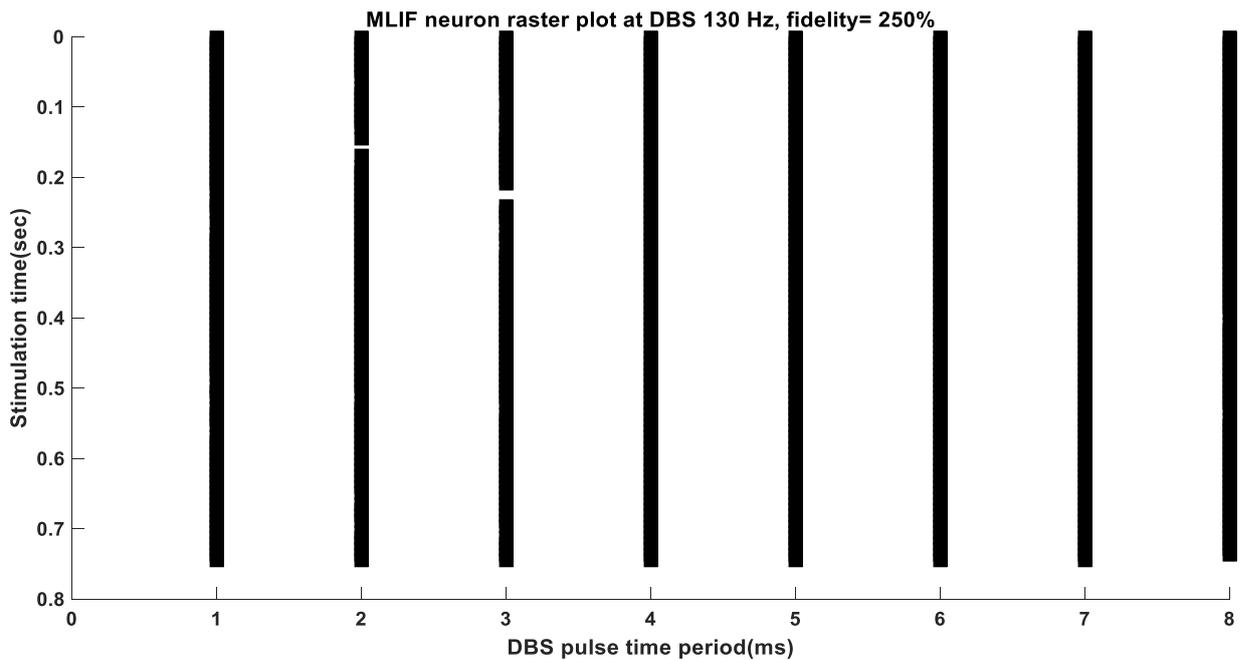


Fig.5.19

Fig.5.16(A) shows the input frequency, i.e. 130Hz. Fig.5.16(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.16(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.16(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.17 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 94 at 4ms, whereas the average no. of spikes generated is 90.22.

Fig.5.18 and Fig.5.19 shows stimulus triggered action potentials during DBS. Fig.5.18 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.19 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 7ms.

MLIF rate without any synaptic connection = 387.5917 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 442.2949 (Hz)

MLIF rate with all synapses during DBS10Hz = 483.6558 Hz

Elapsed time is 15.005125 seconds.

### **fdbs=150Hz**

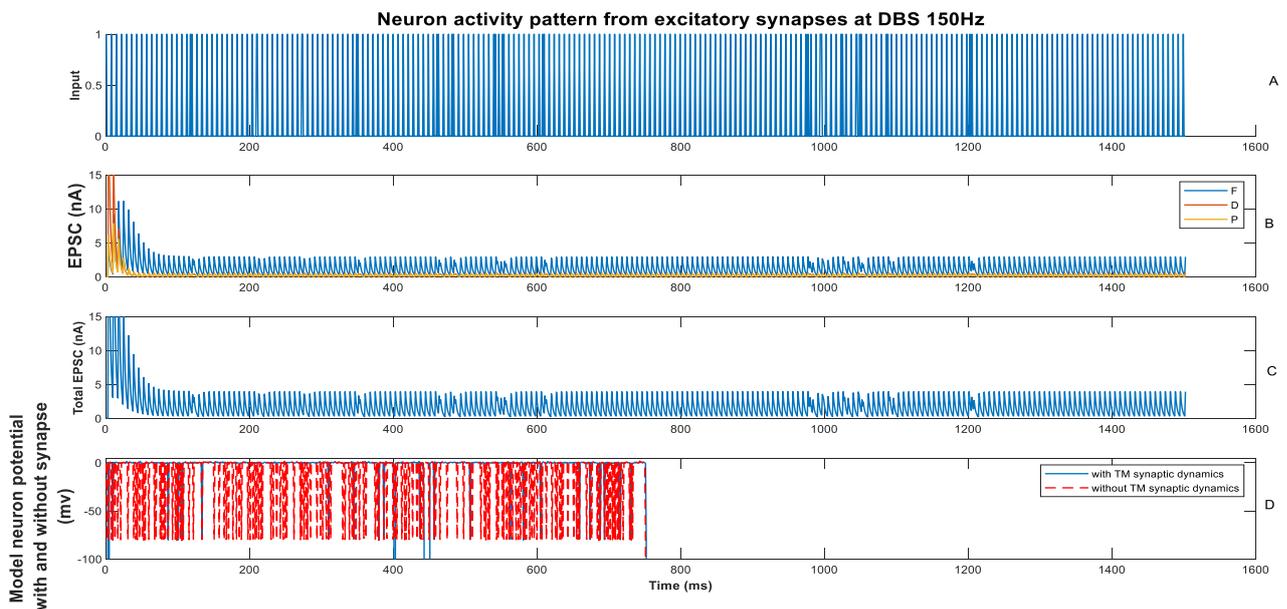


Fig.5.20

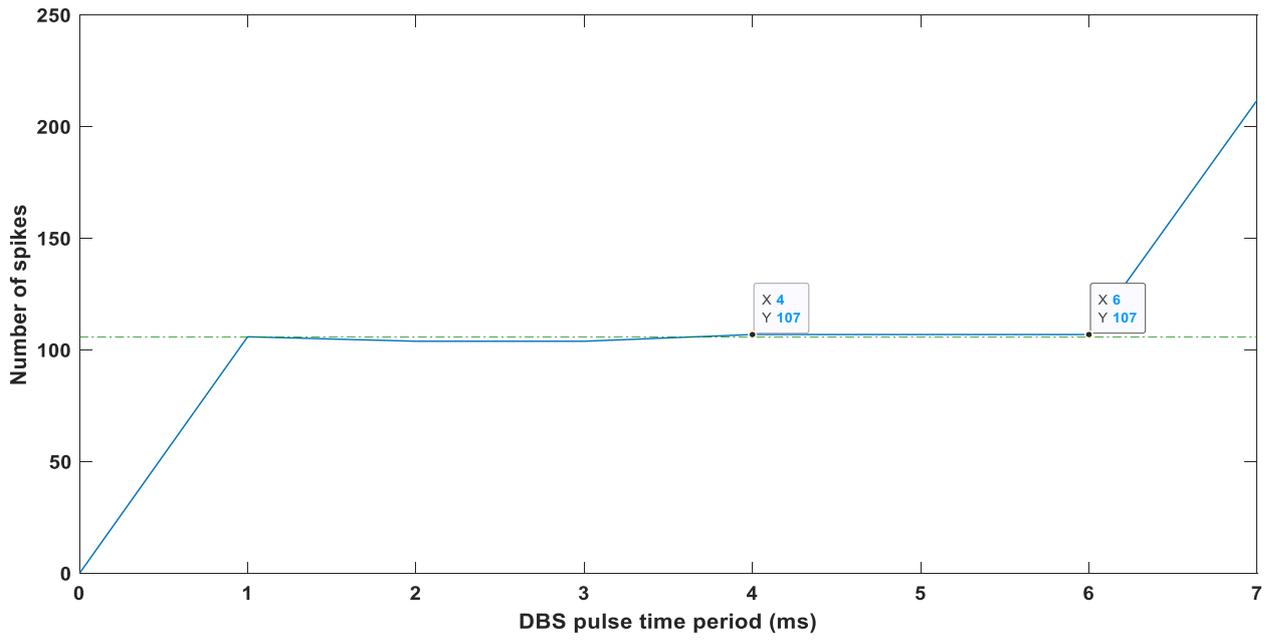


Fig.5.21

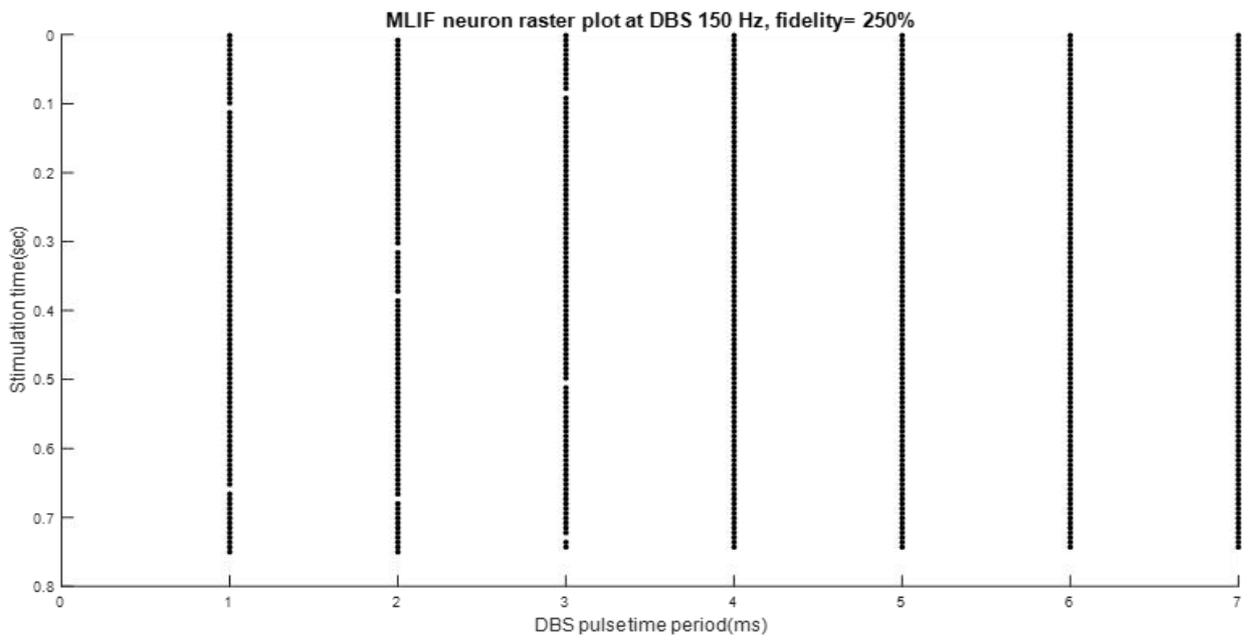


Fig.5.22

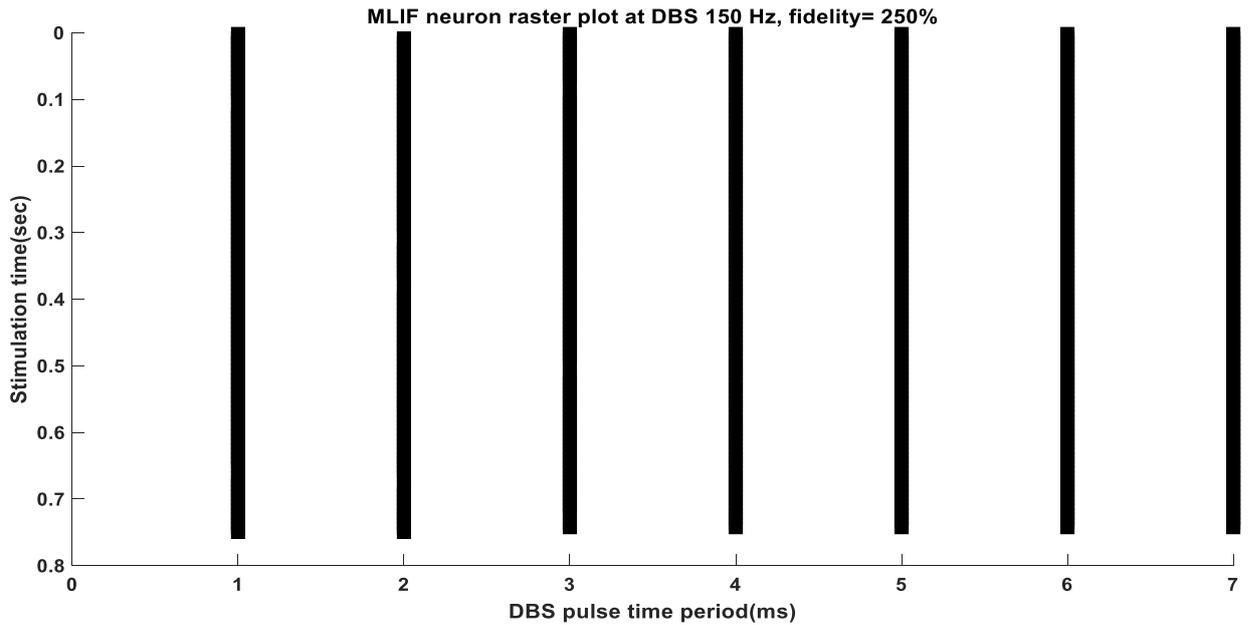


Fig.5.23

Fig.5.20(A) shows the input frequency, i.e. 150Hz. Fig.5.20(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.20(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.20(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics.

Fig. 5.21 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 107 from 4ms to 6ms, whereas the average no. of spikes generated is 105.9.

Fig.5.22 and Fig.5.23 shows stimulus triggered action potentials during DBS. Fig.5.22 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.23 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 6ms.

MLIF rate without any synaptic connection = 392.2615 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 479.6531 (Hz)

MLIF rate with all synapses during DBS10Hz = 494.9967 Hz

Elapsed time is 16.452186 seconds.

Fig.5.8 to Fig.5.23 depicts the post synaptic spiking activity of the F, D and P synapses triggered by DBS. It is found that the average number of spikes

generated by the MLIF neuron model increased as the applied DBS frequency was increased. This implies that as the DBS frequency increases, the spiking activity also increases.

Comparing Fig.4.8-4.23 with corresponding frequency plots in Fig.5.8-5.23, we observe that the number of spikes generated is greater when using MLIF neuron model. Hence, MLIF neuron model exhibits increased spiking activity than LIF neuron model.

## Varying Noise input

(f<sub>DBS</sub>=130Hz)

w<sub>ght</sub>=0

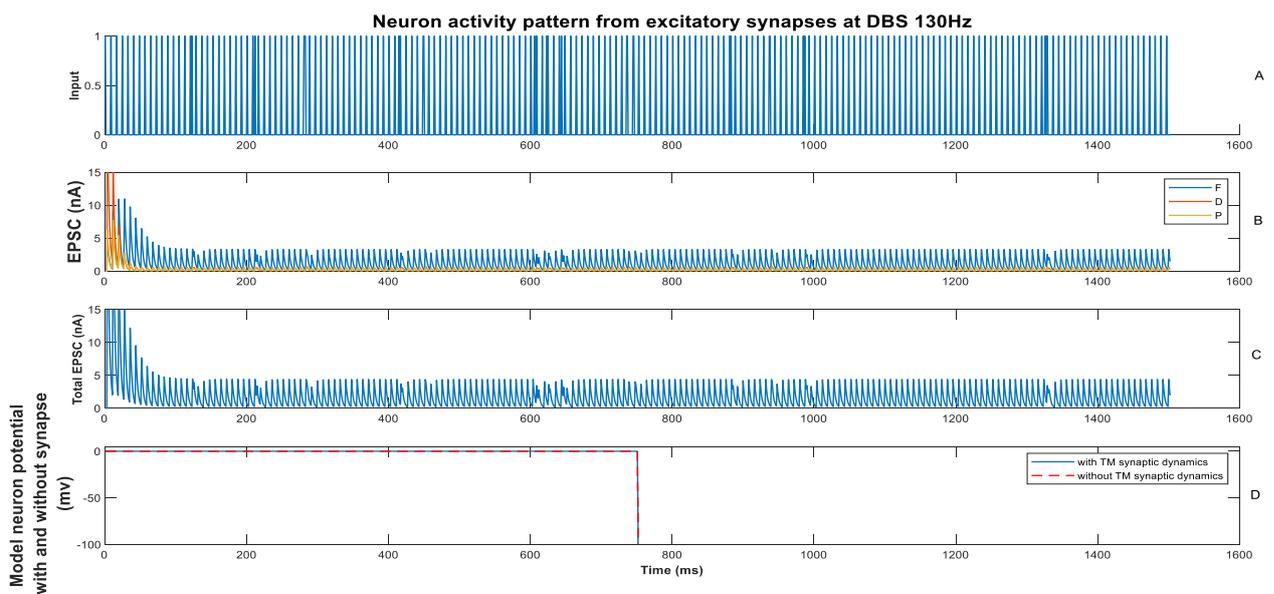


Fig.5.24

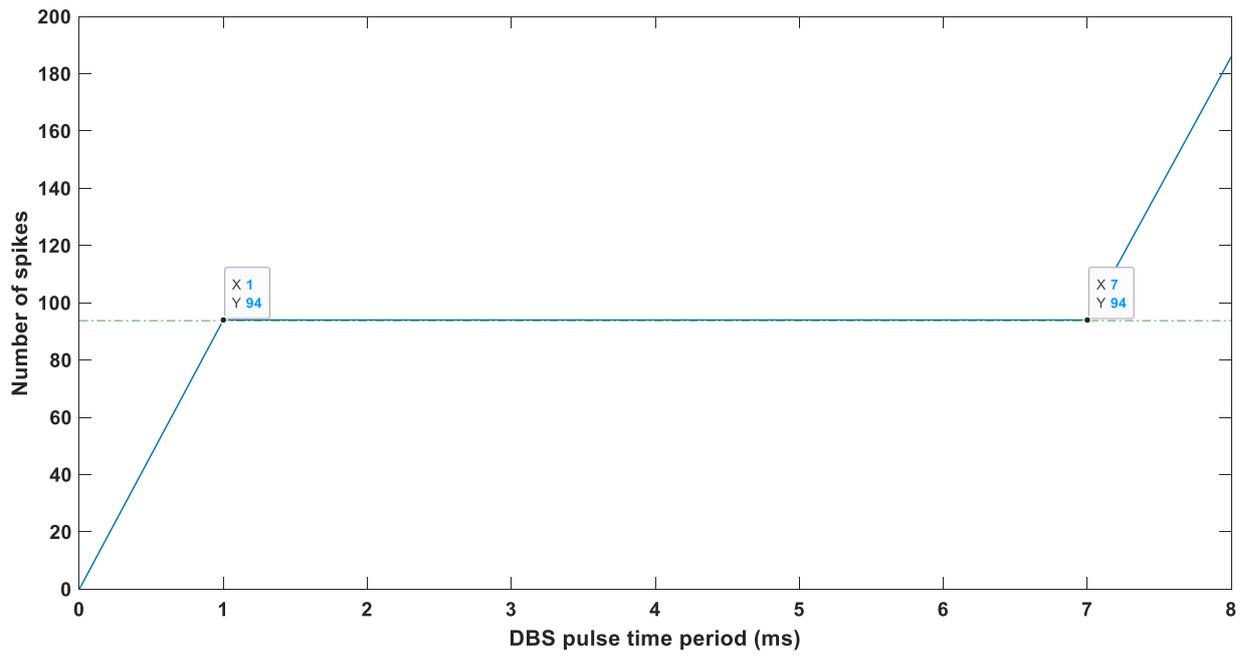


Fig.5.25

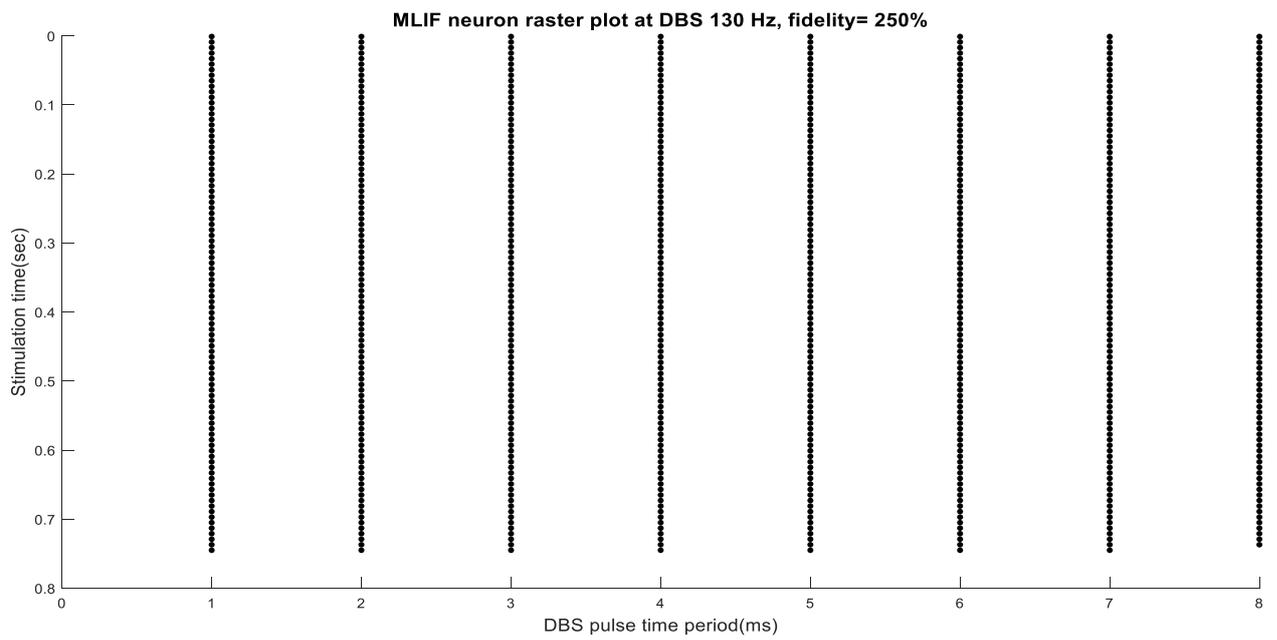


Fig.5.26

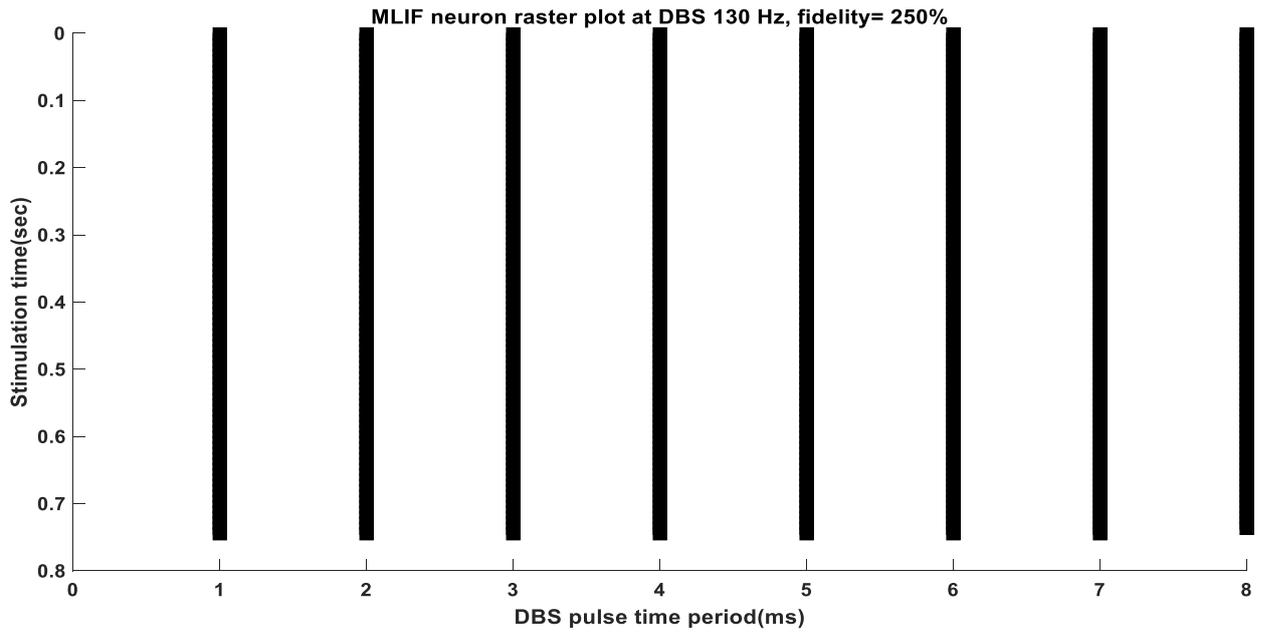


Fig.5.27

Fig.5.24(A) shows the input frequency, i.e. 130Hz. Fig.5.24(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.24(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.24(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. No noise input is given.

Fig. 5.25 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is constant at 94 from 1ms to 7ms, whereas the average no. of spikes generated is 94.

Fig.5.26 and Fig.5.27 shows stimulus triggered action potentials during DBS. Fig.5.26 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.27 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 1ms to 7ms.

MLIF rate without any synaptic connection = 501.0007 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 501.0007 (Hz)

MLIF rate with all synapses during DBS10Hz = 501.0007 Hz

Elapsed time is 17.941460 seconds.

wght=0.5

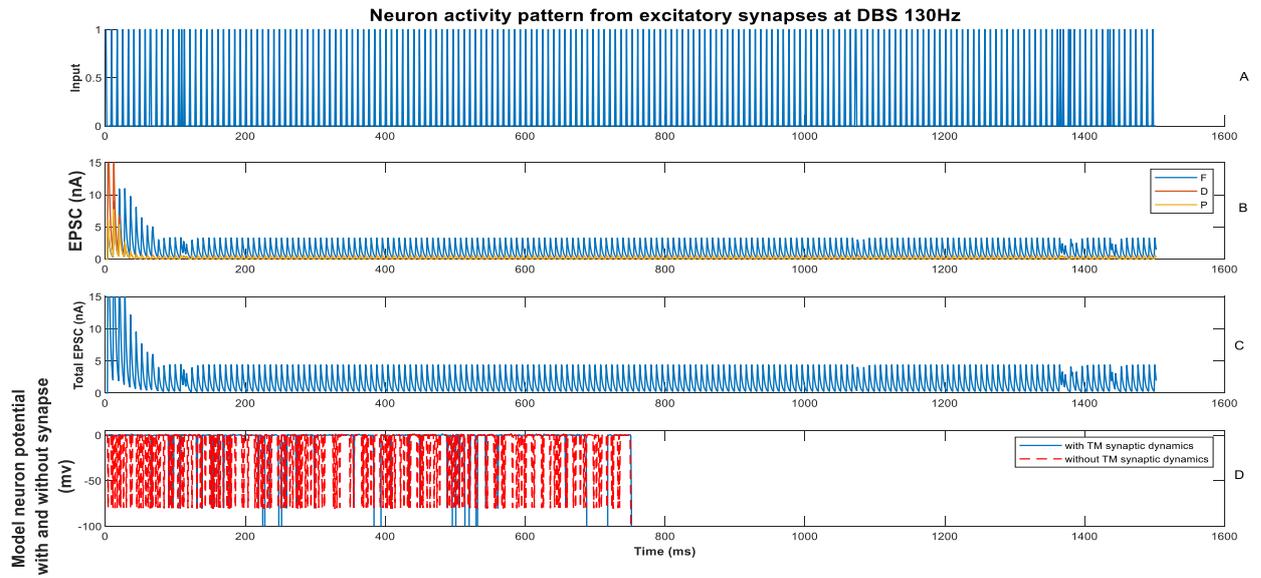


Fig.5.28

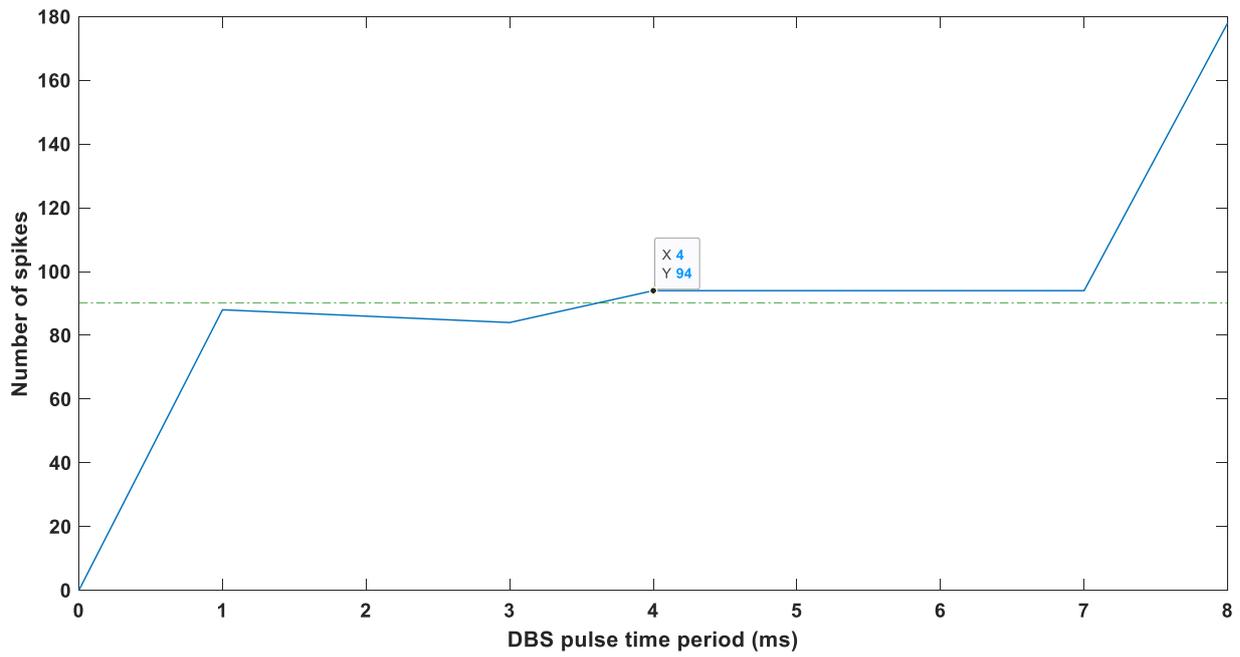


Fig.5.29

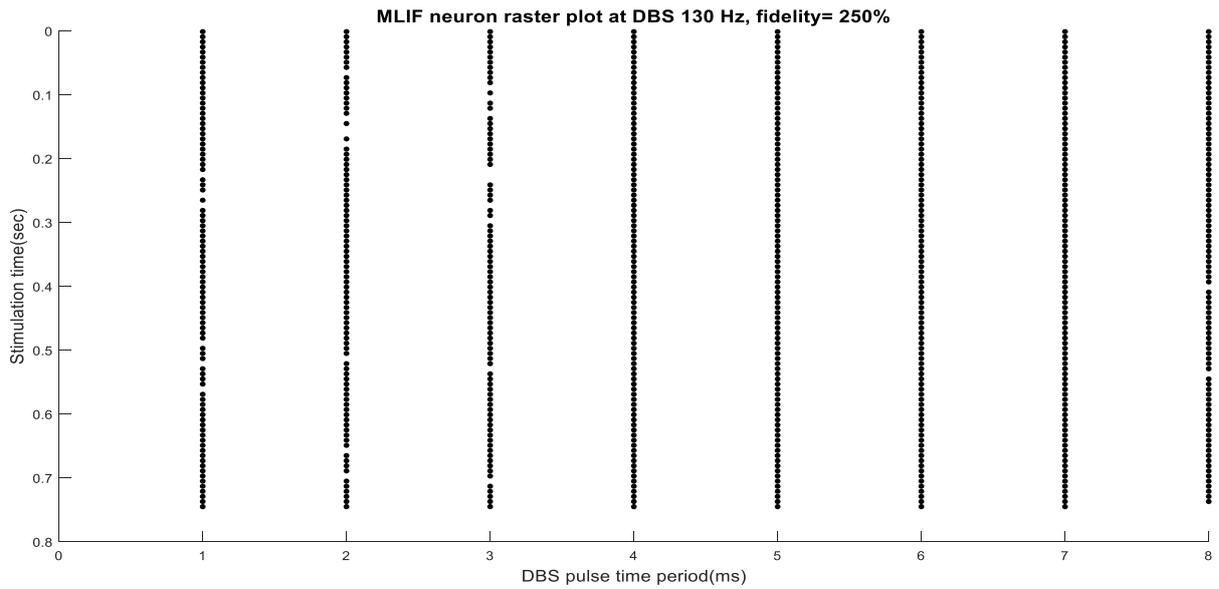


Fig.5.30

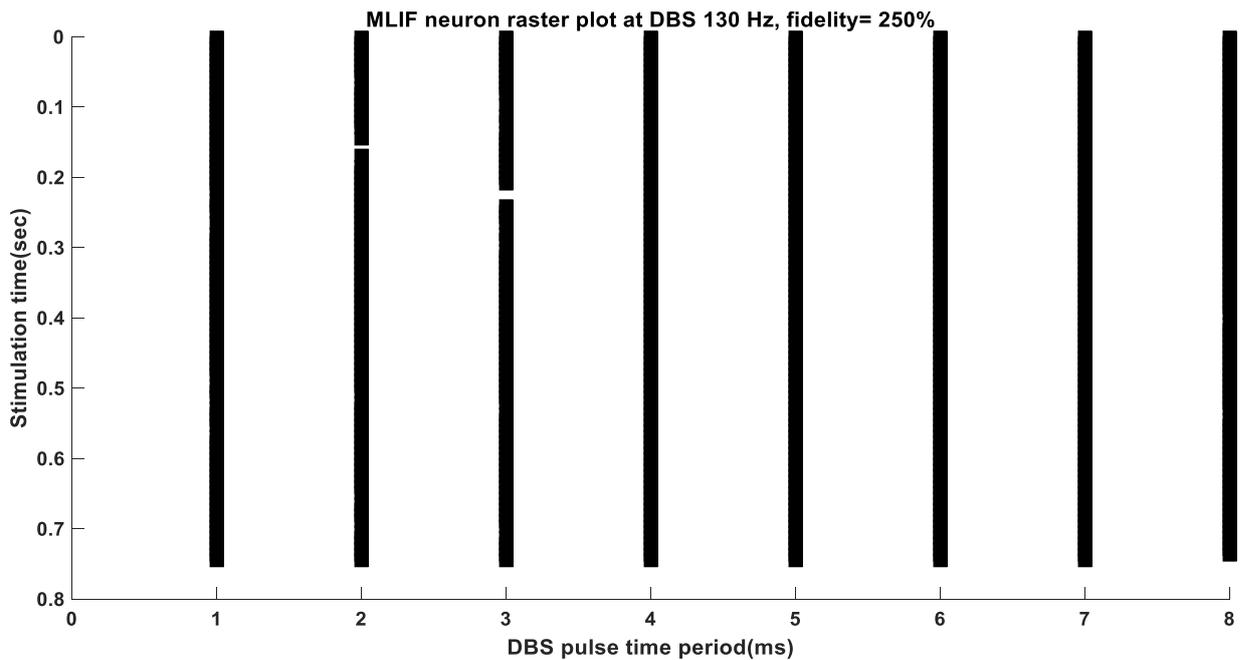


Fig.5.31

Fig.5.28(A) shows the input frequency, i.e. 130Hz. Fig.5.28(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.28(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.28(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. Noise input given is  $wght=0.5$ .

Fig. 5.29 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 94 at 4ms, whereas the average no. of spikes generated is 90.22.

Fig.5.30 and Fig.5.31 shows stimulus triggered action potentials during DBS. Fig.5.30 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig. 5.31 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 7ms.

MLIF rate without any synaptic connection = 387.5917 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 442.2949 (Hz)

MLIF rate with all synapses during DBS10Hz = 483.6558 Hz

Elapsed time is 15.005125 seconds.

**wght=5**

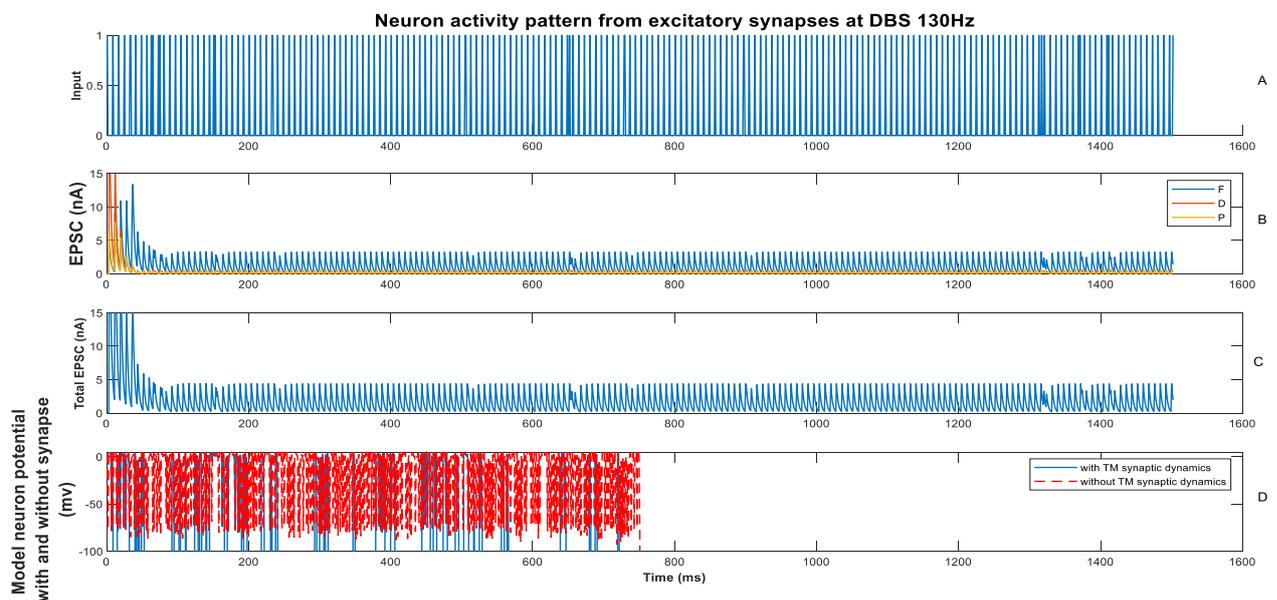


Fig.5.32

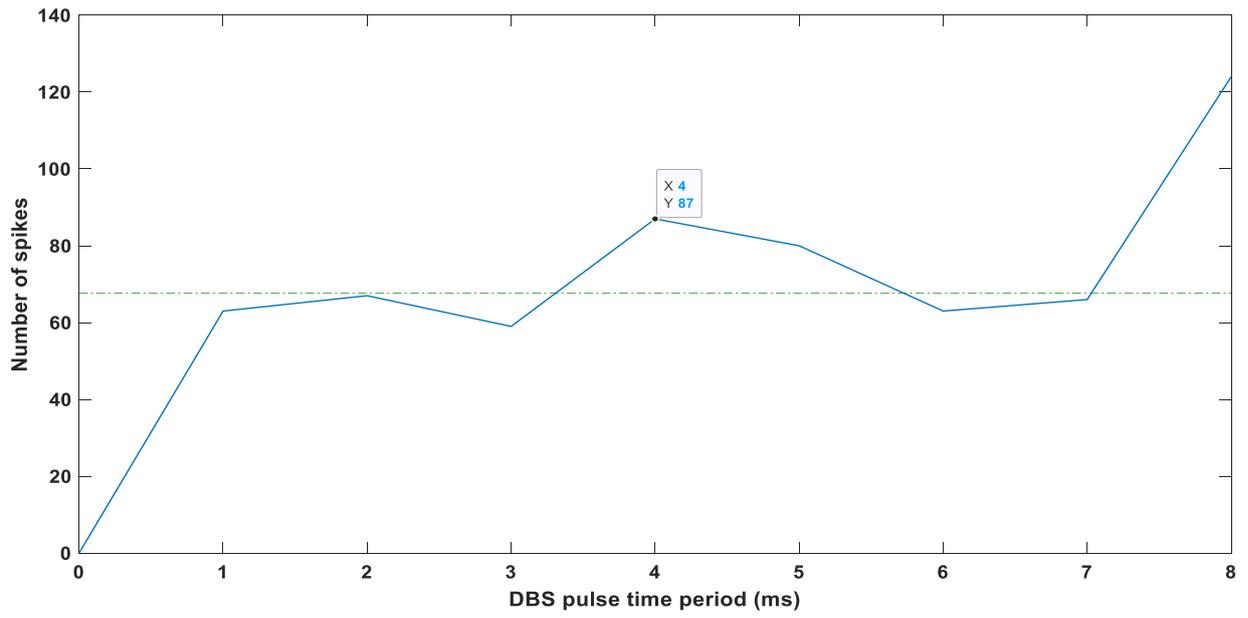


Fig.5.33

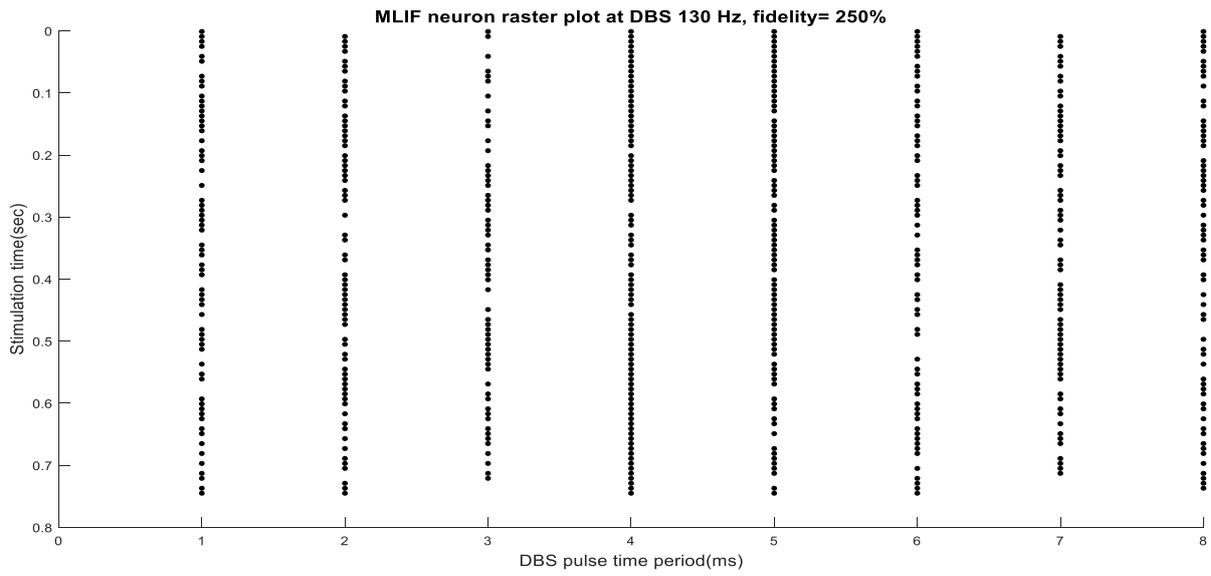


Fig.5.34

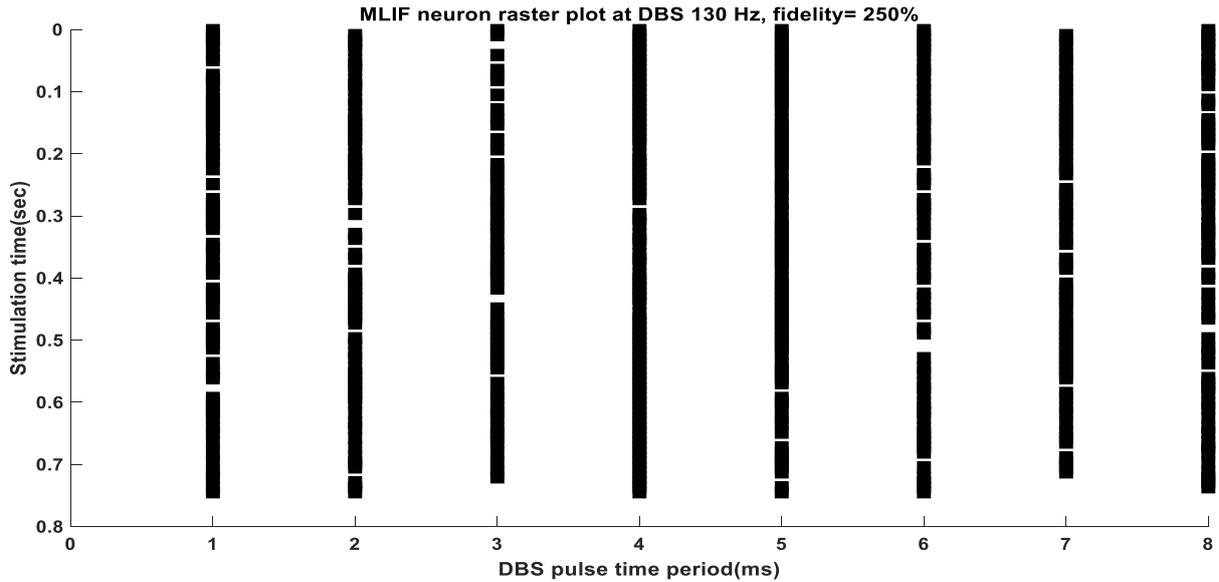


Fig.5.35

Fig.5.32(A) shows the input frequency, i.e. 130Hz. Fig.5.32(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.32(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.32(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. A high noise input is given as wght=5.

Fig. 5.33 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 87 at 4ms, whereas the average no. of spikes generated is 68.

Fig.5.34 and Fig.5.35 shows stimulus triggered action potentials during DBS. Fig.5.34 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig.5.35 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms.

MLIF rate without any synaptic connection = 334.2228 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 112.0747 (Hz)

MLIF rate with all synapses during DBS10Hz = 364.9099 Hz

Elapsed time is 24.509666 seconds.

wght=10

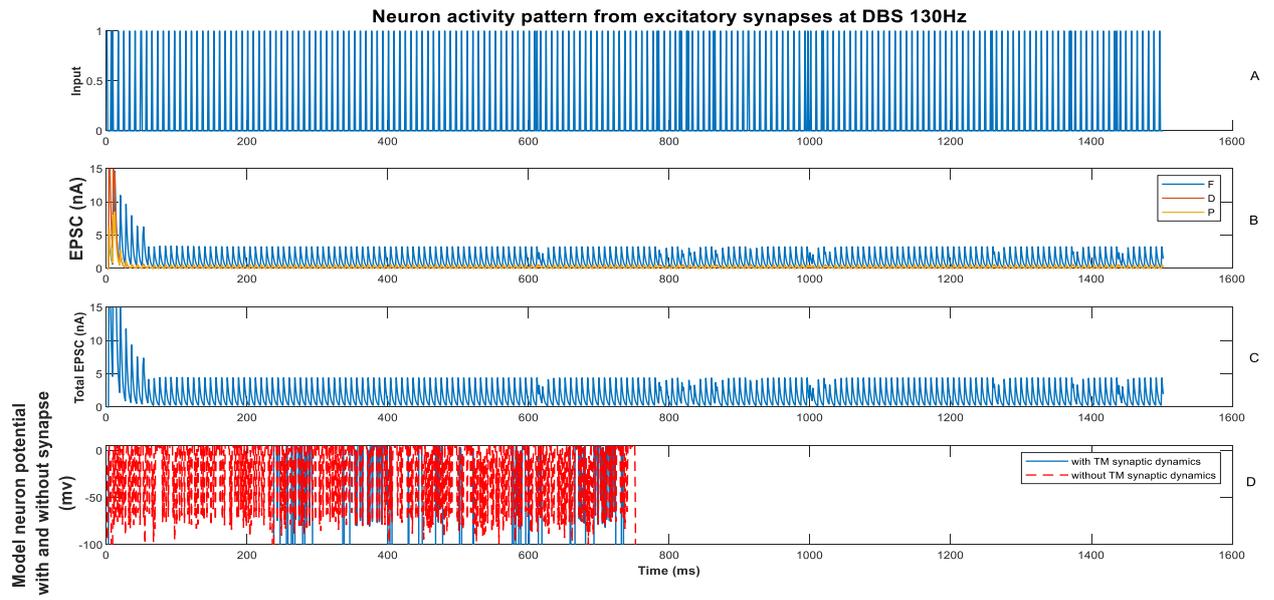


Fig.5.36

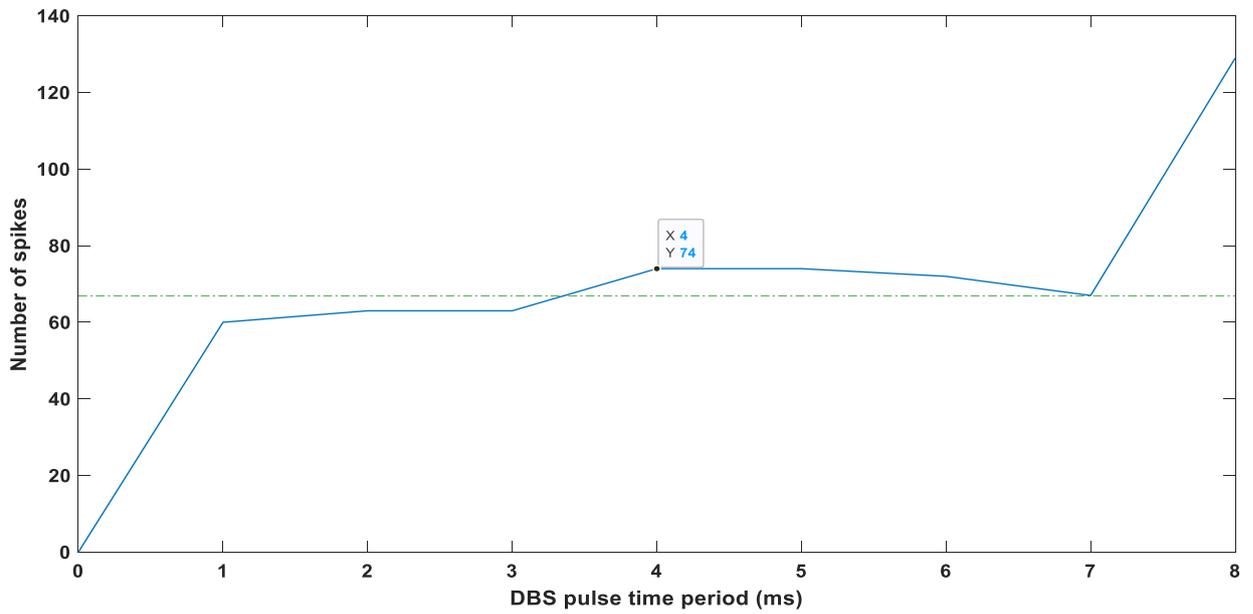


Fig.5.37

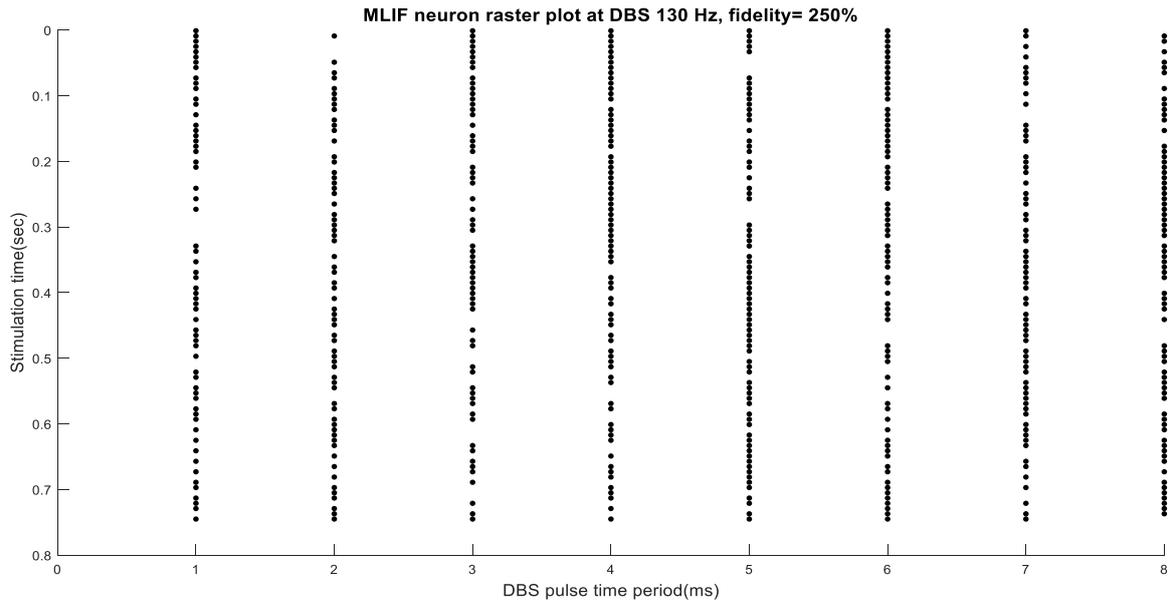


Fig.5.38

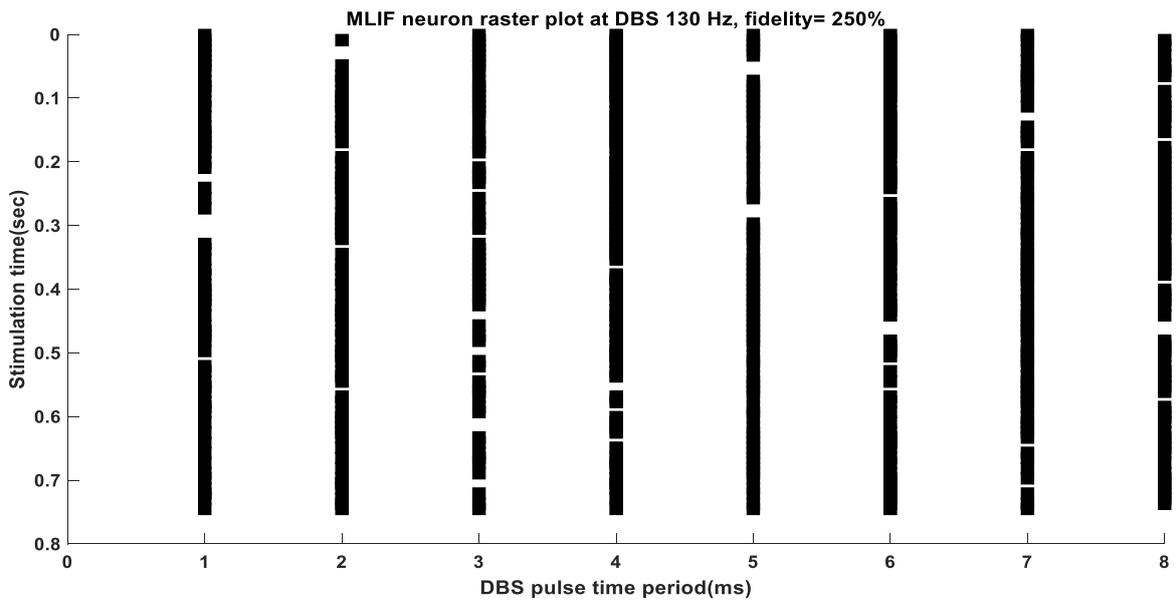


Fig.5.39

Fig.5.36(A) shows the input frequency, i.e. 130Hz. Fig.5.36(B) depicts EPSC from F, D and P synapses distinctly. Fig.5.36(C) shows the total EPSC generated from all the synapses F, D and P. Fig.5.36(D) shows the response of neuron when driven by DBS input with or without TM synaptic dynamics. Noise input is given is wght=10.

Fig. 5.37 shows the number of spikes generated versus DBS pulse time period in milliseconds. The maximum no. of spikes generated is 74 at 4ms, whereas the average no. of spikes generated is 66.

Fig.5.38 and Fig.5.39 shows stimulus triggered action potentials during DBS. Fig.5.38 shows raster plot of the MLIF neuron model with TM synaptic dynamics and Fig.5.39 without TM synaptic dynamics. Maximum no. of spikes generated lie at DBS pulse time of 4ms to 6ms.

MLIF rate without any synaptic connection = 338.8926 (Hz)

MLIF rate with a fraction of synapses during DBS10Hz = 99.3996 (Hz)

MLIF rate with all synapses during DBS10Hz = 362.2415 Hz

Elapsed time is 12.505596 seconds.

Analyzing Fig.5.24-5.39, we observe that as the applied noise input increases, the average number of spikes generated decreases. This implies that, the spiking activity of MLIF neuron model decreases with increasing noise input.

## CHAPTER 6

### DISCUSSION

The objective of this study was to develop a simple model that could capture the overall characteristics of DBS induced synaptic suppression and the DBS triggered post synaptic spiking. We used the Tsodyks-Markram (TM) phenomenological synapse model to represent depressing, facilitating, and pseudo-linear synapses driven by DBS over a wide range of stimulation frequencies. The EPSCs were then used as inputs to a leaky integrate-and-fire neuron model (LIF) and later to a memristor leaky integrate-and-fire neuron model (MLIF) in order to measure the DBS-triggered post-synaptic spiking activity.

Low frequency stimulation can generate a wide range of EPSCs that depend upon the type of synapse. High frequency driving of the synapse models generate marked EPSC suppression, independent of the synapse type. The average spiking activity increased with increase of applied DBS. The average spiking activity was found to decrease with increase in noise input. The MLIF neuron model was found to exhibit better spiking activity than LIF neuron model. Practically, it is undesirable to expose our body to very high frequency stimulation for DBS treatment to control movement disorders. Thus we prefer MLIF neuron model over LIF neuron model for enhanced spiking activity using a particular DBS frequency. The findings of this study are still theoretical, they do represent a step towards analyzing the consequences of DBS from a synaptic first principles approach. We hypothesize that by first understanding the effects of DBS at the synapse level, we may then extrapolate to network-level effects.

The basic purpose of brain stimulation therapy is to employ electrical pulses to modulate the release of neurotransmitters in specific brain circuits. Low frequency stimulation can be used to enhance neurotransmitter release in directly activated pathways, whereas high frequency stimulation can decrease synaptic communication through the methods described in this project. Furthermore, recent computational research and intraoperative human recordings have proven the importance of synaptic suppression in comprehending and interpreting neural activity patterns recorded during the DBS. We propose that the basic mechanism of DBS is to exploit the

physiological limits of the synaptic machinery to suppress connectivity. A simple model for these processes can help in optimization of DBS pulsing.

The LIF model with the non-volatile memristor is successfully proposed in this study, and we aim to develop the application of memristor in neuroscience. We choose the charge-controlled memristor to combine with the LIF spiking model and get the MLIF spiking model. We examined the firing patterns of LIF and MLIF and found the superiority of MLIF model over LIF model. The simulation results show that the MLIF model has good biological spiking frequency adaptation, higher firing frequency, and rich firing patterns. The MLIF model can reproduce the firing behavior of biological neurons very well.

Recent studies have shown that human skin and other biological tissues are memristors. Many researches have found that human skin exhibits non-volatile memory and that analogue information can actually be stored inside the skin at least for three minutes. Human skin actually contains two different memristor types, one that originates from the sweat ducts and one that is based on thermal changes of the surrounding tissue, the stratum corneum; and information storage is possible in both. Assuming that different physiological conditions of the skin can explain the variations in current responses that we observed among the subjects, it follows that non-linear recordings with DC pulses may find use in sensor applications. A new understanding of skin's electrical properties could have implications for medicine. This can even lead to development of artificially implantable skin.

## MATLAB code for TM Model

```
%%%%%%%% This code generates the excitatory postsynaptic currents of
%%%%%%%% facilitating, depressing and pseudo-linear excitatory synapses
%%%%%%%% based on Tsodyks-Markram synaptic model

clearvars

dt=.1; ti=dt; tf=10000;
t=ti:dt:tf;

% DBS input
fdbs=1:130;
T=ones(1,length(fdbs));
dbsi=500/dt; dbsf=10000/dt;

% I Kernel time constant
taus=1.75; %3

%input spike train
sp=zeros(length(fdbs),length(t));

% Synapse parameters % Each column represents E1, E2 and E3 respectively
tauf=[670,17,326];
taud=[138,671,329];
U=[.09,.5,.29];
% A=[0.0025,0.0025,0.0025];
A=[1,1,1];
n=1;
A=n*A;

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbs),length(t));
I=zeros(length(fdbs),length(t));
% It=zeros(length(fdbs),length(t));
EPSC=zeros(length(A),length(fdbs),length(t));
select_time=dbsf-50000:dbsf;
It=zeros(length(fdbs),length(select_time));
M_I=ones(length(A),length(fdbs));
mi=zeros(length(A),1);
M_Iall=ones(length(A),length(fdbs));
area=zeros(length(A),length(fdbs));
areal=zeros(length(A),length(fdbs));
% Sc=zeros(length(A),length(fdbs));

for p=1:3
    for j=1:length(fdbs)
        T(j)=round(1000/fdbs(j)/dt);
        ts=dbsi:T(j):dbsf;
        sp(j,ts)=1/dt;
        for i=1:length(t)-1
            u(j,(i+1)) = u(j,i)+dt*(-(u(j,i)/tauf(p))+U(p)*(1-
u(j,i))*sp(j,i));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(p)*u(j,i+1)*x(j,i)*sp(j,i));
        end
    end
end
```

```

        EPSC(p,j,:)= I(j,:);
%       M_Iall(p,j)=max(I(j,:));
        It(j,:)=I(j,select_time);
        M_I(p,j)=max(It(j,:));
%       mi(p)=max(M_Iall(p,j));
%       M_I(p,j)=M_I(p,j)./mi(p);
t1{p,j}=ts(end-1)+1:ts(end); %last period EPSC curve
It1{p,j}=I(j,t1{p,j});
areal(p,j)=trapz(t1{p,j},It1{p,j})/10; %area under the EPSC curve for
1 EPSC
area(p,j)=areal(p,j)*j; %area under the EPSC curve in
1 second
    end
end

%gain peak frequency
theta=1000/sqrt(tauf(1)*taud(1)*U(1)); %valid only for facilitating synapse

%Make figure
freq1=20; freq2=130;
figure;
ax1=subplot(4,3,1);

plot(t,squeeze(EPSC(1,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Facilitating'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax2=subplot(4,3,2);
qq=EPSC(1,freq2,:);
ww=squeeze(EPSC(1,freq2,:));
%plot(t,squeeze(EPSC(1,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax3=subplot(4,3,3);
scatter(fdbs,squeeze(M_I(1,:,1)), 'k', '.'); ylabel({'Facilitating
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')

hold on
plot((1./fdbs)+.008, '--', 'LineWidth',1); zoom xon; %ylim([0 .14])
ylim([0 .6]);

ax4=subplot(4,3,4);
plot(t,squeeze(EPSC(2,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Depressing'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax5=subplot(4,3,5);
plot(t,squeeze(EPSC(2,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax6=subplot(4,3,6);
scatter(fdbs,squeeze(M_I(2,:,1)), 'k', '.'); ylabel({'Depressing
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

ax7=subplot(4,3,7);

```

```

plot(t,squeeze(EPSC(3,freq1,:)), 'k', 'LineWidth',1); ylabel({'EPSC
(nA)'; 'Pseudo-linear'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax8=subplot(4,3,8);
plot(t,squeeze(EPSC(3,freq2,:)), 'k', 'LineWidth',1); %ylabel({'I_{syn}
(nA)'; 'EPSC'}, 'FontWeight', 'bold')
xlim([450 1000]); ylim([0 .6]);

ax9=subplot(4,3,9);
scatter(fdbs,squeeze(M_I(3,:,1)), 'k', '.'); ylabel({'Pseudo-linear
synapse'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

ax10=subplot(4,3,10);
plot(t,sp(freq1,:), 'k', 'LineWidth',1); zoom xon; ylabel(['Input
',num2str(freq1), ' Hz'], 'FontWeight', 'bold')
xlim([450 1000]);
xlabel('Time (ms)', 'FontWeight', 'bold');

ax11=subplot(4,3,11);
plot(t,sp(freq2,:), 'k', 'LineWidth',1); zoom xon; ylabel(['Input
',num2str(freq2), ' Hz'], 'FontWeight', 'bold')
xlim([450 1000]);
xlabel('Time (ms)', 'FontWeight', 'bold');

ax12=subplot(4,3,12);
scatter(fdbs,squeeze(M_I(1,:,1)), '.'); zoom xon; hold on;
scatter(fdbs,squeeze(M_I(2,:,1)), '.'); hold on
scatter(fdbs,squeeze(M_I(3,:,1)), '.'); hold on
xlabel('Frequency (Hz)', 'FontWeight', 'bold');
ylabel({'All synapses'; 'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .6]);

figure
scatter(fdbs,squeeze(M_I(1,:,1)), 'filled'); zoom xon; hold on;
scatter(fdbs,squeeze(M_I(2,:,1)), 'filled'); hold on
scatter(fdbs,squeeze(M_I(3,:,1)), 'filled'); hold on
xlabel('Frequency (Hz)', 'FontWeight', 'bold');
ylabel({'EPSC_{st} amplitude (nA)'}, 'FontWeight', 'bold')
ylim([0 .5])
set(gca, 'FontSize',12, 'FontWeight', 'bold')

%% Integrals
S1=zeros(length(A),length(fdbs));
S=zeros(length(A),length(fdbs));
for j=1:3
for i=1:length(fdbs)
S1(j,i) = -M_I(j,i)*taus*(exp(-T(i)/taus)-1); %The integral of one EPSC at
the steady state
S(j,i) = S1(j,i)*i;
end
end

arealf=areal(1,:);
areald=areal(2,:);
arealp=areal(3,:);
areaf=area(1,:);
aread=area(2,:);
areap=area(3,:);

```

```

f_weight=.45; d_weight=.38; p_weight=.18;
area_tot=f_weight*areaf+d_weight*aread+p_weight*areap;

figure; title('Area under 1 EPSC'); hold on
for p=1:3
scatter(fdbs,areal(p,:));
hold on
end
legend('F','D','P')
for p=1:3
plot(fdbs,S1(p,:), 'Linewidth',1);
hold on
end
xlabel('DBS frequency (Hz)')
ylabel('S_1')
set(gca, 'FontSize',12, 'FontWeight', 'bold')

figure; title('Area under EPSCs in 1 second of stimulation'); hold on
for p=1:3
scatter(fdbs,area(p,:), 'filled');
hold on
end
scatter(fdbs,area_tot, 'filled', 'k');

legend('F','D','P','Total')
% for p=1:3
% plot(fdbs,S(p,:), 'Linewidth',1);
% hold on
% end
% plot(ff,sf, 'LineWidth',1)
xlabel('DBS frequency (Hz)')
ylabel('S')
set(gca, 'FontSize',12, 'FontWeight', 'bold')

```

## MATLAB code for LIF Neuron Model

```
##### This code computes an LIF neuron activity before and during DBS.
tic
clearvars

% transmission + synaptic delay: td
td=2; %2 ms for trasmission and .5 ms for synaptic delay

dt=1; ti=dt; tf=1500+td;%tf=1500+td;%tf=61000+td; %in mili seconds
t=ti:dt:tf;

% DBS input
fdb=130;
T=ones(1,length(fdb));
% dbsi=(100)/dt; dbsf=1100/dt; %in mili seconds
dbsi=(dt)/dt; dbsf=1500/dt;

%Poissonian input
fr=10; %for fr Hz baseline poissonian firing from other cells
[spikes,tsp]=poissonSpikeGen(fr,tf/1000,1,dt/1000);
tp=find(spikes==1);
% ssp=zeros(1,length(t));
% ssp(tp)=1; %uncomment for stochastic model (adding noise to the system)

%noise term
% wght=0; %no noise
wght=.5; %default noise
% wght=5; %high noise
kisi=wght*randn(1,length(t));

% I Kernel time constant
taus=3; %For excitatory synapse

% transmission + synaptic delay: td
td=td/dt; %convert to simulation step scale

%input spike train
sp=zeros(length(fdb),length(t));

% Synapse parameters % Each column 1,2,3 means F,D,P respectively and each
row means
% Excitatory and inhibitory synapse (1: excitatory, 2: inhibitory)
% In this study we just used the first row, excitstory synapses.
tauf=[670,17,326; 376,21,62];
taud=[138,671,329; 45,706,144];
U=[.09,.5,.29; .016,.25,.32];
A=[.0025,.0025,.0025; .0025,.0025,.0025];
% n=10; A=n*A; % change the strength of A (order of magnitude of totall
number of synapses)
ie=ones(1,2);
w=1;

fid=2.5; %synaptic fidelity
we=fid*200; wi=0;
% Percentage of excitatory and inhibitory synapses:
```

```

ne=we*[45,38,17]; %original: 45,38,17
% ne=zeros(1,3);
% for 1 synapse n1=1 and so forth (approximately giving 2 pA exc. current)
% ne=10; % for 10 synapses (approximately giving 20 pA exc. current)
% ne=100; % for 100 synapses (approximately giving 200 pA exc. current)
% ne=1000;% for 1000 synapses (approximately giving 2 nA exc. current)
% ni=wi*[13,10,6]; % for 1 synapse (approximately giving 10 pA
inhibitory current)
ni=wi*[8,76,16]; %ne=ni;
% ni=zeros(1,3);
% ni=10; % for 10 synapses (approximately giving 100 pA inh. current)
% ni=100; % for 100 synapses (approximately giving 1 nA inh. current)
% ni=1000;% for 1000 synapses (approximately giving 10 nA inh. current)
A=[ne.*A(1,:);ni.*A(2,:)];

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbs),length(t));
I=zeros(length(fdbs),length(t));
Iwo=zeros(length(fdbs),length(t));
% It=zeros(length(fdbs),length(t));
PSC=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSC=zeros(length(A),length(fdbs),length(t));

% Compute EPSP (passive mechanism, membrane potential)
tau_memb=40;
r=10^2; %M Ohm
v=zeros(length(fdbs),length(t));
PSP=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSP=zeros(length(A),length(fdbs),length(t));

% Neuron parameters: (for ~20 Hz base firing .56 and for ~8-10 Hz choose
.26)
Cm= 1; Rm=100; Ie=.26; %(for deterministic model)
% Ie=.16; %subthreshold firing (for noise purpose, stochastic model)
El=-70; Vth=-54;
Vreset=-80;

% % Neuron parameters: (for 62.5 Hz base firing)
% Cm= 1; Rm=100; Ie=1.52; %(for deterministic model)
% % Ie=.18; %subthreshold firing (for noise purpose, stochastic model)
% El=-70; Vth=-54;
% Vreset=-80;

% Compute neuron firing pattern with and without synaptic input:
V=zeros(length(fdbs),length(t));
Vn=zeros(length(ie),length(A),length(fdbs),length(t));
V_all=zeros(length(fdbs),length(t));
% Vn_all=zeros(length(ie),length(A),length(fdbs),length(t));
Vin=zeros(1,length(t));

wk=10; %Poissonian weight
poiss=wk*rand(1,length(sp)).*sp(1,:);
for i=1:length(t)-1
Vin(i+1) = Vin(i) + (dt/Cm)*(((El-Vin(i))/Rm) + Ie + poiss(i) + kisi(i));
if Vin(i+1)>= Vth+kisi(i)
Vin(i)=0+kisi(i);
Vin(i+1)=Vreset+kisi(i);
end
end

```

```

for q=1:length(ie)
    if q==1
        w=1;
    else
        w=-1;
    end
for p=1:length(A)
    for j=1:length(fdfs)
        T(j)=round((1000/fdfs(j))/dt);
        dbs=dbsi:T(j):dbsf;
        ts=[tp,dbs]; %uncomment for Poissonian+DBS
%         ts=dbs; %uncomment for DBS only
        sp(j,ts)=1/dt;
        for i=td+1:length(t)-1
            u(j,(i+1)) = u(j,i) + dt*(-(u(j,i)/tauf(q,p))+U(q,p)*(1-
u(j,i))*sp(j,i-td));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(q,p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i-td));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(q,p)*u(j,i+1)*x(j,i)*sp(j,i-td));
            Iwo(j,(i+1)) = Iwo(j,i) + dt*((-1/taus)*Iwo(j,i) +
A(q,p)*sp(j,i-td));
            v(j,(i+1)) = v(j,i) + dt*(((v(j,i)+r*I(j,i))/tau_memb);
            %Replace I with Iwo for no depletion of synaptic conduction
            V(j,(i+1)) = V(j,i) + (dt/Cm)*((E1-V(j,i))/Rm) +Ie +
w*I(j,i) + poiss(i)+ kisi(i));
            if V(j,i+1)>= Vth+kisi(i)
                V(j,i)=0+kisi(i);
                V(j,i+1)=Vreset+kisi(i);
            end
        end
        %replace I with Iwo for no depletion
        PSC(q,p,j,:)= w*I(j,:); %IPSC(p,j,:)= -I(j,:);
        PSP(q,p,j,:)= w*v(j,:); %IPSP(p,j,:)= -v(j,:);
        Vn(q,p,j,:)= V(j,:);
    end
end
end

PSC_exc=sum(PSC(1, :, :, :), 2);
PSC_inh=sum(PSC(2, :, :, :), 2);
PSC_all=PSC_exc+PSC_inh;

PSP_exc=sum(PSP(1, :, :, :), 2);
PSP_inh=sum(PSP(2, :, :, :), 2);
PSP_all=PSP_exc+PSP_inh;

for j=1:length(fdfs)
for i=1:length(t)-1
    V_all(j,(i+1)) = V_all(j,i) + (dt/Cm)*((E1-V_all(j,i))/Rm)
+ PSC_all(1,1,j,i) +Ie + poiss(i) + kisi(i));
    if V_all(j,i+1)>= Vth+kisi(i)
        V_all(j,i)=0+kisi(i);
        V_all(j,i+1)=Vreset +kisi(i);
    end
end
end
end

```

```

%% Make figure with arbitrary selection of synapse and DBS frequency
(Figure 4 in the paper)
EI=1;    % Choose 1 for excitatory and 2 for inhibitory
syn=1;   % Choose 1 for F, 2 for D and 3 for P synaptic types
freq=1;  % The desired DBS frequency to be illustrated
figure;
ax1=subplot(4,1,1);
hold on
title(['Neuron activity pattern from excitatory synapses at DBS
',num2str(fdbs), 'Hz'], 'FontSize',14, 'FontWeight', 'bold')
plot(t,sp(freq,:), 'LineWidth',1); zoom xon;
ylabel('Input', 'FontSize',13, 'FontWeight', 'bold')
ax2=subplot(4,1,2);
plot(t,squeeze(PSC(EI,syn,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
hold on
plot(t,squeeze(PSC(EI,syn+1,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
hold on
plot(t,squeeze(PSC(EI,syn+2,freq,:)), 'LineWidth',1); ylabel('EPSC
(nA)', 'FontSize',13, 'FontWeight', 'bold')
legend('F', 'D', 'P')
ylim([0 15])
ax3=subplot(4,1,3);
plot(t,squeeze(PSC_all(1,1,freq,:)), 'LineWidth',1);
ylabel('Total EPSC (nA)', 'FontSize',13, 'FontWeight', 'bold')
ylim([0 15])
ax4=subplot(4,1,4);
plot(t,squeeze(Vn(EI,syn,freq,:)), 'LineWidth',1);
hold on
plot(t,Vin, '--', 'Color', 'r', 'LineWidth',1);
legend('with TM synaptic dynamics', 'without TM synaptic dynamics')
ylabel({'Model neur n potential'; ' with and without synapse'; '
(mv)'}, 'FontSize',13, 'FontWeight', 'bold')
xlabel('Time (ms)', 'FontSize',13, 'FontWeight', 'bold');
ylim([-100 5])
linkaxes([ax1,ax2,ax3,ax4], 'x')
%% Compute firing rate of the LIF neuron without synaptic input:
r_isi_without_syn=(1000/dt)*length(find(Vin(dbsi:dbsf)>=Vth))/((dbsf-
dbsi));
disp(['LIF rate without any synaptic connection =
',num2str(r_isi_without_syn), ' (Hz)'])
%% Compute firing rate of the LIF neuron with synaptic input:
r_isi_with_syn=(1000/dt)*length(find(Vn(EI,syn,freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['LIF rate with a fraction of synapses during
DBS',num2str(freq*10), 'Hz = ',num2str(r_isi_with_syn), ' (Hz)'])
%% Compute firing rate of the LIF neuron with all synaptic inputs:
r_isi_with_all_syn=(1000/dt)*length(find(V_all(freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['LIF rate with all synapses during DBS', num2str(freq*10), 'Hz =
',num2str(r_isi_with_all_syn), ' Hz'])
%% Raster plot (Figure 5 in the paper) and PSTH for 130 Hz:
for q=1
    for sq=1:2
        dbsT=round((1000/fdbs(q)/dt));
        width=1;
        edges=0:width:dbsT;
        psth=zeros(1,round(dbsT/width)+1);
    end
end
figure;

```

```

title(['LIF neuron raster plot at DBS ', num2str(fdbs(q)), ' Hz, fidelity=
', num2str(fid*100), '%'], 'FontSize', 14, 'FontWeight', 'bold');
xlabel('DBS pulse time period(ms)', 'FontSize', 13);
ylabel('Stimulation time(sec)', 'FontSize', 13);
hold on

if sq==1
for i=dbsi:dbsT:dbsf-dbsT
    [xx, zz]=find(V_all(q, (i:i+dbsT))>=Vth);
    hh=hist(zz, edges);
    psth=psth+hh;
scat=scatter(zz*dt, (i*dt/1000)*ones(1, length(xx)), 'k', 'filled'); hold on
end
axis ij
%axis off
xlim([0 dbsT*dt])
% ylim([0 60])

figure;
plot(edges*dt, psth, 'LineWidth', 1);
xlabel('DBS pulse time period (ms)')
ylabel('Number of spikes')
xlim([0 dbsT*dt])
hold on
set(gca, 'FontSize', 14, 'FontWeight', 'bold')
% saveas(fig, ['DBS_', num2str(fdbs(q)), num2str(fid), 'fidelity'], 'jpg')
end

if sq==2
for i=dbsi:dbsT:dbsf-dbsT
    [xx, zz]=find(V_all(q, (i:i+dbsT))>=Vth);
    hh=hist(zz, edges);
    psth=psth+hh;
scat=scatter(zz*dt, (i*dt/1000)*ones(1, length(xx)), 121, 'k', 'square', 'MarkerFaceColor', 'k'); hold on
end
axis ij
% axis off
xlim([0 dbsT*dt])
% ylim([42 42.2])
set(gca, 'FontSize', 14, 'FontWeight', 'bold')
end
end
end
toc

```

## MATLAB code for MLIF Neuron Model

```
%%%%%%%% This code computes an MLIF neuron activity before and during DBS.
tic
clearvars

% transmission + synaptic delay: td
td=2; %2 ms for trasmission and .5 ms for synaptic delay

dt=1; ti=dt; tf=1500+td;%tf=1500+td;%tf=61000+td; %in mili seconds
t=ti:dt:tf;

% DBS input
fdbs=130;
T=ones(1,length(fdbs));
% dbsi=(100)/dt; dbsf=1100/dt; %in mili seconds
dbsi=(dt)/dt; dbsf=1500/dt;

%Poissonian input
fr=10; %for fr Hz baseline poissonian firing from other cells
[spikes,tsp]=poissonSpikeGen(fr,tf/1000,1,dt/1000);
tp=find(spikes==1);
% ssp=zeros(1,length(t));
% ssp(tp)=1; %uncomment for stochastic model (adding noise to the system)

%noise term
% wght=0; %no noise
wght=.5; %default noise
% wght=5; %high noise
kisi=wght*randn(1,length(t));

% I Kernel time constant
taus=3; %For excitatory synapse

% transmission + synaptic delay: td
td=td/dt; %convert to simulation step scale

%input spike train
sp=zeros(length(fdbs),length(t));

% Synapse parameters % Each column 1,2,3 means F,D,P respectively and each
row means
% Excitatory and inhibitory synapse (1: excitatory, 2: inhibitory)
% In this study we just used the first row, excitstory synapses.
tauf=[670,17,326; 376,21,62];
taud=[138,671,329; 45,706,144];
U=[.09,.5,.29; .016,.25,.32];
A=[.0025,.0025,.0025; .0025,.0025,.0025];
% n=10; A=n*A; % change the strength of A (order of magnitude of totall
number of synapses)
ie=ones(1,2);
w=1;

fid=2.5; %synaptic fidelity
we=fid*200; wi=0;
% Percentage of excitatory and inhibitory synapses:
ne=we*[45,38,17]; %original: 45,38,17
% ne=zeros(1,3);
```

```

% for 1 synapse n1=1 and so forth (approximately giving 2 pA exc. current)
% ne=10; % for 10 synapses (approximately giving 20 pA exc. current)
% ne=100; % for 100 synapses (approximately giving 200 pA exc. current)
% ne=1000;% for 1000 synapses (approximately giving 2 nA exc. current)
% ni=wi*[13,10,6]; % for 1 synapse (approximately giving 10 pA
inhibitory current)
ni=wi*[8,76,16]; %ne=ni;
% ni=zeros(1,3);
% ni=10; % for 10 synapses (approximately giving 100 pA inh. current)
% ni=100; % for 100 synapses (approximately giving 1 nA inh. current)
% ni=1000;% for 1000 synapses (approximately giving 10 nA inh. current)
A=[ne.*A(1,:);ni.*A(2,:)];

% Compute EPSC
u=zeros(length(fdbs),length(t));
x=ones(length(fdbs),length(t));
I=zeros(length(fdbs),length(t));
Iwo=zeros(length(fdbs),length(t));
% It=zeros(length(fdbs),length(t));
PSC=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSC=zeros(length(A),length(fdbs),length(t));

% Compute EPSP (passive mechanism, membrane potential)
tau_memb=40;
r=10^2; %M Ohm
v=zeros(length(fdbs),length(t));
PSP=zeros(length(ie),length(A),length(fdbs),length(t));
% IPSP=zeros(length(A),length(fdbs),length(t));

% % % Neuron parameters: (for ~20 Hz base firing .56 and for ~8-10 Hz
choose .26)
Cm= 1; Rm=100; Ie=.26; %(for deterministic model)
% Ie=.16; %subthreshold firing (for noise purpose, stochastic model)
El=-70; Vth=-54;
Vreset=-80;

% % % Neuron parameters: (for 62.5 Hz base firing)
% Cm= 1; Rm=100; %Ie=1.52; %(for deterministic model)
% Ie=.18; %subthreshold firing (for noise purpose, stochastic model)
% El=-70;Vth=-54;
% Vreset=-80;

% Compute neuron firing pattern with and without synaptic input:
V=zeros(length(fdbs),length(t));
Vn=zeros(length(ie),length(A),length(fdbs),length(t));

V_all=zeros(length(fdbs),length(t));
d=linspace(-0.5*10^(-4),0.5*10^(-4),1502);
q1=d.*ones(1,length(t));
tau_m=zeros(1,length(t));
o=linspace(-0.75,0.25,1502);
psi=o.*ones(1,length(t));
M=zeros(1,length(t));
% Vn_all=zeros(length(ie),length(A),length(fdbs),length(t));
Vin=zeros(1,length(t));

wk=10; %Poissonian weight;
poiss=wk*rand(1,length(sp)).*sp(1,:);
for i=1:length(t)-1

```

```

    if q1(i)<(-0.5*10^(-4))
        M(i)=20000;
    elseif q1(i)>=(-0.5*10^(-4)) & q1(i)<(0.5*10^(-4))
        M(i)=10^(4)+(-1.99)*10^(8)*q1(i);
    else
        M(i)=100;
    end
    if psi(i)<(-0.75)
        tau_m(i)=20000*q1(i)/Vin(i);
    elseif psi(i)>=(-0.75) & psi(i)<(0.25)
        tau_m(i)=(10^(4)*q1(i)/Vin(i))+((-1.99)*10^(8)*q1(i)*q1(i))/Vin(i);
    else
        tau_m(i)=100*q1(i)/Vin(i);
    end

Vin(i+1) = Vin(i)+ (dt/tau_m(i))*(El-Vin(i) + M(i)*(Ie+ poiss(i) +
kisi(i)));
if Vin(i+1)>= Vth+kisi(i)
    Vin(i)=0+kisi(i);
    Vin(i+1)=Vreset+kisi(i);
end
end

for q=1:length(ie)
    if q==1
        w=1;
    else
        w=-1;
    end
for p=1:length(A)
    for j=1:length(fdbs)
        T(j)=round((1000/fdbs(j))/dt);
        dbs=dbsi:T(j):dbsf;
        ts=[tp,dbs]; %uncomment for Poissonian+DBS
        %      ts=dbs; %uncomment for DBS only
        sp(j,ts)=1/dt;
        for i=td+1:length(t)-1
            u(j,(i+1)) = u(j,i) + dt*(-(u(j,i)/tauf(q,p))+U(q,p)*(1-
u(j,i))*sp(j,i-td));
            x(j,(i+1)) = x(j,i) + dt*((1/taud(q,p))*(1-x(j,i)) -
u(j,i+1)*x(j,i)*sp(j,i-td));
            I(j,(i+1)) = I(j,i) + dt*((-1/taus)*I(j,i) +
A(q,p)*u(j,i+1)*x(j,i)*sp(j,i-td));
            Iwo(j,(i+1)) = Iwo(j,i) + dt*((-1/taus)*Iwo(j,i) +
A(q,p)*sp(j,i-td));
            v(j,(i+1)) = v(j,i) + dt*(((v(j,i)+r*I(j,i))/tau_memb);
            %Replace I with Iwo for no depletion of synaptic conduction
            V(j,(i+1)) = V(j,i) + (dt/tau_m(i))*(El-Vin(i) +
M(i)*(w*I(j,i) +Ie+ poiss(i) + kisi(i)));
            if V(j,i+1)>= Vth+kisi(i)
                V(j,i)=0+kisi(i);
                V(j,i+1)=Vreset+kisi(i);
            end
        end
        %replace I with Iwo for no depletion
        PSC(q,p,j,:)= w*I(j,:); %IPSC(p,j,:)= -I(j,:);
        PSP(q,p,j,:)= w*v(j,:); %IPSP(p,j,:)= -v(j,:);
        Vn(q,p,j,:)= V(j,:);
    end
end

```

```

    end
end
end

PSC_exc=sum(PSC(1, :, :, :), 2);
PSC_inh=sum(PSC(2, :, :, :), 2);
PSC_all=PSC_exc+PSC_inh;

PSP_exc=sum(PSP(1, :, :, :), 2);
PSP_inh=sum(PSP(2, :, :, :), 2);
PSP_all=PSP_exc+PSP_inh;

for j=1:length(fdbs)
for i=1:length(t)-1
    V_all(j, (i+1)) = V_all(j, i) + (dt/tau_m(j, i))*(E1-
V_all(j, i)+ M(j, i)*(PSC_all(1, 1, j, i) +Ie+ poiss(i) + kisi(i)));
        if V_all(j, i+1)>= Vth+kisi(i)
            V_all(j, i)=0+kisi(i);
            V_all(j, i+1)=Vreset +kisi(i);
        end
end
end

%% Make figure with arbitrary selection of synapse and DBS frequency
(Figure 4 in the paper)
EI=1; % Choose 1 for excitatory and 2 for inhibitory
syn=1; % Choose 1 for F, 2 for D and 3 for P synaptic types
freq=1; % The desired DBS frequency to be illustrated
figure;
ax1=subplot(4, 1, 1);
hold on
title(['Neuron activity pattern from excitatory synapses at DBS
', num2str(fdbs), 'Hz'], 'FontSize', 14, 'FontWeight', 'bold')
plot(t, sp(freq, :), 'LineWidth', 1); zoom xon;
ylabel('Input', 'FontWeight', 'bold')
ax2=subplot(4, 1, 2);
plot(t, squeeze(PSC(EI, syn, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
hold on
plot(t, squeeze(PSC(EI, syn+1, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
hold on
plot(t, squeeze(PSC(EI, syn+2, freq, :)), 'LineWidth', 1); ylabel('EPSC
(nA)', 'FontSize', 13, 'FontWeight', 'bold')
legend('F', 'D', 'P')
ylim([0 15])
ax3=subplot(4, 1, 3);
plot(t, squeeze(PSC_all(1, 1, freq, :)), 'LineWidth', 1);
ylabel('Total EPSC (nA)', 'FontWeight', 'bold')
ylim([0 15])
ax4=subplot(4, 1, 4);
plot(t, squeeze(Vn(EI, syn, freq, :)), 'LineWidth', 1);
hold on
plot(t, Vin, '--', 'Color', 'r', 'LineWidth', 1);
legend('with TM synaptic dynamics', 'without TM synaptic dynamics')
ylabel({'Model neuron potential'; 'with and without synapse';
(mv) }, 'FontSize', 13, 'FontWeight', 'bold')
xlabel('Time (ms)', 'FontWeight', 'bold');
ylim([-100 5])
linkaxes([ax1, ax2, ax3, ax4], 'x')

```

```

% Compute firing rate of the LIF neuron without synaptic input:
r_isi_without_syn=(1000/dt)*length(find(Vin(dbsi:dbsf)>=Vth))/((dbsf-
dbsi));
disp(['MLIF rate without any synaptic connection =
',num2str(r_isi_without_syn),' (Hz)'])
% Compute firing rate of the LIF neuron with synaptic input:
r_isi_with_syn=(1000/dt)*length(find(Vn(EI,syn,freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['MLIF rate with a fraction of synapses during
DBS',num2str(freq*10),'Hz = ',num2str(r_isi_with_syn),' (Hz)'])
% Compute firing rate of the LIF neuron with all synaptic inputs:
r_isi_with_all_syn=(1000/dt)*length(find(V_all(freq,dbsi:dbsf)>=Vth))/((dbs
f-dbsi));
disp(['MLIF rate with all synapses during DBS', num2str(freq*10),'Hz =
',num2str(r_isi_with_all_syn),' Hz'])
% Raster plot (Figure 5 in the paper) and PSTH for 130 Hz:
for q=1
    for sq=1:2
        dbsT=round((1000/fdbs(q)/dt));
        width=1;
        edges=0:width:dbsT;
        psth=zeros(1,round(dbsT/width)+1);
        figure;
        title(['MLIF neuron raster plot at DBS ',num2str(fdbs(q)),' Hz, fidelity=
',num2str(fid*100),'%'],'FontSize',14,'FontWeight','bold');
        xlabel('DBS pulse time period(ms)','FontSize',13);
        ylabel('Stimulation time(sec)','FontSize',13);
        hold on

        if sq==1
            for i=dbsi:dbsT:dbsf-dbsT
                [xx,zz]=find(V_all(q,(i:i+dbsT))>=Vth);
                hh=hist(zz,edges);
                psth=psth+hh;
            end
            scat=scatter(zz*dt,(i*dt/1000)*ones(1,length(xx)),16,'k','filled'); hold on
        end
        axis ij
        % axis off
        xlim([0 dbsT*dt])
        % ylim([0 60])

        figure;
        plot(edges*dt,psth,'LineWidth',1);
        xlabel('DBS pulse time period (ms)')
        ylabel('Number of spikes')
        xlim([0 dbsT*dt])
        hold on
        set(gca,'FontSize',14,'FontWeight','bold')
        % saveas(fig,['DBS_',num2str(fdbs(q)),num2str(fid),'fidelity'],'jpg')
        end

        if sq==2
            for i=dbsi:dbsT:dbsf-dbsT
                [xx,zz]=find(V_all(q,(i:i+dbsT))>=Vth);
                hh=hist(zz,edges);
                psth=psth+hh;
            end
            scat=scatter(zz*dt,(i*dt/1000)*ones(1,length(xx)),121,'k','square','MarkerF
acecolor','k'); hold on
        end
        axis ij
        % axis off

```

```
xlim([0 dbst*dt])
% ylim([42 42.2])
set(gca, 'FontSize',14, 'FontWeight', 'bold')
end
    end
end
toc
```

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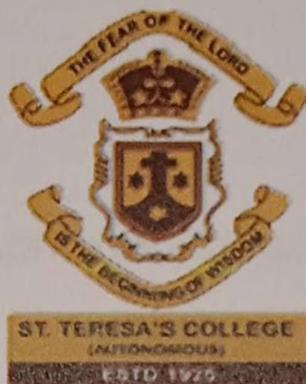
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**A SOCIOLOGICAL STUDY ON THE IMPACT OF  
ONLINE CLASSES ON SCHOOL STUDENTS IN  
KOCHI CITY**



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**MARCH 2022**

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Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of Master of Arts in Sociology*

By

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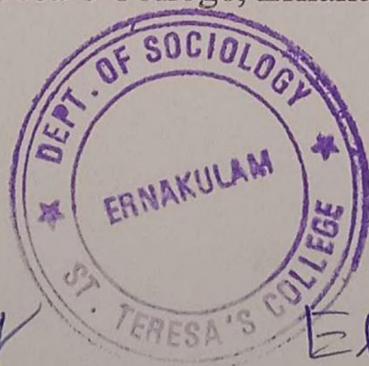
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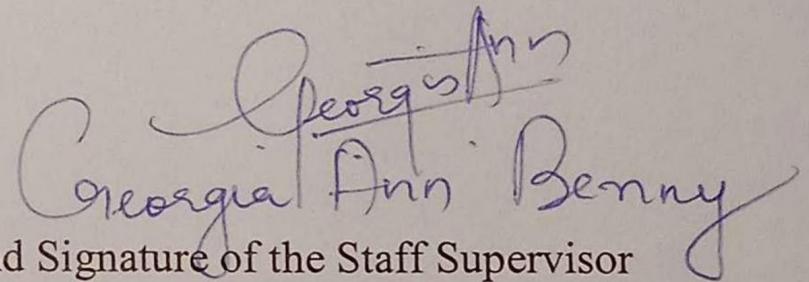
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MARCH 2022

## CERTIFICATE

I certify that the thesis entitled “A SOCIOLOGICAL STUDY ON THE IMPACT OF ONLINE CLASSES, ON SCHOOL STUDENTS IN KOCHI CITY” is a record of bonafide research work carried out by AISWARYA SOMAN, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology



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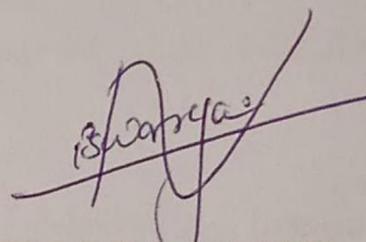
March 2022

## DECLARATION

I, **Aiswarya Soman** hereby declare that the thesis entitled “**A SOCIOLOGICAL STUDY ON THE IMPACT ON ONLINE CLASSES ON SCHOOL STUDENTS IN KOCHI CITY**” is a bonafide record of independent research work carried out by me under the supervision and guidance of **Smt. Georgia Ann Benny** I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



AISWARYA SOMAN

## ACKNOWLEDGEMENT

In this humble endeavor I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt. Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Smt. Georgia Ann Benny for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

Aiswarya Soman

March 2022

## **TABLE OF FIGURES**

SI no;	Title	Pg. no;
4.1	Figure showing the frequency distribution of the respondents with regards to Gender	45
4.2	Figure showing the frequency distribution of the respondents with regards to Education	46
4.3	Figure showing the frequency distribution of the respondents with regards to Family type	47
4.4	Figure showing the frequency distribution of the respondents with regards to Types of internet facility they use	48
4.5	Figure showing the frequency distribution of the respondents with regards to Device they use to attend the online class	49
4.6	Figure showing the frequency distribution of the respondents with regards to Time they spend in online.	50
4.7	Figure showing the frequency distribution of the respondents with regards to Health related issues faced by them.	51
4.8	Figure showing the frequency distribution of the respondents with regards to classes which they like most	52
4.9	Figure showing the frequency distribution of the respondents with regards to the friends they have in online classes	53
4.10	Figure showing the frequency distribution of the respondents with regards to chances which they get to communicate with your friends	54
4.11	Figure showing the frequency distribution of the respondents with	55

	regards to they face sad feelings.	
4.12	Figure showing the frequency distribution of the respondents with regards to they miss there playground	56
4.13	Figure showing the frequency distribution of the respondents with regards to they miss their friends	57
4.14	Figure showing the frequency distribution of the respondents with regards to they miss their extracurricular activities?	58
4.15	Figure showing the frequency distribution of the respondents with regards to miss their annual day	59
4.16	Figure showing the frequency distribution of the respondents with regards to the students get individual attention of the teachers	60

4.17	Figure showing the frequency distribution of the respondents with regards to Teachers friendly	61
4.18	Figure showing the frequency distribution of the respondents with regards to good internet connectivity	62
4.19	Figure showing the frequency distribution of the respondents with regards to whether they miss their school uniform	63
4.20	Figure showing the frequency distribution of the respondents with regards to Who motivates you to attend the online classes	64

# **CONTENTS**

- 1. INTRODUCTION**
- 2. REVIEW OF LITERATURE**
- 3. METHODOLOGY**
- 4. DATA ANALYSIS AND INTERPRETATION**
- 5. FININGS, SUGGESTION AND CONCLUSION**
- 6. BIBLIOGRAPHY**
- 7. APPENDIX**

**CHAPTER- I**  
**INTRODUCTION**

## INTRODUCTION

An online classroom is an environment created through use of a learning management system that allows students and teacher to connect either synchronously real-time, with teacher and students meeting at the same time or asynchronously with interaction between teacher and students occurring intermittently with a time.

A student is a person who goes to school and is learning something. Students can be children, teenagers, or adults who are going to school, but it may also be other people who are learning

Amid rising COVID-19 cases, the Kerala government on Friday decided to make the classes online for students of standard 1 to 9 from January 21. The decision was taken at a COVID-19 evaluation meeting chaired by Chief Minister Pinarayi Vijayan

**The name of online class in Kerala** - The Kerala Infrastructure and Technology for Education (KITE) has rolled out the G-Suite for Education platform that will be used in the first phase of online learning in school

Online Classes are a combination of video recordings and live lectures with course reading and tests. They are generally conducted using a virtual portal through which students gather reading materials, interact with teachers and classmates, view grades, and monitor progress.

The COVID-19 has meant schools across the globe have closed and students, attending classes.

There's a good side to online classes and a bad side too. Schools that are able to provide engaging online classes along with co-scholastic activities and regular peer-to-peer interaction have seen better mental health among students. For others, it has become monotonous, which has led to a rise in anxiety and hyperactivity among children. In this regard, Education World spoke with a few child experts to know why they think this is happening and how it can be addressed.

For classes 1 to 5, schools can conduct two sessions-- 1.5 hours per day, for not more than 5 days in a week. For class 6 to class 8, screen time has been limited to 2 hours and for class 9 to class 12, classes will be limited to a maximum of 3 hours per day.

With educational institutes closed due to the COVID-19 pandemic, the government has been encouraging online education to achieve academic continuity. Most high-end private and public institutions have made the switch smoothly using online platforms such as Zoom, Google classrooms, Microsoft teams etc, while many still find it a herculean task. The challenges of online education are multifaceted. It is time that we Indians, as a society, understand the realms of online education.

The Kerala government has allowed the reopening of schools and colleges across the state from February 7, 2020. As per the guidelines released by Chief Minister Pinarayi Vijayan office, classes have been allowed to reopen in a phased manner following a decline in the number of Covid-19 cases, An online classroom is an environment created through use of a learning management system that allows students and teacher to connect either synchronously (real-time, with teacher and students meeting at the same time or asynchronously with interaction between teacher and students occurring intermittently with a time.

Students need to visit the official website of Victors — [victors.kite.kerala.gov.in](http://victors.kite.kerala.gov.in) — to attend the live class. The classes will also be made available on Victors YouTube channel after the transmission.

Typical online course lengths can range anywhere from 30 minutes to 4 hours, depending on the type of course and complexity of the information you're teaching. For example, if someone wants to learn about Photoshop so they can create a simple graphic to share on social media, they might take a one-hour course.

Instead of distinct class sessions, then homework and preparation, your online courses will usually be divided into week-long modules where you will have: a major topic or task. Supporting materials (videos, reading, or other media) ongoing discussion and collaboration with your professor and classmates.

E-Learning allows the students to interact with their teacher only through the internet. Online, on the other hand, allows the students to use a virtual conferencing software like Cloud Meeting etc. to interact with their teacher face-to-face along with learning online through the internet.

### **Advantages of Online Courses**

Online courses are convenient.

Online courses offer flexibility.

Online courses bring education right to your home.

Online courses offer more individual attention.

Online courses help you meet interesting people.

Online courses give you real world skills

Online education allows for learning something beyond the norm. A learner has access to unlimited topics and global experts in niche subjects – something otherwise not affordable or imaginable for many. Online programs allow people of a wide age group to learn at their own pace, without inhibitions, and without compromising on their other responsibilities.

With the emergence and spread of COVID-19 in India, online education has trickled down to the most basic level — schools and colleges! The experience with online teaching, a student from a college “The online option is a need in this pandemic situation. It has brought education to us without us going anywhere, and it is more flexible”. Probably, students are finding it a welcome change from strict schedules and long-distance commutes to attend classes. For some others, who find learning in large classes intimidating, this may be a less stressful option. Many teachers are making the best of the situation by exploring new methods of teaching and assessment.

This is encouraging. But the moment online education moves from an optional to the only form of learning, and that too long term, the bad and the ugly slowly become evident. India is beginning to get a taste of this now.

Using the internet for entertainment is common, but for online lessons is a big challenge. Teachers may not be well-versed with creating digital content, and conveying it effectively online. A sudden expectation from them to upgrade, and from students to adapt, is unfair.

Body language and eye contact, which are important cues for the teacher, are difficult to perceive in an online class.

Even college students seem to value the in-class physical learning experience much more than a virtual one. Many acknowledge that phones can be very distracting. In addition, science and technology programs often include hands-on laboratory sessions, dissertation projects and field trips to complement theoretical studies. This aspect of learning is severely limited in online education.

Education is not just about subject knowledge but also about developing social skills and sportsmanship among the students, which is built over years. Relying solely on online education may hinder the holistic development of children, and many may underperform later in their professional and personal lives.

### **The COVID-19 pandemic has changed education forever. This is how**

The COVID-19 has resulted in schools shut all across the world. Globally, over 1.2 billion children are out of the classroom.

As a result, education has changed dramatically, with the distinctive rise of e-learning, whereby teaching is undertaken remotely and on digital platforms.

Research suggests that online learning has been shown to increase retention of information, and take less time, meaning the changes coronavirus have caused might be here to stay.

Even before COVID-19, there was already high growth and adoption in education technology, with global tech investments reaching US\$18.66 billion in 2019 and the overall market for online education projected to reach \$350 Billion by 2025. Whether it is language apps, virtual tutoring, video conferencing tools, or online learning software, there has been a significant surge in usage since COVID19.

### **Is learning online as effective?**

For those who do have access to the right technology, there is evidence that learning online can be more effective in a number of ways. Some research shows that on average, students retain 25-60% more material when learning online compared to only 8-10% in a classroom. This is mostly due to the students being able to learn faster online; e-learning requires 40-60% less time to learn than in a traditional classroom setting because students can learn at their own pace, going back and re-reading, skipping, or accelerating through concepts as they choose.

Nevertheless, the effectiveness of online learning varies amongst age groups. The general consensus on children, especially younger ones, is that a structured environment is required, because kids are more easily distracted. To get the full benefit of online learning, there needs to be a concerted effort to provide this structure and go beyond replicating a physical class/lecture through video capabilities, instead, using a range of collaboration tools and engagement methods that promote “inclusion, personalization and intelligence”, according to Dowson Tong, Senior Executive Vice President of Tencent and President of its Cloud and Smart Industries Group.

### **Impact of online learning on school education**

Online education has gained immense popularity among working professionals and students

Pursuing higher education. These categories of online learners find immense benefit in the autonomy and flexibility that these courses offer. Online courses can be planned around their schedule which may include full-time employment, internships and caring for family. Online learning can also help them take out some quiet time to study.

Distance learning has been around for a long time, even before technology made it extremely accessible. Traditional schooling is now seeing an increased proliferation of virtual training materials and online courses. Even in a world of tried and tested schooling systems and curricula, the most successful schools are the ones who adapt to the changing times, as well as to the expectations of students, parents and the society. If online education is here to stay, then what are its implications for traditional learning? Instead of focusing on pros and cons, the conversation we should be having today is about leveraging online education to make our education systems more conducive to learning.

Online courses call for a greater amount motivation and self-discipline than a classroom-based course. A classroom has one or more instructors and peers, who can hold a student accountable for their course-work. In contrast, online courses involve setting our own goals, tracking progress and meeting deadlines. One does not learn effectively in isolation so online courses do offer discussion forums, email and one-on-one support. Technology also adds on to the visual experience by incorporating animations that can be used interactively for effective learning and communication.

### **The classroom advantage**

A school provides structure, support, and a system of rewards and penalties to groom its students. Traditional classroom education offers the benefit of face-to-face interactions with peers which are typically moderated by a teacher. It provides children, especially those in their early developmental years, with a stable environment for social interactions, helping them develop skills like boundary setting, empathy and cooperation. It also allows plenty of room for spontaneity, unlike a virtual learning setup.

## **Online education in the context of schooling**

As students' progress to higher classes in school, they seek more autonomy and intellectual freedom. Online learning can help them pursue highly individualized learning programmes, possibly even college level courses. These, combined with hands-on exercises, real world exploration, and thorough assessments, can be highly beneficial to their learning progress. They can explore their options by trying.

Out introductory topics from different fields, before committing to a specialization. Online learning platforms can help these students become more independent learners, before they make their way into college. I believe that we must not hold back students from pursuing an online course but instead provide them guidance as they navigate through it.

Mobile apps that provide enhanced learning opportunities for school children have become quite popular as of late. Since mobile phones have already found their way into their hands, these apps are being used to supplement classroom learning. Teachers and parents need to act as anchors and mentors, curating the kind of educational content students are exposed to, during this tricky phase of exploring the right career to pursue.

They even offer a combination of the traditional system with online education. There are programmes that provide support to families that wish to home-school their children in the form of online course material. These programmes bring parents and teachers into the fold, by involving them in their child's education from the get go. However, their effectiveness in the long term needs to be studied.

Online learning programmes will also open up opportunities for children from the weaker socio-economic communities who have limited access to learning resources i.e. teachers, text books and infrastructure. It will connect them to a global network of online learners, exposing them to new perspectives. The ideas that they receive will not be limited by the number of heads in one classroom.

### **Online education for educators**

Online education can also be designed to accommodate a variety of learning styles among students. As educators, it is likely that we will have to put in additional efforts to incorporate online learning programs into the curriculum.

Online training programs are helping teachers advance their skills in curriculum implementation, policy, education systems and leadership, both independently and with the support of their institutions. It lets them collaborate with their peers and learn new instructional skills that are relevant to their career. These programs can help them develop new skills and capabilities in their students with the help of technology and interdisciplinary approaches. As the overlap of the traditional and online modes of education is becoming more and more inevitable, we owe it to our students to make their education relevant to their future through ingenuity, passion and careful planning.

### **Strengthening online learning when schools are closed: The role of families and teachers in supporting students during the COVID-19 crisis**

The COVID-19 crisis has forced education systems worldwide to find alternatives to face-to-face instruction. As a result, online teaching and learning have been used by teachers and students on an unprecedented scale. Since lockdowns – either massive or localized - may be needed again in the future to respond to new waves of the infection until a vaccine becomes available, it is of utmost importance for governments to identify which policies can maximize the effectiveness of online learning. This policy brief examines the role of students' attitudes towards learning in maximizing the potential of online schooling when regular face-to-face instruction cannot take place. Since parents and teachers play a fundamental role in supporting students to develop these crucial attitudes, particularly in the current situation, targeted policy interventions should be designed with the aim of reducing the burden on parents and help teachers and schools make the most of digital learning.

A good online course is engaging and challenging. It invites students to participate, motivates them to contribute and captures their interest and attention. It capitalizes on the joy of learning and challenges students to enhance their skills, abilities and knowledge.

A good online course is effective yes, and in many ways online learning is more effective than face to face learning. As research shows 80% of organizations believe their use of digital learning will remain the same, increase or decrease only slightly as restrictions on live training ease

According to recent research, more than 75 percent of academic leaders feel that online education is equal or superior to on-campus learning. Online classes also give students more autonomy over their learning, and allow them to work at an individualized pace.

One of the greatest advantages of online classes is their accessibility from anywhere around the world. Students can simply log in from anywhere and gain access to learning material from the convenience of their home. However, offline classes require students to travel to the location of their educational institution.

The students also shares some challenges that they faced during their online classes. These include anxiety, depression, poor Internet service, and unfavorable home learning environment, which were aggravated when students are marginalized and from remote areas.

Online classes are usually for independent students. You do not have any classmates. It's just you and the teacher. While in traditional classes you will have classmates and peers, you will also have different teachers, and you will be spending the whole day in school depending on your age.

**Better online class or face to face**

In many ways online learning is more effective than face to face learning. As research shows 80% of organizations believe their use of digital learning will remain the same, increase or decrease only slightly as restrictions on live training ease.

An online class is a course conducted over the Internet. They are generally conducted through a learning management system, in which students can view their course syllabus and academic progress, as well as communicate with fellow students and their course instructor.

According to recent research, more than 75 percent of academic leaders feel that online education is equal or superior to on-campus learning. Online classes also give students more autonomy over their learning, and allow them to work at an individualized pace.

Online Learning encompasses a range of technologies such as the worldwide. Web, email, chat, new groups and texts, audio and video conferencing delivered. Over computer networks to impart education. It helps the learner to learn at their. Own pace, according to their own convenience. One of the greatest advantages of online classes is their accessibility from anywhere around the world. Students can simply log in from anywhere and gain access to learning material from the convenience of their home. However, offline classes require students to travel to the location of their educational institution.

### **Some of the biggest challenges in online learning and how to solve them.**

Socio Economic Disparities.

Technical Difficulties.

Passiveness among Students.

Lack of Control and Discipline.

Isolation.

Lack of Motivation.

Data Security.

You can access more information and richer understanding through teacher and other students' body language and voice. You have the opportunity to connect with, problem-solve, and network with other students from a wide range of backgrounds.

Traditional bricks-and-mortar schools, online school offers parents the ability to control their child's Learning environment. In addition, learning at home may offer fewer distractions than a traditional classroom setting, allowing students to focus more easily and get the most out of their time.

Regular attendance in classes helps them interact with other individuals of their own age, be better disciplined, follow a regular schedule, and improve their physical fitness and mental alertness. Classroom learning helps students and teachers know each other in a better manner.

the duty of the government to provide free and compulsory elementary education to all children till the age of 14. But the government had not taken any steps to provide necessary infrastructure facilities to the students to attend online classes. Majority of the students were studying either in government or aided schools and most of these students were rural or urban poor. The parents of these children could not afford to buy costly devices such as television, internet, smartphone, and computer to enable their children to attend online classes.

The government had come out with a policy to purchase laptops with the cooperation of Kerala State Financial Enterprises by providing loans. Of the 60,000 laptops initially ordered through Kudumbasree units, only 5,000 laptops were made available and there was no answer to the needs of the remaining students, who were in need of a computer to follow online classes

Digital tools are increasingly being applied to support the response to the ongoing COVID-19 pandemic in India and elsewhere globally. This article draws from global frameworks to explore the use of digital tools in the state of Kerala across the domains of communication, surveillance, clinical management, non-clinical support, and core health system readiness and response. Kerala is considered India's first digital state, with the highest percentage of households with computers (24%) and the internet (51%) in India, 95% mobile phone penetration, 62% smartphone penetration and 75% digital literacy.

Kerala has long been a model for the early adoption of digital technology for education and health. As part of the pandemic response, technology has been used across private and public sectors, including law enforcement, health, information technology and education. Efforts have sought to ensure timely access to health information, facilitate access to entitlements,

The COVID-19 pandemic's unprecedented global spread and impact has accelerated interest in digital innovation. Kerala's experience showcases the diverse and innovative ways that digital tools can build on a strong underlying health system to support pandemic response across the domains of communication, surveillance, clinical management, non-clinical support and core health system readiness. Digital tools in Kerala were able to proliferate rapidly and help meet diverse citizen needs due to high levels of collaboration and intersectional response that brought together different levels of government and multiple state departments, engaged the private sector, and harnessed the energy of civil society organization's and community volunteers. Digital technology has great potential to strengthen public health measures during pandemics, including to rapidly link citizens to food and mental health support. Adequate oversight and community participation remains essential to safeguard citizen privacy and ensure equity.

Two weeks into the lockdown, 75% of students reported that their life had become more difficult and 50% felt that learning outcomes would be harder to achieve due to the sudden shift to online education. Twelve weeks into the lockdown, the corresponding numbers were 57% and 71%, respectively. The most pressing concerns among students were a lack of social interaction, housing situations that were unfit for home office purposes, including insufficient data bandwidth, and an overall sense of reduced motivation and effort. The students collaborated well in digital groups but wanted smaller groups with students they knew rather than being randomly assigned to groups.

Most students agreed that pre-recorded and streamed lectures, frequent virtual meetings and student response systems could improve learning outcomes in future digital courses. The

preference for written home exams over online versions of previous on-campus exams was likely influenced by student's familiarity with the former. The dropout rate remained unchanged compared to previous years.

The sudden shift to digital teaching was challenging for students, but it appears that they adapted quickly to the new situation. Although the concerns described by students in this study may only be representative for the period right after campus lockdown, the study provide the student perspective on a unique period of time in higher education.

"Students have already lost the majority of two years of their schooling due to the pandemic. Due to the time lost this year, the schools are completing only 60 per cent of the syllabus for this academic year. If the medium shifts back to online, then even that number would be set to go down. This would mean that those preparing for higher studies and competitive exams would suffer a lot. The parents I know are also interested in classes continuing in offline mode,

"Compared to online classes, physical sessions are far more beneficial for children. I have personally seen the kind of frustration and lack of concentration that comes along with offline classes. If the cases rise beyond any control, then maybe we could start online classes once again. But until that time.

As the third wave of the pandemic sweeps through the state, private educational institutions are reverting to online classes. This is when the state government itself has deferred the closure of schools and going back to the online mode to January 21.

It would have been understandable had the government decided to promptly shut the schools and switch to online mode due to the rapid rise in Covid cases. "As of now, many schools and colleges are closing on their own due to the development of Covid clusters in their institutions,"

The infection is not spreading among primary and upper primary students. This is because these kids are not coming into contact with the general public. They are being picked up and dropped

off either by their parents or the school buses. However, in the case of high school and higher secondary sections, the students come in contact with the general public every day, online learning comes in many forms and has been developing with the introduction of new technologies. Most of the universities, high schools and other institutions in the world have all instituted this form of learning and the student population in the online class is increasing fast. There has been a lot of research on the impacts of online education as compared to the ordinary classroom education. There are considerable differences between the online learning environment and classroom environment. In the online environment, teachers and pupils don't meet physically as opposed to the classroom environment where teachers and pupils interact physically. In this study, the impact of the online learning on the students, teachers and institutions involved was examined. Online learning or E learning is a term used to describe various learning environments that are conducted and supported by the use of computers and the internet

Unity Studies is a global sero-epidemiological standardization initiative, which aims at increasing the evidence-based knowledge for action. WHO, in collaboration with technical partners, has developed several standardized unity studies generic epidemiological investigation protocols branded as UNITY studies. These studies aim to support national public health and social measures, promote the international comparability of research and address gaps in current knowledge regarding the COVID-19 pandemic. The emergence of a new virus means that our understanding of the transmission patterns, immunity, severity, clinical features, and risk factors for infection is still limited. The WHO UNITY Studies can be adapted to local settings and implemented rapidly to collect robust data on key epidemiological parameters to understand, respond and control the COVID-19 pandemic. The UNITY Studies promote standardized epidemiological, molecular and serological methods to facilitate international comparisons so that both countries and the global community can collectively address knowledge gaps and inform an evidence-based COVID-19 response.

UNITY Studies enable countries, regardless of their resource setting, to conduct local investigations and are thus an invaluable tool for research equity. The widespread interest in the

UNITY Studies underlines their value. More than 100 countries have signaled their intention to implement one or more UNITY protocols and studies are underway in over half.

While countries are at different points in their COVID-19 infection rates, worldwide there are currently more than 1.2 billion children in 186 countries affected by school closures due to the pandemic.

In Denmark, children up to the age of 11 are returning to nurseries and schools after initially closing on 12 March, but in South Korea students are responding to roll calls from their teachers online. With this sudden shift away from the classroom in many parts of the globe, some are wondering whether the adoption of online learning will continue to persist post-pandemic, and how such a shift would impact the worldwide education market.

Even before COVID-19, there was already high growth and adoption in education technology, with global tech investments reaching US\$18.66 billion in 2019 and the overall market for online education projected to reach \$350 Billion by 2025. Whether it is language apps, virtual tutoring, video conferencing tools, or online learning software, there has been a significant surge in usage since COVID19

**CHAPTER - II**  
**REVIEW OF LITERATURE**

Berge (1998) studied the difference between distance education and distance learning. Distance education was seen as the formal process of distance learning, with information being broad in scope, for example, college courses. While, distance learning was seen as the acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance.

Hall & Snider (2000) studied and, characterized distance learning with three criteria; they are: a geographical distance separates communication between the trainer and the participant; the communication is two way and interactive, and some form of technology is used to facilitate the learning process.

Willis (1994) studied the distance learning identified the acquisition of knowledge and skills as another criterion and supported the former three criteria by saying that distance learning occurred through mediated information and instruction, and encompassed all technologies and other forms of learning at a distance.

Porter (1997) studied that distance learning was education or training offered to learners who are in a different location than the source or provider of instruction. Porter went on to say that the technologies used in distance learning, the structure of a course or program, and the degree of supervision for a distance learning course can be varied to meet a particular's group's needs or interests.

Urban & Weggen (2000) studied that e-learning as a subset of distance learning, online learning a subset of e-learning and computer-based learning as a subset of online learning. Given the review of definitions on all these terms 'subset' does not appear to be the most likely word to describe the relationship among these words and their forms. The definitions show a great depth

of interdependence among themselves. While one person may narrowly define a term, another person could give it the all-encompassing power. This communicates that e-learning, if given the all-encompassing form, can be the larger circle of which all other terms would be overlapping at different times and extents given their user's intention. Another rationale for this choice is that "just-in-time" learning is a major advantage of e-learning but not of distance learning. Distance learning purports planned courses, or planned experiences.

McCrea, Gay & Bacon (2000) studied that related to today, corporate learning and the corporate learning organization have ascended to a position of strategic prominence in the context of managing and growing the enterprise.

Urban & Weggen (2000) studied the knowledge-based economy, the paradigm shift in the way education is viewed and delivered, and huge knowledge gaps as significant trends that have given rise to e-learning. In addition they mention that the second largest sector of the U.S economy is the \$772 billion education industry. The increase in complexity and velocity of the work environment brought about by technological changes are also major issues that have fueled the demand for e-learning.

McCrea, Gay & Bacon (2000) studied and presented the shift from the industrial to the knowledge era, rapid technological change, the ever shortening product developmental cycles, lack of skilled personnel, enterprise resource planning, and migration towards a value chain integration and the extended enterprise as being prominent contributors to the e-learning value chain.

McCrea, Gay and Bacon (2000) studied and recognized the robust economy and the increasingly competitive global business environment as central to the e-learning movement.

Ticoll, Lowy & Kalakos (1998) studied and related that the competitive environment requires companies to work together to create online networks of customers, suppliers, and value-added processes – that is, an e-business community (EBC).

A study by Cohen (1997), though, does not indicate a learning style change after one year. He investigated whether learning styles will change after a year of schooling in a learning environment where computers are used as cognitive tools and are dedicated to a constructivist approach to learning. Although the results failed to show a change after 16 one year, they suggested that learning style is clearly affected by factors within this technology- rich environment. It must be mentioned though that in this study, Cohen applied Dunn and Dunn's Learning Style Inventory instead of Kolb's LSI

Eatmon (1995) studied that and pointed out that self-directed learning is a desirable trait and function of not only learners but also of instructional facilitators and the sponsoring institution. Indeed, this is important if e-learning is to encompass formal, informal, planned and unplanned learning. For an organization to be conducive to the sharing of tacit knowledge, for example, self-directed learning is crucial. Self-directed learning is the impetus of organizational learning at all levels.

Khan (1997) highlighted that if learners are to employ these skills, the learning environment must be supportive and rewarding of these behaviors. Learners should be given full access to a wide range of information (i.e. objectives, learning strategies), and communication options, both synchronous and asynchronous that can be used in large group, small group, and one-on-one settings. In addition, learners should be given feedback and the opportunity to provide feedback on the learning process and content. This gives learners buy-in power and improves the learning architecture.

Thomas (2000) studied and related that potentially inadequate levels of human interaction should be considered as a critical factor in the success of technology-based learning. Development of

strategies for reducing the psychological distance and increasing interaction between participants in e-learning courses is very important. The need for communication and interaction can be analyzed from two primary perspectives, learner-to-learner and learner-to-instructor.

Thompson (2000) studied and also discussed the importance of social presence in distance education. Social presence is defined as “the degree to which an individual is perceived or experienced as a “real” person.” Thompson goes on to suggest that the instructor ability to create a high level of social presence contributes significantly to instructional effectiveness and learner satisfaction. Additionally, social presence can impact motivation and learning.

Urban and Weggen (2000) studied and indicated that e-learning solutions can provide more collaboration and interaction with peers and experts as compared to traditional instruction. They suggested that interaction is facilitated by the fact that the instructor does not monopolize student attention in an online learning environment.

They shared that “electronic learning solutions can offer more collaboration and interaction with experts and peers as well as higher success rates than the live alternative”. They identified case studies, role-playing, simulations, streamed video, project teams, chat rooms, bulletin boards, online references, personalized coaching, and email as some techniques that could help create an interactive online environment. The authors also argued that distance learning can be more stimulating and encourage more critical reasoning than traditional classroom instruction because when using the above mentioned activities it can allow for group problem solving

According to Neal & Ingram (1999) studied that distance learners do not receive the day-to-day feedback available in traditional classroom settings. Instructor-student feedback is important as it helps the instructor to gauge the level of student satisfaction regarding a topic or an entire course. Because of the loss of traditional classroom feedback in e-learning environments, other methods to assess learner satisfaction need to be administered.

Sherry, Fluor, and Zhang (1998) conducted studies on two different measures of distance learners' satisfaction with instruction. The studies were held at a major University known for its early consistent involvement in distance education. The courses were delivered via live two-way audio and video technology. The first study analyzed the accuracy of a short, written survey designed to obtain learner perceptions for opportunity to interact in the distance education course. The survey included questions regarding interaction between the instructor and learner-to-learner interaction. Results revealed that instructor-to-class interaction is positively and moderately correlated with perception of learner-to-learner interaction.

According to Thomas (2000), studied and success in technology-based learning programs is based on an orientation to the learner not the instructor. A strong focus on the learner and the learning environment is a shift from traditional instructional design and development techniques. Norton and Walberg (1998) believed that learner-based tools should be selected based on the way that they help students learn. The most important thing is how well the tool supports the learning process.

Smith (1998) studied and described several important characteristics of distance learning program in a university setting. First, he identified that the interconnection between satellite sites by two way audio/video systems does not provide the same type of interaction available to students in a regular face-to-face

Classroom environment. The experience of being at an off-site location, due to technological limitations, contributes to the perception of the distance learning experience. Second, the site location where learners are located contributes to learner perception and understanding of the

distance learning situation. This involves the level of constructed reality in distance learning situations.

Pall off and Pratt (1999) studied and suggested several ways to measure student achievement. First, they asked learners to submit a self-evaluation as part of the completion of the course. This type of self-evaluation should asks learners if they feel that they have met their own learning goals for the course and how they feel they have performed. Second, in a large course that has been divided into groups or teams, the group may be asked to appoint a leader who can assign grades based on member contribution to team projects

Hall (2000) studied and contended that evaluation and record keeping are important for ongoing assessment. He pointed out that in a quality course, mastery of each course section is required prior to moving onto the next section. He also stated that quizzes and final exams are used to assess learner achievement in quality programs. Finally, automatic recording of learner data, and tracking of time taken to complete courses are also checkmarks of quality courses.

Gilliam, Buckner, and Butt (1998) studied and conducted a user-centered evaluation of Web-supported learning at Queen Margaret University College in Edinburgh, UK. The purpose of the study was to obtain information about a Web site that provided support material for a traditionally taught course and to ascertain learners' perceptions of the site.

Jewett (1998) studied learner satisfaction at the Education Network of Maine (ENM). In this study the ENM was a participant in the Flashlight Project, which is managed by Western Interstate Commission of Higher Education. The goal of the Flashlight Project is to evaluate the use of mediated instructional technologies in higher education. Using a special Flashlight Project Item Bank, the researchers created a survey to obtain information related to student satisfaction with courses delivered by the ENM using interactive television. Twenty three (23) courses were

selected for the study, each have four different audience locations. They are: broadcast (or sending) site, community sites, University Center sites, and individual student homes. A total of 1886 students were surveyed.

Payne and Payne (1998) studied and discussed the use of distance learning to reduce training costs in the Federal Aviation Administration (FAA). Due to government budget cuts the Federal Aviation Administration (FAA) had to cut cost in its training budget. The problem the FAA faced was how to reduce the overall cost of providing training while increasing training opportunities for employees. To meet the required budget cuts in training the FAA determined that it would convert 40 percent of its resident-based training for delivery by using some form of distance education technology to reduce overall training costs.

Wisher and Priest (1998) studied and conducted a study of cost effectiveness in a telelearning course in the U.S. Army National Guard. The study compared the costs of a traditional three-week Military Unit Clerk course to the identical course delivered via telelearning. The researchers described teletraining as a high quality conference call that allows learners at multiple locations to hear and speak to one another with standard telephone lines and a special switchboard called a bridge.

Hall (2000) discussed and studied three case studies that highlighted the cost advantages of e-learning compared to traditional instruction. The first case study, as mentioned before, was at Price Waterhouse, where they conducted a return on investment analysis for a multimedia training program. The total cost for development and delivery over five years was examined. The cost per learner for the multimedia-based program was \$106 –compared to \$760 per learner in the traditional course. Another cost benefit of this case study was that it took learners 50 percent less time to complete the course when compared to the traditional course. This is significant when considering opportunity costs of workers.

In the Berge and Mrozowski (2001) studied more than 100 studies focused on each of the three themes: (1) design issues, (2) learner characteristics, and (3) strategies to increase interactivity and active learning. By design issues, the authors focused on instructional systems design and focused on topics such as content requirement, technical constraints, interactivity, and feedback. The next theme, strategies to increase interactivity and active learning, were closely related to design issues and focused on students' modes of learning.

Talent-Runnels. (2006) reviewed research on online instruction from 1993 to 2004. They reviewed 76 articles focused on online learning by searching five databases, ERIC, PsycINFO, ContentFirst, and Education

Jacqueline Wong explores the connection between online learning and self-regulated learning. The study highlights the significance of supports for self-regulated learning such as the use of prompts or feedback in promoting the development and deployment of strategies for self-regulated learning, leading to better achievement in online learning Ruchan Us and Adem Uzun of 167 undergraduate students on a programming language course compared blended learning with a traditional learning environment. The study found that, for the purpose of developing self-regulated learning skills, blended instruction was more effective than traditional instruction.

Hayward. (2001) studied and measured the perceived impact on learning by students engaged in a tele-mentoring community. They also questioned whether learning is perceived differently by mentors and mentees. Hayward et al. found that, through reflection, co-op students became aware of personal growth and learning. Students indicated they had learned effective communication, problem-solving, self-assessment, reflection, and professionalism through participation in tele-mentoring. Mentors learned effective written communication skills and augmented their problem-solving skills. Therefore, some similarities and differences were found in perceived mentor/mentee learning through this experience, but no actual measure of learning was assessed.

Witmer, 1998) studied and examined learning used computer-mediated communication to enhance communication students' experiences during a summer internship. Findings discussed how the students' written assignments were greatly improved in both structure and conceptual understanding because of participation, and most students managed to apply concepts from the classroom to their work experiences. Connection with faculty also allowed for ongoing instruction in communication concepts and theories. No data or analysis was shared to show improvement in these factors or how they affected overall student education.

Canale & Duwart, 1999). Studied that after a qualitative analysis of the student assignments, the researchers found that students could make better sense of the differences between co-op learning and classroom learning due to co-op experiences and formal reflection, but again, no measure of actual learning was used. Canale & Duwart also raised a concern from students that too many "academic" responsibilities while at work could detract from overall co-op learning. This should be considered in the design of the community. Students should view the community as a learning tool versus as add-on assignment.

Xu and Ebojoh, 2007) studied that advent of the Internet and the world wide web has led educational institutions to change their learning techniques to meet the user demands in providing an ideal learning environment. An online class is a system where students can learn subjects, discuss issues with fellow students, clarify doubts with instructor and share material and check academic progress with help from internet-oriented technologies.

Heyneman and Loxley (1982) studied and also used multiple linear regression to show that in industrialized countries various student background variables (the father's and mother's education, the father's occupation, the number of books in the home, the use of the dictionary in

home, the sex of the student, and the age of the student) explained around 20% of total variance in science achievement (this constituted about 50% of explainable variance<sup>1</sup>).

Velez (1993) studied and founded that in many studies in Latin America student achievement showed positive association with parental education or occupation, family income, access to books, attitudes toward study, previous cognitive achievement, access to TV, and IQ / ability. Family size and student's age were shown to be negative predictors. Since the vote counting cannot provide the effect sizes (and many primary studies do not supply effect sizes,

Salvador, 2008, studied and says that, now in the homes of their students, which they access through the Internet. The role of parents is also to educate, but from different perspectives, complementing those of teachers in the acquisition of children's learning. For these reasons, many families say that they do not know how to undertake these activities with their children for so long.

The study by Clemente-González (2016) of the University of Murcia highlights the relevance of grandparent–grandchild relationships and the role of the former in the social and emotional development of the child, which gives great significance to their grandparents for the appreciation observed in them, recognizing their importance in the family structure. At this point, it is also necessary to point out the lack of relationships between equals, which is so important for the correct emotional development of children.

Fandino-Pérez studied and says that the pandemic has put us in front of the mirror to see a distorted and absurd image of the work of teachers as producers of programming and good

results, which turns them and their students into a kind of machine. We have forgotten the main thing: to be human beings capable of creating a better world and of overcoming ignorance, fear, and demagoguery.

Liu (2020) studied analyze the situation of children whose parents have been infected with the virus or have died;

Zhang. (2020) studied and observe the behavior of children with attention-deficit/hyperactive disorder (ADHD) during this period; and finally

Guan. (2020) studied and deal with the practice of childhood PA during confinement. Therefore, only one of them studies a type of activity in this period, the one dealing with PA coinciding with what is written by the Italians.

Italians Ricci. (2020) studied in the same line, Turks Yarimkaya and Esentürk (2020) who deal with the importance of PA in confinement for children with autism spectrum disorder (ASD). It is important to remember that World Health Organization (2010, 2019b) recommends a minimum of 1 h/day of moderate–vigorous PA in children.

Fandino-Pérez, 2020) studied that educators who are aware that the essence of being in the classroom and the immediate feedback that students offer in this situation has been lost. To this must be added the role of the WHO, overwhelmed by the health events that have occurred so quickly, as described in these lines.

Bozkurt, Ozbek, Yilmazland Others (2015) study “Trends in Distance Education Research: A Content Analysis of Journals 2009-2013” is a study about the current trends in the field of research in distance education. This study has been conducted to see the changing trends of the distance education and how to meet the challenges faced with the onset of the modern technology. This study has been conducted by a group of thirteen scholars. They identified the trends by reviewing 861 articles of the seven peer reviewed journals. They used the content analysis method to find out the trends of the research.

Mishra (2016) “A Study of Some Characteristics of Ph.D. Thesis Uploaded on Shodhganga” is about the characteristics of Ph.D. thesis uploaded on Shodhganga, a repository of theses of all the institutions of higher education in India. The study took hundred theses for quantitative and qualitative analysis. The analysis shows a variation and similarities among the theses in content, forms, methodology, research design etc. The common form of Ph.D. theses is the ‘introduction’, ‘review of the literature’, and ‘methodology’ etc.

M, HT and Trivedi (2018) “A Study on Research Trends in Central Universities of India” is about the trends of research in Central Universities of India in respect of number of published research, citation, affiliation of the authors, areas and subjects, productive author and publishers. This study also throws some light on the quality in higher education. Six objectives were set for the study relating the trends namely publication, affiliation, subjects, quality of papers and productive aspects of authors and publishers. Thirteen Central Universities which were established in 2009 have been chosen for study.

Unnikrishnan, (2008) studied and noted a significant relationship between the study and the purpose of Internet use. Majority of the students preferred internet over text books because it accessed the latest knowledge. Majority of the students wanted that computer and internet use among students should be encouraged in institutions. There searchers also observed that most of

the final year students spent less than three hours with their computer and went online in one week.

Adithya Kumari, H. and Mahadeva murthy, M. and Hydarali, (2013) argued that internet was a most common and useful instrument for all students. The results of the study showed that students used the internet for several objectives, and most of the students also faced many problems while surfing the Internet. A large population used the internet every day. The researchers recommended the teaching institutes to educate and advise students to use Internet.

Shashi Kumar (2012) discovered that internet use among students could stimulate their sexual attitude, behavior and influences their premarital sex position. Further, they also came to know that internet use influenced their study and academic performance. They also found a significant association between sexual interaction and use of internet. Most of the boy had an unmonitored internet service and they use it for sexual activity while no such relationship was found in girls. It was common for students to be exposed to sexual content on internet. The study showed not worthy relationship of having sexual interaction with academic performance and achievement specifically in boys. No significant relationship was found between the duration of watching television and using internet on academic achievement and sexual activity.

Rajeev Kumar and Amritpal Kaur (2006) revealed in their study that majority of students were using Internet for more than 2 years. They found that almost half of the respondents used internet for 2-3 times in a week while only 5 percent used it every day. Most of the respondents used the Internet for educational objective while half of the respondents used it for research purpose and least number of students used the Internet for entertainment aims. A majority of the students also faced some difficulty while surfing the internet such as slow internet speed, slow download speed, difficulty in getting relevant and reliable information and some privacy difficulties. The students found internet information more valuable and it helped them to improve their professional competence. Due to the update and instant availability of information, their

dependency on internet was increased and 44.8 percent respondents felt that theInternet had improved their professional aptitude. Whereas some students also claimed that no doubt internet had revolutionized their life but it could not replace library.

Fayez Ahmad Loan (2011) found that students from different disciplines used internet for communication, information, entertainment and academic purposes. But majority of the students accessed internet for knowing new things, chatting and emailing. Frequency of using internet was varied among the students one third of the students used it for 2/3 times in week while many users accessed internet daily basis. All students faced some problems while accessing the internet. Some of the students did not get reliable and valid information due to overload of information while others faced slow speed, downloading facility, language barriers etc.

Sam path Kumar and G. Manjunath, (2013) researched to find out the academic impact of internet on teachers and researchers. This study found a high use of the internet by teachers and research students in university. Most of respondents used internet service to support their study, research and teaching. They accepted that they learnt to use theInternet with the help of friends. The results of study also showed that internet use has improved their academic performance. The internet helped them write to good research papers and more papers. The researchers recommended that university should provide internet facility to its research scholars and motivated the students to use the internet for their research and academics. The study also advocated that there should be training on how to use the internet for academic and research.

Singh Dhyana and Nutan Sharma (2013) viewed that most of the students used internet on the direction of their teachers for educational purposes and the use of internet among college students was increasing swiftly day by day. The students who had no internet service at their homes, they used it at colleges and cyber cafes. It was also discovered that internet had changed the activities of playing, reading, outgoing, and watching television since they started accessing the internet. The authors also found some positive impacts of internet use in students. If the

internet was used for one-two hours in a day, it made students energetic and fresh. But, who spent much times on internet feel some anxiety, irritation in their behavior, pain in eyes, and other disorders. They also concluded that internet was making students dull, passive and uncreative because they found readymade information on internet.

Bar Thakur (2012) conducted a study to find out the connection between internet use and mental health problems. In the total 268 respondents, 24.6% testified frequent problems due to use of internet. The researchers found several negative effects of internet addiction. A large population from the sample accepted that excessive use of internet effected their work, social life and anticipation. Heavy users of internet felt loneliness, depressive, anxious and other disorders. The researchers recommended that internet users at the college and workplace should be screened and interventions should be planned to prevent mental health problems.

Anita (2013) summed up that there was a significant connection between residential background and emotional maturity of Internet users. The study also confirmed that there was an interactive influence between academic discipline and regularity of Internet use on emotional maturity of Internet users.

Sugata Mitra and Vivek Rana (2001) provided internet facility to the slum children in New Delhi. The researchers observed that children seemed to understand the things and could use the technology easily. Children did not find language and education any significant problem to learning. They also argued that internet technology had been spreading promptly in India like other countries of the world but internet users in India were mostly restricted to the urban areas.

Chetan Sharma (2012) discovered that almost 99% students of all the four universities accepted internet as a significant tool of research. Teachers and researchers used internet for establishing scholarly communication and they spent a heavy time on Internet and had adequate experience of

Internet use. Almost 51% of sample used internet every day while 33% respondents used it two-three times per week. Respondents faced many problems while surfing internet. Further, the researcher recommended that the university should take some adequate steps to make internet service properly so that both teachers and researchers could use it for their betterment.

The study of Chong ham Beda Devi & Nil Ratan Roy (2012) showed that the internet use had affected the research and academic work of Assam University. The study clearly showed that the younger generation had acknowledged the Internet as significant medium for gathering relevant knowledge and information for their academic and research work. The study also found that internet played an important role in their everyday life. Maximum respondents used internet at night for mostly their academic works. Out of 100 students, 24% used the internet less than for an hour in a day, 17% used for one hour, and majority of the students used two hour.

Manoj Kumar Sinha, Sudip Bhattacharjee and Sucheta Bhattacharjee (2013) carried out a study to investigate the impact of ICT and Internet use among the College students. The study revealed that the Internet use had generated a significant influence upon users in their research work, academic, teaching, practical work and assignments. The results of the study clearly showed that new students had claimed the internet as a great tool for obtaining to the needed information for academicians and researchers. The researchers suggested that the training should be provided to the college library users. Then they could use internet effectively for their research work and education. Majority of students went to library to keep them up to date but they did not access appropriate material there. There internet can be a good source for their curiosity. They also found that internet had attracted the students due to its easy access of providing information on any topic. Most of the students faced some problems to use it smoothly and slow speed on internet.

The results of Gualala Suri and Sneha Sharma (2012) study show that there is significant impact of internet use on respondent whereas the attitude towards e-learning has no significant effect of

internet use. A majority of respondents are interested to learn the computer and they have positive attitude towards e-learning also.

A research carried out by Preeti Mahajan (2006) explored that Internet had a great effect on the academic atmosphere of the students. The students of the sciences were using full Internet service provided by the university. Research students of humanities and social sciences considered their university library as the last choice for finding information. The study also concluded that most of the science research students nearly 90% preferred to use Internet instead of the library while the students of social sciences and humanities used library more than internet.

Dineshan Koovakkai and Muhammad P. (2010) revealed that the adolescents in rural areas used the internet for manipulating information, downloading obscene materials pictures and, pornography, and sending unwanted messages to their girl and boy fellows. They also found that the main objective of internet use was to do fun and entertainment. There were differences between rural and urban youth in understanding the internet ethics and laws. Urban youth were more knowledgeable than rural youth. Most of the students copied the internet information for their homework and assignments. It was also analyzed that internet abuse was more in rural youth than urban adolescents because rural youth were unknown and passive about the importance of the issues. They sometimes involved themselves in such activities because of their ignorance and innocence. The researchers advised to train and educate the adolescents about the dangers and benefits of internet use.

Debarati Halder and K. Jaishankar (2013) said that the use of internet among adolescents was satisfactory but the awareness and knowledge of cybercrime was less. They were not aware about privacy matters and plagiarism problems. The study found that students used YouTube and other sites for viewing obscene movies and clippings but at home they did not surf such sites due to the fear of knowing about it by their parents. Most of the students feared from police in doing something illegal on theInternet. The researchers hoped that students would know about the

cybercrime issues and it would help them to become a good citizen to spread the awareness about the cybercrime in the society.

Sumanjit Das and Tapaswini Nayak (2013) in their joint article concluded that cyberbullying was the worst fear among the teenagers now days. This fear has become common due to presence of internet everywhere. They argued that several reports inspected that the group of eighteen years had the more vulnerable and feared from cyber bullying. They also reported that female were the worst vulnerable section of the society. Many persons receive threats, negative comments or negative pictures or comments from other person by internet. This is done via online chatting, messaging, through Facebook and Twitter. They also analyzed that usually feared person could reach a limit of anxiety, depression, threatens and humiliation and to the level of self-harming.

Kumar and Kaur (2004) found that majority of the Internet users used it for educational and research purposes. The researchers suggested that the use of Internet among the teachers and students at Shaheed Bhagat Singh College should be improved and increased for more positive results.

Jain Nilesh, Patidar C, and Malviya Rajesh (2011) research that engineering student sin India use internet on daily basis for different purposes. Majority of the students consider internet a useful tool for their studies. They prefer online study materials and books. They discover internet supportive to increase their confidence for presentations and making reports. They suggest to promoting the use of internet among students. The researchers also observe that excess use of internet might cause some socialization problems. The students' dependency on internet has reduced the face to face among them. They also argue that internet has positive effect on learning but has bad influence on social sides of a student's behavior. They recommend that college should organize seminars to make students aware about the significance of internet as education tool. They conclude that college should inspire group learning via internet and should promote the use of weblogs.

The study of Singh Sanjeet, Sharma Gagan Deep and Kaur Simranjeet (2011) showed direct impact of the internet on the education. They argued that internet networking had shrunk the world boundaries. They also concluded that with the assistance of internet the distance education was growing speedily and the students were receiving more opportunities to learn from any part of the world and had reduced the pressure of writing. Today anyone can find any information on any topic on internet. With the help of internet the speed of education has also become fast, because the computer and internet take less time. Today rural students are also getting the benefit from the Internet. Nowadays, they can learn online without leaving their home, with the support of distance learning. They concluded that the computer and internet has transformed the face of the education and learning has become very easy and convenient.

Lawanda and Atm Prakash Sharma (2013) analyzed that internet users and non-users had some differences in their study habits & adjustment and but did not have significant difference. The effect of sex, discipline and internet use/non-use on academic performance and study habits & adjustment were insignificant. Therefore, the researchers found that 99% of the sample of non-user of internet was superior in all the proportions of adjustment than that of internet users. They rejected the null hypothesis that there was no significant impact of internet use and not use on the adjustment of student. It was found that students of science discipline were mediocre in their adjustment whereas students of arts course were unsatisfactory in their adjustment.

Goel Deepak, Alka Subramanian, and Ravindra Kamath (2013) found that most of the Internet addicts used it habitually in the evening and nights as compared to other internet users who used internet in the mornings and afternoons. The results also showed that there were differences of accessing the internet. The study did not find any significant relationship between internet addiction and the hours of use every day. Addicts took more times on internet than they had already intended. Internet addicts also showed some signs of poor mental and physical health.

The researchers did not find any connection between self-esteem score and internet addiction. But they explored high anxiety, depression, and anxiety depression score among respondents. Researchers also set some boundaries for internet addicts.

Sharma, A., Sahu, R., Kasar, P. K. & Sharma, R. (2014) conducted a survey on 391 and found that males students were more addicted to the internet use than female. Both boys and girls spent 1.29 hours per day on internet. There was only 0.3% students' addict of internet, remaining had normal, mild, and moderate systems. The study also concluded that Internet addiction was mounting problems in students particularly of professional courses. Therefore, policies and strategies for prevention of internet addiction as well as therapeutic interventions should be monitor that would promote healthy and safe use of the Internet.

Priyanka Yadav et al. (2013) took a sample of 620 students from six English medium schools of Ahmedabad to identify the level of internet addiction. They used the Young's Internet Addiction Test and applied the Logistic regression analysis method to find the predictors of Internet Addiction (IA). The results show that 65 students had Internet Addiction that was projected by time spent online etc. They also found strong positive relationship between internet addiction and stress, depression and stress. Ahead, the researchers claimed that internet addiction was a relevant clinical concept, and requires conducting research in developing countries also. They asserted that the students of high school who were suffering from anxiety and depression should be screened internet addict.

Nalwa K, and Anand AP. (2003) claimed that internet had become a medium of addiction in students. The researchers used the Davis Online Cognition Scale (DOCS) to assess pathological Internet use among students. On the basis of total scores gathered from 100 respondents two groups were made; dependents and non-dependents respectively. The study found a significant behavioral and practical use differences between these two groups. Dependent group found to

delaying works when time spent online and they lost sleep due to late-night online habit. Some of the respondents accepted that without

Internet their life would be boring. The dependent group spent more hours on the Internet comparatively to the non-dependents group. On the loneliness amount, dependent group scored higher than the non-dependent group.

Guan SS, and Subramanian K. (2009) confirmed in their study that online dangers and risks such as cyber bullying, internet addiction and sexual solicitation were connected with negative concerns for youth. They argued that it was essential to note that not every youth was similarly vulnerable and more studies were necessary to investigate about youth who were at risk and needed to formulate some effective interventions. The Internet could similarly offer benefits in the fields of social, cognitive and physical development. So, The Internet represented both opportunities and risks for youth. They recommended conducting research to know which youth were mostly at risk to the online addiction, bullying, and solicitation and there was need to make strong interventions. The said Internet also had various positive features and could be used to increase and improve learning and empowerment of youth

Vidyachathoth, Kodavanji B, Kumar NA, Pai SR (2014) noted and reviewed that excessive Internet use was evolving as a major negative consequence in adolescent and youth and they were at most risk in terms of mounting problematic internet use, The internet addiction was associated with the academic performance, dullness, the lack of time and pursuing hobbies. Among the other students group, medical students appeared to be a group of specific concern because they spent more time on the Internet. The study also confirmed a strong association between the number of hours using internet every day and the harmful affect score. Frequent use of the internet and spending a significant volume of time online might be a medium of lowering the anxiety that personifies withdrawal.

Tadasad G, Maheswarappa B and Alur Seema (2003) observed that students used the internet for their general purposes and they did not realise its potential to education and other fields. Many respondents were just beginners with one year of experience. They used internet mostly in the cyber cafe. The researchers argued that Internet facility should be increased to the library and awareness about internet use should be created among the students.

The study of Lakhani Govindappa, Sekar Kasi, and Grace Henry (2013) concludes that popularity of internet has been growing among Indian adolescents and it has become a significant tool for their social and academic development. They argued that exponential increase in the use of the internet has leading them to internet addiction. The study was mainly focused on to assess the risky behaviors of the adolescents. The Results show that the students of 15 –year spent 34 hours in a week on internet for various objectives. It shows adolescents have become addict of internet use.

Parameshwar S and Patil D. (2009) found that research students and faculty members were using the internet for different objectives in which emailing, searching e-journals and sharing online information was the major. But, they did not use the internet for technical reporting and electronic dissertations and theses because of the lack of awareness. Students got most of their information through search engines particularly from Google. Students also faced poor speed, downloading, information overloading and fake information problems. Researchers advised to create awareness about use of electronic theses, online journals, and technical reports.

Thanuskodi, S, (2013) found that internet were used by boys and girls to some extent. Both boys and girls had equal access to Internet but there was a difference in usage pattern. The access was similar in boys and girls because both had high exposure to the internet because of their educational experience. The boys and girls used internet in different ways at their home because girls were not given same freedom as given to boys by their parents. The researcher also noted

that most of the male students (37%) used internet for less than two hours while most of the female students (31%) had less than two hours of access to the internet.

Nazim Mohd and Saraf Sanjiv (2006) found that majority of the students used Internet for research because in the library there were no facilities of Journals. Half of the students accepted that they searched the information through the search engines while thirty- five percent went to the particularly sites. Thirty five percent acknowledged that Internet was the most useful place for seeking valuable information. There searchers also observed that the students were facing many hardships to using theinternet smoothly and properly.

A study done by Jali (2010) showed an increase in internet knowledge among students which was better than that observed in Nigeria, Malaysia and UK studies. Most of the respondents used internet at home and their hostel. Students preferred internet for getting new information and a majority of the student chose computer for learning curriculum program. Students preferred internet instead of textbooks due to its update nature. 10% of students used internet every day in 10.6% and 23 times per week for dental objectives that was higher than students of Dental in Turkey and lesser to the students of Britain. They also suggested that computers should be additional medium and not should be substituted to traditional education. Hence, computer education among students should be improved and encouraged.

Lal P, R. Malhotra, C. Ahuja, and G. K. Ingle (2006) noted that the students of PG and M.Phil. Used internet for their educational purposes while most of the UG students surfed internet for chatting and entertainment. All the students were dissatisfied with slow speed of data transfer service. The study also observed that (90.6%) students were aware of the availability of the internet cafe in the campus but most of them did not use it.

Kumar Santosh. (2010) surveyed 247 dental students to identify the impact of internet on their life. They found students used the internet every day for general information and dental purposes. More than half of the students (55.5%) never used the internet for education objectives. Approximately, half of the students accessed the internet at home. About 60% of the respondents used search engines to access dental subjects, and the students from clinical course used the Google, yahoo for dental education. But there was a lower use of internet among the dental students due to limited access and availability of internet at the college.

Sumit Kochhar (2013) revealed that engineering students used internet more than their other colleagues because they had no accessibility of internet at the institution. The study argued that awareness, availability of internet service and skill for computer use were needed to best utilization of digital resources by students. Approximately, half of the students stated that they preferred to use the internet at home and they also reported difficulty in finding appropriate information on internet. Most of the students used internet for Facebook, Orkut etc. and e-mail. Only about 20% of the students favored internet use for clearing their doubts relating to their studies. Less than half of the respondents used internet to download electronic books of their syllabus.

Cisco (2011) reported that 95 percent of the college students admitted the internet was as important in their lives as food, water, shelter and air. Approximately, 64 percent of the students accepted to choose an internet connection over a car. The study also concluded that four out of five college students interviewed assumed that the internet was significant and essential part of their lives. The report also found that the use of paper had been gone down in the youth, as 40 percent students had not bought a book from a market in the last two-year. The use of Facebook was highest among Indian students in the survey. With 92 percent of respondents were checking their accounts daily while one third checked their account five times a day.

**CHAPTER - III**  
**METHODOLOGY**

## **Statement of the problem**

Online learning is education that takes place over the Internet. It is often referred to as e- learning among other terms. However, online learning is just one type of distance learning - the umbrella term for any learning that takes place across distance and not in a traditional classroom. In the pandemic situation, students are forced to attend online classes, this topic is closely related with the psychologically health of children.

## **General objective**

The impact of online classes on school students in Kochi city

## **Specific Objective**

1. To find socio-economic details of respondents.
2. To find the level of satisfaction of the respondents.
3. To find out the merits and demerits of online classes.

## **Clarification of concepts**

### **Theoretical definition**

Online Class

According to Oxford dictionary a system of education in which people study at home with the help of technology.

### **Operational definition**

In this study, the same meaning theoretic definition is used, 'Online classes is the process where the students attend classes with the help of internet facility.

## **Variables**

**Dependent variable**

Satisfaction of students

**Independent Variable**

Age, Income the family, Sex,

**Tools**

The tool taken for this study is questionnaire. [Google form]

**Universe**

All the school students in Kochi city.

**Sample & Sampling method**

The sampling techniques is used is snowball sampling, there are many categories of students leaning in online mode in Kochi city. Using snowball sampling techniques, a sample of 50 High School and Higher secondary school students were choosen.

**Pretest**

Pretest was conducted amoung 15 respondents

**Pilot study**

After selecting the topic, a pilot study was conduct amoung students in kochi city, so resechers, found feasible to gather information with regards to the objectives of the study.

**Data collection**

A structured Google form scheduled is tool used in the present study for obtaining primary and secondary data is collected from magazines and journals.

**Data analysis**

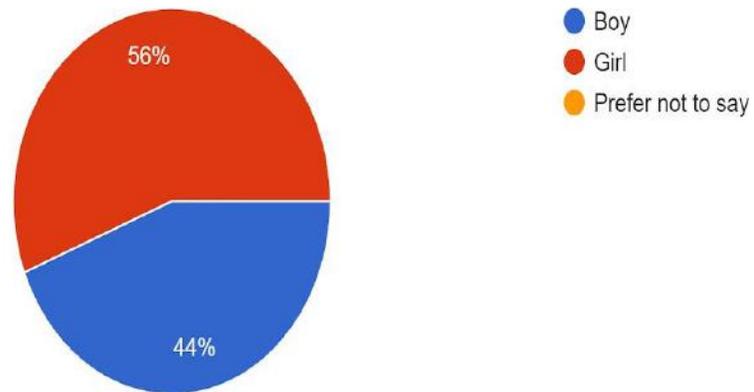
Primary data was collected using Google forms schedule the data, based on the analysis and interpretation the thesis has been prepared and documented.

**CHAPTER IV**  
**DATA ANALYSIS AND**  
**INTERPRETATION**

**Interpretation is the act of explaining, reframing, or otherwise showing your own understanding of something.**

Figure 4.1

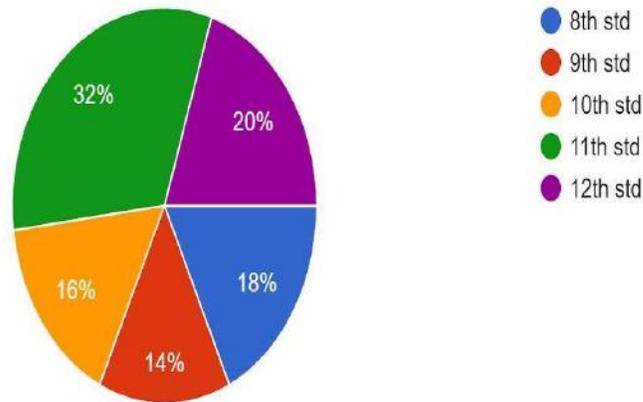
Gender  
50 responses



In the study, majority of the respondents were girl students.

Figure 4.2

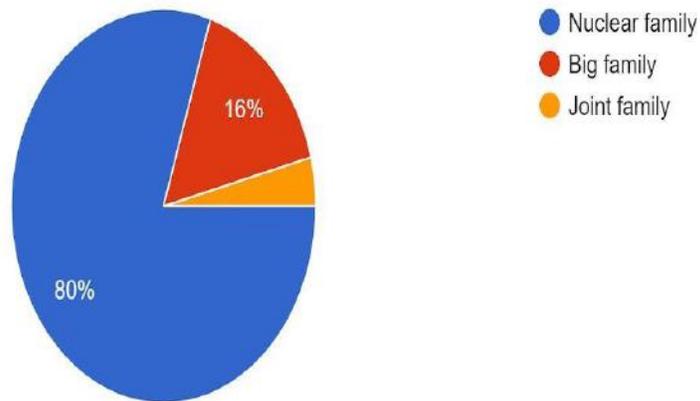
Education  
50 responses



By viewing this figure we will get a clearly picture about the participants educational status, highest number of participants are from 11<sup>th</sup> grade, next belong to 12<sup>th</sup> grade, next highest number is from 8<sup>th</sup> grade, after than we can see the 9<sup>th</sup> grade and the lowest participants are from 10<sup>th</sup>, it's because there exam was going during this period.

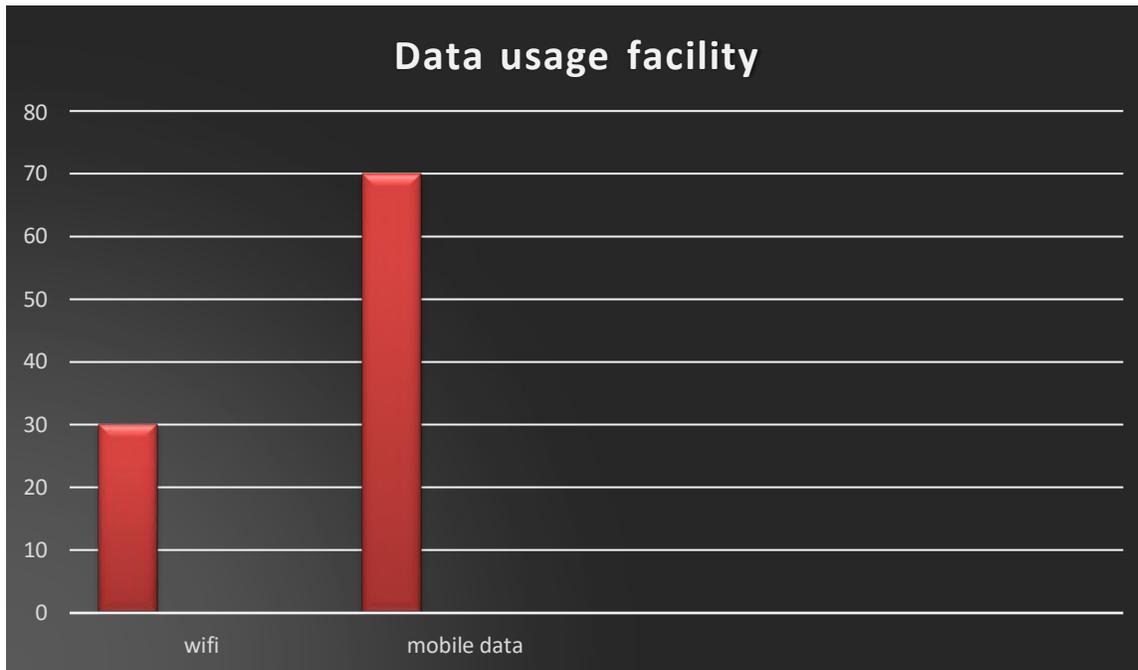
Figure 4.3

Family type  
50 responses



This diagram posturizes 80% of the participants belongs to nuclear family, it is notable change happened because of the concept modernization, during olden time it was just opposite, joint family was higher in number in olden society, but now it is not like that, from this study we received only 16% of joint family's, from that we gets brief ideas about the family system.

Figure 4.4

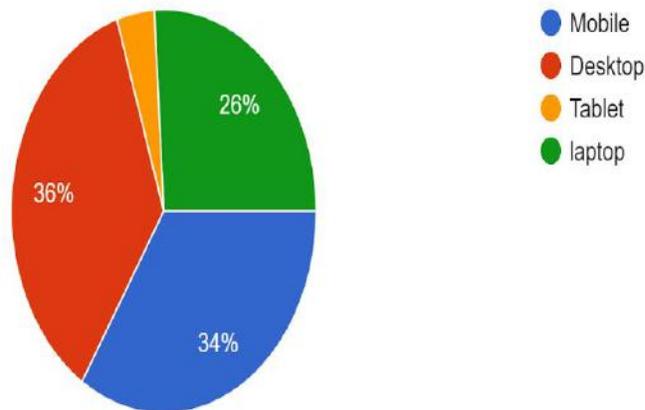


This figure shows a specific picture of the internet facility which the students use, 70% of students are using mobile data and the 30% of students are using WIFI connections. Main reason is because, the mobile data's are comparatively low in rates and affordable to all section of people. WIFI are quite expensive

Figure 4.5

With the help of which device you attend the online class?

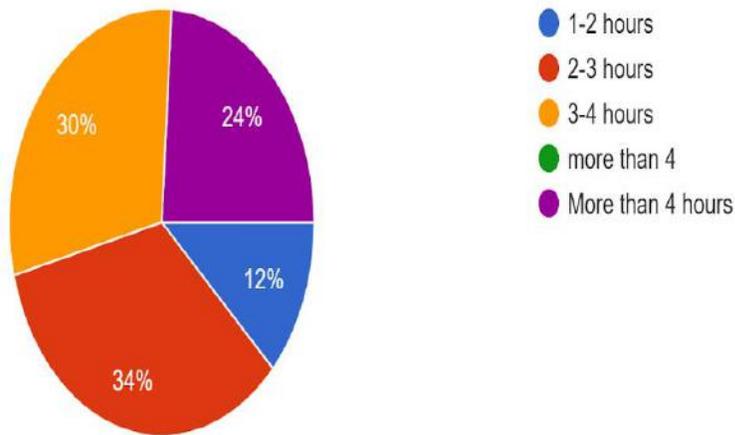
50 responses



This figure gives us a graphical representation of the responses, 36% is desktop users' and it's in the highest number and lowest is tablet. Percentage of mobile users are 34%, then the laptop percentage is 26%. Study is conducted among the school students, and it is the main reason in the increase in the number of laptops,

Figure 4.6

time spend  
50 responses

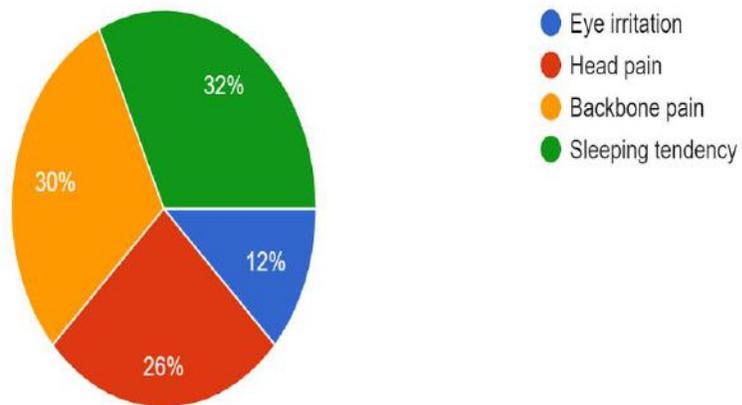


34% Highest number of students are engaged in online is 2-3 hours, next section engaged 3-4 hours , then the next section below more than 4 hours and the least group of students uses 1-2 hours and they are 24%

Figure 4.7

Do you have any health related issues?

50 responses

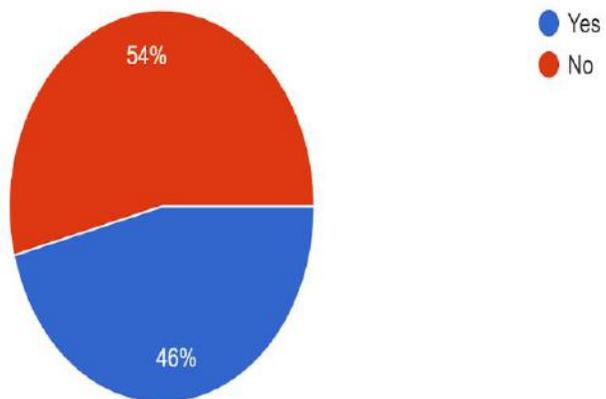


32% of student's are having sleeping tendency, 30% of students are having backbone pain. 26% of students are facing head ace problems and 12% of children are fed up with eye irritation.

Figure 4.8

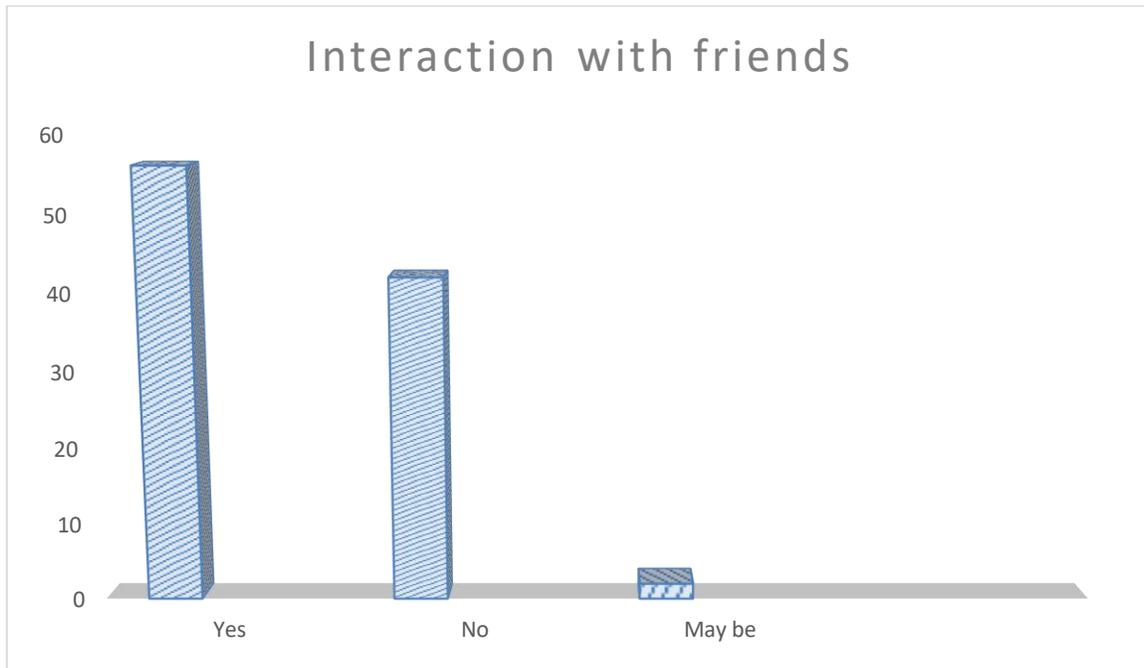
Do you have friends in online classes?

50 responses



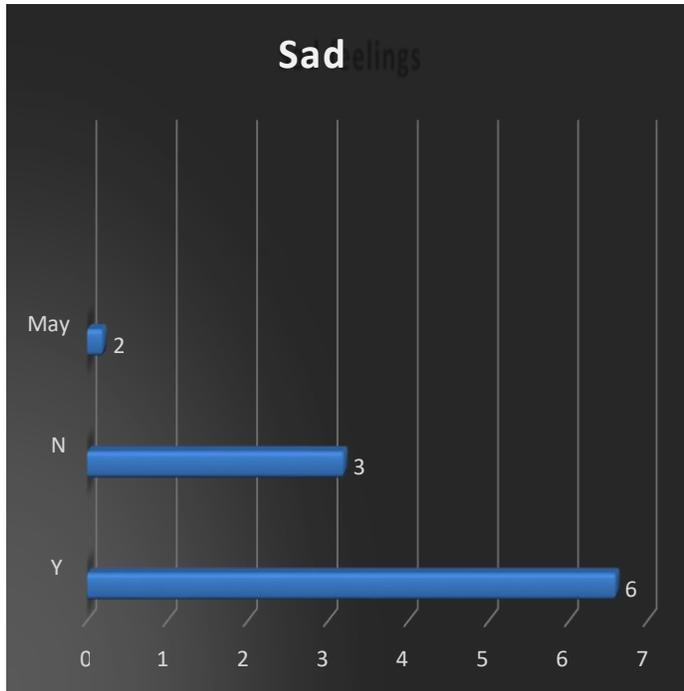
54% More than half of the percentage of students don't have friends in online classes And the remaining 46% of students have friends.

Figure 4.9



From this figure we will get an idea about students who get chances to communicate with their friends. Large group says that they don't get a chance to communicate with their friends, there are 56% and the students who say they get chances are 42%. Face to face interaction is not possible and it is the main hindrance.

Figure 4,10



Mostly a large group feel depressed it is mainly because of the covid pandemic condition, commonly students likes to play with there friends this is not possible , and this is the main issues of the students, even they cannot go outside

Figure 4, 11

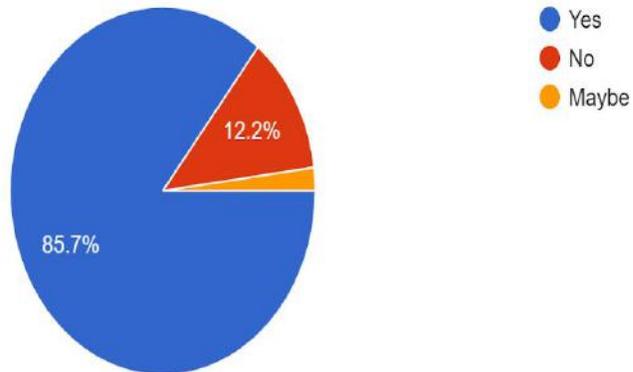


From this we can interpret that large group of students miss their playground, 60% says that they miss and 40% says that they don't miss, mostly large number of students like to play games, and that is the main problem of them.

Figure 4, 12

Do you miss your friends?

49 responses

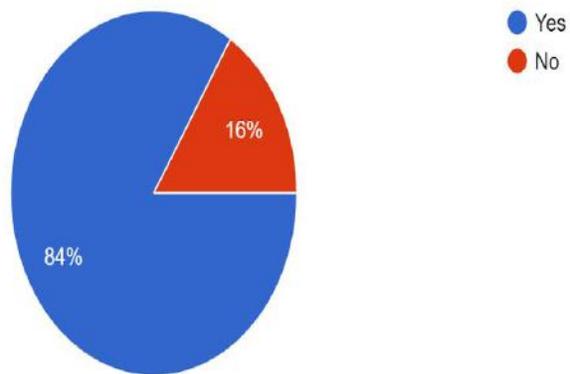


85% of students miss their friends ,its percentage is more in number, and only 12.2% says that they don't miss they friends, its shows that majority of students miss there friends More than half of the students says that they miss their friends, 85% says that they miss and the 12 % says they don't, in the schooling days peer group influences in every person's life, friends are consider as brothers or sisters, too

Figure 4.13

Do you miss your extracurricular activities?

50 responses

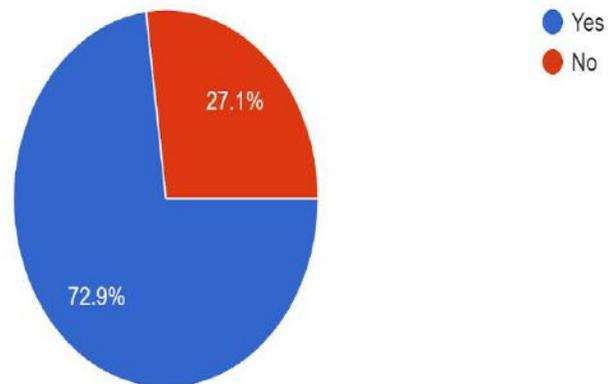


A large number of students miss their extracurricular activities, 84% responded that they miss their extracurricular activities. And only 16% of students responded that they don't miss, the reason is because most of the students are from nuclear families, so friends are the main part of their life, without friends and extracurricular activities children think environment as a blank space.

Figure 4.14

Do you miss your annual day?

48 responses

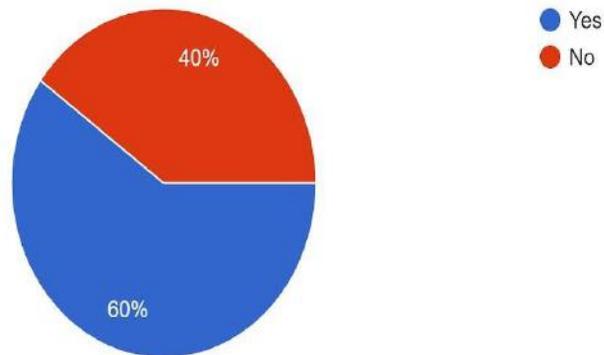


More than half of the students miss their annual day, 72% and the remaining says they don't its percentage is 27.1% during schooling days students are very much interested to participate in programs.

Figure 4.15

Do you get individual attention of the teachers?

50 responses

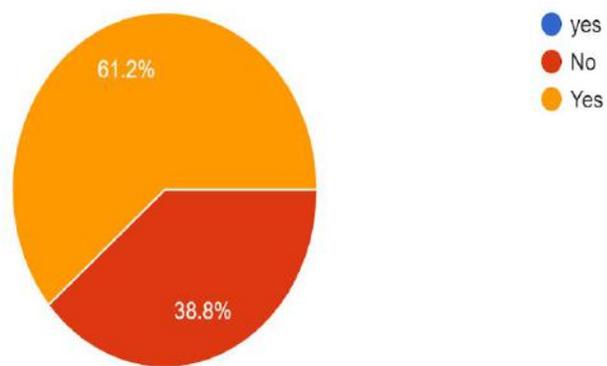


More than half of the students says that the teachers will gives individual attantion to the students,60% says that the teachers gives attension and the remaining 40% they don't get attension, mostly all the teachers ask questions, its mainly for gaining attension of children61% of students responded that the teachers are friendly, and the remaining 38% says no,In the modern educational system teachers are just like friends,we are realy free to talk to them.

Figure 4.16

Is your Teachers friendly?

49 responses

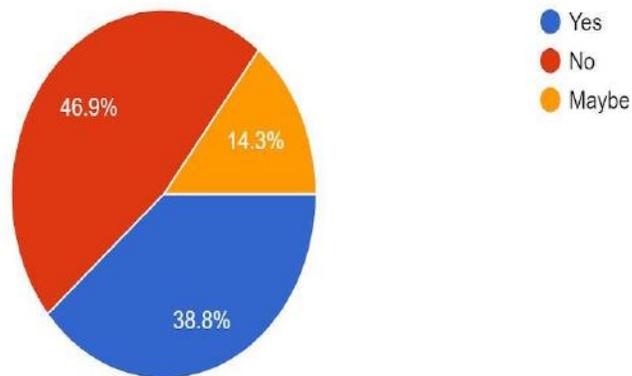


61.2 % of students says that the teachers are friendly, only 38.8% says that they are not friendly, from this figure we can understand that most teachers are friendly towards children.

Figure 4.17

Do you have good internet connectivity?

49 responses

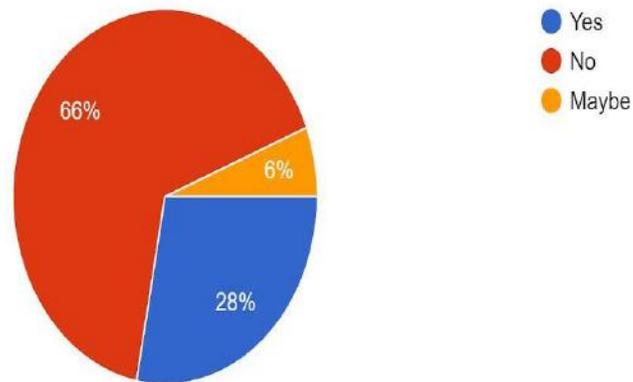


On the bases of connectivity the students responded that they are receiving poor connectivity, majority says that and 46.9% and only 38.8% only receive good connectivity, and the remaining 14.3 says may be. They can be consider in both .

Figure 4.18

On the bases of online clases, do you write regular notes?

50 responses

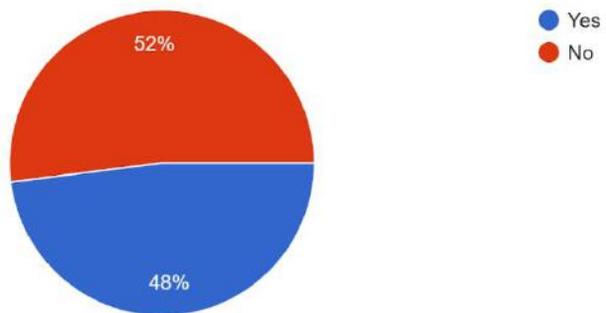


More than half of the students are not writing regular notes ,this is mainly because of the lack of supervision, in online classes free to do anything, accurate supervision cannot be done here. It is a limitation

Figure 4.19

Do you miss your school uniform?

50 responses

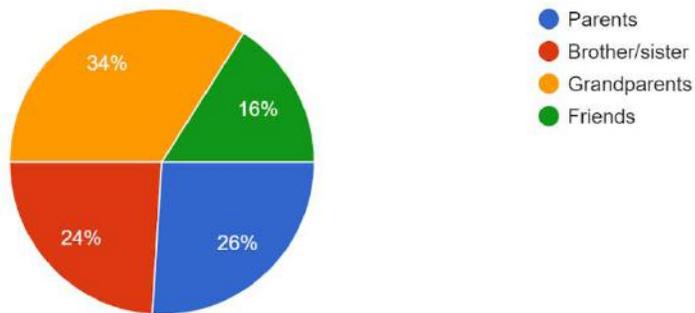


Most of the students miss their uniforms, they are 52% only when they go to school they are able to dress it, in the online section they can't go outside, the remaining 48% don't miss their uniforms.

Figure 4.20

Who motivates you to attend online classes?

50 responses



From this diagram we can see that 34% students are motivated by their grandparents, next is motivated highly from brothers and sisters, next is by their parents 26%, and friends is 16%. During Covid pandemic situation mostly people when back to their own places, and it is the reason why higher number goes to grandparents

**CHAPTER V**  
**FINDINGS, SUGGESTION AND CONCLUSION**

## Major findings

- The number of students participated in the study is highest is girls and lowest is boys, we will get a clearly picture about the participants educational status, highest number of participants are from 11<sup>th</sup> grade, next belong to 12<sup>th</sup> grade, next highest number is from 8<sup>th</sup> grade, after than we can see the 9<sup>th</sup> grade and the lowest participants are from 10<sup>th</sup>, it's because there exam was going during this period.
- Large percentage of the participants belongs to nuclear family, it is notable change happened because of the concept modernization, during olden time it was just opposite, joint family was higher in number in olden society, but now it is not like that, from this study we received only low number of joint family's, from that we gets brief ideas about the present family system existed in Kerala society,
- The internet facility which the students largely use is mobile data and the less number of students are using WIFI connections. Main reason is because, the mobile data are comparatively low in rates and it's affordable to all section of people. WIFI connections are quite expensive,
- The large group of students says that they don't have friends, and they are more in numbers and only less number of students have friends, the main reason behind this is because, in online classes students cannot interact each other, from this we will get an idea about students who get chances to communicate with their friends.
- Large group says that they don't gets a chances to communicate with their friends, Face to face interaction is not possible and it is the main hindrance in online classes. Mostly a large group are depressed and sad, it is mainly because of the covid pandemic condition, commonly students likes to play with there friends, but now this is not possible , and this is the main issues of the students too , even they cannot go outside, from this we can interpect that large group of students miss there play ground, and less students says that that don't miss, mostly large number of students like to play games , and that is the main problem of them
- A large number of students miss there extracaricular activities, the Responded says that they miss there extra caricular activities. And only less number of students reponded that they don't miss, the reason is because most of the students are from nulear families ,so

friends are the main part of their life, without friends and extracurricular activities children think the environment as a blank space

- Large group likes extracurricular activities and only less group says they don't miss, extracurricular activities are the main means of engagement during schooling days, and it is the main entertainment too, because of corona pandemic situation children can't engage, and it is the huge issues for their sadness.
- Many of students says that they miss their annual day, only less says they do not miss, its mainly because they belong to joint family, so they are entertained, during schooling days children like to dance, sing music, these all were very much encouraged during schooling days, here there are no limitation on the bases of performances, and this is why students miss their annual day.
- More than half of the students says that the teachers will gives individual attention to the students, the teacher's gives attention and the remaining says that don't get attention, mostly all the teachers ask questions, it's mainly for gaining attention of children.
- Large group students responded that the teachers are friendly, and the remaining small group says no, In the modern educational system teachers are just like friends, we are free to talk to them.
- On the bases of connectivity the students responded that they are receiving poor connectivity, majority says that large group receive good connectivity, and the remaining small group says may be.
- More than half of the students are not writing regular notes ,this is mainly because of the lack of supervision, in online classes free to do anything, accurate supervision cannot be done here and it is a limitation too,in online class.
- Most of the students miss their uniforms, they are high in number only when they goes to school they are able to dress it, in the online section they cant go outside, the pending don't miss their uniforms.
- We can see that highest number of students are motivated by their grandparents, next is motivated highly from brothers and sisters, next is by their parents, and friends. During Covid pandemic situation mostly people when back to their own places, and it is the reason why higher number goes to grandparents.

# Suggestions

1. Build a personal connection with your students - It can also help you understand students' motivation for taking your class.
2. Motivate students - Motivation is a key to effective learning,
3. Help students maintain focus - The problem of focus exists on multiple dimensions.
4. Create a sense of community - Help students get to know one another. Split a large class into smaller units. Within the smaller breakout groups, have the students participate in icebreaker activities
5. Make discussions meaningful - Whether a discussion takes place orally, within a breakout sessions, or by text, either through chat or a discussion forum, make sure that the discussion genuinely contributes to students' learning.
6. Increase student engagement - Since motivation tends to flag over time, it is necessary to sustain student enthusiasm and interest.
7. Address equity issues - The shift to remote learning has exacerbated issues relating to equity. Not all students have equal access to technology or to reliable, high speed Internet connections or to a distraction-free study space. Be mindful of the challenges students face, recognizing that students vary markedly in their comfort level with online learning and some are located in different time zones. Many worry, not without reason that their classmates are cheating.
8. Identify and support struggling students - During the current crisis, our students are struggling in many ways. Some need academic support; others, technology assistance. Many, perhaps most, need non-academic support. Many mental health needs are going unaddressed. Still others need help in balancing their responsibilities and priorities.

9. Use the chat function for students to respond to questions - Use physical whiteboards for students to show their thinking. Allow students to share their screen to showcase their work and explain how they solved a problem. Use virtual whiteboards for increased engagement.
10. Recognize that your students have different levels of technological proficiency.
11. Take Notes in Class.
12. Take care in setting up your home environment.
13. Provide different learning options
14. Create shorter content
15. Prepare Your Own Study Note.
16. Take Regular Study Breaks
17. Recall Your Learning.
18. Know where to turn for help.
19. Minimize Phone Distractions. Turn off all unnecessary phone notifications.
20. Start with the Difficult Things.

## Conclusion

Online Education has brought a positive impact and negative in the lives of students. So the online study helps the faculty to save time in which they can interact with the students. The quality of education has improved by online courses and even it has become easy for students to refer the content as per their leisure. In the era of digitalization the scope of online education increase even more and will be beneficial for students, Online learning is beneficial to the students, tutors and the institution offering these courses. I would therefore recommend that online learning be implemented on all learning institutions and research on how to improve this learning process should be carried out. Online learning is one of the new innovative study methods that. In the last few years, there has been a great shift in the training methods.

Various studies and articles documents the merits, demerits and challenges of online studies. These studies show that online study is far beneficial to the students, teachers and the institution in general and that the current challenges can be overcome through technological advancement and increasing efficiency of the learning process. One of the key advantages of online learning is the ability of students to study at their own comfort. For a long time students had to leave their comfort areas and attend lecturers. This change in environment causes lack of concentration to students. In contrast, E-learning enables the students to choose the best environment for study and this promotes their ability to understand. As a result, students enjoy the learning process as compared to the conventional classroom learning.

Another benefit is time and cost saving. Online students are able to study at home and this saves them the travel and accommodation costs. This is in contrast with the classroom environment where learners have to pay for transport and accommodation costs as well as any other costs associated with the learning process. Online study has been found to reduce the workload on the tutors. Most of the online notes and books are availed to the students and this reduces the

teacher's workload. Due to the availability of teaching materials online, tutors are not required to search for materials. Teachers usually prepare lessons and this reduces the task of training students over and over again. Accessibility to learning materials is another benefit of online learning. Students participating in online study have unlimited access to learning materials and this makes them have the ability to study effectively and efficiently. On the other hand, students in the classroom environment have to take notes as the lecture progress and these notes may not be accurate as compared to the materials uploaded on the websites. Unlimited resources are another advantage of online study. Traditionally, learning institutions were limited on the number of students that could study in the classroom environment.

However, student using the web to study at most of the time are likely to be exposed to the vast online educational resources that are available. This results to the students gaining a better understanding of the concept as opposed to those in the classroom environment Online study environment allows tutors to update their notes and other materials much faster as compared to the classroom environment. This ensures that the students receive up to date information on a given study area. Another disadvantage of online learning as compared to the classroom environment is lack of feedback from the students. In the classroom environment, students listen to the lecture and ask the tutors questions and clarifications of any issues they didn't understand. In the online environment, the response by the teacher may not be immediate and students who don't understand a given concept may find it hard to liaise with the teachers.

In culmination, a comparative study between classroom study and online study was carried out. The study was done by examining. The study revealed that, online learning has many benefits as compared to the conventional learning in the classroom environment. Though online learning has several challenges such as lack of feedback from students and lack of the proper technology to effectively conduct online learning, these limitations can be overcome by upgrading the E-Learning systems and the use of online discussion forums and new web based software's.

In conclusion, online learning is beneficial to the students, tutors and the institution offering these courses. I would therefore recommend that online learning be implemented on all learning institutions and research on how to improve this learning process should be carried out. The sudden shift to digital teaching was challenging for students, but it appears that they adapted quickly to the new situation. Although the concerns described by students in this study may only be representative for the period right after lockdown, the study provide the student perspective on a unique period of time in higher education.

Technology is becoming an even larger part of the student and faculty experience as institutions prepare for fall and the new normal. However, a big challenge of the new normal is the need to be prepared for the constantly shifting scenarios brought on by the continued pandemic. In response, institutions need to plan how their use of technology can shift alongside those scenarios. Additionally, they need to update and improve faculty training and dedicate resources to instructional design as we move forward to improve our online and hybrid learning. One other important aspect that institutions need to keep top of mind during this shift to new technologies and course delivery methods is accessibility and the inclusion of all students. If students need to access their course materials, lectures, and learning activities online, they need to have access to proper hardware and reliable networks.

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# **APPENDIX**

1. Gender

Boy,

Girl,

Prefer not to say

2. Education

8th

9th

10th

11th

12th

3. Family type

Nuclear family

Big family

Joint family

4. What type of internet facility do you use?

WIFI

Mobile data

5. with the help of which device you attend the online class?

Mobile

Laptop

Desktop

Tablet

6. How many time do you spend Online other than classes?

1-2 hours

2-3 hours

3-4 hours

More than 4

7. Do you have any health related issues?

Eye irritation

Head pain

Backbone pain

Sleeping tendency

8. Which class do you like most?

Online

Offline

9. Do you have friends in online classes?

Yes

No

10. Do you get chances to communicate with your friends?

Yes

No

11. Do you face any sad feelings?

Yes

No

Maybe

12. Do you miss your playground?

Yes

No

May be

13. Do you miss your friends?

Yes

No

Maybe

14. Do you miss your extracurricular activities?

Yes

No

15. Do you miss your annual day?

Yes

No

16. Do you get individual attention of the teachers?

Yes

No

17. Is your Teachers friendly?

Yes

No

18. Do you have good internet connectivity?

Yes

No

19. Do you miss your school uniform?

Yes

No

20. Who motivates you to attend the online classes?

Parents,

Brother/sister

Grandparents,

Friends

**A SOCIOLOGICAL STUDY ON THE PHONE ADDICTION OF  
PARENTS FROM THE PERSPECTIVE OF CHILDREN WITH  
SPECIAL REFERENCE TO KOCHI CITY**



**By**

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**MARCH 2022**



**A SOCIOLOGICAL STUDY ON THE PHONE ADDICTION OF PARENTS FROM THE  
PERSPECTIVE OF CHILDREN WITH SPECIAL REFERENCE TO KOCHI CITY**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of **Master of Arts in Sociology***

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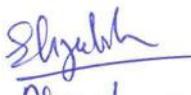
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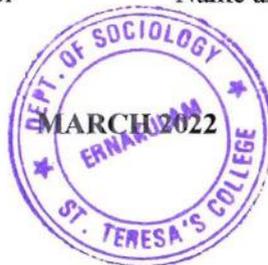
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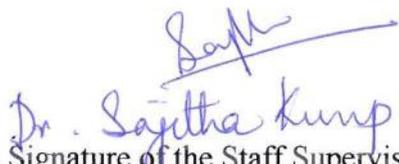
  
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## CERTIFICATE

I certify that the thesis entitled **“A SOCIOLOGICAL STUDY ON THE PHONE ADDICTION OF PARENTS FROM THE PERSPECTIVE OF CHILDREN WITH SPECIAL REFERENCE TO KOCHI CITY”** is a record of bonafide research work carried out by **ALEENA FRANCIS**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.

  
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## DECLARATION

I, **Aleena Francis**, hereby declare that the thesis entitled “**A Sociological Study on the Phone Addiction of Parents from the Perspective of Children with Special Reference to Kochi City**” is a bonafide record of independent research work carried out by me under the supervision and guidance of **Dr. Sajitha J Kurup**, I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

Ernakulam

March 2022

*Aleena Francis*   
Name and signature of the student

## ACKNOWLEDGEMENT

In this humble endeavor, I have received a great deal of support and guidance from different quarters. First and foremost, I thank God almighty, for bestowing upon me an abundance of grace, wisdom, and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt. Elizabeth Abraham, head of the department of sociology, and to all the members of teaching for their encouragement and guidance in accomplishing the work.

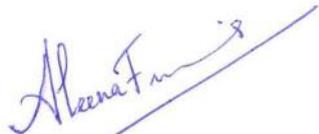
I am grateful to Dr. Sajitha J Kurup for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have been conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's College (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends, and my family for their love and support.

Ernakulam

March 2022

  
Aleena Francis

# CONTENTS

CHAPTER	PAGE
1. INTRODUCTION.....	1-13
2. REVIEW OF LITERATURE.....	14-23
3. METHODOLOGY.....	24-27
4. DATA ANALYSIS AND INTERPRETATION.....	28-59
5. FINDING AND CONCLUSION.....	60- 64
BIBLIOGRAPHY	
APPENDIX	

## LIST OF TABLES

TABLE NO:	TOPIC	PAGE NO:
4.1	TABLE SHOWING THE AGE OF RESPONDENTS FATHERS	28
4.2	TABLE SHOWING THE AGE OF RESPONDENT'S MOTHERS	29
4.3	TABLE SHOWING OCCUPATION OF FATHERS OF RESPONDENTS	33
4.4	TABLE SHOWING WHETHER THEY ARE HAVING GOOD INTERNET CONNECTION	36
4.5	TABLE SHOWING WHETHER THE RESPONDENTS THINK THEIR PARENTS WILL BE ABLE TO NOT USE THEIR PHONES FOR A WHOLE DAY.	45
4.6	TABLE SHOWING WHETHER THE PARENTS OF THE RESPONDENTS BECOME DISTURBED WHEN YOU INTERRUPT THEM WHILE USING PHONE	48
4.7	TABLE SHOWING WHETHER THE PARENTS OF THE RESPONDENTS BECOME IRRITATED IF THE MOBILE DATA OR Wi-Fi IS UNAVAILABLE	49
4.8	TABLE SHOWING THE RESPONSES OF THE PARTICIPANTS REGARDING WHETHER THEY THINK PARENTS HAVE BECOME LAZY OR IDLE BECAUSE OF TOO MUCH USAGE OF THE PHONE.	51

## LIST OF FIGURES

FIGURE NO:	TOPIC	PAGE NO:
4.1	GRAPHICAL REPRESENTATION OF AREA OF THE RESPONDENT	30
4.2	GRAPHICAL REPRESENTATION OF ANNUAL INCOME OF FAMILY	31
4.3	GRAPHICAL REPRESENTATION OF THE EDUCATIONAL LEVEL OF PARENTS OF THE RESPONDENTS	32
4.4	GRAPHICAL REPRESENTATION OF OCCUPATION OF MOTHERS OF RESPONDENTS	34
4.5	GRAPHICAL REPRESENTATION OF THE TYPE OF PHONE USED BY THE PARENTS OF RESPONDENT	35
4.6	GRAPHICAL REPRESENTATION OF THE SOURCES OF DATA	37
4.7	GRAPHICAL REPRESENTATION OF THE MONEY SPENT BY THE PARENTS OF THE RESPONDENT FOR DATA RECHARGING	38
4.8	GRAPHICAL REPRESENTATION OF MOSTLY USED APP BY YOUR PARENTS	39
4.9	GRAPHICAL REPRESENTATION OF THE HOURS SPENT ON THE MOST USED APP BY THE FATHERS OF RESPONDENTS	40

4.10	GRAPHICAL REPRESENTATION OF THE HOURS SPENT ON THE MOST USED APP BY THE MOTHERS OF RESPONDENTS	41
4.11	GRAPHICAL REPRESENTATION OF WHEN THE RESPONDENT'S PARENTS BEGIN TO USE THEIR PHONES EXCESSIVELY	42
4.12	GRAPHICAL REPRESENTATION OF HOURS SPENT BY YOUR PARENTS ON THE PHONE PER DAY	43
4.13	GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONES CONTINUOUSLY	44
4.14	GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONES IN THE EARLY MORNING.	46
4.15	GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONE IN LATE NIGHT	47
4.16	GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS GET NERVOUS/RESTLESS/UNEASY WHEN THEY ARE NOT AROUND THE PHONE.	50
4.17	GRAPHICAL REPRESENTATION OF RESPONSE OF THE PARTICIPANT ON WHETHER THEIR PARENTS OVERREACT TO WHEN YOU INTERRUPT THEM WHILE USING THE PHONE.	52

4.18	GRAPHICAL REPRESENTATION OF, FOR WHAT PURPOSE DID THE RESPONDENTS FATHER USE THE PHONE MOST.	53
4.19	GRAPHICAL REPRESENTATION OF, FOR WHAT PURPOSE DID THE RESPONDENT'S MOTHER USE THE PHONE MOST.	54
4.20	GRAPHICAL REPRESENTATION OF THE HOURS SPENT BY THE RESPONDENT'S PARENTS BY CALLING THEIR LOVED ONES IN ONE DAY.	55
4.21	GRAPHICAL REPRESENTATION OF THE REASONS THAT LEAD TO THE OVER USAGE OF PHONE IN PARENTS OF THE RESPONDENTS.	56
4.22	GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS ARE FINDING ENOUGH TIME TO SPENT WITH THE RESPONDENTS.	57
4.23	GRAPHICAL REPRESENTATION OF THE RESPONSE OF PARTICIPANTS, WHETHER THEY FEEL THAT THE OVER USAGE OF PHONE BY YOUR PARENTS HAD RESULTED IN THE WEAKENING OF PARENT-CHILD RELATIONSHIP IN THEIR FAMILY	58
4.24	GRAPHICAL REPRESENTATION OF THE PROBLEMS FACED BY THE RESPONDENTS, DUE TO THE PHONE USAGE OF PARENTS	59

# **CHAPTER – I**

## **INTRODUCTION**

# INTRODUCTION

Addiction can be in any form of substance, thing, or behavior. It doesn't only refer to the obsessive use or dependence on the substances such as heroin or cocaine. There are other addictive behaviors such as inability or difficulty quitting a job such as eating, drinking, reading, writing, working, gambling, fighting, stealing, etc.... According to the American Addiction Medicine community, they describe addiction is "chronic as well as a treatable, medical condition that involves complex interactions between the regions of the brain, genes, environment, and individual life experiences. Addicts can't control themselves. Some symptoms are anxiety, headache, lack of sleep, anger, aggression, and other physical, mental, and psychological problems.

## PHONE ADDICTION

The phone is one of the most important companions of our life. Now in the present society, the phone had become a part of an organ of the human body. We can't even imagine a second without having our phone. And even though access to smartphones is making our lives easier in different ways. The devices are designed in a very specific way that makes the people attracted towards it by their colors, sounds, vibrations, variations that they are introducing each day. Phone addiction is also known as "Nomophobia". Which occurs due to the overuse of gadgets, devices like phones, computers, etc.... These smartphone addictions can create many problems like:

- **Virtual Relationships**

Through the use of phones, we get addicted to dating apps, social networking apps, etc.... by this, people are becoming more addicted to the virtual world rather than the real-world people and relations with them. The Internet can help connect to people and even make new friends, but it's not that good to substitute it with real people or real-life interactions.

- **Information Overload**

The continued usage of phones like web surfing, watching videos and news which can lead to a decrease in productivity at work and schools and you prefer to be

alone all the time, so you will isolate yourself for hours. The over usage of the phone may cause you to neglect the social aspects of the real-life

- **Cybersex addiction**

Excessive use of internet pornography, adult messaging, and other means can affect your life negatively, and it can make many negative impacts in your life. Pornography and sex chatting are sexual addictions. The internet makes it easily accessible for everyone, which will lead to or make it more difficult to make a long relationship or it can damage an existing relationship because they are spending hours for fantasies that are impossible in real life.

- **Online compulsions**

There are many online compulsions like online gaming, stock marketing, online shopping which can cause problems in the financial field and also in life. You are using these online sites for the sake of it, not for your real need which will lead to wasting of money, things and will also affect their financial status.

A heavy smartphone can cause stress, depression, loneliness, and anxiety. At the same time, the phone can help us to eradicate these problems like we can use our smartphones as a “security Blanket” which help us to relieve the feelings of anxiety, it can be a companion when we are feeling loneliness, it can help us in different ways when we are feeling awkward in certain situations.

## **NEGATIVE EFFECTS OF PHONE ADDICTION**

The most recently developed form of addiction is Chronic phone use. According to the American Psychiatric Association, they had not yet officially accepted the condition, but it had acknowledged it as a behavioral addiction.

Phone addiction may lead to:

- Shortage in sleep
- Concentration decreases
- Barriers towards the creativity
- Apprehension
- Tensions
- Isolation

- Lack of confidence
- Weaken parent-child relationship
- Weak Academic performance
- Decrease in the deep thinking and Actions, exercise
- Psychological disorders
- Crimes
- Aggravated attention deficit disorders

This may also cause or lead to physical dysfunctions, like GABA dysfunction and loss of grey matter is other disorders.

## GABA DYSFUNCTION

Overuse of the phone leads to chemically changing the reward circuits in the brain. GABA is an inhibitory neurotransmitter that produces a calming or joyful effect. Even it helps in controlling our fear and anxieties. Many research shows that the overuse of phones may result in an increase or decrease in GABA production. And also, the heavy use of the phones will result in the upsetting ratio of GABA to other neurotransmitters.

## DECREASE IN THE GREY MATTER

Grey matter is one of the important parts of the central nervous system which helps in the movement of the individuals and controlling those movements, memory, and even emotions. According to the study and the research, there was a huge change in the brain's grey matter in those who were addicted to the phone. For those who are addicted to phones, it shows like the grey matter had been decreased in important areas, which is a resemblance of the drug users.

## SIGNS AND SYMPTOMS OF PHONE ADDICTION

There is a limit or a line between the health full life and the mobile phone use. Over usage of the phone may lead to mobile addiction. There are some ways to understand if an individual is battling a phone addiction. They are:

- People lie about their smartphone usage on their phones.
- Their significant ones or loved ones were expressing the concern about their usage of phone
- Hiding the phone usage
- Very poor social life
- Phantom vibrations (People may feel that the phone is ringing when it doesn't.
- People wait till the last minute for completing the tasks.
- People who are slowly isolating from others
- People who get irritated or angry when the phone usage is interrupted or cannot be reached.
- People who get panic when the phone is left at home or even the battery dies.
- They take the phones when they are bored or left alone.
- There will be a lack of connection
- Limiting the usage of phones is difficult
- Spending most of the time on the phone
- Even after sleeping, getting up at night to check the phone.
- Isolation from our loved ones.
- Accidents occurs due to the over usage of phone
- Neglecting our duties and responsibilities at school, work, even at home for chatting, playing games, watching videos, scrolling, surfing, texting, chatting.
- Longingness for access to your smartphone or another device.

## PHONE ADDICTION TREATMENT

Phone addiction is still prevalent in our society. There are many ways to prevent and treat this disorder. Even there are many specialized deaddiction centers. In these detox centers, there are many varieties of treatments or programs which will help people to overcome the digital addiction

- Group therapy
- Group support
- Psychotherapy
- Medical-assisted treatment
- Cognitive-behavioral therapy

- Marriage or couples counseling
- Motivational interviewing

Smartphones are very a useful tool as well as a dangerous tool, for everyone. Many issues arise from the over usage of the phone, but all those problems which arise due to excessive phone usage are not completely understood.

We all know that the children use or spend most of their time on the gadgets, not only the child even the parents are found engaged on the phones for the longer time than the child. Addiction can be various types, which can be the individual's urge to check the phone most often, or their urge to check the messages, callings, and scrolling through the internet or the social media or playing online games.

### IMPACT ON CHILDREN OF PARENTS PHONE ADDICTION

- **Chance for the children to develop a negative attitude**  
Studies show that children develop negative attitudes. And also, they are found with low tolerance towards disturbing situations and lack interest in going outside and exploring. The over usage of phones among the parents may adversely affect the parent-child relationship.
- **Children may feel that they are unimportant in the family**  
When the parents are busier and you are more interested to use their phones when the children need them this will create an impact on the children that they will think are unimportant in the family. The feeling of belongingness is diminishing among the members of the family due to the feeling of unimportant.
- **Impact on Children's Emotional Development**  
When the parents use the gadgets many times and when they are not given the proper care that the children are needed of then the children will feel sad and angry. The children wouldn't get the attention that they are needed. The willingness of the children to share things with their parents is also affected due to this will lead to an end to the positive emotional development. The most important positive feelings are happiness, excitement, appreciation, love, care was not available to the children, so it will hurt their social behavior and it will affect their socialization process.

## SMARTPHONE ADDICTION AFFECTS HEALTHY PARENTING

Parents are found to be more engaged with smartphones, even at the dining tables. According to a study, a researcher says that the first thing that a parent does will look on the phone when they are gone out for a family dinner or lunch. They will be taking pictures and updating the photos on social media and posting in the media. Whenever the child tries to talk to you, parents will get interrupted and become angry. The child may not be listening to you but they will closely and carefully observe things that the parents do. So, it will negatively affect the children.

## HOW PARENTS CAN GET RID OF SMARTPHONE ADDICTION

- Only check phones for a valid reason  
Every time that you take the phone you should ask yourself some questions, what is the purpose of taking the phone now, whether it is important? You have to question yourself about your usage of your phone. Which will help you to reduce your engagement with smartphones.
- Limit the usage of the phone.  
You have to limit the usage of the phones, mainly when you are with your children. You have to schedule the timing of the usage of the phone. You have to find out the time to spend with your child. You may not be able to adjust on the first day itself after some time you will be able to cope with the situation and it will help you in better parenting.
- Ask someone to track your activities for better controlling  
Rely on someone who can help in keeping track of what you are doing. So, you have to find out someone who will be very supportive of you and can help you to overcome this addiction, it can be anyone your partner, colleagues, friends, etc.....
- Celebrate when you achieve the goal  
You can mark the days which you had strictly followed the schedule. After the successful completion of it, we can celebrate, share it with our significant others. We can share it with children, through it you can able to explain how you have managed to do it. This can inspire them a lot. When are you with your child you should put all the toxic devices, through it you can have quality time with your

family? And both the parent and children get very special moments that you spend together to remember.

Marshal McLuhan extended the idea proposed by Harold Innis and stated that

- “The Medium is the message, that is, characteristic of all media; the ‘content’ of any medium is always another medium. The content of writing is speech, just as the written word is the content of print, and print is the content of the telegraph (McLuhan, 1964).
- Hot and cool media: There is a basic principle that distinguishes a hot medium like radio from a cool one like the telephone, or, a hot medium like the movie from a cool one like TV. A hot medium extends one single sense in ‘High definition.’ High definition is the state of being well filled with data. On the other hand, hot media does not leave so much to be filled in or completed by the audience. Hot media are, therefore, low in participation, and cool media are high in participation or completion by the audience” (McLuhan, Understanding Media).

A careful study of the above statements leads us to the conclusion that the cell phone is the hottest medium activity that covers all the media available to humans right now. And it is the coolest as it offers more opportunities for the user to fill out details and at the same time interact with other users. Young people from the community often use this device.

## DEVELOPMENT OF THE PHONE

In the primitive or ancient society, the people were made use of many things such as the smoke signal, carrier pigeons, jungle drums, and semaphores to send and receive messages from one place to another. While in the present society, it's very clear that the importance of communication is increasing day by day, Communication is the most important factor for transmitting the messages from one person to another from any corner of the earth. In the earlier stage, Alexander Graham Bell had realized the importance of communication and he invented the Telephone in 1876 as part of this realization. This invention on communication has made a huge change or revolutionized the daily lives of the common individuals to

a large extent. A telephone is any device that can convey or send sound over any distance. The telephone is a combination of two words, The Greek word 'Tele' means 'afar' and 'phone' means 'voice'. And then the telephone had evolved in many forms, had occurred many changes had happened in it.

The telephone has faced many changes and evolved into many forms like, from the tin can telephones to the payphones which can be operated by the coin, then it changed into pagers and bulky mobile phones. And in modern societies, cellular phones had become widespread in the society. First, it was in a wired form and then it changed into a wireless form. The basic concept of cellular phones started in 1947. Now mobile phones have become the most common way to communicate with other people. Now there are many different types, brands of Smartphones are available in the market, which is more likely to represent the status symbol and more like a fashion statement. These Smartphones had created an unspoken dependency. In the present scenario, all individuals are more likely to engage in SMS, messaging, making phone calls, accessing the internet from the phone, playing games on phone, attending classes on phones, even doing work from using the phones, and even doing our transaction, banking, shopping, etc... using the phones.

## ROLE OF SMARTPHONES IN THE PRESENT SOCIETY

Now during this pandemic situation, we are seeing a tendency of increased use of phones among people irrespective of their age, from child to aged people. They were using phones for different purposes for shopping, reading, gaining information, writing, playing, booking appointments for doctors, even the consulting process is conducted through it, everything thing is done through the phone, it had become like a part or organ of our body itself. People in modern society cannot live detached from the phone, they were having a very close attachment to their phone.

According to De Santis, Poole, and Orlicowski (2011) technology is not rendered as an artifact but instead examines how people as they interact with technology in their outgoing practices which shape their emergent and positioned the use of that

technology. On the other hand, cellular phones depend upon an individual, on how he will use them, whether it surrender oneself from other influence or use it as a purpose of communicating and personal satisfaction. Moreover, Bandura (1973) claims that human behavior is learned observationally from others, one forms an idea of how new behavior is performed, and later occasions this coded information serves as a guide for action, changes in technological development among cellular phones is very alarming, especially to adolescence.

From the 21<sup>st</sup> century onwards, digital technologies were becoming a very important factor in our daily life, which have a very important role in our daily practices and habits. In the present society, there are many digital technologies which are defining our present-day reality, the way through which we look upon society have been changed. Now, each person has their technological equipment. Within a very few decades of inception mobile phone, technology has become a universal artifact. The mobile phone is such a technology which is used by a high or larger amount of people. There is no other technology that has been widely accepted or adopted by the entire population of the world. In the present world the old ideas and assumptions about the development, planning, and management of the modern, industrial city seem less important and less useful. And also, the accepted notions about the nature of time, space, distance, and urban life are similar under question.

Giddens had written that “We live today- in a world which intensely worrying, yet full of extraordinary promise for the future. It is a world of awash with change, marked by deep conflicts, tension, and social divisions, as well as by the destructive onslaught of modern technology on the natural environment”. (Giddens, Sociology, 2006, pg. no. 4). In the present society, the use of the internet was widespread due to the advancements in technology, through mobile phones, smartphone production had increased very much. We can almost perform all operations with smartphones that provide access to the internet. The usage of phones and the time spent with mobile phones is increasing, which in turn have positive and negative sides or aspects to it. The excessive use of mobile phones is resulting in creating an addiction. The ability to access the internet with mobile phones, smartphones at any time, use of social media applications, mobile games, online shopping,

banking, transactions, entertainment, online streaming had increased the use of the internet and mobile addiction.

With the emergence of advancements in the technologies operated on the internet, people became users of the social networks and became more content producers through the accounts that they had created. Due to these technological advancements, it has become inevitable for all people, irrespective of their age, they spend excessive time on the phone, social media, and also fulfilling their social, economic, educational, professional duties and responsibilities. And also, they were experiencing many kinds of psychological, physical, and social problems.

Even during this Covid 19 time, with the use of this rapid progress in the technology, we were able to meet the educational needs, professional needs anything was possible. In recent years it had become very important and widespread and people began to use it continuously in every field like education, vocational, training, professional, medical, economic, political, etc..... The family is the place where the informal education of an individual starts, so it's the duty or the responsibility of the family to develop a positive attitude towards the classes and technology. The children's attitude towards the technology and the beneficial uses of it is depended upon the positive attitude and behaviors of the children's parents. If the parents create the necessary awareness among the children, it will be easy for a child to gather or collect the benefit from the technology correctly. The main thing that the parents should take care of is that they should not use the phones and social media excessively, should use only to the extent that they need, and should not be addicted to it.

Mobile phones have a very strong influence on our day-to-day life and also in social relationships. Mobile phones have made our life more easy, convenient and the continuous and frequent usage of mobile phones can lead to mobile phone addiction. Phone addiction has many negative consequences, including sleeping problems, health issues, anxiety, disorder, and even poor performance in schools, the place you were working. "Phubbing" this term refers to the kind of social exclusion and interpersonal neglect, which is the combination of the two words "Phones" and "Snubbing", Phubbing refers to the interruptions among the social

relations due to or caused by the usage of mobile phones. In a family, the scholars focus on the ‘partner phubbing’, which doesn’t only make negative impacts on the quality of the conversation and the intimacy it also affects the mental health of the partners. And there is also the influence of phubbing on the parent-child relationships, they say that the parents play an important role in the development of the adolescents. According to the recent study, it shows that during the conversation between the children, when the parents tend to use mobile phones which will negatively affect the conversation and also adversely affect the interactions with children, the quality of the interactions will be decreased.

Many studies focus on the use of mobile phones among children. Smart addiction can be classified as technological addiction, which can be said as a subpart of behavior addictions which includes the human-computer interactions with software that might lead or promote the addictive tendencies (Griffiths, 1996). The most important symptom of Mobile phone addiction is listed as “impaired control”. Phone addiction has many features like functional impairment, Withdrawal (which is measured by psychological symptoms such as irritability, uneasiness, restlessness which occurs due to the unavailability of smartphones.), tolerance (it’s defined as the increase in the times of engaging in the smartphone) and even the symptoms of the compulsive disorder. At first, the studies were focusing on the psychopathologies such as depression, anxiety, unintentional injuries like accidents, falls, pedestrian collisions, sleeplessness, decrease in physical activities, or their, problematic behavior, decrease in emotional intelligence, negative habits and lifestyles, and poor achievement in the academic field.

## PARENTAL MEDIATION ON THE CHILDREN’S USAGE OF PHONE

Parents play the most important role in the influence in the use of smartphones by the child. Parental mediation is the management of the relationship between the children and the media by the parents. According to a European Union study, there are 4 types of parental mediation on the children’s usage of the internet and mobile devices. They are:

- Active Mediation of the Internet use - Parents have to make the children aware of the internet content through the talking process.
- Active Mediation of the Internet safety – Parents should promote the safer means to use the internet and they should be responsible and make the children aware of the uses of the internet.
- Restrictive Mediation – Parents should set the rules which should regulate and limit and regulate the usage of the internet among the children and which will also help to regulate the time that the children are spending online.
- Monitoring or Technical Mediation – Parents can use different means of software and technical tools for the filtering and also can install different apps or software's for controlling the activities of the children through these parents can restrict and also can monitor the activities of the children's online activities

## **SIGNIFICANCE OF THE STUDY**

Phone addiction is a common condition that we can see in the present world. Many studies focus on the phone addiction of the students, children, youth, and adolescents. Phone addiction is not a condition that affects only these people. Phone addiction is a condition that affects people in all sects. This study is providing information about the phone addiction of parents from the perspective of the children with special reference to Ernakulam district. And this study also tries to understand the socio-economic background of the parents. It also helps to find out whether there is phone addiction among the parents or not and also helps to know about the challenges and issues faced by the parents and the children due to the phone addiction of parents. Since the data is collected from direct sources, it can provide a more reliable and realistic view without any prejudices. And also, from this study, we can understand what are the different causes for phone addiction among parents.

**CHAPTER – II**

**REVIEW OF LITERATURE**

## REVIEW OF LITERATURE

Phone addiction is also known as “Nomophobia”. Which occurs due to the overuse of gadgets, devices like phones, computers, etc.... These smartphone addictions can create many problems. Heavy smartphone usage can cause stress, depression, loneliness, and anxiety. At the same time, the phone can help us to eradicate these problems like we can use our smartphones as a “security Blanket” which help us to relieve the feelings of anxiety, it can be a companion when we are feeling loneliness, it can help us in different ways when we are feeling awkward in certain situations. In the present world, the phone had become an inevitable thing. It had become like an organ of our body; we can’t even live without it. While it started, no one ever imagined that it would cause worry. But as technology advances and now everyone has access to phones irrespective of any differences. Phone addiction has caused many social, physical, mental issues. The advancements in information technology have a major role in phone addiction. There is many research, studies, articles, that are conducted on phone addiction.

Bandura (1971) in his work “social learning theory” in *The War System: An interdisciplinary Approach* says that the social learning theory reflects that observational learning is a great way for kids and teens to learn. This theory states that children's behavior is informed by looking at the thing’s parents do. Phubbing is an unhealthy behavior that can hurt people’s social life (David & Roberts, 2017). In the current study, we described parental deception as undesirable for cell phones when communicating with children and adolescents. While there is no direct evidence to support the belief that parental phubbing increases teen cell addiction, it is a logical argument while considering the following three points. First, studies based on social learning theory and informal social control theory (Bandura, 1971; Mason & Windel, 2002) found that parents who report themselves using cell phones are positively correlated with teens’ online addiction (Cho & Lee, 2017). Second, the marginalized family's environment created by a difficult parent or poor parent-child relationship makes it worsen the teen’s usage of the internet online (Boniel-Nissim & Sasson, 2018; Wang & Qi, 2017). Third, people feel excluded from society, and as a result use social media to compensate for related needs (David & Roberts, 2017).

Mason and Windel (2002), had stated that the informal social control theory shows that the family is the most important factor in controlling deviant behavior of children and teens and that a poor family environment will exacerbate youth misconduct. Informal social control theory shows that the parents are the center of social control in adolescent socialization, and unprotected parent-child relationships promote deviant behavior among adolescents. The informal social control theory shows the relationship between peers is an informal control source that is related to perverted or deviant behavior. Teens with active friends who are engaged in disrespectful conduct or delinquent behaviors there is an increased risk of developing deviant or anti-social behavior.

Skopp, McDonald, Jouriles, & Rosenfield (2007), In their article “partner aggression and children’s externalizing problems: Maternal and partner warmth as protective factors” in the journal “Journal of Family Psychology” Skopp and colleagues found that, in a marital relationship, husband and wife's anger has exacerbated the problems of children who go out of their way, especially in the families there is very low maternal warmth.

Marie Brannon (2009) criticized that compulsive cell phone users left others confused, trapped, disrespected, and angry. These users often feed their egos at the expense of others.

Banjo, Yifeng Hu, and Sundar (2008) conducted research and developed a method for detecting cell phone use in public places. There are potential negative consequences in dealing with others around you. It causes isolation and confusion and closeness to others. The mere presence of a cell phone in public clashes with the privacy and confidentiality of the public and prevents contact with close people (strangers or acquaintances). Users can distract themselves from public activities, as they ignore the environment, their surroundings. They neglect help to get closer to others (even at the time of emergencies). Accessibility and use of the cell phone create a form of confinement and isolation that prevents reckless behavior

SteeGAR& Rosenfield (2013) they had attempted to describe the longitudinal study they had conducted through which they had found that the sixth graders who had more conflict with mothers and teens than their peers later reported higher anger or aggressiveness in seventh grade.

Cho & Lee (2017) had pointed out that parents who reported themselves using cell phones were positively related to teen online addiction.

Vaidyanathan and Latu (2007) After reviewing the literature and research work, the authors argued that it was in line with peer pressure, family upbringing, and ultimately habits, attitudes, and strengths rather than technology alone. These are communication services they are ubiquitous and even though they cause society to unite and divide, the ultimate goal is to link and coordinate the activities of everyone, regardless of age. Cell phones eliminate the need for the middle person. Everyone has the right to live in a healthy family environment. The authors claim that if technology is not embraced properly the digital natives or people will turn either “Digital Addictive” or “Digital Refugees” which results in an imbalance in society.

Stewart (2008) pointed out that over the years, communication between parents and their children may become impersonal. Teens often text their parents instead of talking. They are at risk for getting into accidents (walking into the dark, running on unstoppable traffic, etc.), and, in turn, are prone to cyberbullying and sexual harassment of the opposite sex. They view cell phones as a means of communication that will give them greater space and more secure security.

Ravichandran (2009) focuses on the positive or negative effects of consumption of mobile usage. A cell phone is a safety device that can be used in the event of an emergency. However, young people are addicted to texting and are distracted in their studies. Bullying and harassing messages are another form of cell phone threat. The most important suggestion found in this study is that adolescents lose control of cell phone access. The negative impact outweighs the positive effects. The use of cell phones by teenagers is opposed by all parents, as teenagers are immature.

Prezza, Pacilli, and Dinell (2004) conducted research in Italy and found no gender differences. But weaker social and economic relations were found. They wish the cell phone to avoid negative labeling which is related to non-possession. Loneliness was not related to the use of cell phones.

Chigona, Chigona, Ngqokelela, and Mpofu (2009) examined and have found the perception patterns of both parents and teens. Both, the parents and children have developed attachment and dependency on cell phones. They experience cognitive dissonance, which changes as a result of capturing two incompatible perceptions. Self-justification is used to overcome the disease. It has become a tradition as well as instrumental

Walsh, White, Cox, and Young (2010) have shown that age and self-esteem significantly predict the frequency of cell phone use. In contrast, age (younger), gender (female), self-identity, and the norms in the group predicted cell phone involvement in adolescents.

Campbell (2005) studied the effect of mobile phones on young people's social lives (such as peer relationships, family relationships, and school environment). Teens constructively use cell phones to organize and maintain social networking sites. Other negative effects of cell phones can also be seen in peer relationships, such as stigma and cyberbullying. Likewise, the use of a mobile phone has led to a shift or created a change in the activities of the family. Issues of safety and surveillance from the perspective of parents lead to discussions about the changes in the freedom of young people. While functional coordination in the family can be beneficial, but also other problems can arise, including financial hardship, noncustodial parents' access, and over-reliance on cell phones for safety issues and disrupting young people's lives. Studying the lessons of interruptions or disruptions, cheating incidents, bullying, etc... these all are the negative effects of using a cell phone at school while texting to parents of logged-in students or those students present in the school, seems to be the best. And he also checked that the cell phone had turned into a technological tool from the social tool. The cell phone has become a status symbol for young people and is considered a fashion accessory. Research shows that they prefer it over television and the Internet. It is considered a sign of independence even in his own family. It has practical, social, functional, relational, and negative consequences such as discrimination and family bullying. It also has an impact on improving and evolving family relationships.

Campbell and Rachel (2006) have suggested that in the case of a teenage girl, the cell phone is an all-encompassing feature, namely independence, security, and

femininity. It works as a 'technology of the self'. Teenagers go against norms by practically spacing their behavior to actions and identities of society and what they internally desire.

Leung (2007) researched these objectives

(1) Identify symptoms of addiction that are specifically related to cell phone use within

youth in Hong Kong;

(2) to evaluate the way how demographics and psychological characteristics (such as sensation seeking, boredom, and self-esteem) of individuals are associated with symptoms of addiction;

(3) to examine how these are features, cell phone addiction symptoms, and public finances can predict the misuse of a cell phone.

The study was conducted in Hong Kong in China, between 402 young people and young adults aged 14-20. The four symptoms of addiction are identified using exploratory factor analysis. These were: „loss of control and acceptance of complaints, ‘anxiety and longing,’ ‘withdrawal/skipping,’ and ‘loss of productivity. ‘And the research had found that those participants who have scored higher on boredom and sensation-seeking likely to have higher addiction. In contrast, participants with high scores on self-esteem showed such a slight tendency. Again, respondents received lower scores on self-esteem but wanted to feel superior, showing more misuse of mobile phones.

Chawla (2012) conducted a study to assess the relationship between the family environment and academic achievement among 200 randomly selected students (100 boys and 100 girls) of the 9th Marathi schools in Nasik city. Drs. Harpreet Bhatia and Dr. N.K. Chadha (1993) put forward the Family Environment scale and second semester (year) students of 9th standard were used to measure family environment and academic achievement also. Data were analyzed using the Pearson correlation coefficient and found that the family environment score was positively associated with the academic success of the students.

Shambare, Rugimbana, and Zhoua (2012) conducted a study on an important research question, what are the behaviors associated with cell phone use? Thus, a questionnaire of 33 items was prepared to measure addictive and habitual behavior and was provided to the students. Researchers have found that the use of cell phones is not habit-forming and relatively addictive. The result also suggests that the cell phone may be a major non-drug addict of the 21st century.

Thomee, Harenstam, and Hagberg (2011) highlighted high cell phone usage was associated with sleep disorders and male depression symptoms and 1-year follow-up symptoms in women. It was advised to limit cell phone usage and accessibility as it causes mental health consequences. The study was conducted on the mental health effects of adults aged 20-24. The study was conducted on adults aged 20-24.

Den Bulck (2007) has identified the most important effects of cell phone use even after turning off the lights. Excessive use of cell phones leads to increased levels of fatigue and tiredness. There is no safe rate and no safe time to use the phone to send messages or make phone calls after the lights are off. Current research suggests that there are many other threats to teen sleep in the bedroom. Cell phones are very attractive to use even after the lights are turned off, they may be too much.

Cotten (2008) argued that cell phone use was widespread and high among US and Canadian students. Social welfare and wellbeing are marked by their heavy usage. Several impacts have been uncertainty, mitigation, security, efficiency, access to information, communication, social media, and public control. Researchers have noted that “the use of cell phones may be a lifesaver to facilitate the preservation of social relationships and to reduce the insecurity of the physical environment.

Hoong (2003) confirmed that cell phones emit radiation that raises skin temperature and the heating of tissue in the ear or head. Therefore, excessive use of cell phones is dangerous to health. It is thought to be harmful to the baby's brain and cause cancer, too.

Lane and Manner (2010) presented a study and found that extroverts use smartphones and are more involved in texting. Extraverts are outgoing and friendly and have a strong desire to connect with others. Texting is a great tool that can satisfy this need. However, more compatible people prefer to call than to send text

messages. The value of a smartphone decreases with age. Women are less likely to have their smartphones when compared to men.

Long (2010) studied the effect of cell phones on the Fire Station Department. It has shown that a modern cell phone now improves productivity at work and allows the family to stay connected. However, literature shows that cell phones lead to stressful and angry times. Employees and managers are frustrated, annoyed, distracted, inefficient, misuse technology which leads to litigation and chaos. Members of the Chesapeake Fire Department photographed and uploaded them to Facebook and this violating the organization's fire safety policies and breach of privacy could lead to significant penalties. Cell phones often disrupt training, meetings, and face-to-face conversations, which many consider being careless and unreasonable. Unfortunately, this practice goes in the wrong direction, and it can be believed that misconduct on mobile phones could adversely affect the reputation of organizations. Mobile is used for both emergency and non-emergency responses. Although the commonwealth of Virginia restricts the use of mobile phones; public safety facilities have been granted an exemption. The practice still exposes the Chesapeake Fire Department to liability and "(CFD) may be officially charged with a head-on collision caused by disturbed employees talking on cell phones while driving". Cell phones caused disruptions and injuries at work

Zeewaqr (2009) discovers that mobile phone companies are launching attractive packages and destroying our youth. They are deviating from training, professionalism, and commitment to education, changing the culture of the stagnant mind. Most importantly, art, creativity, and innovation are hindered by regular cell phone chat. Young people do not care about human relationships and are interested in segregation and alienation. They become mentally weak and the strained family ties gradually weaken the betrayed parents and lead to a dramatic decline in moral values. They cross borders and boundaries, which are important in a well-organized society

Stuckey (2004) identifies 5 components like imagination, appropriation, objectification, incorporation, and conversion as the causes of cell phone addiction. He explained that cell phones have an unprecedented ability to influence our interactions with people and with our daily life. They are very active in our social

environment. This technology can cause a person to have a unique personality that separates him from society or to change a single language or group of habits.

Kathleen et.al. (2008) studied technology spending patterns of mobile cell phones and poverty level change among households in Uganda. The results showed gender inequality with improved asset control and a lack of knowledge about cell phones furthering digital diversity. However, the increase in small business development is encouraging mobile phone ownership for women

Onwumele (2011) conducted a study to assess the effect of cell phones on rural livelihoods assets in Ovia, in the northeastern part of local government, in rural Nigeria with a questionnaire. Results show that cell phone use has a profound effect on the social and human capital livelihood assets in rural areas.

Furuholt and Matotay (2011) investigate the use of mobile phones among rural farmers in Tanzania to provide informative information about the role of technology development. The results showed improved access to telecommunications and information on mobile phones affected the entire agricultural life revolving around time and caused major changes in livelihoods, increased opportunities, and reduced risks.

Kuldeep and Meenakshi (2012) conducted interviews to assess users and cell phone usage patterns in the Haryana area. More than 70% of active mobile phone users of the age group (15-45), 97% were educated 79% have a school level (primary to twelve). Mobile phone users were 42% of rural elite, 26% middle class, and 22% lower. More than 80% of users have purchased cell phones to connect with family and friends. Purchasing decisions (over 75%) on mobile phones are made by the head of the household, especially fathers or grandparents, with only 16% of users using customer care services.

Adnan Yousef Atoum, "Internet Addiction and its Relation to Psychosocial Adaptation among Jordanian High Basic Stage Students" in this paper he tries to identify the categories of internet needs among high school students (grades 8, 9, and 10) in Jordan. They also found the effect of psychological problems and other variables related to internet use dependent on internet addiction. They also found that the internet is attractive, so many users face problems with psychological

addiction. It was one of the factors associated with isolation, anxiety, depression, difficulty concentrating, and social problems in general. The study also suggests that many studies have suggested that depression, anxiety, overwork, social anxiety, self-esteem, and motivation are the most predictive variables for internet addiction.

Ahmet A et.al (2011) “Internet Addiction and Depression, Anxiety and Stress” in this paper he represents the relationship between online addiction and depression, anxiety and depression. They found that there was a significant relationship between these variables. They also found that there was a positive correlation between Internet addiction and these three factors. They also suggested that Internet addiction had given a direct impact on these factors.

Aaron Smith (2011) conducted a national telephone survey of 2,277 adults during April 26-May 22, 2011 in the United States of America. 1,522 interviews were conducted through landlines, and 755 interviews were conducted over the mobile phone. Pew Research Center, Washington, DC published a report based on the survey above. The report confirmed that ‘Cell phones can help prevent unwanted personal interactions– 13% of mobile phone owners pretend to use their phones to avoid contact with the people around them (Smith, 2011). He goes on to add that ‘Cell phones help retrieve information quickly (so that their absence can cause problems) - Half of all adult cell phone owners (51%) used their phone at least once to get the information they needed immediately. One-third (27%) said they encountered a situation where they had trouble doing something because their phones were not in hand.

David & Robert’s (2017) found that the parents who be phubbed will experience a sense of social exclusion, and the adolescents will feel neglected when they are phubbed by parents. And Parental neglect is a dangerous factor that affects the bond between parent and child. McDaniel had summarized that Parental telephone disruption is a serious precursor to behavioral problems for children and adolescents.

Boreli & Decio, (2015) they had reported that those children who face parental neglect have a high insecure attachment. Based on this evidence, I have concluded that parental deception or being phubbed by parents is harmful to both parent and

child. And I thought that parental negligence due to over usage of the phones would increase the risk of teen cell phone addiction due to the insecure attachment between the parent and child.

**CHAPTER -III**  
**METHODOLOGY**

## **METHODOLOGY**

“Research Methodology is the specific procedures or techniques used to identify, select, process, and analyze information about a topic. In a research paper, the methodology section allows the reader to critically evaluate a study’s overall validity and reliability. The methodology section answers two main questions: How was the data collected or generated? How was it analyzed?”. This chapter explains the methodology that has been followed in this study and this chapter contributes to the discussed topic to be upgraded and updated. This chapter contains information regarding the statement of the problem, general and specific objectives, concepts and their theoretical and operational definition, Independent and dependent variables, the universe, sampling method, sample size, research design, tools for data collection.

### **STATEMENT OF THE PROBLEM:**

Phone addiction is considered as the obsessive use of phones. In the present scenario, Phone addiction is becoming increasing and also very common. But most of the research are focusing on phone addiction among children and youth. Also, the parents are getting addicted to phones. So, in this study, I’m trying to find out the extent of addiction among the parents, to study the reasons regarding their addiction, and also trying to analyze the challenges and issues related to it.

### **GENERAL OBJECTIVES**

- To study the phone addiction of parents from the perspective of children with special reference to the Kochi City.

## SPECIFIC OBJECTIVE

- To study the socio-economic profile of the parents.
- To examine whether there is phone addiction among the parents or not?
- To identify the challenges and issues faced by the parents.
- To understand the causes of phone addiction among parents.
- To identify the challenges and issues faced by the child due to the phone addiction of parents.

## DEFINITION OF CONCEPTS:

### 1. Phone Addiction:

- Theoretical Definition: According to the Addiction Center “Phone addiction is the obsessive use of a smartphone. The behavioral addiction is often dubbed as “nomophobia,” or the fear of being without a mobile device”.
- Operational Definition: In this study, Phone Addiction refers to the disorder involving compulsive overuse of mobile devices among parents in Kochi city.

### 2. Parents:

- Theoretical Definition: According to Merriam Webster “Parents are that person who is a father or mother and the person who has a child”.
- Operational Definition: In this study, parents refer to a person who has a child in Kochi city.

## VARIABLES:

### 1. Dependent Variable:

- Phone Addiction among Parents

## 2. Independent Variables:

- Gender
- Age
- Education
- Occupation
- Income
- Type of Phone
- Internet Availability
- Age of Children
- Locality

### RESEARCH DESIGN:

This Quantitative research is descriptive in nature. The research is designed to know the Phone addiction among parents, from the viewpoint of children, especially in Kochi city.

### UNIVERSE:

The universe in this study refers to all the children who have a mother or father in Kochi city.

### SAMPLE:

50samples are selected from the children in Kochi City. These samples will portray the children who have mothers or fathers in Kochi city.

## **SAMPLING METHOD:**

Snowball Sampling is used as the method in this study. Snowball sampling is non-probability sampling. This snowball sampling will help us to find the traits that are rare to find.

## **TOOL OF DATA COLLECTION:**

The questionnaire is used as the tool for data collection in this study. Due to this Covid-19 pandemic situation, we are using google forums for collecting the data.

**CHAPTER-IV**

**DATA ANALYSIS AND**

**INTERPRETATION**

## DATA ANALYSIS AND INTERPRETATION

The purpose of collection and interpretation is to acquire useful and usable information and to make the most informed decisions possible. It provides limitless benefits for a wide range of institutions and individuals. It includes data identification and explanation, comparing and contrasting of data, identification of data outliers, future predictions. It helps improve and identify problems.

TABLE NO: 4.1

TABLE SHOWING THE AGE OF RESPONDENTS FATHERS

AGE	NUMBER	PERCENTAGE
41-45	3	6
46-50	5	10
51-55	19	38
56-60	13	26
61-65	8	16
66-70	2	4
<b>TOTAL</b>	<b>50</b>	<b>100</b>

Table 4.1 reveals that the majority of the respondent's fathers fall under the age group of 51-55 and then 56-60 years. And as compared to these two class intervals, 41-45 and 66-70 age groups have fewer respondents. Out of total respondents, 38 percent of respondents' fathers fall under the age group of 51-55 years. And only 4 percent fall under the age group of 66-70 years. 80 percent of the respondent's fathers are in the Middle age and only 10 percent fall in old age.

From the entire sample, it was found that the maximum number of participants' fathers of the study belonged to the age group of 51-55 years.

TABLE: 4.2

TABLE SHOWING THE AGE OF RESPONDENT'S MOTHERS

AGE	NUMBER	PERCENTAGE
36-40	2	4
41-45	8	16
46-50	22	44
51-55	12	24
56-60	6	12
<b>TOTAL</b>	<b>50</b>	<b>100</b>

Table 4.2 reveals that the majority of the respondent's mothers fall under the age group of 46-50 and then 51-55 years. And as compared to these two class intervals, the 36-40 age group has fewer respondents. Out of total respondents, 44 percent of respondents mothers fall under the age group of 46-50 years and only 4 percent fall under the age group of 36-40 years. 96 percent of the respondent's mothers are in the Middle age and only 4 percent fall in adulthood(20-40yrs.). From the entire sample, it was found that the maximum number of participants' mothers of the study belonged to the age group of 46-50 years.

FIGURE:4.1

GRAPHICAL REPRESENTATION OF AREA OF THE RESPONDENT

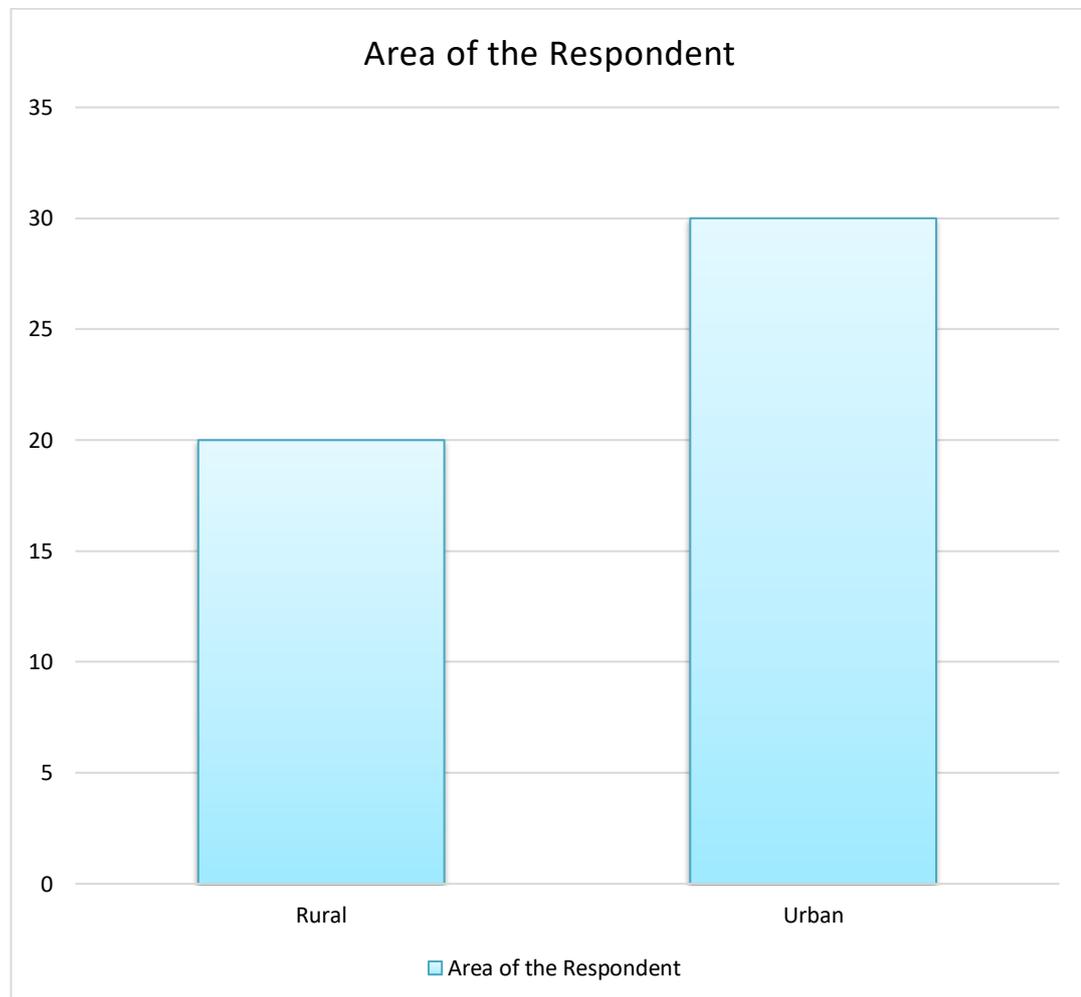


Figure: 4.1 shows the area of the respondent of the study. The table gives the status of the area of the respondent of the study, whether it's a rural area or urban area. And the majority of the respondents are from the Urban area. 60 percent of the respondents are from the urban area and the rest 40 percent are from the rural areas. The main reason for the high usage of phones in the urban area is the good internet connection they got as compared to rural areas. From the entire sample, it was found that the maximum number of participants of the study belonged to the urban area.

FIGURE: 4.2

GRAPHICAL REPRESENTATION OF ANNUAL INCOME OF FAMILY

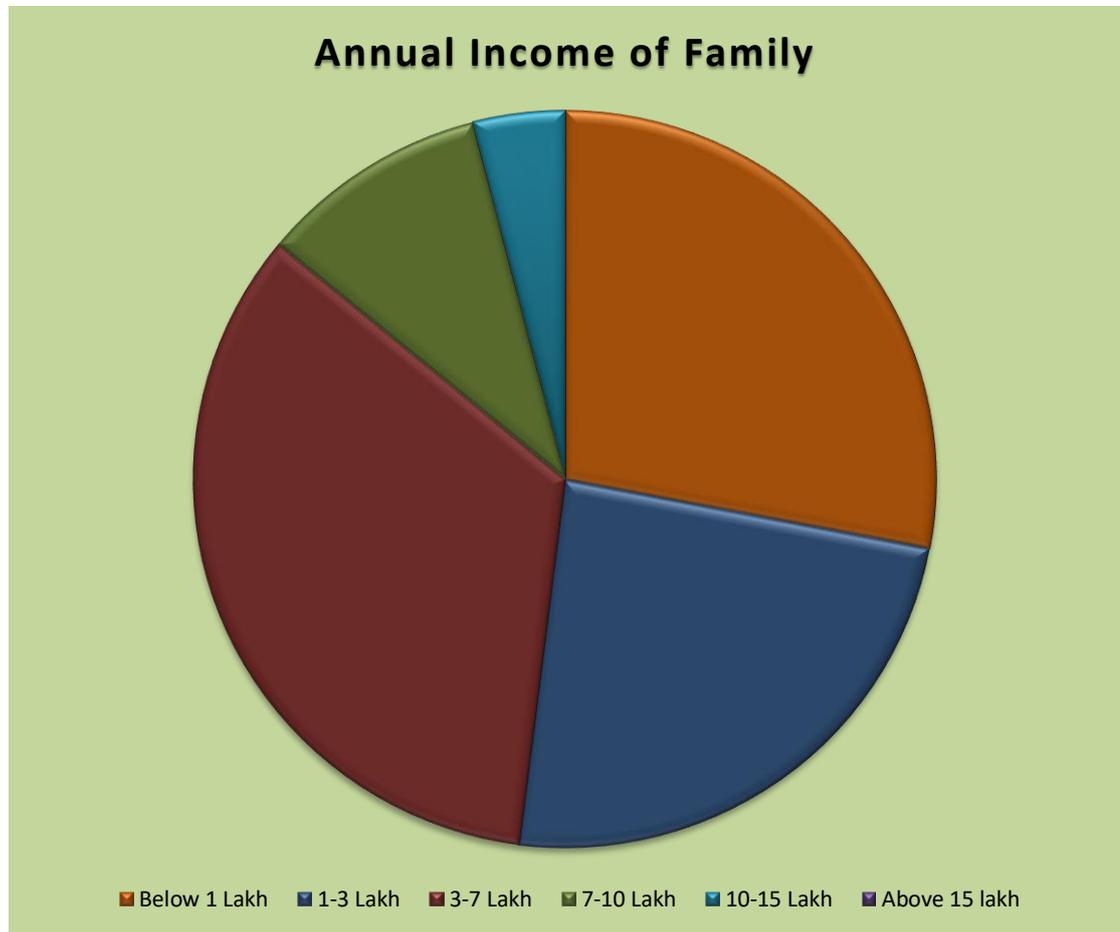


Figure:4.2 showed the status of family income per annum. The majority of the Respondents are from a middle-class families and a few respondents belong to low-class families. 72 percent of the respondents are from middle-class families and the rest 28 percent belong to low-class families. Therefore, from the entire sample, it was found that 28% of participants' annual family income was found to be below within the rupees of 1,00,000. 24% of participants reported as within the rupees of 1,00,00 to 3,00,000, while 34% participants showed their annual family income within 3,00,000 to 7,00,000, 10% claimed that their family income was within the rupees of 7,00,000 to 10,00,000 only 4% participants said that their family income was within the rupees of 10,00,000 to 15,00,000 From this

table, it was found that maximum participants of the study belonged to the family income group ranging within the rupees of 30,00,000 to 7,00,000.

FIGURE: 4.3

GRAPHICAL REPRESENTATION OF THE EDUCATIONAL LEVEL OF PARENTS OF THE RESPONDENTS

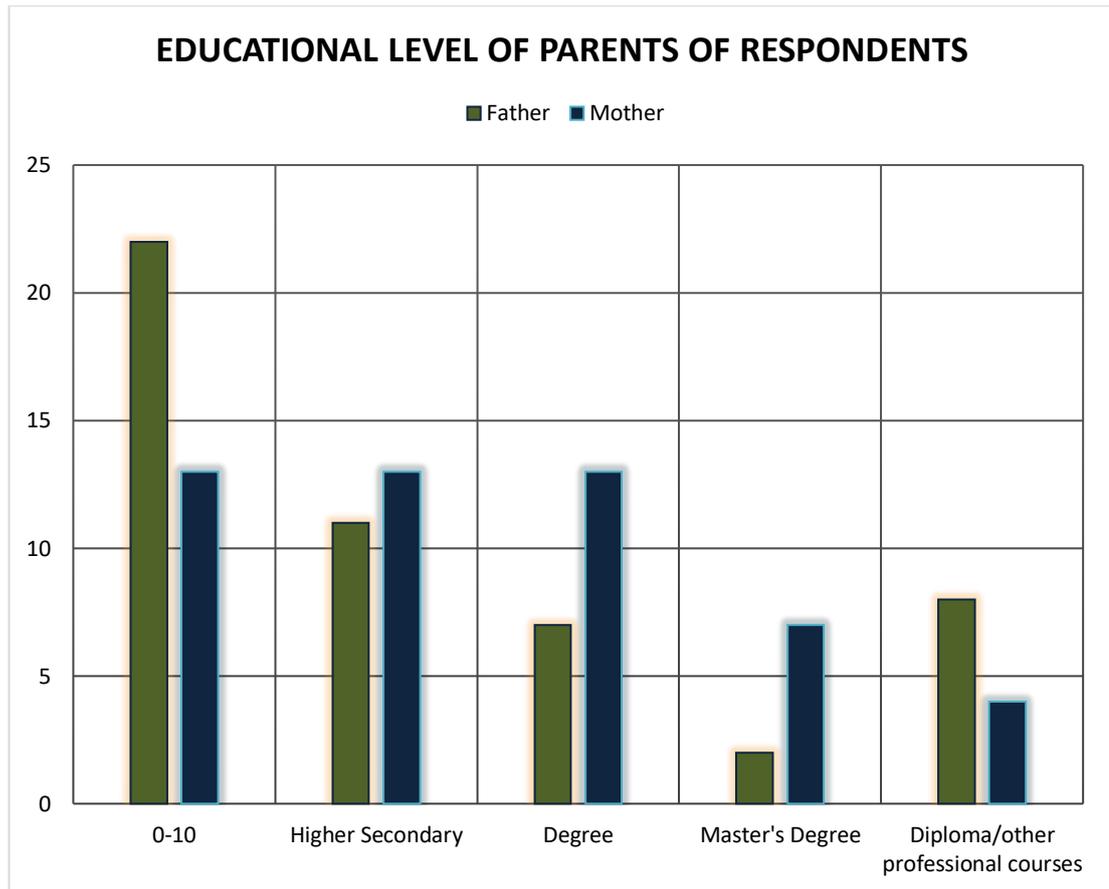


Figure: 4.3 represents the educational level of the father and mother of the respondent. Both the father and mother of the participants are literate. The majority of the fathers are passed high school (44 percent) and 22 percent had passed higher secondary, degree (14 percent) and diploma/ other related professional courses (16 percent) and master's degree (4 percent). The majority of the mothers had passed high school, higher secondary and degree (26 percent) And 14 percent had passed master's degree and 8 percent had passed diploma/other professional courses. When we compared both of these it's clear that the mothers have got more higher education more than fathers, but even then, the mothers have had literacy, 78 percent of them are not working.

TABLE: 4.3

TABLE SHOWING OCCUPATION OF FATHERS OF RESPONDENTS

OCCUPATION	NUMBER	PERCENTAGE
ADVOCATE	2	4
BANK EMPLOYEE	2	4
BUSINESS	11	22
DAILY-WAGE WORKERS	21	42
CENTRAL- GOVT. SERVICES	2	4
GOVT. EMPLOYEE	4	8
DESIGNER	1	2
FILM INDUSTRY	1	2
FARMER	1	2
FISHERMAN	3	6
MERCHANT NAVY	1	2
NAVAL CIVILIAN EMPLOYEE	1	2
TOTAL	50	100

Table:4.4 showed the occupations of the fathers of respondents. At first, the table gave the status of the occupations of fathers of respondents. Most of the fathers were daily wage earners, followed by business. Some of them were government employees, central government employees. While a few of them were engaged in farming, fishing, designing, and others. So, the table cited above is suggested that

the occupation of most of the fathers was daily wage-earning. But, diversification in occupation was seen.

FIGURE: 4.4

GRAPHICAL REPRESENTATION OF OCCUPATION OF MOTHERS OF RESPONDENTS

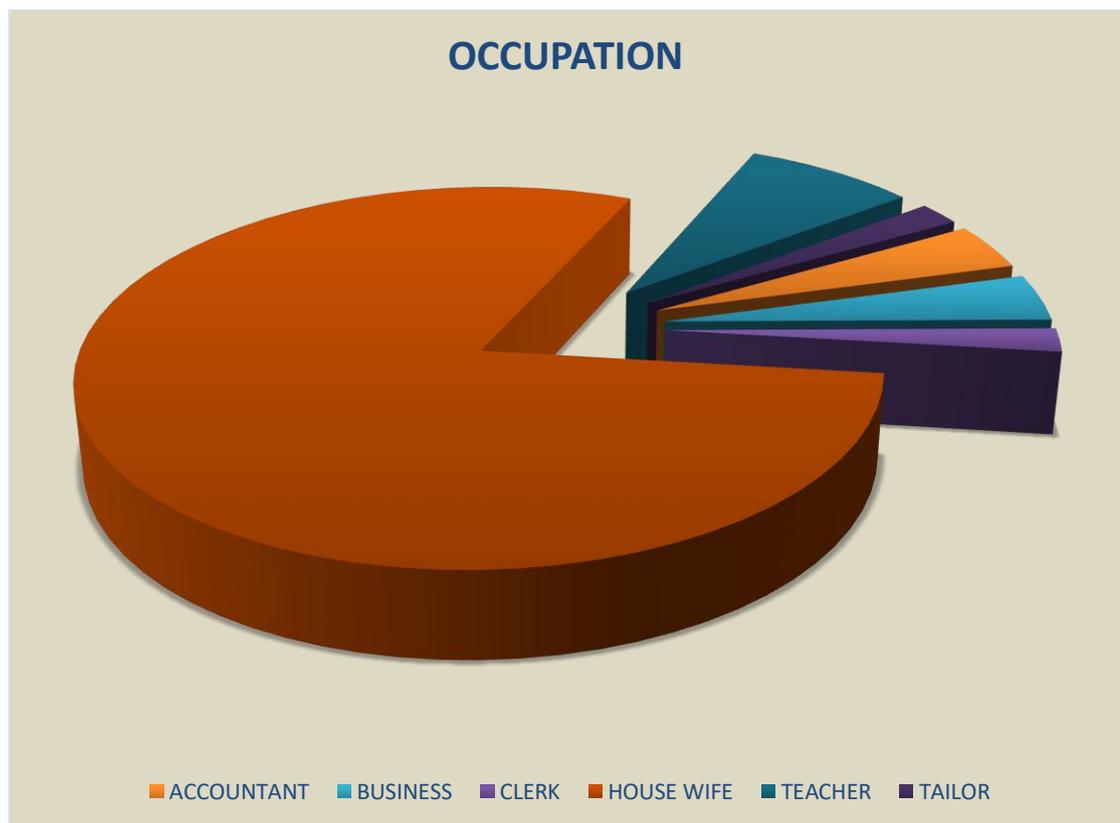


Figure 4.4 showed the occupations of the mothers of respondents. the figure gave the status of occupations of mothers of respondents. Most of the mothers were housewives, followed by the teacher, business, and others. Others included self-employed, clerical jobs and others. From the total sample, it was found that the maximum numbers of mothers were housewives, followed by service, business, and others. But when we compared it with Figure 4.3, we can see that the mothers have achieved higher education than fathers, but in the field of occupation, 78 percent of the mothers are not working.

FIGURE: 4.5

GRAPHICAL REPRESENTATION OF THE TYPE OF PHONE USED BY THE PARENTS OF RESPONDENT

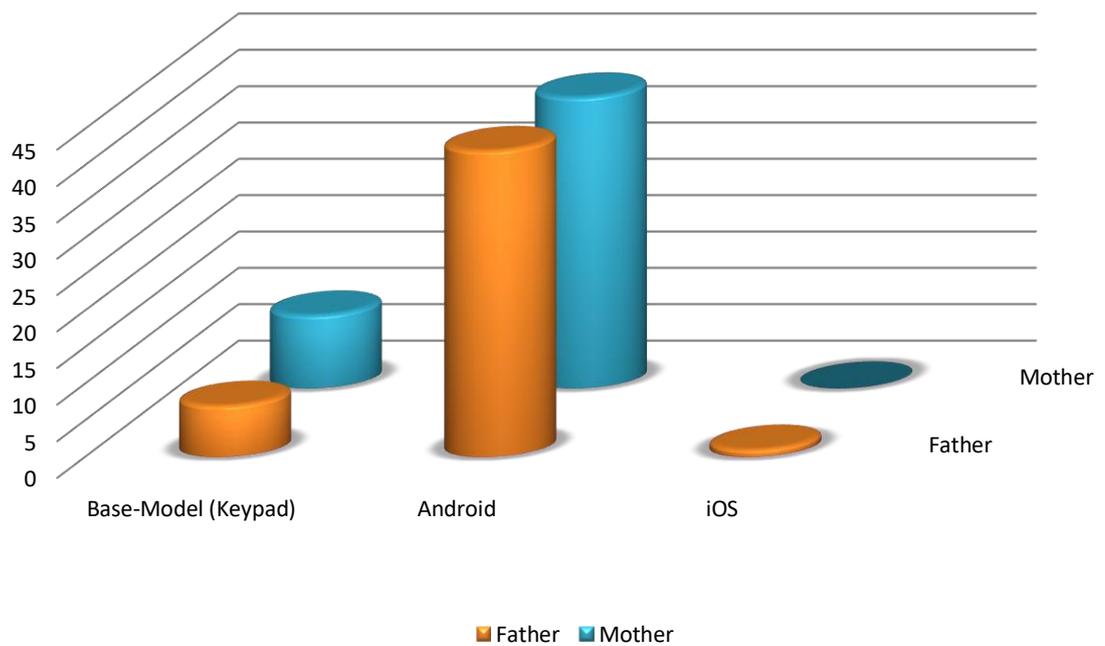


Figure:4.5 Showed the graphical representation of the phone used by the parents of the respondents. The figure gives the data about the types of phones used by both the mother and father of the respondent. Most of the fathers are using Android phones, followed by the base model and then iOS. The same kind of trend can be seen in the mother's case also. Most of the mothers are using Android phones, followed by base models. And 82 percent of the parents are using the Android type of phone and then 17 percent use the Base model type of phone and only one percent are using iOS phones. But we can see diversification in mobiles they use.

TABLE:4.4

TABLE SHOWING WHETHER THEY ARE HAVING GOOD INTERNET CONNECTION

RESPONSE	NUMBER	PERCENTAGE
YES	46	92
NO	4	8
TOTAL	50	100

Table:4.4 shows whether the respondents are having a good internet connection. The table gives us data on whether the respondents are having a good internet connection, in their area. The majority of the respondents are having a good internet connection and a few respondents are not having a good internet connection. 8 percent of them are not getting good internet connection, the main reason behind it is that they are living in a rural area. Every respondent in the urban area is getting a good internet connection. And 32 percent of the respondents those who are living in the rural area are also getting internet connection and 8 percent of people in a rural area are not getting. From the entire sample, it was found that the maximum number of respondents of the study are having good internet connections.

FIGURE: 4.6

GRAPHICAL REPRESENTATION OF THE SOURCES OF DATA

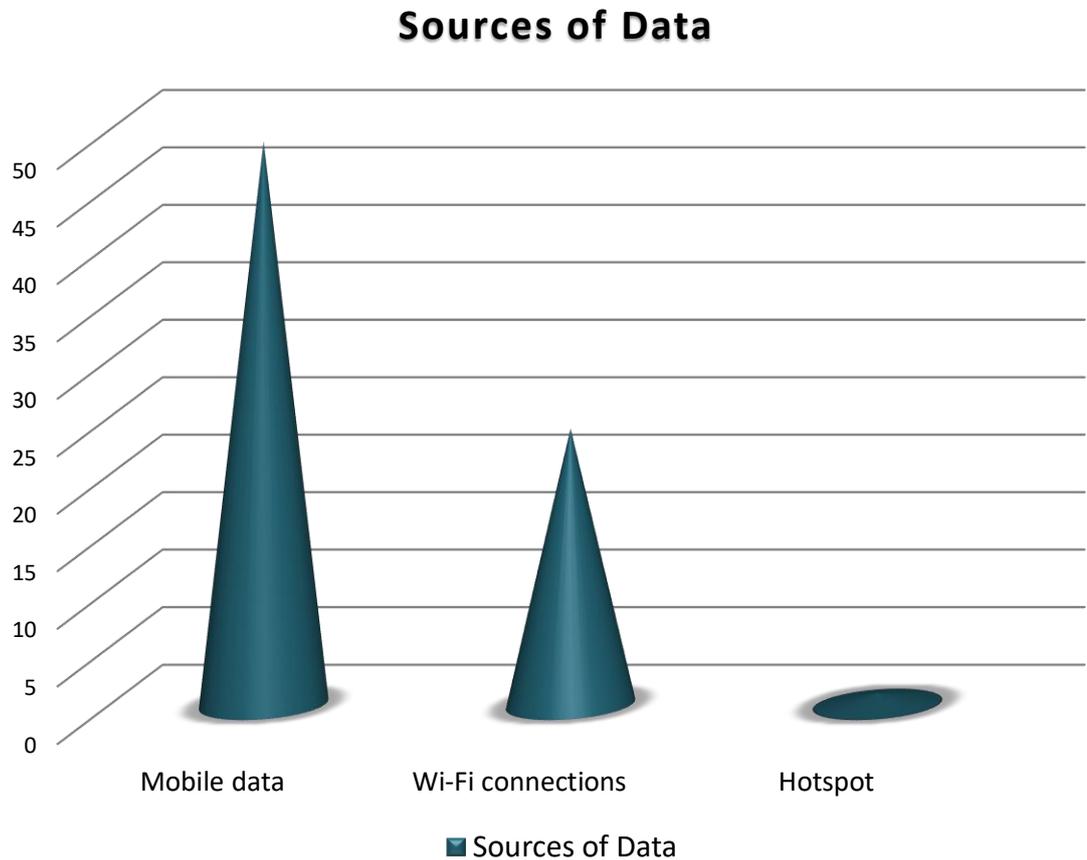


Figure: 4.6 reveals the graphical representation of the sources of data. The Figure gives us a clear understanding of the different sources of the internet data received by the respondents. The Source of data of the majority of the respondent is Mobile data, followed by Wi-Fi connections and the only respondent use the Hotspot. 50 percent of the respondents are using Mobile data as a source of data and 48 percent of the respondents are using both Mobile data and Wi-Fi connections and only 2 percent are using the hotspot. From the entire sample, it was found that the maximum number of respondents of the study are using Mobile data as a source.

FIGURE: 4.7

GRAPHICAL REPRESENTATION OF THE MONEY SPENT BY THE PARENTS OF THE RESPONDENT FOR DATA RECHARGING



Figure: 4.7 reveals the money spent by the parents of the respondents for the data recharging. The Line graph gives clear data about the amount spent by both the mother and father of the respondent for data recharging. Therefore, from the entire sample, the money spent by fathers of the respondent for data recharging, 12 percent of respondent's fathers comes within rupees of 100-200 and 40 percent comes within the rupees of 200-300, 26 percent comes within the rupees of 300-400 and 8 percent comes within the rupees of 400-500, 10 percent comes within the rupees of 500-600,

4 percent comes above the rupees of 600. And also, the money spent by the mothers of the respondent for data recharging, 36 percent of respondent's mothers come within the rupees of 100-200 and 32 percent comes within the rupees of 200-300, 20 percent comes within rupees of 300-400 and 8 percent comes within the rupees of 400-500, 4 percent comes within the rupees of 500-600. And from this, it is clear that the Majority of the fathers spent rupees of 200-300 and 300-400 for data recharging and clear that the Majority of the mothers spent rupees of 100-200 and 200-300 for data recharging.

FIGURE: 4.8

GRAPHICAL REPRESENTATION OF MOSTLY USED APP BY YOUR PARENTS

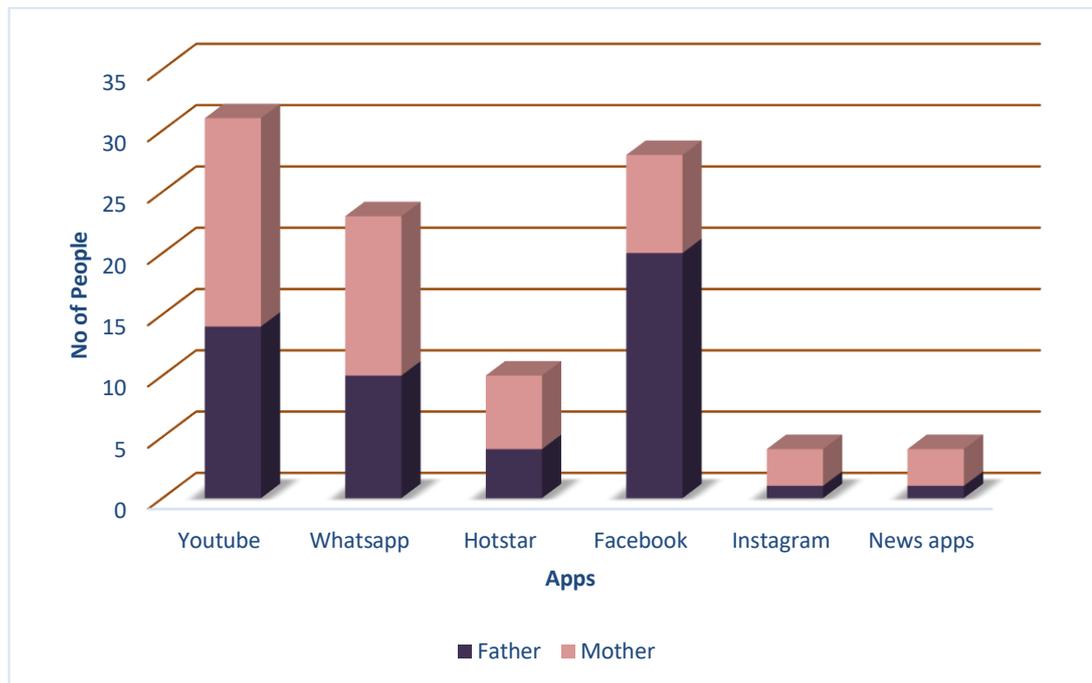


Figure: 4.8 represents the most used app by your parents. At first, it gives a clear idea about the most used app by the father and mother of the respondent of the study. Therefore, from the entire sample, the most used app by mothers of the respondents is YouTube, and it's followed by WhatsApp, Facebook, Hotstar, Instagram,

Newspaper apps. The most used app by fathers of the respondents is Facebook, and then it's followed by YouTube, WhatsApp, Hotstar, Instagram, News related apps. From this graphical representation, it is clear that the majority of mothers of respondents, mostly used the app is YouTube and that the majority of fathers of respondents, mostly used the app is Facebook.

FIGURE: 4.9

GRAPHICAL REPRESENTATION OF THE HOURS SPENT ON THE MOST USED APP BY THE FATHERS OF RESPONDENTS

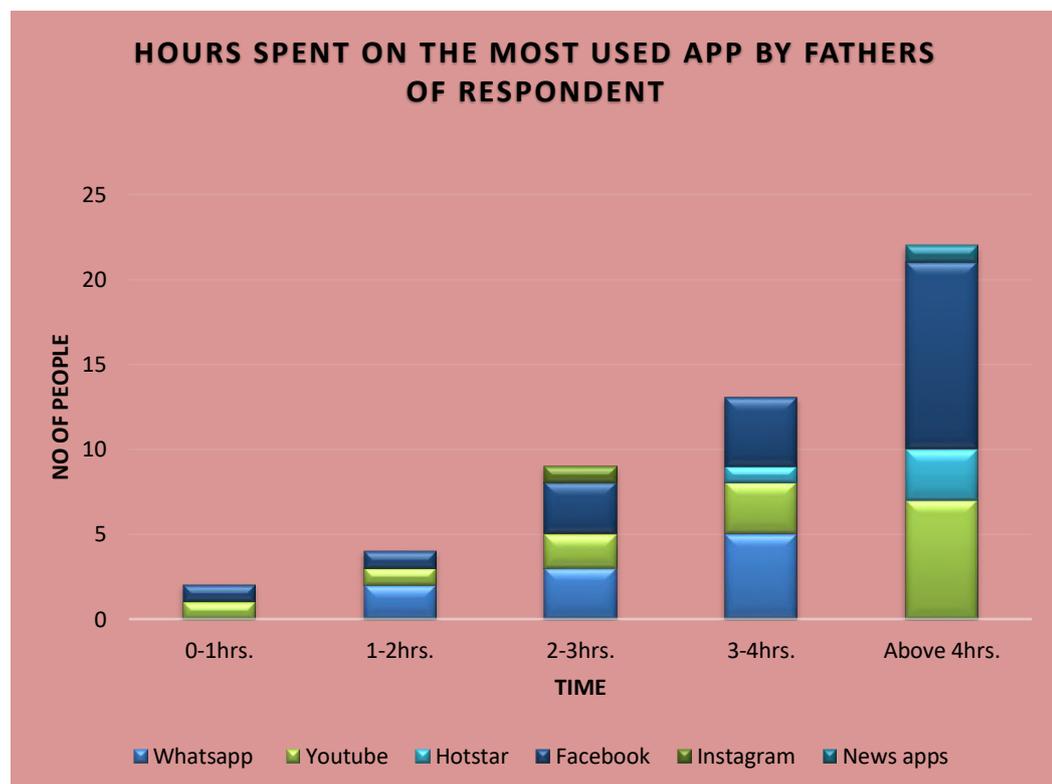


Figure: 4.9 shows the graphical representation of the hours on the most used app by the fathers of the respondents. The majority of the fathers of respondents spent more than 4 hours in the apps. Therefore, from this entire sample, the majority of the respondent's fathers use the most-used app for more than 4 hours. 44 percent of the respondent's fathers use apps for more than 4 hours daily. 26 percent of the

respondents use apps for 3-4 hours, 18 percent use apps for 2-3 hours, 8 percent use apps for 1-2 hours, and 4 percent use apps only for below 1 hour.

FIGURE: 4.10

GRAPHICAL REPRESENTATION OF THE HOURS SPENT ON THE MOST USED APP BY THE MOTHERS OF RESPONDENTS

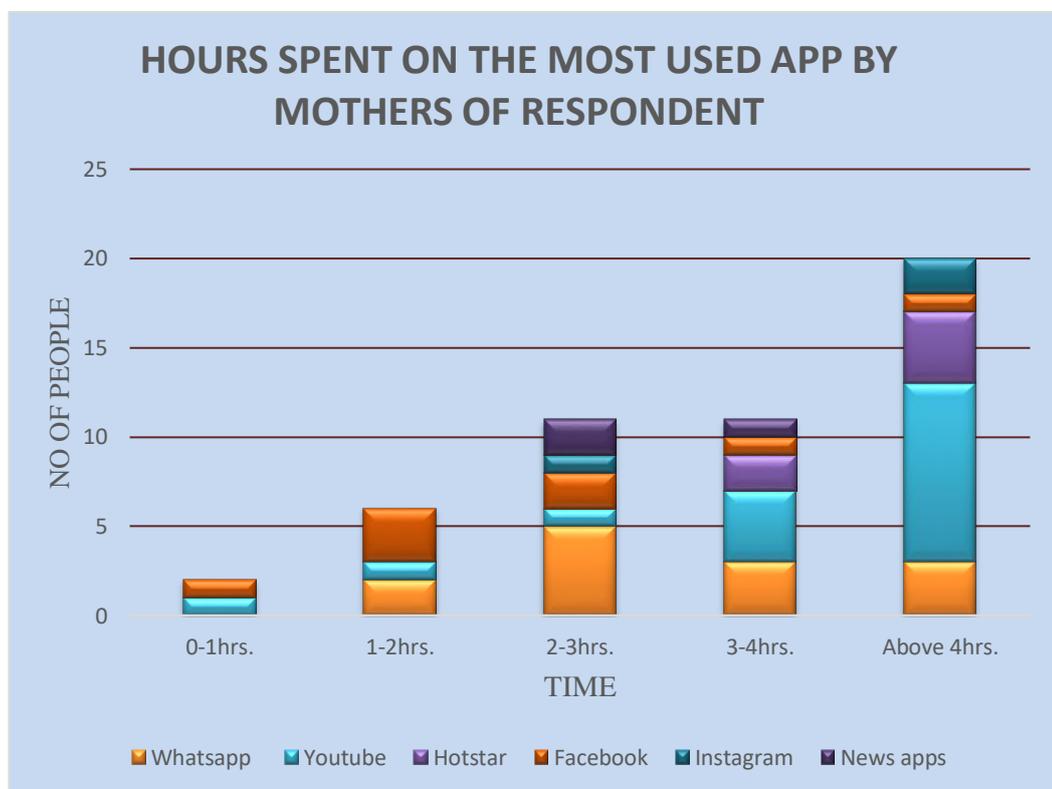


Figure: 4.10 shows the graphical representation of the hours on the most used app by the mothers of the respondents. The majority of the mothers of the respondent spent more than 4 hours in the apps. Therefore, from this entire sample, the majority of the respondent's mothers use the most-used app for more than 4 hours. 40 percent of the respondent's mothers use apps for more than 4 hours daily. 22 percent of the respondents use apps for 3-4 hours, 22 percent use apps for 2-3 hours, 12 percent use apps for 1-2 hours, and 4 percent use apps only for below 1 hour.

FIGURE: 4.11

GRAPHICAL REPRESENTATION OF WHEN THE RESPONDENT'S PARENTS BEGIN TO USE THEIR PHONES EXCESSIVELY



Figure: 4.11 shows the graphical representation of when the parents of the respondents of the study, began to use their phones excessively. The figure gives a clear understanding of when the excessive use of phones had begun among the parents. From the total sample, it is clear that the majority of the parents of the respondents have increased the usage of the phone after covid-19. 60 percent of the parents had been using the phone excessively after the covid-19 and 40 percent of the parents were using the phones excessively before the covid. Therefore, it is clear that the majority of the parents of the respondents of the study has started to use phones excessively after the covid-19. The covid-19 had played a crucial role in the usage of the phone and the situation had led to making use of the phone. Some of the respondents have pointed out that the mothers during the covid-19 lockdown, had started watching soap operas.

FIGURE: 4.12

GRAPHICAL REPRESENTATION OF HOURS SPENT BY YOUR PARENTS ON THE PHONE PER DAY

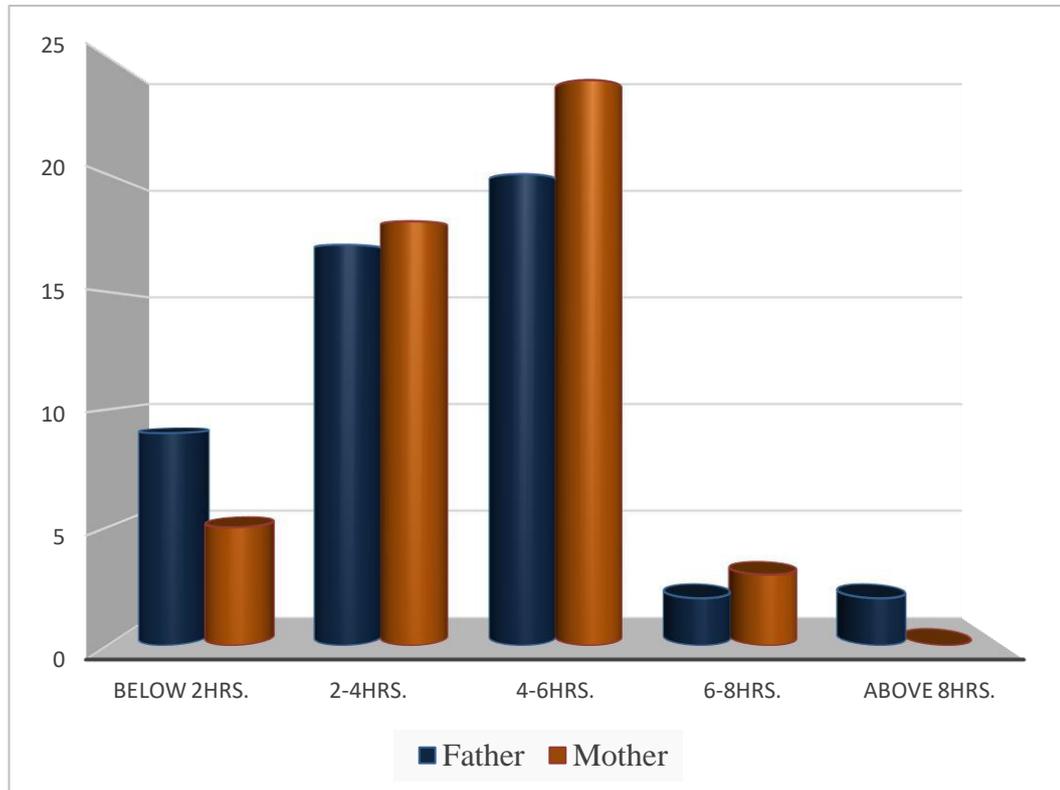


Figure: 4.12 portrays the graphical representation of the hours spent by the respondent's parents on phone per day. The figure gives a clear understanding of how many hours does the father and mother of the respondents spend on the phone every day. From the total sample, it's clear that the majority of the parents of the respondents of the study spent 4-6 hours daily. 40 percent of fathers of the respondent belong to the group of 4-6 hours and also 48 percent of mothers of the respondent belong to the group of 4-6hours. Therefore, it is clear that the majority of the parents of the respondents use their phones for 4-6 hours daily. And some of the respondents say that they become absent-minded sometimes, which also leads to a stressful life.

FIGURE: 4.13

GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONES CONTINUOUSLY.

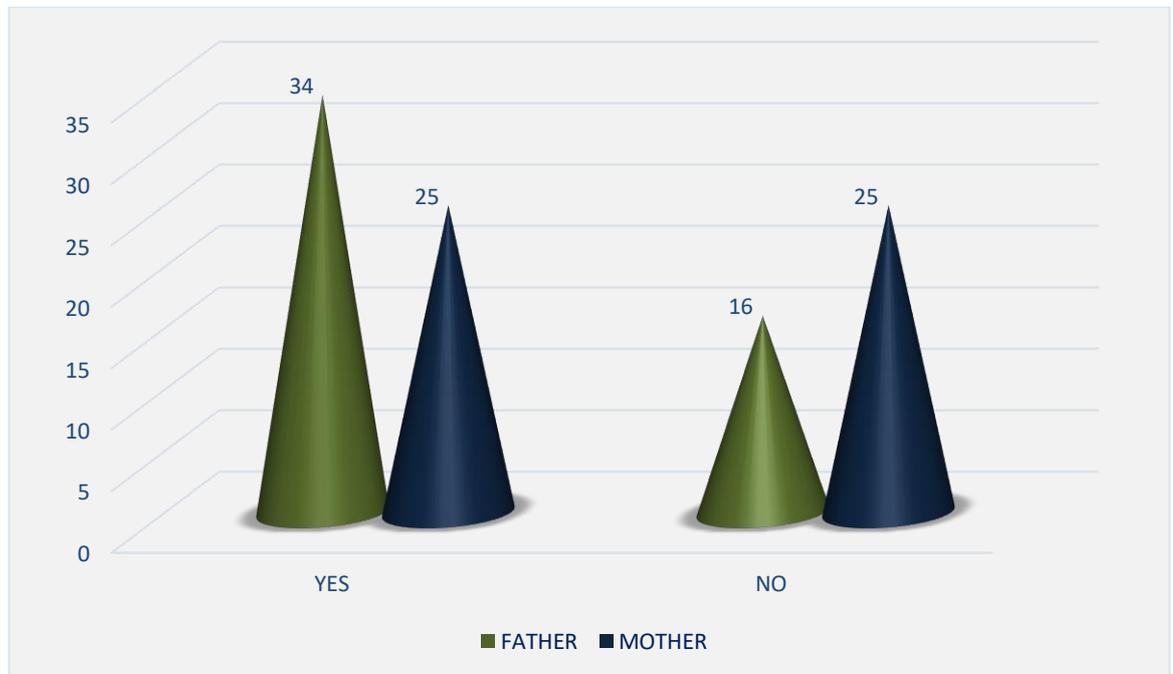


Figure: 4.13 shows whether the parents of the respondents of the study, check their phones continuously. The figure gives us a clear understanding of the response of the participants regarding whether their parents continuously check their phones or not. From the entire sample, it is clear that 68 percent of the fathers of the respondent continuously check their phones and 32 percent of the fathers of the respondents are not continuously checking their phones. From the entire sample, it is clear that 50 percent of the mothers of the respondent continuously check their phones and 50 percent of the mothers of the respondents are not continuously checking their phones. Therefore, it is clear that the majority of the respondent's parents are checking their phones continuously.

TABLE: 4.5

TABLE SHOWING WHETHER THE RESPONDENTS THINK THEIR PARENTS WILL BE ABLE TO NOT USE THEIR PHONE FOR A WHOLE DAY.

RESPONSE	FATHER	MOTHER
YES	23	25
NO	27	25
TOTAL	50	50

Table: 4.5 reveals whether the respondents think, that their parents will be able to not use their phone for a whole day. The table gives a clear understanding of the responses of the participants of the study regarding whether their mother and father will be able to not use their phones for a whole day. From the entire sample, 54 percent of the fathers can't able to not use the phone for one day and 46 percent can do it. 50 percent of the mothers can't able to not use the phone for one day and 50 percent can do it. From the entire sample total of 52 percent of the parent can't be able to not use their phone for one day. Therefore, it's clear that the majority of the parents of the respondents are not able to not use their phones for a whole day.

FIGURE: 4.14

GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONES IN THE EARLY MORNING.

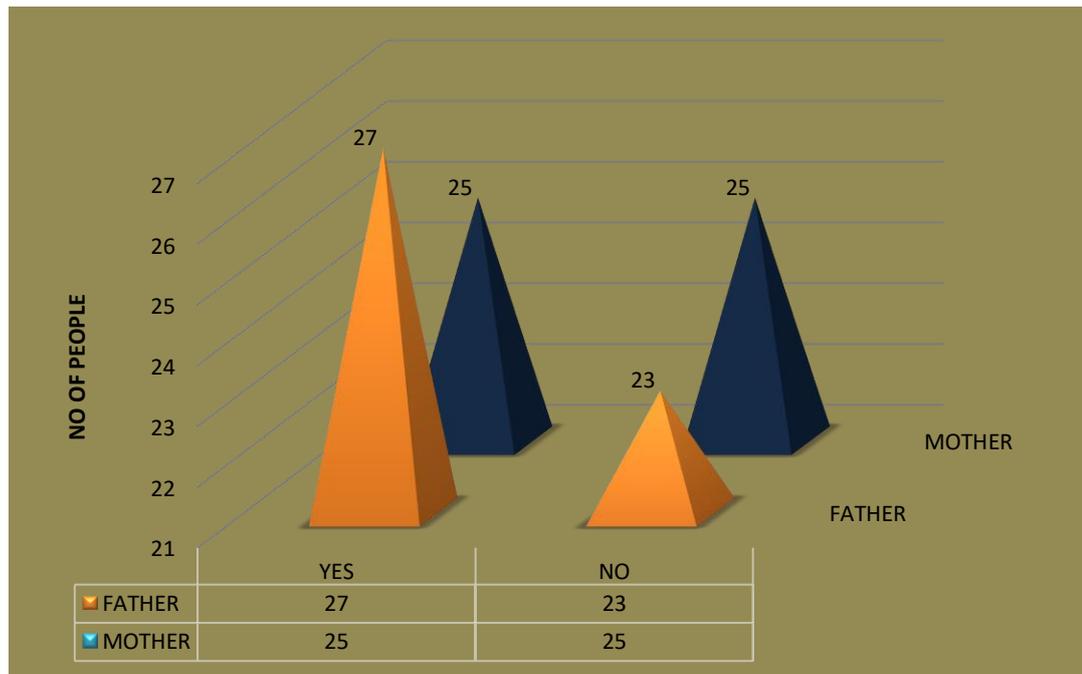


Figure: 4.14 shows whether the parents of the respondents check their phones in the early morning. Graphical representation gives a clear idea of whether the parents of the respondents of the study check their phones in the early morning or not. From the entire sample, 52 percent of the parents check their phones in the early morning and 48 percent of them don't. Therefore, it's clear that the majority of the respondent's parents are checking phones in the early morning. As compared with both parents we can see that 54 percent of the fathers are checking their phones in the early morning and 50 percent of the mothers are checking the phone in the early morning.

FIGURE: 4.15

GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS CHECK THEIR PHONE IN LATE NIGHT

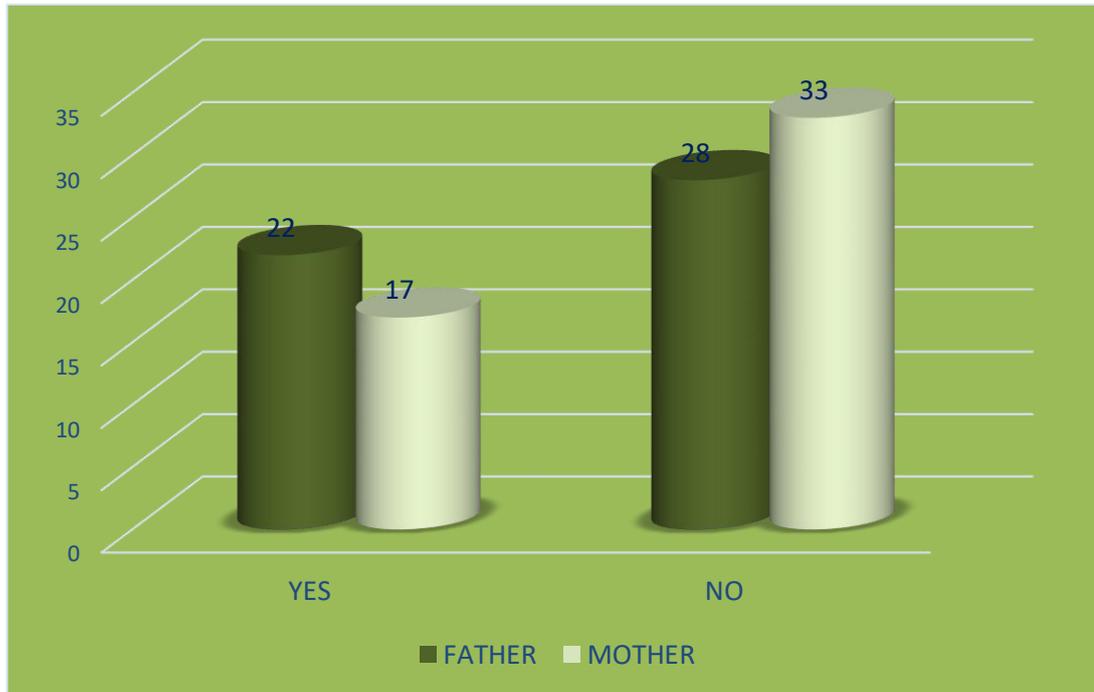


Figure: 4.15 reveals whether the parents of the respondents check their phones late at night. Graphical representation gives a clear idea of whether the parents of the respondents of the study check their phones late at night or not. From the entire sample, 39 percent of the parents check their phones in the early morning and 61 percent of them don't. Therefore, it's clear that the majority of the respondent's parents are not checking phones in late at night. As compared with both parents we can see that 44 percent of the fathers are checking their phones in late at night and 34 percent of the mothers are checking the phone at late night. And 56 percent of the fathers are not using phones late at night and 66 percent of the mothers are also not using the phones late at night.

TABLE: 4.6

TABLE SHOWING WHETHER THE PARENTS OF THE RESPONDENTS BECOME DISTURBED WHEN YOU INTERRUPT THEM WHILE USING PHONE

RESPONSES	FATHER	MOTHER
YES	30	18
NO	20	32
TOTAL	50	50

Table: 4.6 shows the responses of the participants regarding whether their parents become disturbed when you interrupt them while using the phone. The table gives a clear idea of whether the parents of the respondents become disturbed or not when you interrupt them while using the phone. From the entire sample, 48 percent of the parents get disturbed and 52 percent don't. But when we take both the parents separately, we can see that 60 percent of the fathers are getting disturbed. Whereas only 36 percent of mothers get disturbed while using their phones. Therefore, the majority of the parents of respondents don't get disturbed when the respondents interrupt while using the phone and the majority of fathers get disturbed when the respondents disturb them while using the phone.

TABLE: 4.7

TABLE SHOWING WHETHER THE PARENTS OF THE RESPONDENTS BECOME IRRITATED IF THE MOBILE DATA OR Wi-Fi IS UNAVAILABLE.

RESPONSE	FATHER	MOTHER
YES	27	22
NO	23	28
TOTAL	50	50

Table: 4.7 shows the responses of the participants regarding whether their parents become irritated if mobile data or Wi-Fi is unavailable. The table gives a clear idea of whether the parents of the respondents become irritated or not when the mobile data or Wi-Fi is unavailable. From the entire sample, 49 percent of the parents get irritated and 51 percent don't. But when we take both the parents separately, we can see that 54 percent of the fathers are getting irritated. Whereas only 44 percent of mothers get irritated if Mobile data or Wi-Fi is unavailable. Therefore, the majority of the parents of respondents don't get irritated if mobile data or Wi-Fi is unavailable and the majority of fathers get irritated when the mobile data and Wi-Fi become unavailable.

FIGURE: 4.16

GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS OF THE RESPONDENTS GET NERVOUS/RESTLESS/UNEASY WHEN THEY ARE NOT AROUND THE PHONE.

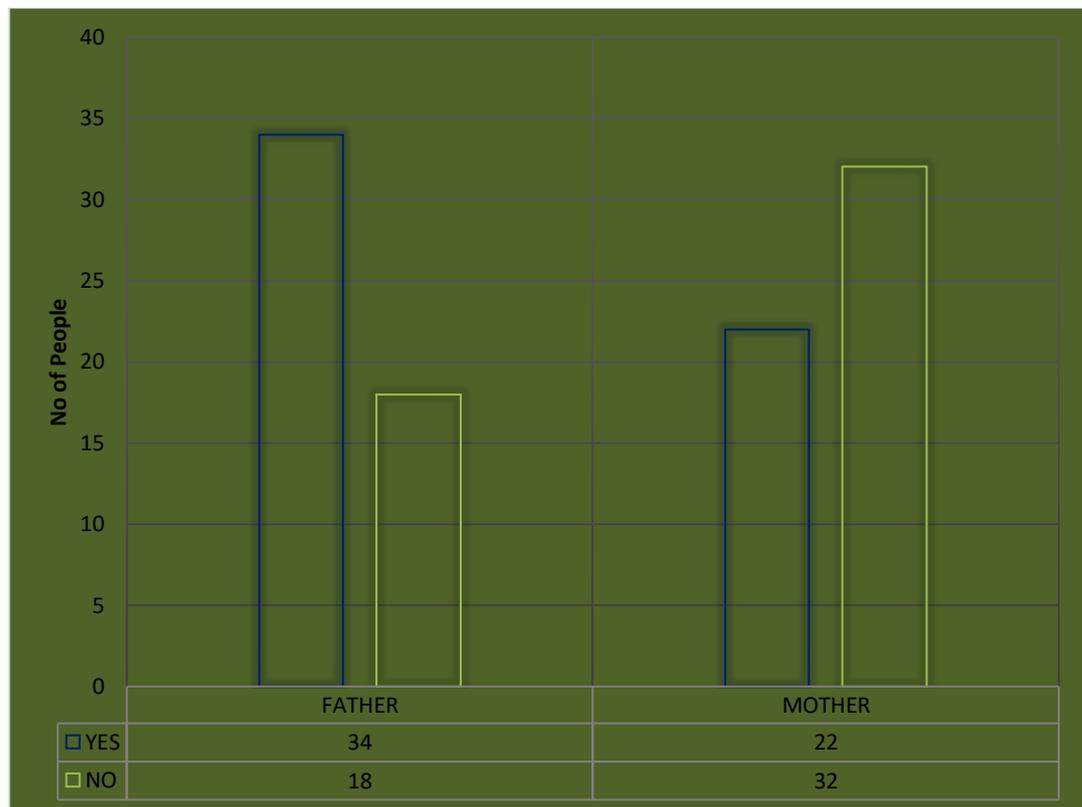


Figure: 4.16 shows the responses of the participants regarding whether their parents become nervous/restless/uneasy when they are not around the phone. The Graphical representation gives a clear idea of whether the parents of the respondents become nervous/restless/uneasy or not when they are not around the phone. From the entire sample, 56 percent of the parents get nervous and 48 percent don't. But when we take both the parents separately, we can see that 68 percent of the fathers are getting disturbed. Whereas only 44 percent of mothers get disturbed while using their phones. Therefore, the majority of the parents of respondents get nervous/restless/uneasy when they are not around the phone and the majority of fathers get nervous/restless/uneasy when they are not around the phone

TABLE: 4.8

TABLE SHOWING THE RESPONSES OF THE PARTICIPANTS REGARDING WHETHER THEY THINK PARENTS HAVE BECOME LAZY OR IDLE BECAUSE OF TOO MUCH USAGE OF THE PHONE.

<b>RESPONSE</b>	<b>FATHER</b>	<b>MOTHER</b>
<b>YES</b>	19	16
<b>NO</b>	31	34
<b>TOTAL</b>	50	50

Table: 4.8 shows the responses of the participants regarding whether their think parents have become lazy/idle because of too much usage of the phone. The table gives a clear idea of whether the parents of the respondents have become lazy/idle or not, due to too much usage of the phone. From the entire sample, 35 percent of the parents had become lazy due to the over usage of the phone and 65 percent don't. But when we take both the parents separately, we can see that only 38 percent of the fathers are becoming lazy. Whereas only 32 percent of mothers are become lazy while using their phones. Therefore, the majority of the parents of respondents haven't become lazy/idle because of too much usage of the phones.

FIGURE: 4.17

GRAPHICAL REPRESENTATION OF RESPONSE OF THE PARTICIPANT ON WHETHER THEIR PARENTS OVERREACT TO WHEN YOU INTERRUPT THEM WHILE USING THE PHONE.



Figure: 4.17 shows the responses of the participants regarding whether their parents overreact to when the respondents interrupt them while using the phone. The table gives a clear idea of whether the parents of the respondents overreact or not when they interrupt them while using the phone. From the entire sample, 43 percent of the parents overreact to when the respondents interrupt them while using the phone and 57 percent don't overreact. When we take both the parents separately, we can see that 52 percent of the fathers don't overreact when the respondents interrupt them while using the phone. Whereas only 62 percent of mothers also don't overreact when the respondents interrupt them while using the phone. Therefore, the majority of the parents of respondents come haven't overreacted to when the respondents interrupt them while using the phone.

FIGURE: 4.18

GRAPHICAL REPRESENTATION OF, FOR WHAT PURPOSE DID THE RESPONDENTS FATHER USE THE PHONE MOST.

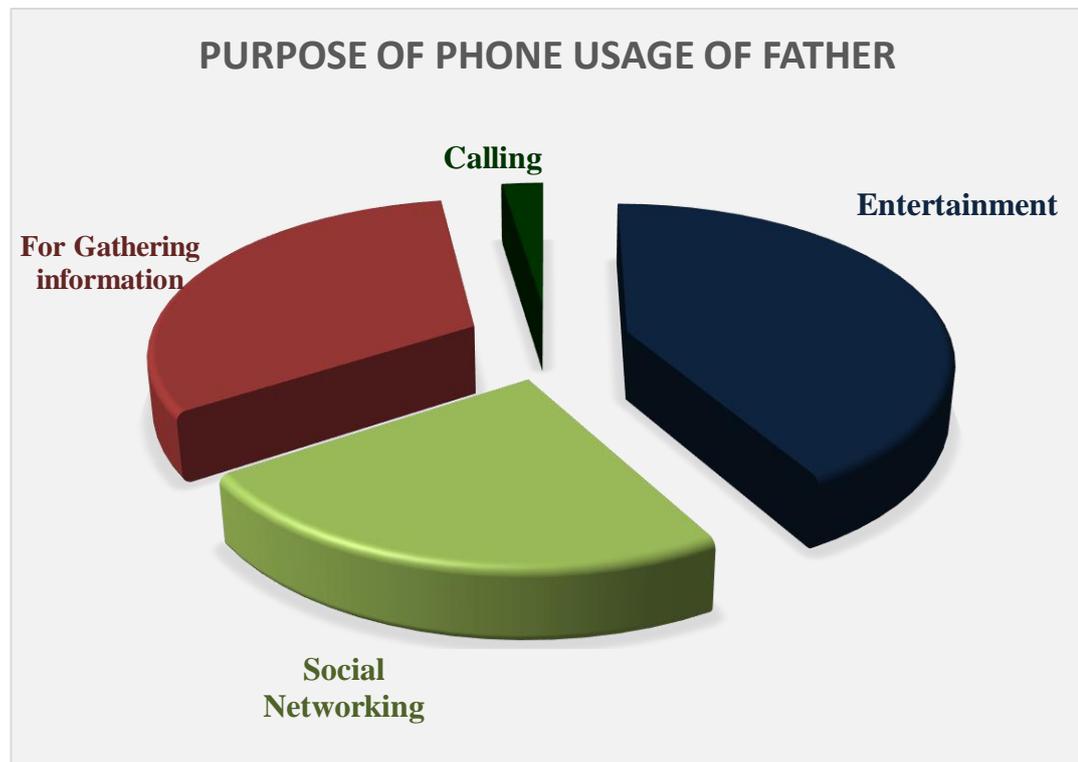


Figure: 4.18 shows a graphical representation of, what are the purposes did the respondent's father use the phones for most. Most of the fathers use phones mostly for entertainment purposes, which is followed by gathering information, social networking, and calling. From the entire sample, it is clear that the majority of the fathers are using the phone for entertainment. 42 percent of the fathers are using the phones for their entertainment, 32 percent on information gathering, 24 percent on social networking, and only 2 percent for calling. Therefore, we can understand the majority of the respondent's fathers of the study use phone for entertainment and then for information gathering and others.

FIGURE: 4.19

GRAPHICAL REPRESENTATION OF, FOR WHAT PURPOSE DID THE RESPONDENT'S MOTHER USE THE PHONE MOST.

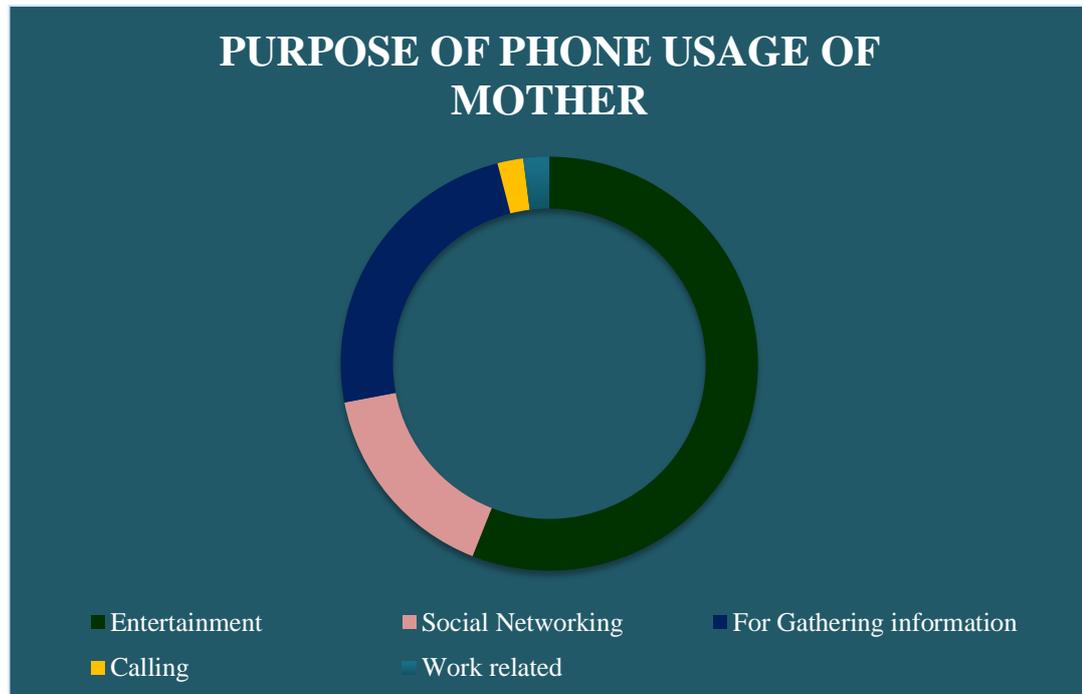


Figure: 4.19 shows a graphical representation of, what are the purposes did the respondent's mother use the phones for most. Most of the mothers use phones mostly for entertainment purposes, which is followed by gathering information, social networking, calling, and work-related things. From the entire sample, it is clear that the majority of the mothers are using their phones for entertainment. 56 percent of the mothers are using the phone for their entertainment, 24 percent for information gathering, 16 percent for social networking, 2 percent for calling, and two percent for work-related things. Therefore, we can understand the majority of the respondent's mothers of the study use phone for entertainment and then for information gathering and others.

FIGURE: 4.20

GRAPHICAL REPRESENTATION OF THE HOURS SPENT BY THE RESPONDENT’S PARENTS BY CALLING THEIR LOVED ONES IN ONE DAY.



Figure: 4.20 shows a graphical representation of the hours spent by the respondent’s parents by calling their loved ones (friends and families) in one day. Parents spent hours calling their beloved ones, most of them spent below ½ hour and then around 1 hour, 2hour, 3hours goes on. From the entire sample, it is clear that the majority of the respondent’s parents spent ½ hours calling their loved ones (families and friends) and then Around 1 hour. 35 percent of parents spent below ½ hours for calling, 27 percent around 1 hour, 14 percent around two hours, 13 percent around 3hours, 7 percent around 4hours, 3 percent around 6hours, and 1 percent most of the time. So, it’s clear that the majority of the parents of the respondents use limitedly for calling their beloved ones per day.

FIGURE: 4.21

GRAPHICAL REPRESENTATION OF THE REASONS THAT LEAD TO THE OVER USAGE OF PHONE IN PARENTS OF THE RESPONDENTS.

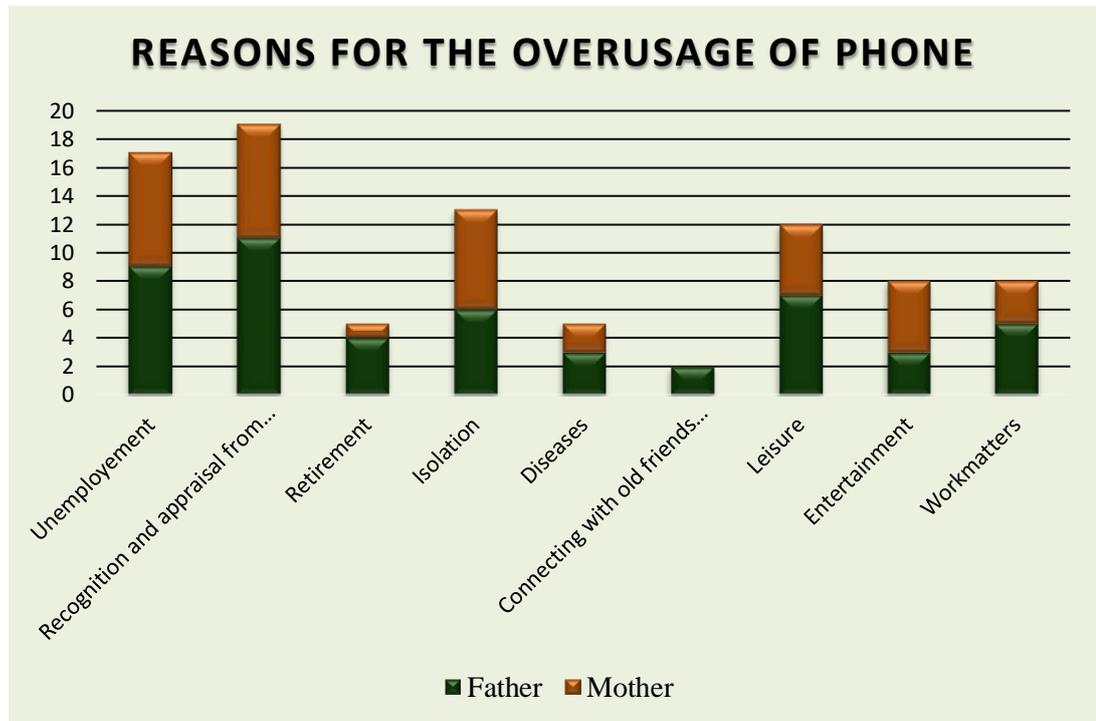


Figure: 4.21 shows the graphical representation of the reasons that lead to the over usage of phones by parents of the respondents of the study. Most of the parents use the used phone for recognition and appraisal. Recognition and appraisal, unemployment, isolation, leisure, entertainment, work-related things, diseases, retirement all are the reasons for the over usage of phones among the parents of the respondents of the study. For the majority of the parents of the respondents of the study recognition and appraisal from social media and unemployment are the reasons that led to the over usage of phones among parents, followed by leisure, isolation, entertainment, work-related things, diseases, retirement, connecting with old friends through social media and others.

FIGURE: 4.22

GRAPHICAL REPRESENTATION OF WHETHER THE PARENTS ARE FINDING ENOUGH TIME TO SPENT WITH THE RESPONDENTS.

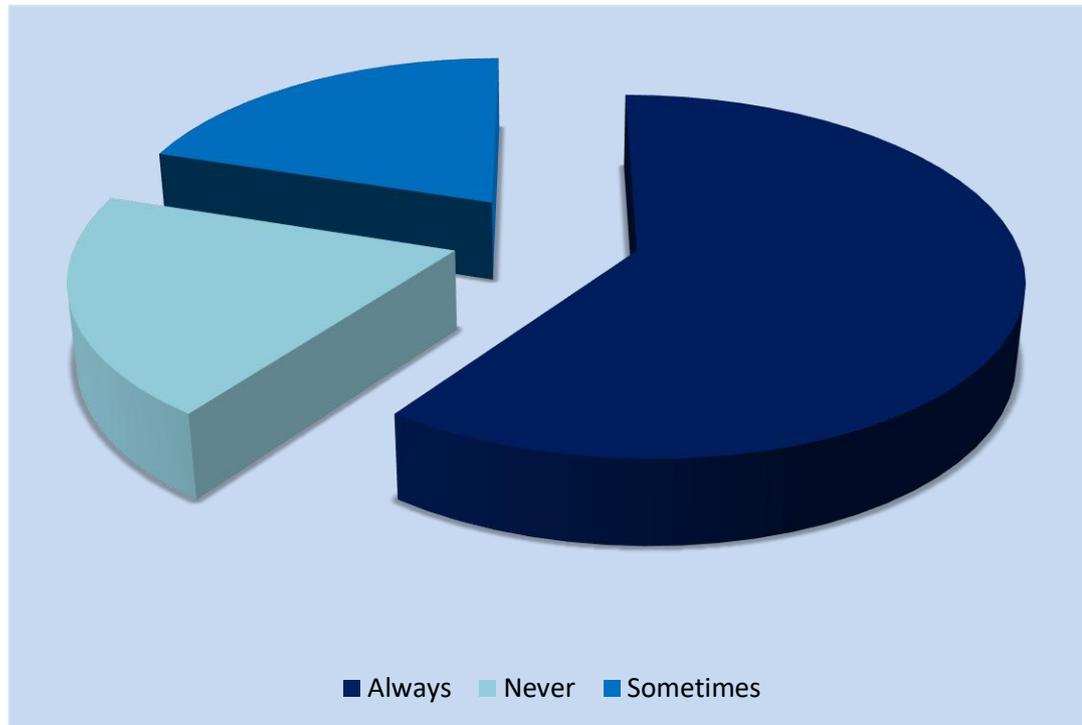


Figure: 4.22 shows the graphical representation of the responses, regarding whether the parents are finding enough time to spend with the children. The majority of the children say that the parents always find time to spend with them. From the entire sample, we understand that 60 percent of the parents always find time to spend with children, 20 percent of the parents never find time to spend with the children and another 20 percent of the parents sometimes find time to spend with children. Therefore, it is clear that the majority of the parents of the respondents find time to spend with children.

FIGURE: 4.23

GRAPHICAL REPRESENTATION OF THE RESPONSE OF PARTICIPANTS, WHETHER THEY FEEL THAT THE OVER USAGE OF PHONE BY YOUR PARENTS HAD RESULTED IN THE WEAKENING OF PARENT-CHILD RELATIONSHIP IN THEIR FAMILY.

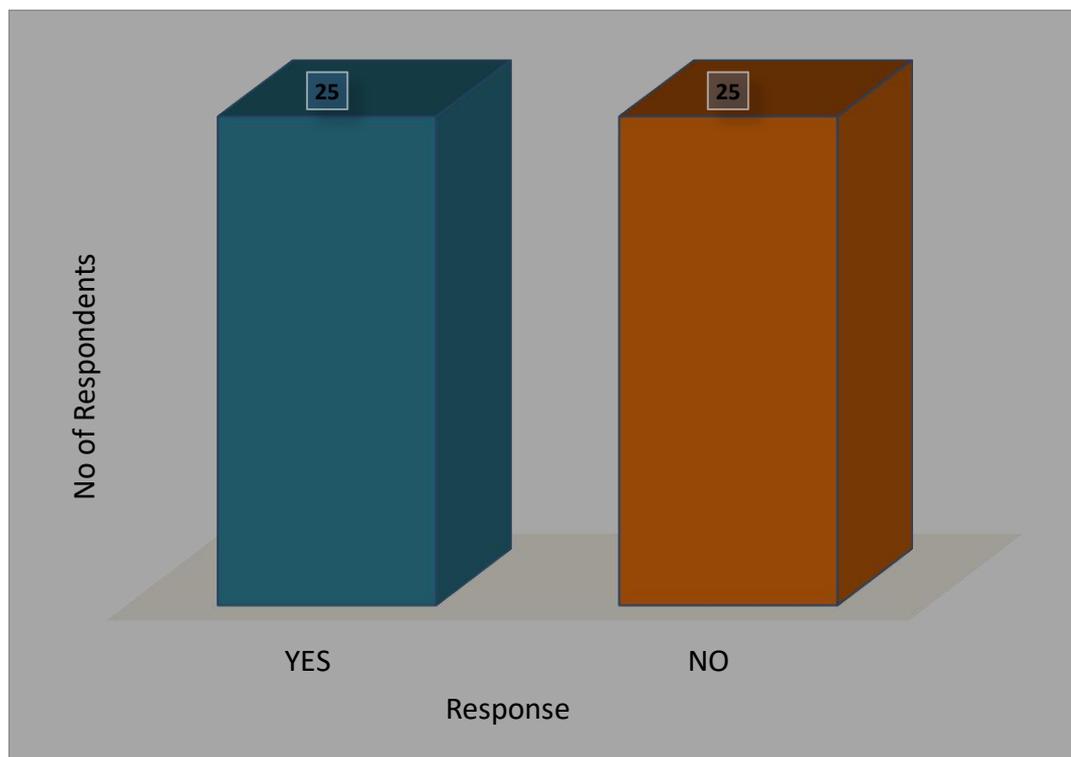


Figure: 4.23 shows the graphical representation of the responses of the respondents regarding whether the respondents feel that the over usage of the phone by your parents had resulted in the weakening of the parent-child relationship. 50 percent of the participants of the study say that the usage of the phone had resulted in the weakening of the relationship between the parent-child relationship in the family and another 50 percent of the respondents say that it hadn't affected the relationship between the parent and child in the family. Therefore, there are equal respondents in both the response.

FIGURE: 4.24

GRAPHICAL REPRESENTATION OF THE PROBLEMS FACED BY THE RESPONDENTS, DUE TO THE PHONE USAGE OF PARENTS

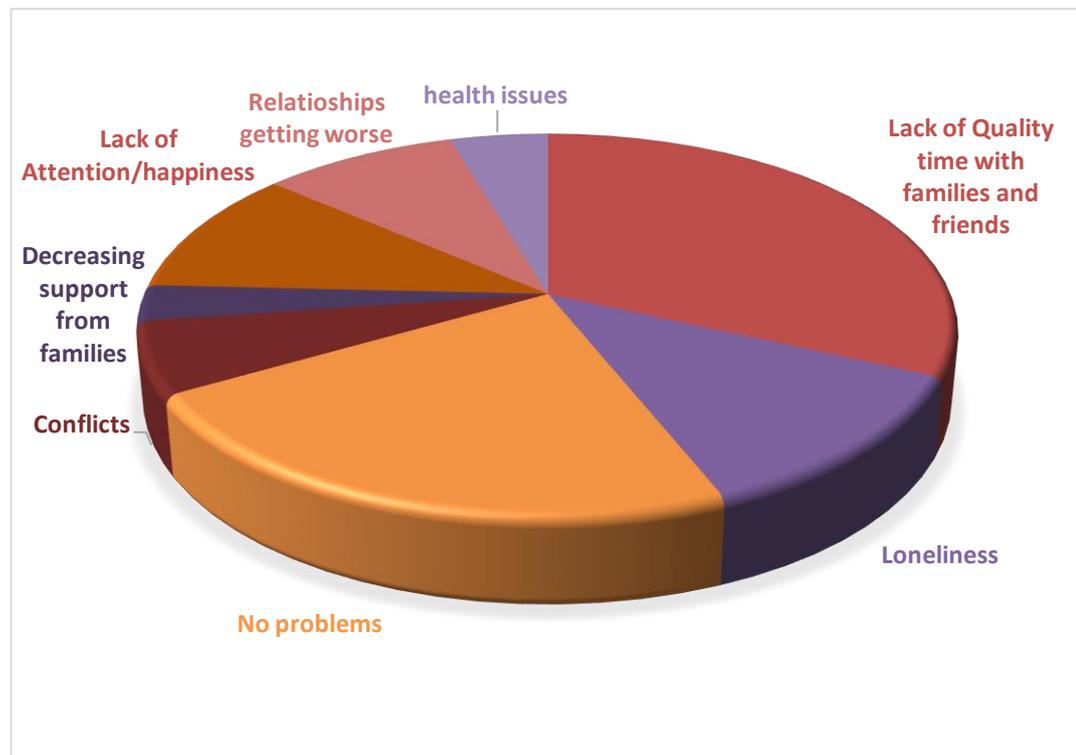


Figure: 4.24 shows the what are the problems faced by the respondents, due to the phone usage of parents. This graphical representation represents the responses of the respondents regarding the problems faced by them due to the phone usage of their parents. The majority of the children say that there is a lack of quality time with parents and there are respondents who say that there is no problem, and they also say the reason that their parents use the phone moderately, make time for them and also give the child the freedom they need. There are other problems like health issues, relationships getting worse due to lack of communication and misunderstandings, conflicts, loneliness, decreasing support from family and others.

# **CHAPTER-V**

## **FINDINGS AND CONCLUSION**

## **FINDINGS AND CONCLUSION**

Phone addiction is a common condition that we can see in the present world. Many studies focus on the phone addiction of the students, children, youth, and adolescents. Phone addiction is not a condition that affects only these people. Phone addiction is a condition that affects people in all sects. This study is providing information about the phone addiction of parents from the perspective of the children with special reference to Kochi City. And this study also tries to understand the socio-economic background of the parents. It also helps to find out whether there is phone addiction among the parents or not and also helps to know about the challenges and issues faced by the parents and the children due to the phone addiction of parents. Since the data is collected from direct sources, it can provide a more reliable and realistic view without any prejudices. And also, from this study, we can understand what are the different causes for phone addiction among parents.

The first objective of the study was to find out the socioeconomic profile of the parents who have phone addiction in Kochi city. In the sample of 50 responses, the Majority of the respondent's (80%) parents belong to the middle age group. And 60 percent of the parents of the respondents are residing in the urban area and 40 percent of the parents are residing in the rural area. Majority of the respondents (34%) comes within the 3,00,000 to 7,00,000 rupees. All of the parents of the respondent are literate and the mothers have high literacy rate than the fathers. The majority (42 %) of the fathers of the respondent have daily waged workers and the Majority of the mothers (82%) of the respondents are homemakers. 82 percent of the parents of the respondents of this study use android phones.

The second objective of the study was to find out whether there is phone addiction among the parents or not. 92 percent of the respondents are available with a good internet connection. 50 percent of the respondent's parents are using Mobile data and 48 percent are using Wi-Fi connections as a source of data. The majority of the fathers (26%) spent 300-400 rupees for data recharging and the majority of the mothers (36%) are spending 100-200 rupees for the data recharging. The most used app by the mothers of the respondent is YouTube and Facebook by the fathers. The majority of the fathers (44%) are using the single app for more than 4 hours. And the majority of the mothers

(40%) are using the single app for more than 4 hours. 60 percent of the parents had started to use the phone excessively after the Covid-19 and 40 percent of the parents were using phone excessively before Covid-19. And Most of the parents were using the phones for 4-6 hours daily, which shows that they use the phone very often and some of the respondents have been responded that they become absent-minded sometimes. The majority of the parents often check their phones continuously, 68 percent of the fathers continuously check their phones and 50 percent of the mothers check their phones continuously. 50 percent of the respondents had responded that their parents cannot use the phone for the whole day. The majority of the parents of the respondent of the study check their phone in the early morning, but most of them doesn't check their phone late at night. Only half of the parents become disturbed and irritated when the children interrupt them while using the phone, but when we compared the statistics of the father and mother the fathers are more easily getting disturbed than the mothers. the majority of the parents of respondents don't get irritated if mobile data or Wi-Fi is unavailable and the majority of fathers get irritated when the mobile data and Wi-Fi become unavailable. From the statistical analysis, we come to the point that there is high usage of phones among the fathers as compared to the mothers.

The third objective of the study was to identify the challenges and issues faced by the parents. The majority of the parents (56%) get nervous when they are not around the phone. the majority of the parents of respondents haven't become lazy/idle because of too much usage of the phones. And also, the majority of the parents don't overreact when the respondents interrupt them while using the phone.

The fourth objective of this study was to understand the causes of phone addiction among parents. Most parents use phones mostly for the entertainment process, and then for social networking and gathering information. 35 percent of parents spent below ½ hours calling, 27 percent around 1 hour, 14 percent around two hours. The parents use limited for calling their beloved ones per day. Most of the parents use the used phone for recognition and appraisal. Recognition and appraisal, unemployment, isolation, leisure, entertainment, work-related things, diseases, retirement all are the reasons for the over usage of phones among the parents of the respondents of the study.

The fifth objective of this study was to identify the challenges and issues faced by the child due to the phone addiction of parents. The majority of the children say that the parents always find time to spend with them. From the entire sample, we understand that 60 percent of the parents always find time to spend with children. 50 percent of the participants of the study say that the usage of the phone had resulted in the weakening of the relationship between the parent-child relationship in the family and another 50 percent of the respondents say that it hadn't affected the relationship between the parent and child in the family. The majority of the children say that there is a lack of quality time with parents and there are respondents who say that there is no problem, and they also say the reason that their parents use the phone moderately, make time for them and also give the child the freedom they need. There are other problems like health issues, relationships getting worse due to lack of communication and misunderstandings, conflicts, loneliness, decreasing support from family and others.

## **SUGGESTIONS**

- To reduce the phone addiction among the parents, the family members should ensure that they get proper awareness classes and counseling sessions.
- Parents should be more encouraged to participate in some physical activities, exercise, outdoor games, and socially-oriented activities.
- Children or family members should encourage and give support to parents for developing their skills and creative ideas.
- Keep the phone and other related gadgets outside the bedroom and the place where the family members are present.
- Try to find out more time to spend with the family members and the children.
- Parents can also include yoga and meditation in their daily routines, which will help to reduce the stress and also it will help in reducing their phone addiction as well.

## **CONCLUSION**

The phone is one of the most important companions of our life. Now in the present society, the phone had become a part of an organ of the human body. We can't even imagine a second without having our phone. And even though access to smartphones is making our lives easier in different ways. Phone addiction is considered as the obsessive use of phones. In the present scenario, Phone addiction is becoming increasing and also very common. But most of the research are focusing on phone addiction among children and youth. From this study, we had found out that there is phone addiction among the parents, but when we compared both the fathers and mothers, we can see that the fathers are more addicted to phones. And respondent's mothers having more educational qualifications are spending quality time with the children and are using the phone limited.

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# APPENDIX

## QUESTIONNAIRE

### **Sociological Analysis on Phone Addiction among parents from the viewpoint of children: Special Reference to Kochi City.**

This survey is to study Phone Addiction among parents. This study may help in analyzing the phone addiction among parents from the viewpoint of children in Kochi city. And will also help to study the causes and challenges that they face. So please carefully read this questionnaire and give sincere answers.

#### INFORMED CONSENT

The study has been explained to me, & I understand the purpose of the research & what my participation involves.

- Yes
- No

I understand that the information given to the researchers will be treated as strictly confidential according to the Data Protection Act & will use only for their search purpose.

- Yes
- No

I understand that the research report will include my views but I will not be identified by name

- Yes
- No

I understand that my participation is voluntary & I can withdraw from their search at any time without providing a reason

- Yes
- No

I agree to take part in answering the questionnaire with the researcher

- Yes
- No

1. Age of your Father:
2. Age of Mother:
3. Area:
  - Urban
  - Rural
4. Educational Level of your father:
  - 1-10
  - Higher Secondary
  - Degree
  - Master's Degree
  - Diploma/ other professional courses
  - Other:
5. Educational Level of your mother:
  - 1-10
  - Higher Secondary
  - Degree
  - Master's Degree
  - Diploma/ other professional courses
  - Other:
6. Family Income:
  - Below 1 Lakh
  - 1Lakh - 3Lakh
  - 3Lakh - 7Lakh
  - 7Lakh - 10Lakh
  - 10Lakh - 15Lakh
  - Above 15 Lakh
7. Occupation of your Father:
8. Occupation of your Mother:
9. Type of phone your father use:
  - Base Model (Keypad)
  - Android
  - iOS

10. Type of phone your mother use:

- Base Model (Keypad)
- Android
- iOS

11. Do they have a good internet connection?

- Yes
- No

12. What is the source of data?

- Mobile Data
- Wi-Fi Connection
- Free Wi-Fi Connections
- Hotspot

13. How much money does your father spend for the data recharge per month?

14. How much money does your mother spend for the data recharge per month?

15. The most used app by your father on phone and how many hours do they spend on that single app?

16. The most used app by your mother on phone and how many hours do they spend on that single app?

17. When did they begin to use their phone excessively?

- Before Covid19
- After Covid19

18. How many hours does your father spend on the phone per day?

- Below 2hrs.
- 2-4hrs.
- 4-6hrs.
- 6-8hrs.
- Above 8hrs

19. How many hours does your mother spend on the phone per day?

- Below 2hrs.
- 2-4hrs.
- 4-6hrs.
- 6-8hrs.
- Above 8hrs

20. Does your father Continuously check their phone?

- Yes
- No

21. Does your mother Continuously check their phone?

- Yes
- No

22. Do you think that your father will be able to not use the phone for a whole day?

- Yes
- No

23. Do you think that your mother will be able to not use the phone for a whole day?

- Yes
- No

24. Does your father check the phone in the early morning?

- Yes
- No

25. Does your mother check the phone in the early morning?

- Yes
- No

26. Does your father use his phone late at night?

- Yes
- No

27. Does your mother use her phone late at night?

- Yes
- No

28. Does your father become disturbed when you interrupt him while using the phone?

- Yes
- No

29. Does your mother become disturbed when you interrupt him while using the phone?

- Yes
- No

30. Does your father get nervous/restless/uneasy when they are not around the phone or not using the phone?

Yes

No

31. Does your mother get nervous/restless/uneasy, when they are not around the phone or not using the phone?

Yes

No

32. Does your father become irritated if the Mobile data or Wi-Fi is unavailable?

Yes

No

33. Does your mother become irritated if the Mobile data or Wi-Fi is unavailable?

Yes

No

34. Do you think that your father has become lazy or idle because of too much usage of the phone?

Yes

No

35. Do you think that your mother has become lazy or idle because of too much usage of the phone?

Yes

No

36. Do your father overreact, when you are interrupting him while he is using the phones

Yes

No

37. Do your mother overreact, when you are interrupting him while he is using the phones

Yes

No

38. For what purpose did your father use the phone the most

Entertainment

Social Networking

For Gathering Information

Others

39. For what purpose did your mother use the phone the most?

- Entertainment
- Social Networking
- For Gathering Information
- Others

40. How many hours do your father spend in one day calling their loved ones (Family and Friends)?

- Below ½ hour
- Around 1 hour
- Around 2 hours
- Around 3 hours
- More than 4 hours
- Other:

41. How many hours do your mother spend in one day calling their loved ones (Family and Friends)?

- Below ½ hour
- Around 1 hour
- Around 2 hours
- Around 3 hours
- More than 4 hours
- Other:

42. What may be the reasons that lead to the over usage of the phone in father?

- Unemployment
- Recognition and Appraisal that they get from the social media
- Retirement
- Isolation
- Diseases
- Other:

43. What may be the reasons that lead to the over usage of the phone in the mother?

- Unemployment
- Recognition and Appraisal that they get from the social media
- Retirement
- Isolation

Diseases

Other:

44. Are they finding enough time for spent with you?

Always

Never

Sometimes

45. Did you feel that the over usage of the phone by your parents had resulted in the weakening of the parent-child relationship in your family?

Yes

No

46. What do you think are the problems, you face with the phone's usage of the parents?

Specify it.....

# **A SOCIOLOGICAL STUDY OF THE WORK-LIFE BALANCING ISSUES FACED BY THE MARRIED NURSES IN COCHIN CITY**



By

**ANJALI OUSEPH**

**AM20S0C004**

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**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM**

**MARCH 2022**



**A SOCIOLOGICAL STUDY OF THE WORK-LIFE BALANCING ISSUES FACED BY THE  
MARRIED NURSES IN COCHIN CITY**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of **Master of Arts in Sociology***

**By**

**ANJALI OUSEPH**

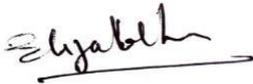
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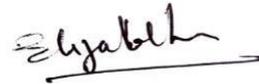
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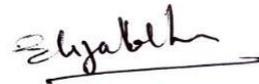
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**MARCH 2022**



## **CERTIFICATE**

I certify that the thesis entitled **“A SOCIOLOGICAL STUDY OF THE WORK-LIFE BALANCING ISSUES FACED BY THE MARRIED NURSES IN COCHIN CITY”** is a record of bonafide research work carried out by **ANJALI OUSEPH**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology

A handwritten signature in black ink, appearing to read "Elizabeth", with a horizontal line underneath it.

Name and Signature of the Staff Supervisor

Assistant Professor

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Ernakulam

March 2022

## **DECLARATION**

I, **ANJALI OUSEPH** hereby declare that the thesis entitled “**A SOCIOLOGICAL STUDY OF THE WORK-LIFE BALANCING ISSUES FACED BY THE MARRIED NURSES IN COCHIN CITY**” is a bonafide record of independent research work carried out by me under the supervision and guidance of **Smt. ELIZABETH ABRAHAM**. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022

**ANJALI OUSEPH**

## **ACKNOWLEDGEMENT**

In this humble endeavor I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Smt. Georgia Ann Benny for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

**ANJALI OUSEPH**

March 2022

## CONTENT

<b>NO:</b>	<b>TITLE</b>	<b>PAGE</b>
1	Introduction	5-20
2	Review Of Literature	21-34
3	Methodology	35-38
4	Analysis And Interpretation	39-83
5	Findings and conclusion	84-85
6	Appendix	86-90
7	Bibliography	91-92

## LIST OF TABLES

<b>TABLE NO:</b>	<b>TITLE</b>	<b>PAGE NO:</b>
4.1	Age of respondents	40
4.2	Religion of respondents	41
4.3	Educational qualification of respondents	42
4.4	Working Department of the Respondents	43
4.5	Annual income of the Respondents	44
4.6	Type of family of the Respondents	45
4.7	Type of house of the Respondents	45
4.8	Type of vehicles the respondents were used to come to hospital	46
4.9	Hours of work per day of the respondents	47
4.10	Working hours of the respondents in the period of Corona	48
4.11	Respondents get support for house hold works	49
4.12	Cooking in charge in family	50
4.13	Support to Respondents for house hold activities.	51
4.14	Balancing of domestic work and Job of Respondents	52
4.15	Source of income of the Respondents.	53
4.16	Taking care of children of the Respondents when they are going to work.	54

4.17	Brest feeding mothers.	55
4.18	Respondent's difficulties to cope with tasks at home due to shift.	56
4.19	Respondent's attachment with children	57
4.20	Emotional issues of Children	58
4.21	Spending time with family members.	59
4.22	Taking care of elderly at home by the respondents.	60
4.23	Casual leave taken by the respondents	61
4.24	Leave taken for the needs of respondent's children	62
4.25	Decision making for taking leave.	63
4.26	Seriousness of taking leave	64
4.27	Respondents as a primary care giver	65
4.28	Difficulties during menstrual period of the Respondents	66
4.29	Leisure time in between the working hours of the Respondents	67
4.30	Health issues of the Respondents	68
4.31	Schedule of having food of the Respondents	69
4.32	Work pressure stress level of the Respondents	70
4.33	Sleeping habit of the Respondents	71
4.34	Physical complaints related to the Respondents	72
4.35	Level of satisfaction based on the attitude of hospital management	73
4.36	Respondents working satisfaction in the hospital	74

4.37	Respondent's relationship level with the colleagues	75
4.38	satisfaction level based on the approach of doctor	76
4.39	Level of discrimination based on gender	77
4.40	Level of importance that get from the hospital management to the respondents	78
4.41	Satisfaction level of the facilities provided by the hospital management	79
4.42	Level of medical assistance provided by the hospital	80
4.43	Level of bad experiences from the patient's side	81
4.44	Satisfaction level of increments and promotion for the carer growth	82

# **INTRODUCTION**

# CHAPTER I

## INTRODUCTION

*“The nurses are one who opens the eyes of a newborn & closes the eyes of a dying man. It is indeed a high blessing to be first and last to witness the beginning and end of life”*

21<sup>st</sup> Century nursing is the glue that holds a patient’s health care journey together. Across the entire patient experience, and wherever there is someone in need of care, nurses work tirelessly to identify and protect the needs of the individual.

Beyond the time-honoured reputation for compassion and dedication lies a highly specialized profession, which is constantly evolving to address the needs of society. From ensuring the most accurate diagnoses to the ongoing education of the public about critical health issues; nurses are indispensable in safeguarding public health.

Nursing can be described as both an art and a science; a heart and a mind. At its heart, lies a fundamental respect for human dignity and an intuition for a patient’s needs. This is supported by the mind, in the form of rigorous core learning. Due to the vast range of specialisms and complex skills in the nursing profession, each nurse will have specific strengths, passions, and expertise.

However, nursing has a unifying ethos: In assessing a patient, nurses do not just consider test results. Through the critical thinking exemplified in the nursing process nurses use their judgment to integrate objective data with subjective experience of a patient’s biological, physical and behavioural needs. This ensures that every patient, from city hospital to community health centre; state prison to summer camp, receives the best possible care regardless of who they are, or where they may be.

In a field as varied as nursing, there is no typical answer. Responsibilities can range from making acute treatment decisions to providing inoculations in schools. The key unifying characteristic in every role is the skill and drive that it takes to be a nurse. Through long-term monitoring of patients’ behaviour and knowledge-based expertise, nurses are best placed to take an all-encompassing view of a patient’s wellbeing.

All nurses complete a rigorous program of extensive education and study, and work directly with patients, families, and communities using the core values of the nursing process. In the United States today, nursing roles can be divided into three categories by the specific responsibilities they undertake

The main responsibilities of the nurses are Perform physical exams and health histories before making critical decisions, provide health promotion, counselling and education, Administer medications and other personalized interventions, Coordinate care, in collaboration with a wide array of health care professionals

Advance Practice Registered Nurses (APRN) hold at least a Master's degree, in addition to the initial nursing education and licensing required for all RNs. The responsibilities of an APRN include, but are not limited to, providing invaluable primary and preventative health care to the public. APRNs treat and diagnose illnesses, advise the public on health issues, manage chronic disease and engage in continuous education to remain at the very forefront of any technological, methodological, or other developments in the field. The roles of these nurses are Nurse Practitioners prescribe medication, diagnose and treat minor illnesses and injuries, Certified Nurse-Midwives provide gynaecological and low-risk obstetrical care, Clinical Nurse Specialists handle a wide range of physical and mental health problems, Certified Registered Nurse Anaesthetists administer more than 65 percent of all anaesthetics.

Licensed Practical Nurses (LPN), also known as Licensed Vocational Nurses (LVNs), support the core health care team and work under the supervision of an RN, APRN or MD. By providing basic and routine care, they ensure the wellbeing of patients throughout the whole of the health care journey. The main responsibilities of these nurses are Check vital signs and look for signs that health is deteriorating or improving, perform basic nursing functions such as changing bandages and wound dressings, ensure patients are comfortable, well-fed and hydrated, may administer medications in some settings

No matter what their field or specialty, all nurses utilize the same nursing process; a scientific method designed to deliver the very best in patient care, through five simple steps.

- **Assessment** – Nurses assess patients on an in-depth physiological, economic, social and lifestyle basis.
- **Diagnosis** – Through careful consideration of both physical symptoms and patient behaviour, the nurse forms a diagnosis.
- **Outcomes / Planning** – The nurse uses their expertise to set realistic goals for the patient’s recovery. These objectives are then closely monitored.
- **Implementation** – By accurately implementing the care plan, nurses guarantee consistency of care for the patient whilst meticulously documenting their progress.
- **Evaluation** – By closely analysing the effectiveness of the care plan and studying patient response, the nurse hones the plan to achieve the very best patient outcomes.

The health and wellbeing of nurses and midwives are essential to the quality of care they can provide for people and communities, affecting their compassion, professionalism and effectiveness. Ensuring that working conditions across all settings – in primary, secondary, mental health, community and social care – are supporting nurses and midwives in their work is fundamental to ensuring the best outcomes for people who need health and care services. In this study focuses on their work life experience and what needs to be done to address the problems they face.

One unique study used a qualitative style of research by conducting interviews to record nurses’ feedback on staff shortages, long hours, and uncooperative patients. One profound participant responded, “I am not able to sleep at all and even if I do then by that time it is already time to wake up”. The nurses have been overworked by having to fill in for staff shortages on top of the more demanding working conditions. Another response read, “wearing PPE was the most troublesome. No food or water for 12 h”, PPE accessibility varied in many countries, but all countries faced similar shortages of the proper supplies to protect them when working in a highly infectious environment every day.

All nurses now say they experience moderate to high-stress levels, with over 60 percent reporting emotional exhaustion. High-stress levels can affect a nurse's health and

well-being, even deplete their energy and impede their critical thinking. nurses in secondary health care, the most stressful factors are low pay, poor interpersonal relationships in the workplace, and psychological or physical abuse in the workplace. Stress can have a significant impact on individual nurses and their ability to accomplish tasks and more specifically, poor decision making, lack of concentration, apathy, decreased motivation and anxiety may impair job performance creating uncharacteristic errors. Nursing is, unquestionably, a very high-stress environment. Although most nurses know right off the bat what they're getting themselves into and are aware that nursing has its challenges, sometimes just how stressful being an RN can get takes a lot of professionals by surprise. Some argue that it is the most stressful role. These nurses work in the ICU. They work with patients who have significant injuries and morbidity risks. Data shows that more than half of all critical care nurses experience burnout syndrome.

Nurses can have an especially difficult time balancing work and personal life because of the increased amount of physical and emotional stress that nurses experience. Taking time to decompress after a shift and remembering to prioritize their own needs are necessary to developing a healthy work-life balance. Without balance in their life, nurses may become susceptible to illness or job burnout. If they are exhausted and distracted, nurses may make medical mistakes that can harm patients. A poor work-life balance can cause higher turnover, which can lead to staffing shortages and increased healthcare costs.

A nurse is a person who is trained to give care to people who are sick or injured. Nurses work with doctors and other health care workers to make patients well and to keep them fit and healthy. Nurses also help with end-of-life needs and assist other family members with grieving. Nursing is a profession within the health care sector focused on the care of individuals, families, and communities so they may attain, maintain, or recover optimal health and quality of life. Nurses may be differentiated from other health care providers by their approach to patient care, training, and scope of practice. Nurses practice in many specialties with differing levels of prescription authority. Nurses comprise the largest component of most healthcare environments; but there is evidence of international shortages of qualified nurses. Many nurses provide care within the ordering scope of physicians, and this traditional role has shaped the public image of nurses as care providers. Nurse practitioners are nurses with a graduate degree in advanced practice nursing. They are however permitted by most jurisdictions to practice

independently in a variety of settings. Since the post-war period, nurse education has undergone a process of diversification towards advanced and specialized credentials, and many of the traditional regulations and provider roles are changing.

Nurses develop a plan of care, working collaboratively with physicians, therapists, the patient, the patient's family, and other team members that focuses on treating illness to improve quality of life. In the United Kingdom and the United States, clinical nurse specialists and nurse practitioners, diagnose health problems and prescribe the correct medications and other therapies, depending on particular state regulations. Nurses may help coordinate the patient care performed by other members of a multidisciplinary health care team such as therapists, medical practitioners, and dietitians.

Nurses provide care both interdependently, for example, with physicians, and independently as nursing professionals. Nursing historians face the challenge of determining whether care provided to the sick or injured in antiquity is called nursing care. In the fifth century BC, for example, the Hippocratic Collection in places describes skilled care and observation of patients by male "attendants," who may have been early nurses. Around 600 BC in India, it is recorded in Sushruta Samhita, Book 3, Chapter V about the role of the nurse as "the different parts or members of the body as mentioned before including the skin, cannot be correctly described by one who is not well versed in anatomy. Hence, any one desirous of acquiring a thorough knowledge of anatomy should prepare a dead body and carefully, observe, by dissecting it, and examine its different parts."

Before the foundation of modern nursing, members of religious orders such as nuns and monks often provided nursing-like care. Examples exist in Christian, Islamic and Buddhist traditions amongst others. Phoebe, mentioned in Romans 16 has been described in many sources as "the first visiting nurse". These traditions were influential in the development of the ethos of modern nursing. The religious roots of modern nursing remain in evidence today in many countries. One example in the United Kingdom is the use of the historical title "sister" to refer to a senior nurse in the past.

During the Reformation of the 16th century, Protestant reformers shut down the monasteries and convents, allowing a few hundred municipal hospices to remain in operation in northern Europe. Those nuns who had been serving as nurses were given pensions or told to get

married and stay home. Nursing care went to the inexperienced as traditional caretakers, rooted in the Roman Catholic Church, were removed from their positions. The nursing profession suffered a major setback for approximately 200 years.

During the Crimean War the Grand Duchess Elena Pavlova issued the call for women to join the Order of Exaltation of the Cross for the year of service in the military hospitals. The first section of twenty-eight "sisters", headed by Aleksandra Petrovna Stakhovich, the Directress of the Order, went off to the Crimea early in November 1854.

Florence Nightingale laid the foundations of professional nursing after the Crimean War. Her *Notes on Nursing* (1859) became popular. The Nightingale model of professional education, having set up one of the first school of nursing that is connected to a continuously operating hospital and medical school, spread widely in Europe and North America after 1870. Nightingale was also a pioneer of the graphical presentation of statistical data. Nightingale's recommendations built upon the successes of Jamaican "doctresses" such as Mary Seacole, who like Nightingale, served in the Crimean War. Seacole practised hygiene and the use of herbs in healing wounded soldiers and those suffering from diseases in the 19th century in the Crimea, Central America, and Jamaica. Her predecessors had great success as healers in the Colony of Jamaica in the 18th century, and they included Seacole's mother, Mrs. Grant, Sarah Adams, Cubah Cornwallis, and Grace Donne, the mistress and doctress to Jamaica's wealthiest planter, Simon Taylor.

Other important nurses in the development of the profession include: Agnes from Shropshire was the first orthopaedic nurse and was pivotal in the emergence of the orthopaedic hospital The Robert Jones & Agnes Hunt Hospital in Oswestry, Shropshire. Valerie who opened, with her husband Agénor de Gasparin, the first nursing school in the world : La Source, in Lausanne, Switzerland. Agnes Jones, who established a nurse training regime at the Brownlow Hill infirmary, Liverpool, in 1865. Linda Richards, who established quality nursing schools in the United States and Japan, and was officially the first professionally trained nurse in the US, graduating in 1873 from the *New England Hospital for Women and Children* in Boston. Clarissa Harlowe "Clara" Barton, a pioneer American teacher, patent clerk, nurse, and humanitarian, and the founder of the American Red Cross. Saint Marianne Cope, a sister of St. Francis who opened and operated some of the first general hospitals in the United

States, instituting cleanliness standards which influenced the development of America's modern hospital system.

Red Cross chapters, which began appearing after the establishment of the International Committee of the Red Cross in 1863, offered employment and professionalization opportunities for nurses (despite initial objections from Florence Nightingale). Catholic orders such as Little Sisters of the Poor, Sisters of Mercy, Sisters of St. Mary, St. Francis Health Services, Inc. and Sisters of Charity built hospitals and provided nursing services during this period. In turn, the modern deaconess movement began in Germany in 1836. Within a half century, there were over 5,000 deaconesses in Europe. Formal use of nurses in the modern military began in the latter half of the nineteenth century. Nurses saw active duty in the First Boer War, the Egyptian Campaign (1882), and the Sudan Campaign (1883). Hospital-based training came to the fore in the early 1900s, with an emphasis on practical experience. The Nightingale-style school began to disappear. Hospitals and physicians saw women in nursing as a source of free or inexpensive labour. Exploitation of nurses was not uncommon by employers, physicians, and educational providers.

Many nurses saw active duty in World War I, but the profession was transformed during the Second World War. British nurses of the Army Nursing Service were part of every overseas campaign. More nurses volunteered for service in the US Army and Navy than any other occupation. The Nazis had their own Brown Nurses, 40,000 strong. Two dozen German Red Cross nurses were awarded the Iron Cross for heroism under fire.

The modern era saw the development of undergraduate and post-graduate nursing degrees. Advancement of nursing research and a desire for association and organization led to the formation of a wide variety of professional organizations and academic journals. Growing recognition of nursing as a distinct academic discipline was accompanied by an awareness of the need to define the theoretical basis for practice.

In the 19th and early 20th century, nursing was considered a women's profession, just as doctoring was a men's profession. With increasing expectations of workplace equality during the late 20th century, nursing became an officially gender-neutral profession, though in practice the percentage of male nurses remains well below that of female physicians in the early 21st century. The authority for the practice of nursing is based upon a social contract that

delineates professional rights and responsibilities as well as mechanisms for public accountability. In almost all countries, nursing practice is defined and governed by law, and entrance to the profession is regulated at the national or state level.

The aim of the nursing community worldwide is for its professionals to ensure quality care for all, while maintaining their credentials, code of ethics, standards, and competencies, and continuing their education. There are a number of educational paths to becoming a professional nurse, which vary greatly worldwide; all involve extensive study of nursing theory and practice as well as training in clinical skills. Nurses care for individuals of all ages and cultural backgrounds who are healthy and ill in a holistic manner based on the individual's physical, emotional, psychological, intellectual, social, and spiritual needs. The profession combines physical science, social science, nursing theory, and technology in caring for those individuals.

To work in the nursing profession, all nurses hold one or more credentials depending on their scope of practice and education. In the United States, a Licensed Practical Nurse (LPN) works independently or with a Registered Nurse (RN). The most significant difference between an LPN and RN is found in the requirements for entry to practice, which determines entitlement for their scope of practice. RNs provide scientific, psychological, and technological knowledge in the care of patients and families in many health care settings. RNs may earn additional credentials or degrees.

Some nurses follow the traditional role of working in a hospital setting. Other options include: paediatrics, neonatal, maternity, OBGYN, geriatrics, ambulatory, and nurse anaesthetists and informatics. There are many other options nurses can explore depending on the type of degree and education acquired. RNs may also pursue different roles as advanced practice nurses. Nurses are not doctors' assistants. This is possible in certain situations, but nurses more often are independently caring for their patients or assisting other nurses. RNs treat patients, record their medical history, provide emotional support, and provide follow-up care. Nurses also help doctors perform diagnostic tests. Nurses are almost always working on their own or with other nurses. However, they also assist doctors in the emergency room or in trauma care when help is needed.

Despite equal opportunity legislation, nursing has continued to be a female-dominated profession in many countries; according to the WHO's 2020 State of the World's Nursing, approximately 90% of the nursing workforce is female. For instance, the male-to-female ratio of nurses is approximately 1:19 in Canada and the United States. This ratio is represented around the world. Notable exceptions include Francophone Africa, which includes the countries of Benin, Burkina Faso, Cameroon, Chad, Congo, Côte d'Ivoire, the Democratic Republic of Congo, Djibouti, Guinea, Gabon, Mali, Mauritania, Niger, Rwanda, Senegal, and Togo, which all have more male than female nurses. In Europe, in countries such as Spain, Portugal, Czech Republic and Italy, over 20% of nurses are male.<sup>[51]</sup> In the United Kingdom, 11% of nurses and midwives registered with the Nursing and Midwifery Council (NMC) are male. The number of male nurses in the United States doubled between 1980 and 2000. However female nurses are still more common, but male nurses receive more pay on average.

Research has indicated that there can be negative effects of diversity within nursing. When there is a heavier focus on diversity in nursing, the quality of care or performance of the nurses can be hindered. Research demonstrates that as people begin to be different in a work setting, this can create issues if not addressed correctly. When hospitals begin to focus on diversity over their patients, the quality of care can be negatively affected if diversity becomes the main goal. Nursing practice is the actual provision of nursing care. In providing care, nurses implement the nursing care plan using the nursing process. This is based around a specific nursing theory which is selected in consideration with the care setting and the population served. In providing nursing care, the nurse uses both nursing theory and best practice derived from nursing research.

In general terms, the nursing process is the method used to assess and diagnose needs, plan outcomes and interventions, implement interventions, and evaluate the outcomes of the care provided. Like other disciplines, the profession has developed different theories derived from sometimes diverse philosophical beliefs and paradigms or worldviews to help nurses direct their activities to accomplish specific goals.

Nurses practice in a wide range of settings, including hospitals, private homes, schools, and pharmaceutical companies. Nurses work in occupational health settings, free-standing clinics and physician offices, nurse-led clinics, long-term care facilities and camps. They also work

on cruise ships and in the military service. Nurses act as advisers and consultants to the health care and insurance industries. Many nurses also work in the health advocacy and patient advocacy fields at companies such as Health Advocate, Inc. helping in a variety of clinical and administrative issues. Some are attorneys and others work with attorneys as legal nurse consultants, reviewing patient records to assure that adequate care was provided and testifying in court. Nurses can work on a temporary basis, which involves doing shifts without a contract in a variety of settings, sometimes known as *per diem nursing*, *agency nursing* or *travel nursing*. Nurses work as researchers in laboratories, universities, and research institutions. Nurses have also been delving into the world of informatics, acting as consultants to the creation of computerized charting programs and other software. Nurse authors publish articles and books to provide essential reference materials.

Internationally, there is a serious shortage of nurses. One reason for this shortage is due to the work environment in which nurses practice. In a recent review of the empirical human factors and ergonomic literature specific to nursing performance, nurses were found to work in generally poor environmental conditions. Some countries and states have passed legislation regarding acceptable nurse-to-patient ratios.

The fast-paced and unpredictable nature of health care places nurses at risk for injuries and illnesses, including high occupational stress. Nursing is a particularly stressful profession, and nurses consistently identify stress as a major work-related concern and have among the highest levels of occupational stress when compared to other professions. This stress is caused by the environment, psychosocial stressors, and the demands of nursing, including new technology that must be mastered, the emotional labour involved in nursing, physical labour, shift work, and high workload. This stress puts nurses at risk for short-term and long-term health problems, including sleep disorders, depression, mortality, psychiatric disorders, stress-related illnesses, and illness in general. Nurses are at risk of developing compassion fatigue and moral distress, which can worsen mental health. They also have very high rates of occupational burnout (40%) and emotional exhaustion (43.2%). Burnout and exhaustion increase the risk for illness, medical error, and suboptimal care provision.

Nurses are also at risk for violence and abuse in the workplace. Violence is typically perpetrated by non-staff, whereas abuse is typically perpetrated by other hospital

personnel. Of American nurses, 57% reported in 2011 that they had been threatened at work; 17% were physically assaulted. There are 3 different types of workplace violence that nurses can experience. First, physical violence, which can be hitting, kicking, beating, punching, biting, and using objects to inflict force upon someone. Second, psychological violence is when something is done to impair another person through threats and/or coercion. Third, sexual violence which can include any completed or attempted non-consensual sexual act.

Workplace violence can also be categorized into two different levels, interpersonal violence and organizational coercion. Interpersonal violence could be committed by co-workers and/or patients by others in the hospital. The main form of this level is verbal abuse. Organizational coercion may include an irrationally high workload, forced shifts, forced placement in different wards of the hospital, low salaries, denial of benefits for overwork, poor working environment, and other workplace stressors. These problems can affect the quality of life for these nurses who may experience them. It can be extremely detrimental to nurses if their managers lack understanding of the severity of these problems and do not support the nurses through them. There are many contributing factors to workplace violence. These factors can be divided into environmental, organizational, and individual psychosocial. The environmental factors can include the specific setting, long patient wait times, frequent interruptions, uncertainty regarding the patients' treatment, and heavy workloads. Organizational factors can include inefficient teamwork, organizational injustice, lack of aggression and/or stress management programs, and distrust between colleagues. Individual psychosocial factors may include nurses being young and inexperienced, previous experiences with violence, and a lack of communication skills. Misunderstandings may also occur due to the communication barrier between nurses and patients. An example of this could be the patient's condition being affected by medication, pain, and/or anxiety.

There are many causes of workplace violence. The most common perpetrators for harassment and/or bullying against nursing students were registered nurses including preceptors, mentors, and clinical facilitators. However, the main cause of workplace violence against nurses were patients. 80% of serious violence incidents in health care centers were due to the nurses' interactions with patients. There are many different effects of workplace violence in the field of Nursing. Workplace violence can have a negative impact on nurses both emotionally and

physically. They feel depersonalized, dehumanized, fatigued, worn out, stressed out, and tired. Because of the severity of some incidents of violence, nurses have reported manifestations of burn-out due to the frequent exposure. This can heavily impact of a nurses' mental health and cause nurses to feel unsatisfied with their profession and unsafe in their work environment.

There are a number of interventions that can mitigate the occupational hazards of nursing. They can be individual-focused or organization-focused. Individual-focused interventions include stress management programs, which can be customized to individuals. Stress management programs can reduce anxiety, sleep disorders, and other symptoms of stress. Organizational interventions focus on reducing stressful aspects of the work environment by defining stressful characteristics and developing solutions to them. Using organizational and individual interventions together is most effective at reducing stress on nurses. In some Japanese hospitals, powered exoskeletons are used. Lumbar supports have also been trialled.

The oldest method of nursing education is the hospital-based diploma program, which lasts approximately three years. Students take between 30 and 60 credit hours in anatomy, physiology, microbiology, nutrition, chemistry, and other subjects at a college or university, then move on to intensive nursing classes. Until 1996, most RNs in the US were initially educated in nursing by diploma programs. According to the Health Services Resources Administration's 2000 Survey of Nurses only six percent of nurses who graduated from nursing programs in the United States received their education at a Diploma School of Nursing.

The most common initial nursing education is a two-year Associate Degree in Nursing (Associate of Applied Science in Nursing, Associate of Science in Nursing, Associate Degree in Nursing), a two-year college degree referred to as an ADN. Some four-year colleges and universities also offer the ADN. Associate degree nursing programs have prerequisite and corequisite courses (which may include English, Math and Human Anatomy and Physiology) and ultimately stretch out the degree-acquiring process to about three years or greater. Another pathway into the profession, or a higher level of education for other nurses, is obtaining a Bachelor of Science in Nursing (BSN), a four-year degree that also prepares nurses for graduate-level education. For the first two years in a BSN program, students usually obtain general education requirements and spend the remaining time in nursing courses. In some new programs the first two years can be substituted for an active LPN license along with the required general studies.

Advocates for the ADN and diploma programs state that such programs have an on the job training approach to educating students, while the BSN is an academic degree that emphasizes research and nursing theory. Some states require a specific amount of clinical experience that is the same for both BSN and ADN students. A BSN degree qualifies its holder for administrative, research, consulting and teaching positions that would not usually be available to those with an ADN, but is not necessary for most patient care functions. Nursing schools may be accredited by either the Accreditation Commission for Education in Nursing (ACEN) or the Commission on Collegiate Nursing Education (CCNE).

Advanced education in nursing is done at the master's and doctoral levels. It prepares the graduate for specialization as an advanced practice registered nurse (APRN) or for advanced roles in leadership, management, or education. The clinical nurse leader (CNL) is an advanced generalist who focuses on the improvement of quality and safety outcomes for patients or patient populations from an administrative and staff management focus. Doctoral programs in nursing prepare the student for work in nursing education, health care administration, clinical research, public policy, or advanced clinical practice. Most programs confer the PhD in nursing or Doctor of Nursing Practice (DNP). Areas of advanced nursing practice include that of a nurse practitioner (NP), a certified nurse midwife (CNM), a certified registered nurse anaesthetist (CRNA), or a clinical nurse specialist (CNS). Nurse practitioners and CNSs work assessing, diagnosing and treating patients in fields as diverse as family practice, women's health care, emergency nursing, acute/critical care, psychiatry, geriatrics, or paediatrics, additionally, a CNS usually works for a facility to improve patient care, do research, or as a staff educator.

Completion of any one of these three educational routes allows a graduate nurse to take the NCLEX-RN, the test for licensure as a registered nurse, and is accepted by every state as an adequate indicator of minimum competency for a new graduate. However, controversy exists over the appropriate entry-level preparation of RNs. Some professional organizations believe the BSN should be the sole method of RN preparation and ADN graduates should be licensed as "technical nurses" to work under the supervision of BSN graduates. Others feel the on-the-job experiences of diploma and ADN graduates makes up for any deficiency in theoretical preparation.

RNs are the largest group of health care workers in the United States, with about 2.7 million employed in 2011. It has been reported that the number of new graduates and foreign-trained nurses is insufficient to meet the demand for registered nurses; this is often referred to as the nursing shortage and is expected to increase for the foreseeable future. There are data to support the idea that the nursing shortage is a voluntary shortage. In other words, nurses are leaving nursing of their own volition. In 2006 it was estimated that approximately 1.8 million nurses chose not to work as a nurse. The Bureau of Labour Statistics (BLS) reported that 296,900 healthcare jobs were created in 2011. RNs make up the majority of the healthcare work force, therefore these positions will be filled primarily by nurses. The BLS also states that by 2020, there will be 1.2 million nursing job openings due to an increase in the workforce, and replacements.

The International Council of Nursing (ICN), the largest international health professional organization in the world, recognizes the shortage of nurses as a growing crisis in the world. This shortage impacts the healthcare of everyone worldwide. One of the many reasons is that nurses who pursue to become nurses do so very late in their lives. This leads to a non-lengthy employment time. A national survey prepared by the Federation of Nurses and Health Professionals in 2001 found that one in five nurses plans to leave the profession within five years because of unsatisfactory working conditions, including low pay, severe under staffing, high stress, physical demands, mandatory overtime, and irregular hours. Approximately 29.8 percent of all nursing jobs are found in hospitals. However, due to administrative cost cutting, increased nurse's workload, and rapid growth of outpatient services, hospital nursing jobs will experience slower than average growth. Employment in home care and nursing homes is expected to grow rapidly. Though more people are living well into their 80s and 90s, many need the kind of long-term care available at a nursing home. Many nurses will also be needed to help staff the growing number of out-patient facilities, such as HMOs (Health Maintenance Organizations), group medical practices, and ambulatory surgery centers. Nursing specialties will be in great demand. There are, in addition, many part-time employment possibilities.

Levsey, Campbell, and Green voiced their concern about the shortage of nurses, citing Fang, Wilsey-Wisniewski, & Bednash, 2006, who state that over 40,000 qualified nursing applicants were turned away in the 2005–2006 academic year from baccalaureate nursing programs due to a lack of masters and doctoral qualified faculty, and that this number was

increased over 9,000 from 32,000 qualified but rejected students from just two years earlier. Several strategies have been offered to mitigate this shortage including; Federal and private support for experienced nurses to enhance their education, incorporating more hybrid/blended nursing courses, and using simulation in lieu of clinical (hospital) training experiences.

Furthermore, there is a shortage of academically qualified instructors to teach at schools of nursing worldwide. The serious need for educational capacity is not being met, which is the underlying most important preparation resource for the nurses of tomorrow. The decrease in faculty everywhere is due to many factors including decrease in satisfaction with the workforce, poor salaries, and reduction in full-time equivalent. Throughout the span of 6 years the nursing faculty shortage has been written about an increasing amount. There is no clear consensus or an organized plan on how to fix the ongoing issue.

With health care knowledge growing steadily, nurses can stay ahead of the curve through continuing education. Continuing education classes and programs enable nurses to provide the best possible care to patients, advance nursing careers, and keep up with Board of Nursing requirements. The American Nurses Association and the American Nursing Credentialing Centre are devoted to ensuring nurses have access to quality continuing education offerings. Continuing education classes are calibrated to provide enhanced learning for all levels of nurses. Many States also regulate Continuing Nursing Education. Nursing licensing boards requiring Continuing Nursing Education (CNE) as a condition for licensure, either initial or renewal, accept courses provided by organizations that are accredited by other state licensing boards, by the American Nursing Credentialing Centre (ANCC), or by organizations that have been designated as an approver of continuing nursing education by ANCC. There are some exceptions to this rule including the state of California, Florida and Kentucky. National Healthcare Institute has created a list to assist nurses in determining their CNE credit hours requirements. While this list is not all inclusive, it offers details on how to contact nursing licensing boards directly.

Nurses help people and their families cope with illness, deal with it, and if necessary live with it, so that other parts of their lives can continue. Nurses do more than care for individuals. They have always have been at the forefront of change in health care and public health.

# **REVIEW OF LITERATURE**

## CHAPTER II

### REVIEW OF LITERATURES

*“The motherly care and affection of nurses are the key reason behind the recovery of so many patients.”*

A person trained to provide medical care for the sick or disabled, especially one who is licensed and works in a hospital or physician's office. The definition of a nurse is someone who cares for sick, old or young people, or someone who provides medical assistance. “Nursing is not a job. Being a nurse means patients in your care must be able to trust you. It means treating your patients and colleagues with respect, kindness, dignity and compassion.” Nurses are not doctors' assistants. This is possible in certain situations, but nurses more often are independently caring for their patients or assisting other nurses. RNs treat patients, record their medical history, provide emotional support, and provide follow-up care. Nurses also help doctors perform diagnostic tests. Nurses are almost always working on their own or with other nurses. Nurses will assist doctors in the emergency room or in trauma care when help is needed. Nurses care for individuals of all ages and cultural backgrounds who are healthy and ill in a holistic manner based on the individual's physical, emotional, psychological, intellectual, social, and spiritual needs. The profession combines physical science, social science, nursing theory, and technology in caring for those individuals.

Related studies about nurses:

According to the article **“The impact of occupational stress on nurses' caring behaviours and their health-related quality of life”** Nursing is perceived as a strenuous job. Although past research has documented that stress influences nurses' health in association with quality of life, the relation between stress and caring behaviours remains relatively unexamined, especially in the Greek working environment, where it is the first time that this specific issue is being studied. The aim was to investigate and explore the correlation amidst occupational stress, caring behaviours and their quality of life in association to health. Contact with death, patients and their families, conflicts with supervisors and uncertainty about the therapeutic effect caused significantly higher stress among participants. A significant negative correlation was observed amidst total stress and

the four dimensions of CBI. Certain stress factors were significant and independent predictors of each CBI dimension. Conflicts with co-workers was revealed as an independent predicting factor for affirmation of human presence, professional knowledge and skills and patient respectfulness dimensions, conflicts with doctors for respect for patient, while conflicts with supervisors and uncertainty concerning treatment dimensions were an independent predictor for positive connectedness. Finally, discrimination stress factor was revealed as an independent predictor of quality of life related to physical health, while stress resulting from conflicts with supervisors was independently associated with mental health. Occupational stress affects nurses' health-related quality of life negatively, while it can also be considered as an influence on patient outcomes.

**According to the article “Nurses' satisfaction with their work environment and the outcomes of clinical nursing supervision on nurses' experiences of well-being” - a Norwegian study**

Various studies have demonstrated that nursing is stressful and that the incidence of occupational stress-related burnout in the profession is high. This descriptive-correlational study examined nurses' satisfaction with their psychosocial work environment, their moral sensitivity and differences in outcomes of clinical nursing supervision in relation to nurses' well-being by systematically comparing supervised and unsupervised nurses. The nurses' satisfaction with their psychosocial work environment was reflected in six factors: 'job stress and anxiety', 'relationship with colleagues', 'collaboration and good communication', 'job motivation', 'work demands' and 'professional development'. The nurses' perceptions of moral sensitivity comprised seven factors: 'grounds for actions', 'ethical conflicts', 'values in care', 'independence patient-oriented care', 'the desire to provide high-quality care' and 'the desire to provide high-quality care creates ethical dilemmas'. Nurses well-being were reflected in four factors 'physical symptom and anxiety', 'feelings of not being in control', 'engagement and motivation' and 'eye strain sleep disturbance'. The moral sensitivity 'ethical conflicts' were found to have mild negative correlations with psychosocial work environment 'job stress and anxiety professional development' and with 'total score' psychosocial work, moral sensitivity factor 'independence were correlated with psychosocial work factor 'relationships with colleagues' and 'total score', moral sensitivity were mildly correlated with 'collaboration and good communication and had a negative correlation to psychosocial work factor 'work demands'. In addition, significant correlations were found between

the nurses' well-being profile and demographic variables, between 'engagement and motivation' and 'absence due to illness' and between 'time allocation for tasks', 'physical symptoms and anxiety' and 'age'. Mild significant differences were found between nurses attending and not attending group supervision and between 'physical symptoms and anxiety' and 'feelings of not being in control'. We conclude that ethical conflicts in nursing are a source of job-related stress and anxiety. The outcome of supporting nurses by clinical nursing supervision may have a positive influence on their perceptions of well-being. clinical nursing supervision have a positive effect on nurses physical symptoms and their feeling of anxiety as well as having a sense of being in control of the situation. We also conclude that psychosocial work have an influence on nurses experience of having or not having control and their engagement and motivation.

According to the article **“Work environment and workforce problems: a cross-sectional questionnaire survey of hospital nurses in Belgium”** This study investigated Belgian hospital nurses' perceptions on work environment and workforce issues, quality of care, job satisfaction and professional decision making. The study identified several areas of tension in the nursing profession. The commitment to being competent providers of quality care was remarkably strong among the nurses, but they also perceived the barriers in the work environment to be multiple and complex. Concerns about the quality of leadership and management, insufficient staff, time demands and stressful work environment are experienced as obstacles in providing good nursing care. Four out of ten nurses (39.2%) would not choose nursing again as a career and more than half of the nurses (54.3%) have contemplated leaving the profession at some point in time. To effectively tackle the professional and workforce issues in nursing, investments should focus on redesigning a work environment that supports nurses in providing comprehensive professional care.

According to the article **“Association between Health Problems and Turnover Intention in Shift Work Nurses: Health Problem Clustering”** Shift work nurses experience multiple health problems due to irregular shifts and heavy job demands. However, the comorbidity patterns of

nurses' health problems and the association between health problems and turnover intention have rarely been studied. This study aimed to identify and cluster shift work nurses' health problems and to reveal the associations between health problems and turnover intention. In this cross-sectional study, we analysed data from 500 nurses who worked at two tertiary hospitals in Seoul, South Korea. Data, including turnover intention and nine types of health issues, were collected between March 2018 and April 2019. Hierarchical clustering and multiple ordinal logistic regressions were used for the data analysis. Among the participants, 22.2% expressed turnover intention and the mean number of health problems was 4.5 (range 0-9). Using multiple ordinal logistic regressions analysis, it was shown that sleep disturbance, depression, fatigue, a gastrointestinal disorder, and leg or foot discomfort as a single health problem significantly increased turnover intention. After clustering the health problems, four clusters were identified and only the neuropsychological cluster-sleep disturbance, fatigue, and depression-significantly increased turnover intention. We propose that health problems within the neuropsychological cluster must receive close attention and be addressed simultaneously to decrease nurse's turnover intentions.

According to the article **“Impact of workplace violence against nurses' thriving at work, job satisfaction and turnover intention: A cross-sectional study”** To investigate the interrelationships between workplace violence, thriving at work and turnover intention among Chinese nurses and to explore the action mechanism among these variables. Workplace violence is a dangerous occupational hazard globally, and it is pervasive in the health service industry. As a corollary, workplace violence may produce many negative outcomes among nursing staff. Consequently, it hinders nurses' professional performance and reduces nursing quality. Workplace violence significantly negatively influenced nurses' job satisfaction and thriving at work, and significantly positively influenced nurses' turnover intention. Job satisfaction significantly predicted thriving at work and turnover intention. Job satisfaction not only fully mediated the relationship between workplace violence and thriving at work, but also partially mediated the relationship between workplace violence and turnover intention. Subjective well-being moderated the relationship between workplace violence and job satisfaction and the relationship between workplace violence and nurses' turnover intention. Adverse effects of workplace violence were

demonstrated in this study. Decreases in job satisfaction were a vital mediating factor. The moderating effect of subjective well-being was helpful in reducing the harm of workplace violence to nurses and in decreasing their turnover intention. Workplace violence and its negative impact on nursing work should not go unnoticed by nursing managers. Nurses' subjective well-being is critical in controlling and mitigating the adverse effects of workplace violence.

According to the article **“The Value of Nursing”** This article is part of a wider study entitled Value of Nursing, and contains the literature search from electronic databases. Key words for the search included 'values of nursing', 'values in nursing', 'organisational values' and 'professional identity'. Thirty-two primary reports published in English between 2000 and 2006 were identified. The findings highlight the importance of understanding values and their relevance in nursing and how values are constructed. The value of nursing is seen to be influenced by cultural change, globalization, and advancement in technology and medicine. These factors are crucial in providing a more structured and measured view of what nursing is, which will result in greater job satisfaction among nurses, better nurse retention and enhanced patient care within a supportive and harmonious organization. The findings of this review have implications for policy makers in recruitment and retention in determining the global value of nursing.

According to the article **“Disaster preparedness among nurses”** This review explored peer-reviewed publications that measure nurses' preparedness for disaster response. The increasing frequency of disasters worldwide necessitates nurses to adequately prepare to respond to disasters to mitigate the negative consequences of the event on the affected population. Despite growing initiatives to prepare nurses for any disasters, evidence suggests they are under prepared for disaster response. Factors that increase preparedness for disaster response include previous disaster response experience and disaster-related training. However, it is widely reported that nurses are insufficiently prepared and do not feel confident responding effectively to disasters. The findings of this review contribute to a growing body of knowledge regarding disaster preparedness in nurses and have implications for academia, hospital administration and nursing educators. The findings of this review provide evidence that could be used by nurse educators and nurse administrators to better prepare nurses for disaster response. The findings from this review place an emphasis on hospitals to implement policies to address lack of preparedness among their employees.

Furthermore, this review highlights the benefit of further research and provision of well-grounded disaster exercises that mimic actual events to enhance the preparedness of the nursing workforce.

According to the article “**Impact of job satisfaction components on intent to leave and turnover for hospital-based nurses**” The United Kingdom (UK), alongside other industrialised countries, is experiencing a shortage of nurses partly due to low retention rates. Job satisfaction has been highlighted as a contributing factor to intent to leave and turnover, yet this is a complex area with many elements affecting its measurement. The key findings suggest that stress and leadership issues continue to exert influence on dissatisfaction and turnover for nurses. Level of education achieved and pay were found to be associated with job satisfaction, although the results for these factors were not consistent. Investigating possible changes over time in sources of dissatisfaction revealed that factors related to the work environment rather than individual or demographic factors were still of most importance to nurses’ turnover intentions. The differences found to occur across work settings necessitates analysis of job satisfaction at ward level, and the contribution of qualitative methods to develop more detailed insight is emphasised. The inconsistent findings over time associated with the effects of educational attainment and pay on intent to leave suggest that it is imperative that sources of job satisfaction are reassessed in the light of ongoing changes.

According to the article “**Factors that influence nurses’ job satisfaction**” Job satisfaction has become a critical issue for healthcare organisations in recent years, particularly in nursing, because of potential labour shortages, their effect on patient care, and the associated costs. Work satisfaction is a major factor in nurse retention and the delivery of high-quality care, but rapid changes in healthcare services have placed more demands on nurses and this has increased the need for organisations to consider ways to sustain and improve nurses’ job satisfaction. To achieve this, they need to understand the factors that affect job satisfaction and dissatisfaction. This article reports the results of a literature review that was aimed at examining and reaching a deeper understanding of the factors related to nurses’ job satisfaction.

According to the article “**Nurses’ attitudes towards self-harm People who self-harm experiences many problems and needs related to management of emotional and practical stress.**” A positive attitude among nurses is especially important given the close contact they have with people who self-harm. This article is based on a review of the literature. It includes articles

that concern both general and mental health nurses who work in various healthcare settings (e.g. acute inpatients wards, community mental health, emergency departments and medical admission units). The literature shows that negative attitudes towards self-harm are common among nurses. It remains unclear how nurses' age, work experience and gender influence their attitudes. The setting in which nurses work appears to influence their attitude, as does their level of qualification. For example, mental health nurses appear to have more positive attitudes than general nurses. Nurses' attitudes can be improved with the help of education comprising reflective and interactive elements. Supervision and support from colleagues appear to be especially important for mental health nurses. Self-harm is a growing health problem. Nurses in a variety of healthcare settings play a central role in the care of people who self-harm. Their professional attitudes towards these people are essential for high-quality care. This review aims to develop insight into nurses' attitudes towards self-harm as they exist in contemporary nursing practice. A literature search was conducted in four databases, and a total of 15 relevant articles were found. This review indicates that negative attitudes towards self-harm are common among nurses.

The influence of nurses' age, gender and work experience remains unclear. Healthcare setting and qualification level appear to be influencing factors. Education can have a positive influence on nurses' attitudes towards self-harm, especially when it includes reflective and interactive components. It is demonstrated in this review that a major change is needed regarding nurses' attitudes. To realize this change, nurses need to be trained and educated adequately concerning self-harm. They need time and resources to build a therapeutic relationship with people who harm themselves so they can offer high-quality care for this vulnerable group.

According to the article **“Nurses’ intention to leave the profession”** Lack of nurses and nurse turnover represent problems for the healthcare system in terms of cost, the ability to care for patients and the quality of care. At a time of current nursing shortage, it is important to understand the reasons why nurses intend to leave the profession. Further research is needed using sound measurement instruments, consistent measures of leaving intention and more rigorous sampling. More in-depth research is needed to give nurses opportunities to explain in their own words the reasons for their intentions to leave.

According to the article “**What works to address obesity in nurses?**” There is evidence that the prevalence of overweight and obesity among nurses is increasing. As well as the impact on health, the costs associated with obesity include workplace injury, lost productivity and sickness absence. Finding ways to address obesity in nurses may be a challenge because of the barriers they face in leading a healthy lifestyle. Eleven primary studies were found concerning lifestyle interventions for nurses. There was no strong evidence for any particular intervention to address obesity, although integrating interventions into nurses’ daily working lives may be important. Case studies from the grey literature showcased a range of interventions, but very few studies reported outcomes. The review demonstrates that there is insufficient good-quality evidence about successful interventions to address obesity in nurses. Evidence does indicate that interventions should be designed around the specific barriers nurses may face in leading a healthy lifestyle.

Moral distress experienced by nurses are frequently confronted with ethical dilemmas in their nursing practice. As a consequence, nurses report experiencing moral distress. The aim of this review was to synthesize the available quantitative evidence in the literature on moral distress experienced by nurses. We appraised 19 articles published between January 1984 and December 2011. This review revealed that many nurses experience moral distress associated with difficult care situations and feel burnout, which can have an impact on their professional position. Further research is required to examine worksite strategies to support nurses in these situations and to develop coping strategies for dealing with moral distress.

According to the article “**Critical Review on Suicide Among Nurses**” Research shows that there is a high prevalence of suicide among nurses. Despite this, it has been 15 years since the last literature review on the subject was published. *Aim:* The aim of this article is to review the knowledge currently available on the risk of suicide among nurses and on contributory risk factors. *Method:* A search was conducted in electronic databases using keywords related to prevalence and risk factors of suicide among nurses. The abstracts were analysed by reviewers

according to selection criteria. Selected articles were submitted to a full-text review and their key elements were summarized. *Results:* Only nine articles were eligible for inclusion in this review. The results of this literature review highlight both the troubling high prevalence of suicide among nurses as well as the persistent lack of studies that examine this issue. Considering that the effects of several factors related to nurses' work and work settings are associated with high stress, distress, or psychiatric problems, we highlight the relevance of investigating work-related factors associated with nurses' risk of suicide. Several avenues for future studies are discussed as well as possible research methods.

According to the article “**Factors related to perioperative nurses' job satisfaction and intention to leave**” A multivariate linear regression model explained 49% of variance in nurses' job satisfaction, and a multivariate logistic regression explained 19% of the variance in their intent to leave. After controlling for work status and other predictors, nurse-physician relationship was significantly related to nurses' job satisfaction, and emotional exhaustion was the key predictor for both outcome variables. This study demonstrated that higher emotional exhaustion is associated with decreased job satisfaction and increased intention to leave among perioperative nurses. The findings suggest that nurse managers should create an empowering and open work environment that fosters perioperative nurses' job satisfaction and reduces their intention to leave.

**Medication calculation competencies for registered nurses: A literature review** Objective To describe the literature that focuses on safe administration of medications, medication calculation skills development and maintenance of ongoing competence in nurses. Setting University and hospital nurse education departments. Subjects Theoretical and empirical literature focusing on nurse mediated medication administration errors Primary argument Nurse education departments devote a high proportion of time to medication calculation skill development and testing. Annual testing is time consuming for both nurse educators and nurses, and the validity, frequency, acceptable pass mark, self-efficacy and maintenance of skills related to medication calculation testing is largely unclear. Conclusion The theoretical literature focuses on drug administration errors, development of tools and techniques to improve nurses' medication calculation skills and

guidelines. There is considerable debate as to nurses' self-perception of their arithmetical skills, their educational needs in this area and the relationship between skill level and patient outcomes. Empirical literature focuses on the incidence of errors, evaluation of medication calculation skills; the relationship between test results and errors, effectiveness of strategies to improve medication calculation skills and medication calculation testing and policy. Course content and delivery are thought to influence safe medication administration; however, there has been a lack of rigorous research demonstrating the efficacy of educational models. Several studies report low levels of calculation proficiency in nurses; however, it is unclear whether medication calculation testing affects medication administration error rates. Further research is required to determine the robustness of the current processes to assess nurses' medication calculation competence and ensure optimal patient safety.

According to the article **“Job stress in new nurses during the transition period”** new nurses perceived low to moderate levels of stress mainly from heavy workloads and lack of professional nursing competence. Individual and organizational factors that might contribute to their stress experiences were rarely explored. This integrative review evaluated and synthesized available evidence examining stress in new nurses and contributed to the literature regarding stress in nursing professionals. The findings of this review may offer specific information to nurse administrators that can relate to the stress encountered by new nurses who enter into healthcare facilities. Findings of this review may provide valuable input to assist nurse administrators in developing and implementing organizational measures to reduce stress in new nurses while maximizing and facilitating their integration into the nursing workforce. Such measures may include the following: establishment of a well-structured transition programme, provision of an adequate orientation and senior staff mentorship, stress management programmes, in-service educational programmes and exposure to clinical simulation scenarios.

**“Role stress in nurses: Review of related factors and strategies for moving forward”** The aim of this paper was to review the literature on factors related to role stress in nurses, and present strategies for addressing this issue based on the findings of this review while considering potential areas for development and research. Computerized databases were searched as well as hand

searching of articles in order to conduct this review. This review identified multiple factors related to the experience of role stress in nurses. Role stress, in particular, work overload, has been reported as one of the main reasons for nurses leaving the workforce. This paper concludes that it is a priority to find new and innovative ways of supporting nurses in their experience of role stress. Some examples discussed in this article include use of stress education and management strategies; team-building strategies; balancing priorities; enhancing social and peer support; flexibility in work hours; protocols to deal with violence; and retention and attraction of nursing staff strategies. These strategies need to be empirically evaluated for their efficacy in reducing role stress.

According to the article **“Image: changing how women nurses think about themselves.”** This paper presents a review of the public and professional images of nursing in the literature and explores nurse image in the context of Strasen's self-image model. Nurses have struggled since the 1800s with the problem of image. What is known about nurses' image is from the perspective of others: the media, public or other healthcare professionals. Some hints of how nurses see themselves can be found in the literature that suggests how this image could be improved. The findings were examined using the framework of Strasen's self-image model. Public image appears to be intimately intertwined with nurse image. This creates the boundaries that confine and construct the image of nursing. As a profession, nurses do not have a very positive self-image nor do they think highly of themselves. Individually, each nurse has the power to shape the image of nursing. However, nurses must also work together to change the systems that perpetuate negative stereotypes of nurses' image.

According to the article **“factors related to hospital nurses' health-related quality of life”** To conduct a literature review in order to determine the predictors of nurses' health-related quality of life and to clarify the implications for nursing management and future study in this area. Good health is essential to the performance of health care workers. Relevant studies were retrieved from PubMed, Medline, CINAHL, the Japan Medical Abstract Society, and the Technology Information Aggregator, Electronic. The studies selected for this review were published in English or Japanese between 1995 and 2012, investigated nurses' health-related quality of life. The identified predictive factors of each study were categorised according to type. Based on the criteria, 22 studies were

reviewed. The predictive factors of nurses' health-related quality of life were classified into eight categories. Age and occupational stress should be considered when examining unknown predictive factors of nurses' health-related quality of life. In addition, it may be useful to adopt a conceptual framework and consider patient and organisational factors in future research. It is necessary to identify nurses' occupational stressors and consider age during job placement in order to support their health.

**“Workplace-related generational characteristics of nurses: A mixed-method systematic review”** Generational differences affect occupational well-being, nurses' performance, patient outcomes and safety; therefore, nurse managers, administrators and educators are interested increasingly in making evidence-based decisions about the multigenerational nursing workforce. Thirty-three studies were included with three main themes and 11 subthemes: (1) Job attitudes (work engagement; turnover intentions, reasons for leaving; reasons, incentives/disincentives to continue nursing); (2) Emotion-related job aspects (stress/resilience; well-being/job satisfaction; affective commitment; unit climate; work ethic) and (3) Practice and leadership-related aspects (autonomy; perceived competence; leadership relationships and perceptions). Baby Boomers reported lower levels of stress and burnout than did Generations X and Y, different work engagement, factors affecting workplace well-being and retention and greater intention to leave compared with Generation Y, which was less resilient, but more cohesive. Although several studies reported methodological limitations and conflicting findings, generational differences in nurses' job attitudes, emotional, practice and leadership factors should be considered to enhance workplace quality.

According to the article **“Nurses on the Frontline against the COVID-19 Pandemic”** COVID-19 has affected the life and health of more than 1 million people across the world. This overwhelms many countries' healthcare systems, and, of course, affects healthcare providers such as nurses fighting on the frontlines to safeguard the lives of everyone affected. Exploring the issues that nurses face during their battle will help support them and develop protocols and plans to improve their preparedness. Thus, this integrative review will explore the issues facing nurses during their response to the COVID-19 crisis. The major issues facing nurses in this situation are the critical

shortage of nurses, beds, and medical supplies, including personal protective equipment and, as reviews indicate, psychological changes and fears of infection among nursing staff. The implications of these findings might help to provide support and identify the needs of nurses in all affected countries to ensure that they can work and respond to this crisis with more confidence. Moreover, this will help enhance preparedness for pandemics and consider issues when drawing up crisis plans. The recommendation is to support the nurses, since they are a critical line of defence. Indeed, more research must be conducted in the field of pandemics regarding nursing. Nurses are on the frontline, and they have a significant role in fighting COVID-19. Nurses are facing critical shortages of nursing staff, beds, and medical supplies. Thus, addressing these needs and providing supplies is essential. More research is needed to explore the experiences of nurses who are on the frontlines for better development, preparedness, and response measures for future pandemics.

According to the article **“Doctors, nurses share Covid-19 challenges, apprehensions as crisis deepens”** The female frontline workers posted at AIIMS Trauma Centre say that they try to keep the patients motivated towards their path of recovery As India is fighting the Covid-19 crisis with nationwide lockdown, doctors and healthcare workers are working day and night to minimise the damage due to the pandemic with constant checks on the patients, either through phone or video conferencing. The threat of them catching the coronavirus and infecting their own families also looms large, due to which most of the doctors have given up going homes and have shifted to solitary accommodations. "The disease is very contagious and till now we do not have any concrete solutions on how to manage it effectively which for us is the primary challenge. We always have to keep in mind that whatever we are doing for the patients should not be harmful, if it is not beneficial. We had to remodel the infrastructure into COVID ward keeping in mind various aspects," Dr Rakesh Garg, who is presently working at Covid-19 facility, National Cancer Institute, AIIMS Jhajjar told news agency ANI. Personal protective equipment (PPE) is an essential gear that health workers have been mandatorily instructed to wear to protect themselves from harmful biological agents or contaminated surfaces.

# **METHODOLOGY**

## **CHAPTER III**

### **METHODOLOGY**

#### **Statement Of The Problem**

Nursing is a profession within the health care sector focused on the care of individuals, families, and communities so they may attain, maintain, or recover optimal health and quality of life. The nursing profession was founded to protect, promote, and improve health for all ages.

In the contemporary world all are busy with their working life. For that majority of the people were focusing on professional jobs. So, the nursing is one of the main stream of selection. The put lot of their effort in their profession for the people who were suffer with different health sickness. In this study the researcher is focusing on the various problems that face by the nurses due to the stressful career.

#### **General Objective**

To study about the work -life balance of the nurses in cochin city

#### **Specific Objective**

- 1) To understand the socio-economic profile.
- 2) To know about the issues related to family management due to the time schedule.
- 3) To understand the health problem faced by the nurses due to duty.
- 4) Challenges related to work environment
- 5) To measure Job satisfaction

#### **Conceptual And Operational Definition**

1) **NURSE:** The definition of a nurse is someone who cares for sick, old or young people, or someone who provides medical assistance.

**NURSE:** In this study the nurses means that the professionally certified people who were serve for the corona patients.

2) **STRESS:** Stress can be defined as any type of change that causes physical, emotional, or psychological strain. Stress is our body's response to anything that requires attention or action.

**STRESS:** In this study the stress means that the nurses mental or emotional imbalance due to overtime work schedule.

3) **FAMILY MANAGEMENT:** The basics to managing your family include effective communication between family members, having routines that are followed by all family members, sharing tasks and chores, showing affection to one another and responding to one another in gentle and respectful ways.

**FAMILY MANAGEMENT:** In this study family management refers to the management difficulties of nurses due to continuous duty in their profession.

4) **HEALTH PROBLEM:** a state in which you are unable to function normally and without pain. synonyms: ill health, healthiness. Antonyms: good health, healthiness. the state of being vigorous and free from bodily or mental disease.

**HEALTH PROBLEM:** In this study health problem means that the physical difficulties faced by the nurses due to continuous working time with no rest.

### **Identification Of Variables**

Independent variables are Age, Sex, income, Facilities, Type of family, Duration of shift, Private nurses.

Dependent variables are Level of stress among their work, to understand the job satisfaction, to know about the problems of family management.

### **Universe, Sample Size And Method Of Sampling**

The universe of study is married nurses who in cochin city. Sample consist of 50 nurses. The sample method intended to use is simple random sampling.

### **Research Design**

The qualitative research method is followed in this reach.

### **Analysis Of Data**

The collected data in the study was edited clarified and tabulated by using SPSS. Tables were provided in order to understand the data on the basis of this statistical analysis was carried out for the interpretation of data.

### **Tools Of Data Collection**

Interview schedule and telephonic interview was used to collect the data. It includes the questions pretending to the socio-economic profile, family management issues, the health problem faced by the nurses due to over time duty, and the job satisfaction of the nurses.

# **ANALYSIS AND** **INTERPRETATION**

**CHAPTER IV**  
**DATA ANALYSIS AND INTERPRETATION**

This chapter deals with the data analysis and interpretation the study is aimed to measure work-life balance of the married nurses, and it is the process of assigning meaning to the collected data and determining the conclusions, significance and implications of findings.

Table 4.1

Age of the Respondents

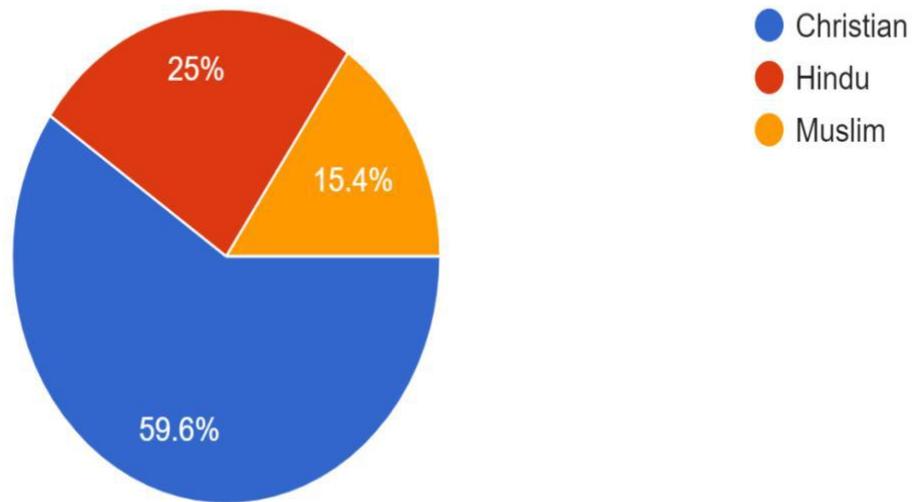
<b>AGE</b>	<b>FREQUENCY</b>	<b>PERCENTAGE (%)</b>
Below 25	3	6
25 - 30	18	35
30 - 35	20	38
Above 35	11	21
Total	52	100

From the total 52 respondent's majority were under the age category of 30 -35. It shows that the middle age people were more in this field of nursing. The elderly people were very less as compare with the middle age people.

Figure 4.2

Religion of the Respondents

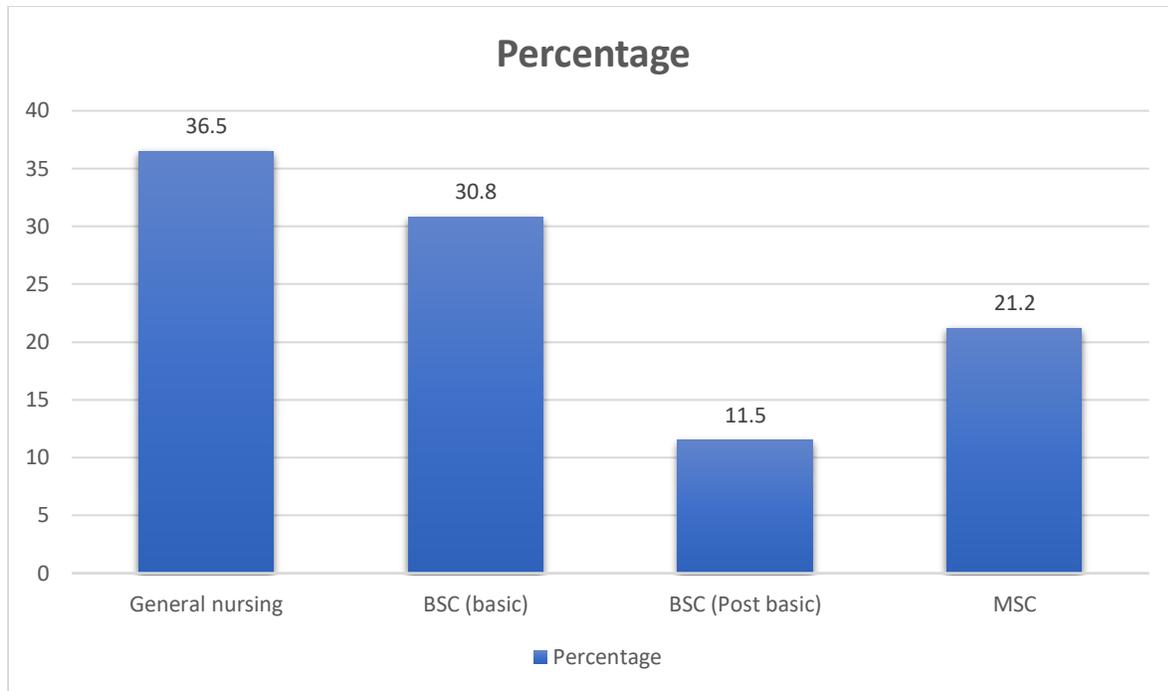
Religion  
52 responses



From the above diagram, we can clearly see that the Christians are more in this field of nursing. It consists of 59.6% that is more than half of the total percentage. Then the nurses belonging to Hindu religion consist of 25% are in the second category and the nurses belonging to Muslim religion is only 15.4%. So, we can understand that the Christians are more in the field of nursing.

Figure 4.3

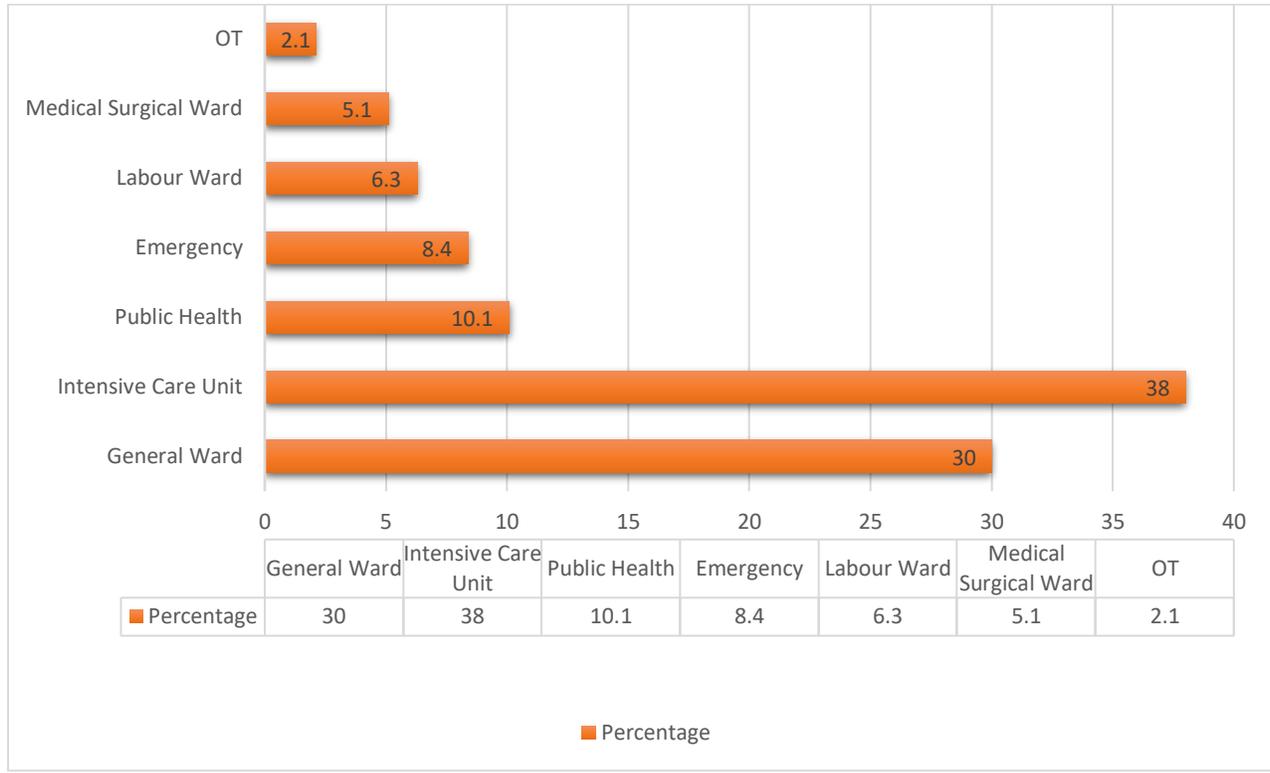
Educational Qualification of Respondent's



From the above figure we can see that 36.5% of nurses are belonging to general nursing, 30.8% of the nurses are qualified with BSC (basic), then only 11.5% of nurses are BSC (post basic) and 21.2% of nurses are MSC. So, we can understand that most of the nurse's qualification are belonging to the general nursing.

Figure 4.4

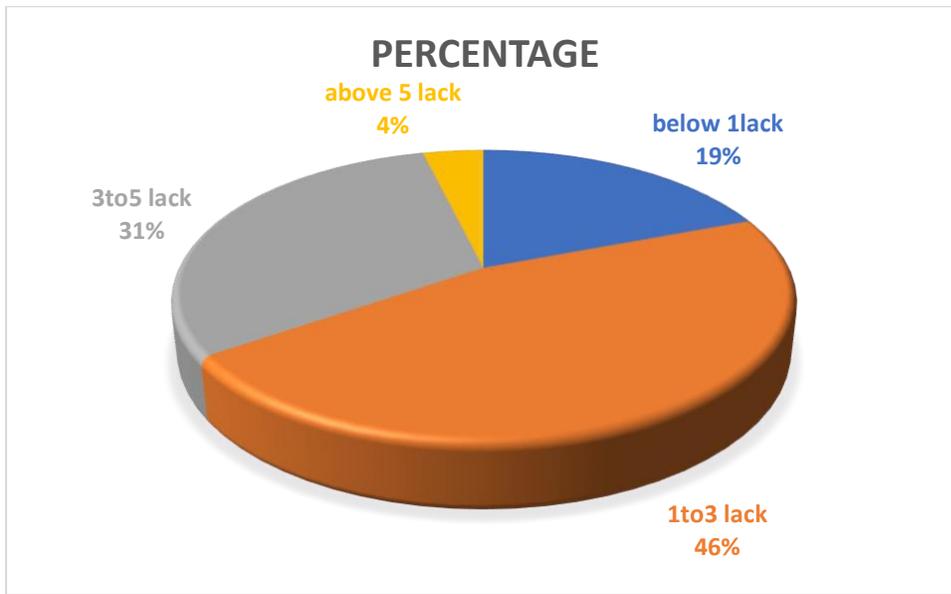
Working Department of the Respondents



The above shows that, 38% of nurses are belonging to Intensive care unit, 30% of the nurses are working in General ward, then only 10.1% of nurses are Public Health, 8.4% are duties assigned in Emergency ward, 6.3% of them are in Labor Room, and only 1% are belonging to Medical Surgical ward and 2.1% of nurses are in OT. So, we can understand that most of the nurse's working Intensive care unit. It is because of the care wanted to the patients is very important in this intensive care unit. The patients in intensive care unit are not able to do things by themselves. So, the care from the nurses is needed.

Figure 4.5

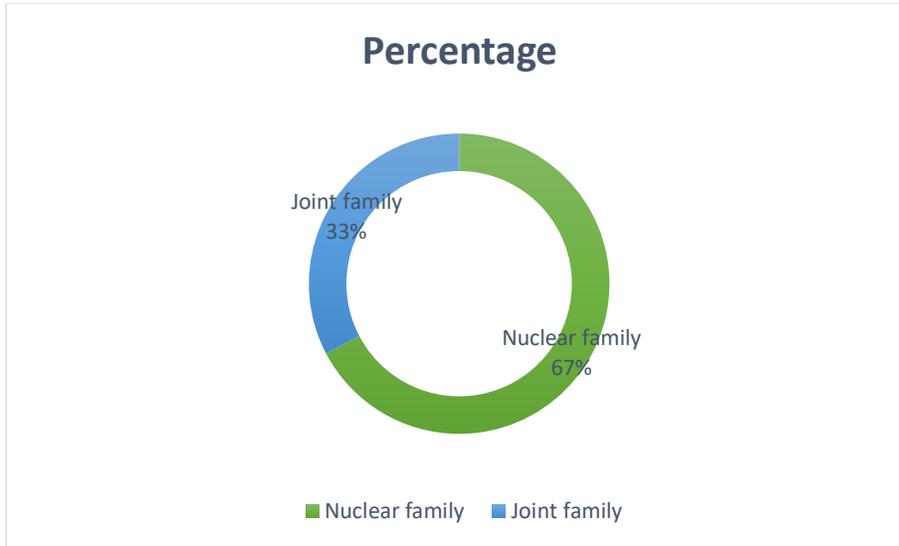
Annual income of the Respondents



From the above figure we can understand that the higher percentage consist of 46% of nurses were having their annual income in between 1to3 lack. And only 4% of nurses were having the higher annual income.so we can see that the income that get for the nurses is very low when we compare with the working importance.

Figure 4.6

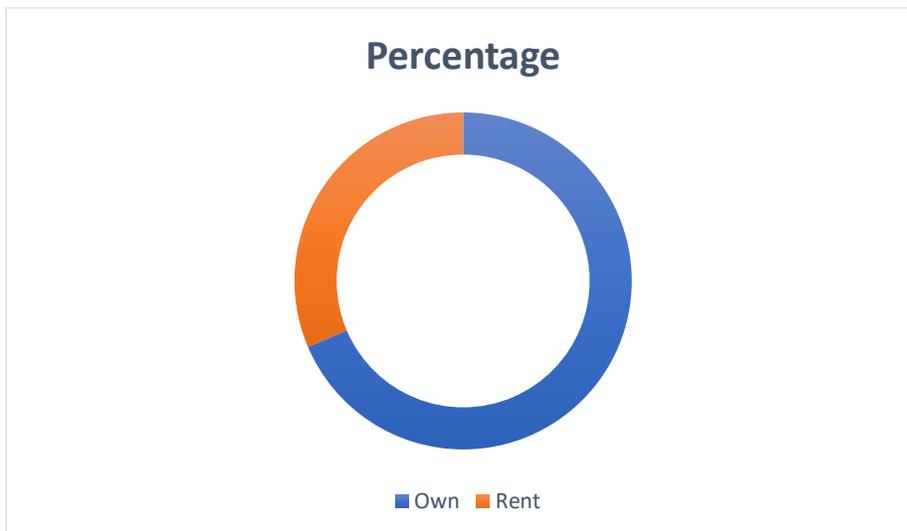
Type of family of the Respondents



From the above diagram we can interpret that the nuclear family is more than that of the joint family. 67% of the nurses were belonging to the nuclear family.

Figure 4.7

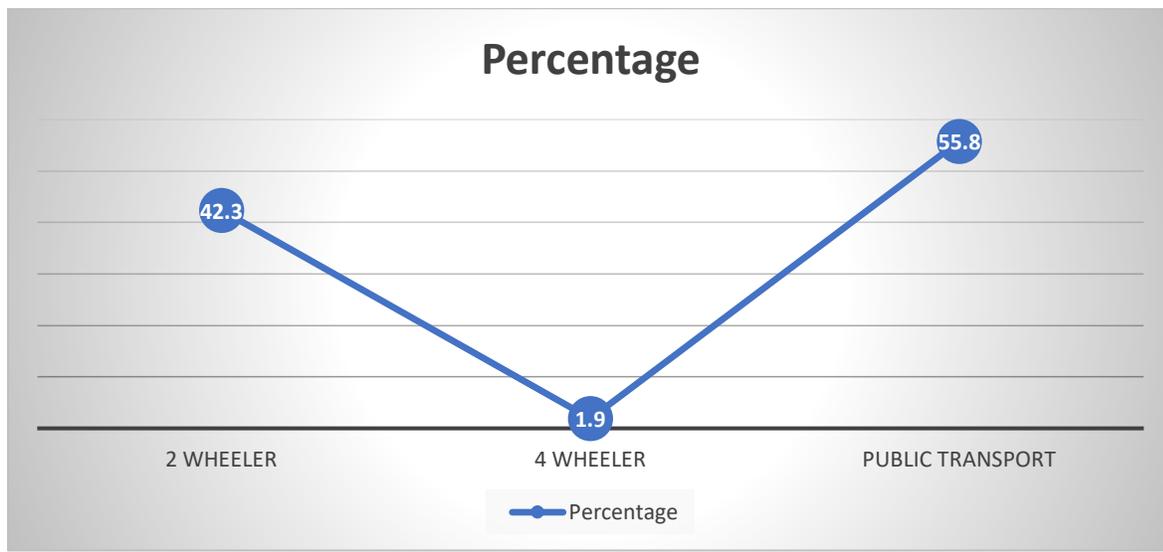
Type of house of the Respondents



From the figure we can see that the majority of the nurses were having their own houses. It consists of 68.6% and only 31.4 of them were in rented houses.

Figure 4.8

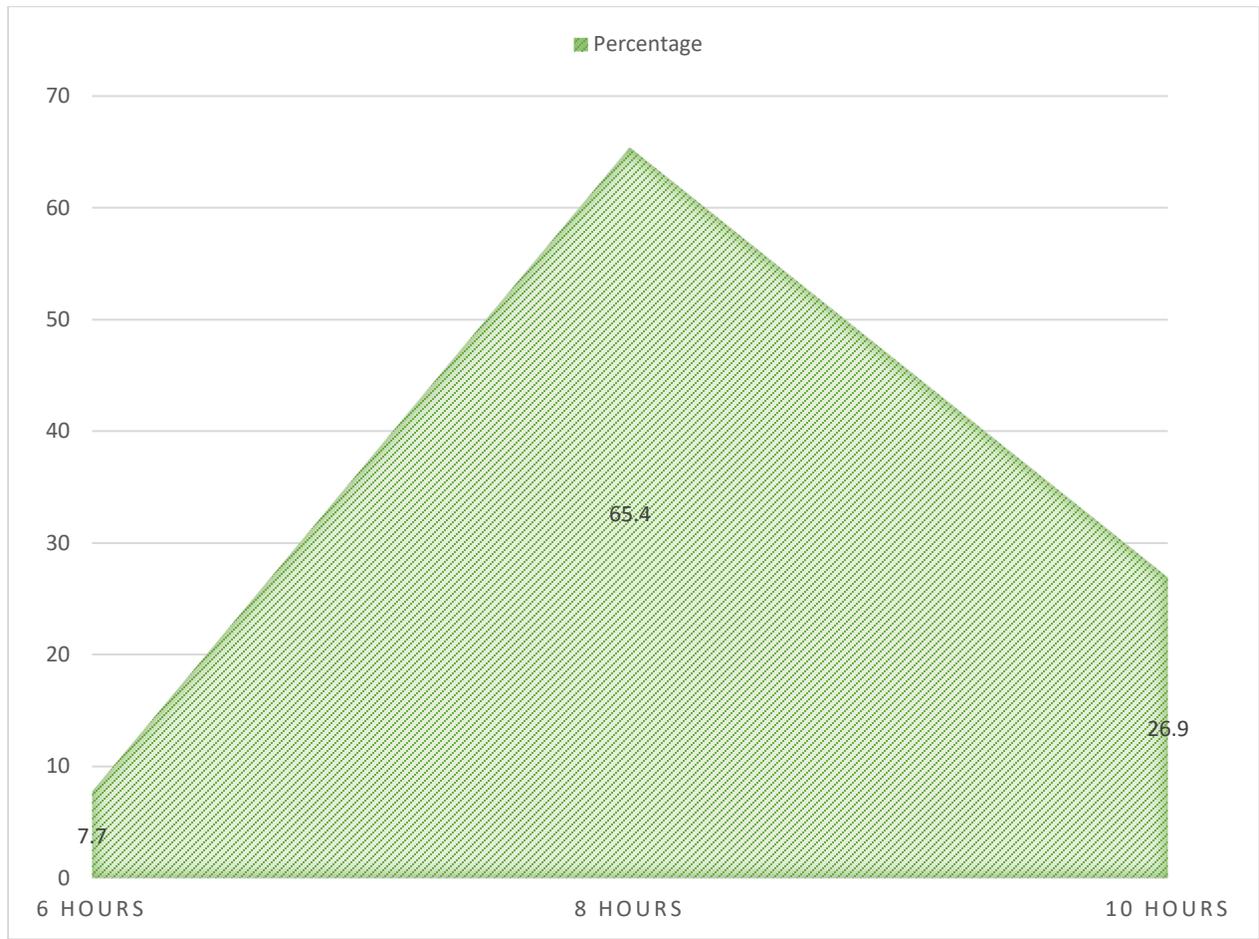
Type of vehicles the respondents were used to come to hospital



In the above diagram we can see that the majority of the nurse were coming to the hospital by using public transportation facilities. that is more than half of the total samples. using of 4 wheelers is very low, it is only 1.9 %. The travel by 2 wheelers is also having major proportion but there is only few of them having their own independent vehicle, otherwise they were doped by someone in their home like father, husband etc.

Figure 4.9

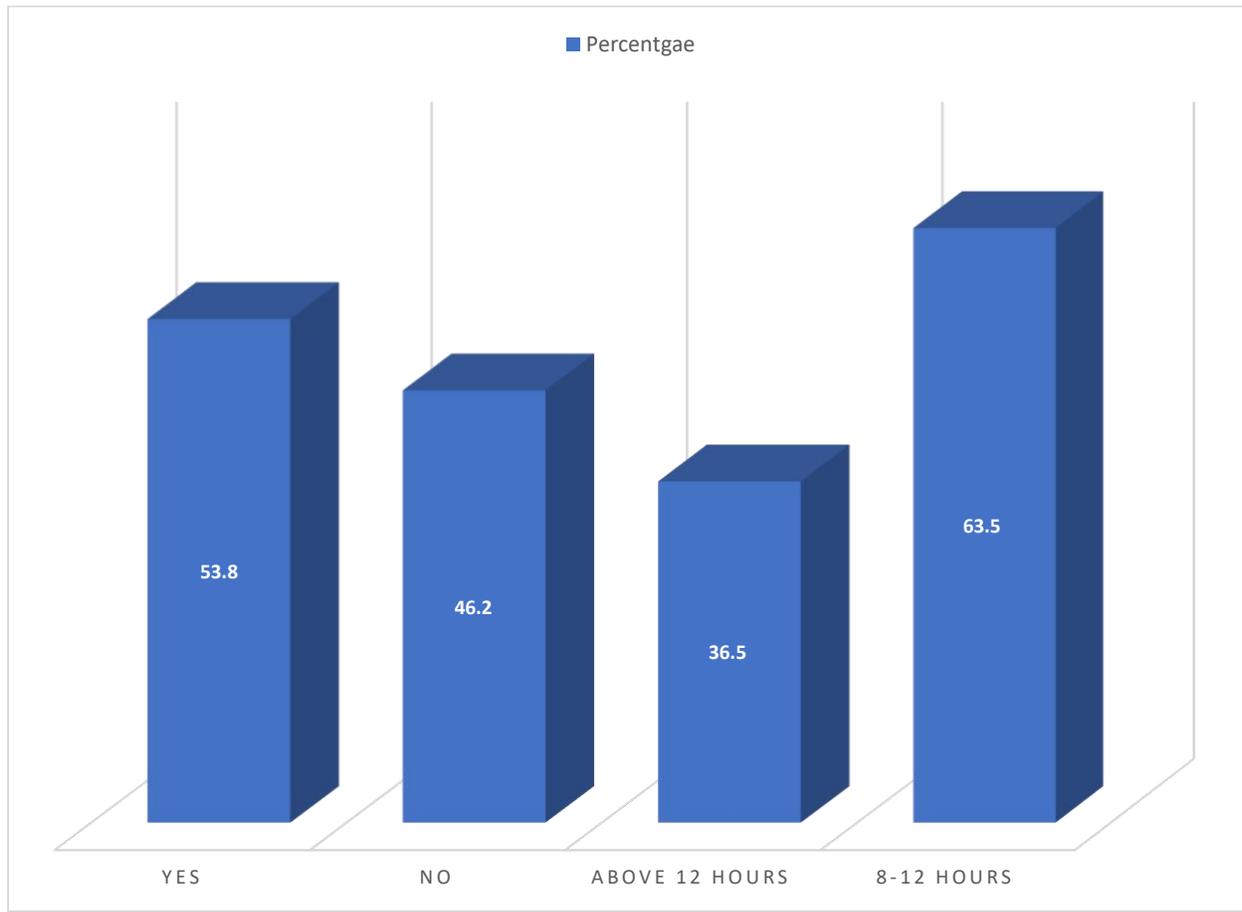
Hours of work per day of the respondents



In this diagram we can see that the majority of the nurses were having 8 hours of working per day. But there are nurses who works more than that consist of 10 hours and all. The 8 hours is the basic working hour of the nurses in cochin city.

Figure 4.10

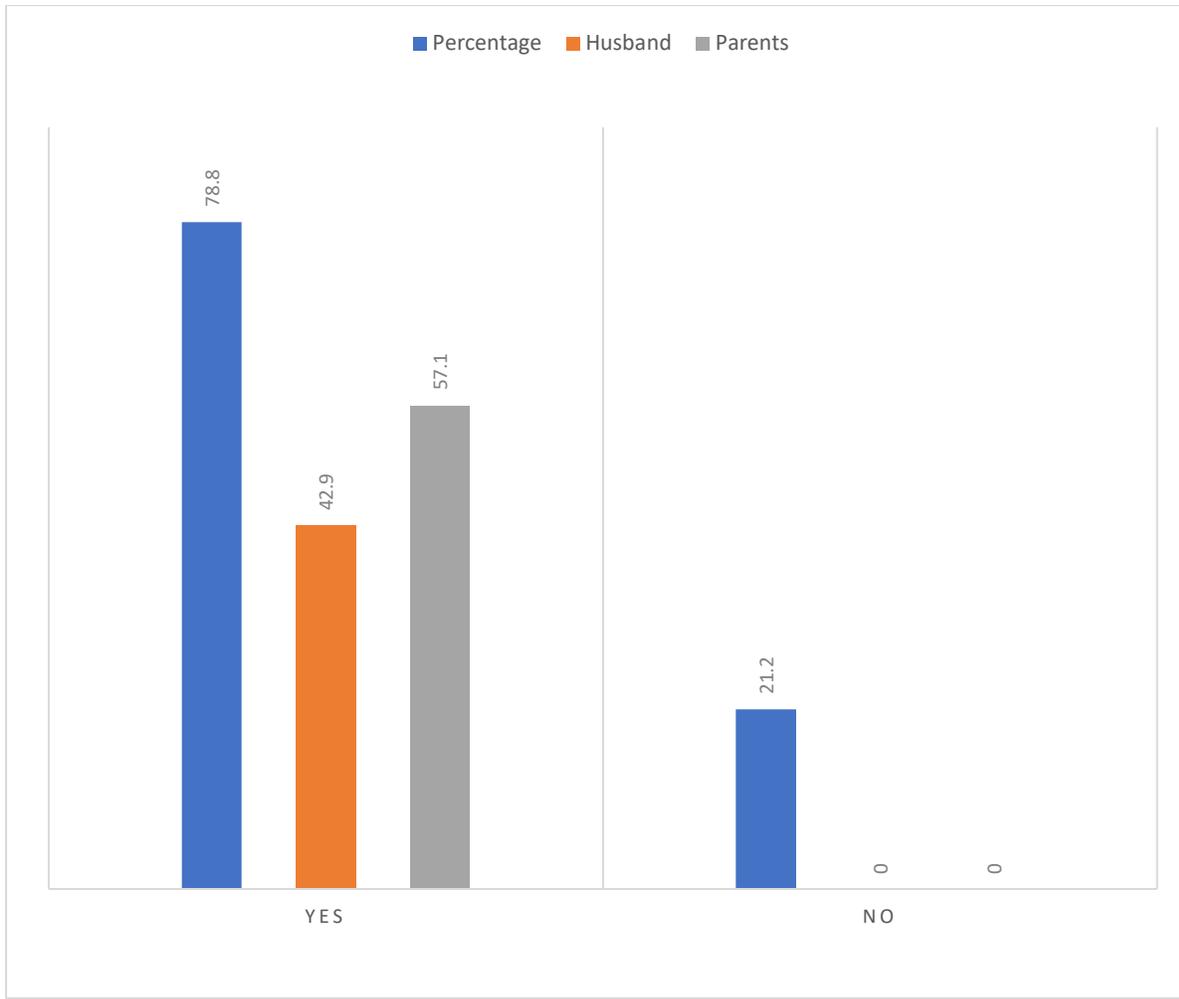
Working hours of the respondents in the period of Corona.



From this graph we can interpret that, most of the nurses having continues duty without the shift during the period of corona. They have to work continuously for 12 hours or mor than that for a long period of time. It is because of the shortage of staffs due to quarantine.

Figure 4.11

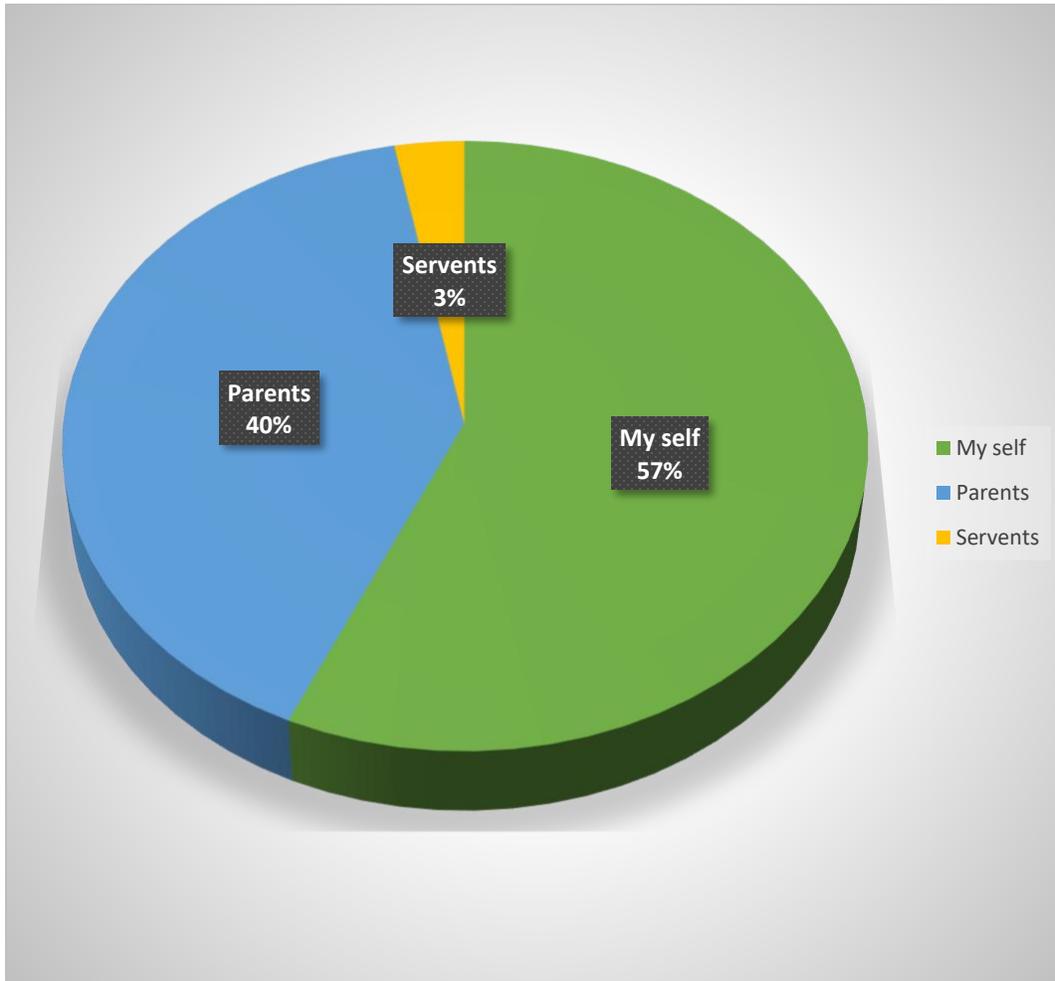
Respondents get support for house hold works



In the above figure we can see that, the help that get for the house hold works are of 78.8%. that is comparatively more from the parents and some support from the side of life partners. but also, there is nurses consist of 21.2% were not getting any supports.

Figure 4.12

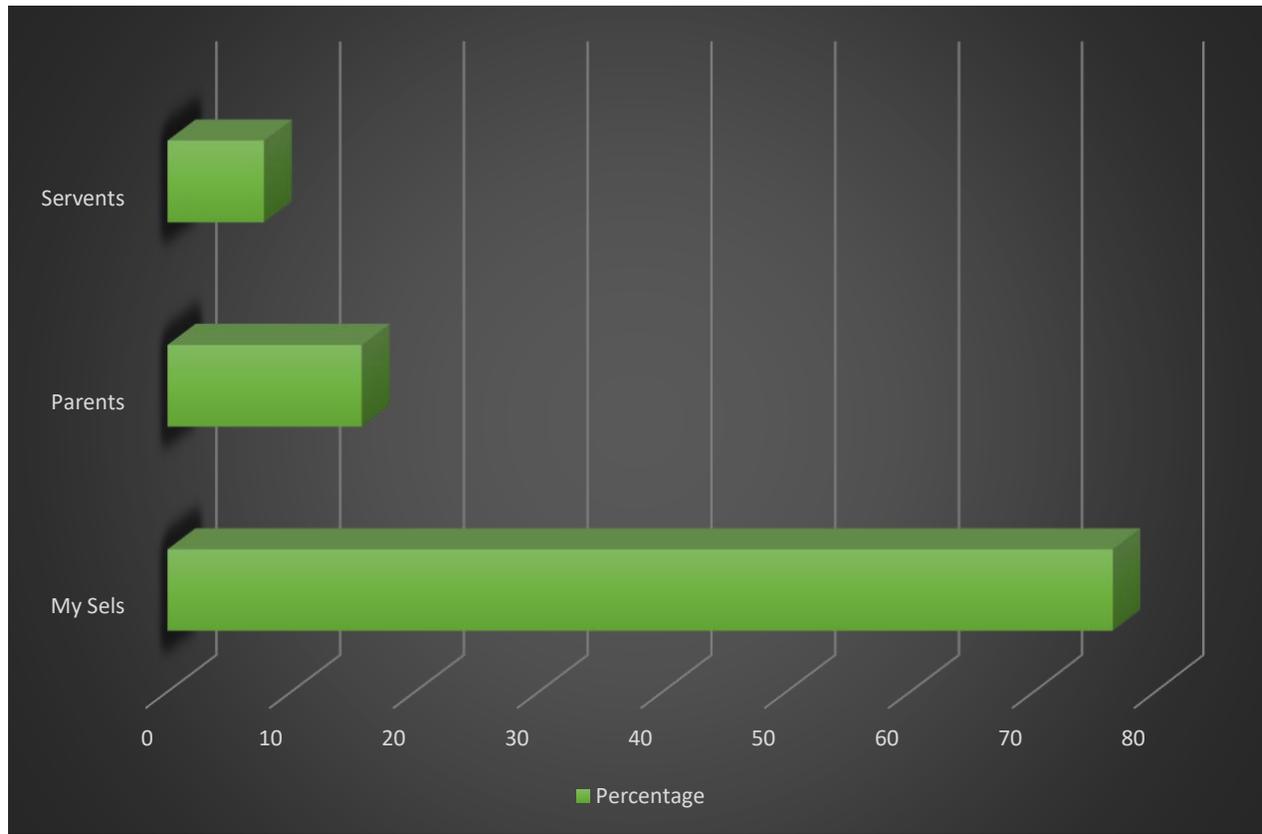
Cooking in charge in family



From this figure we can understand that most of the nurses are having the main duty to cook for their family. but there is 40% of nurses were getting support from their parents. The servants are only of 3%.

Figure 4.13

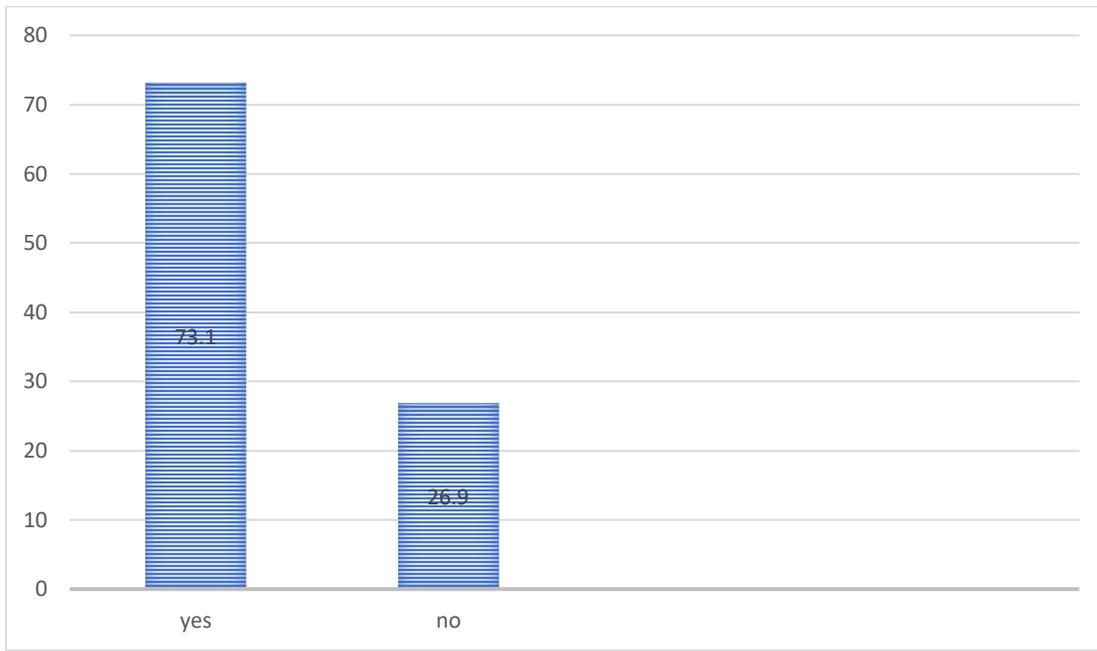
Support to Respondents for house hold activities.



Form this data we can interpret that the house hold activities like washing clothes, cleaning are all done by them self's it consists of 76.5%. then there is having only 15.7% of them were getting support from their parents. But there only least percentage is done by the servants.

Figure 4.14

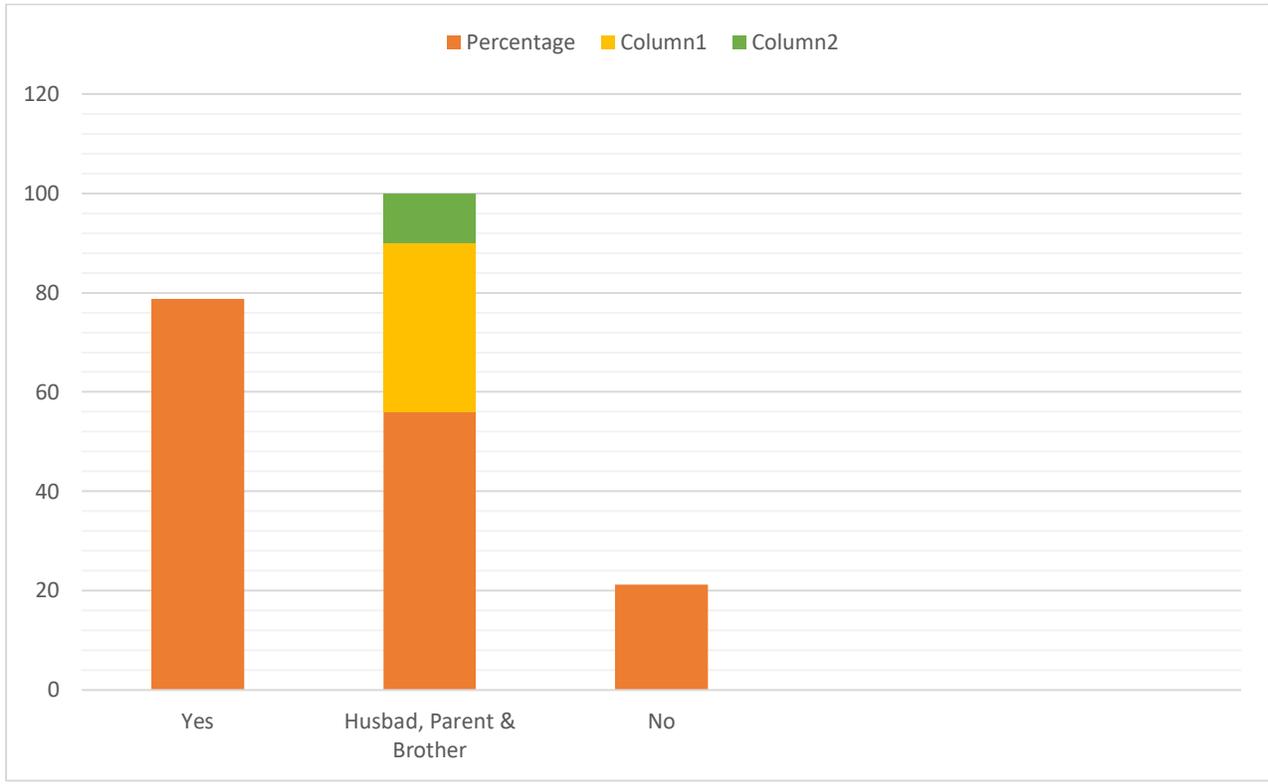
Balancing of domestic work and Job of Respondents.



From the above diagram we can see that the balancing of domestic work and job was very difficult for the nurses. from this data 73.1% of nurses were responded that they were struggle a lot to manage their responsibilities.

Figure 4.15

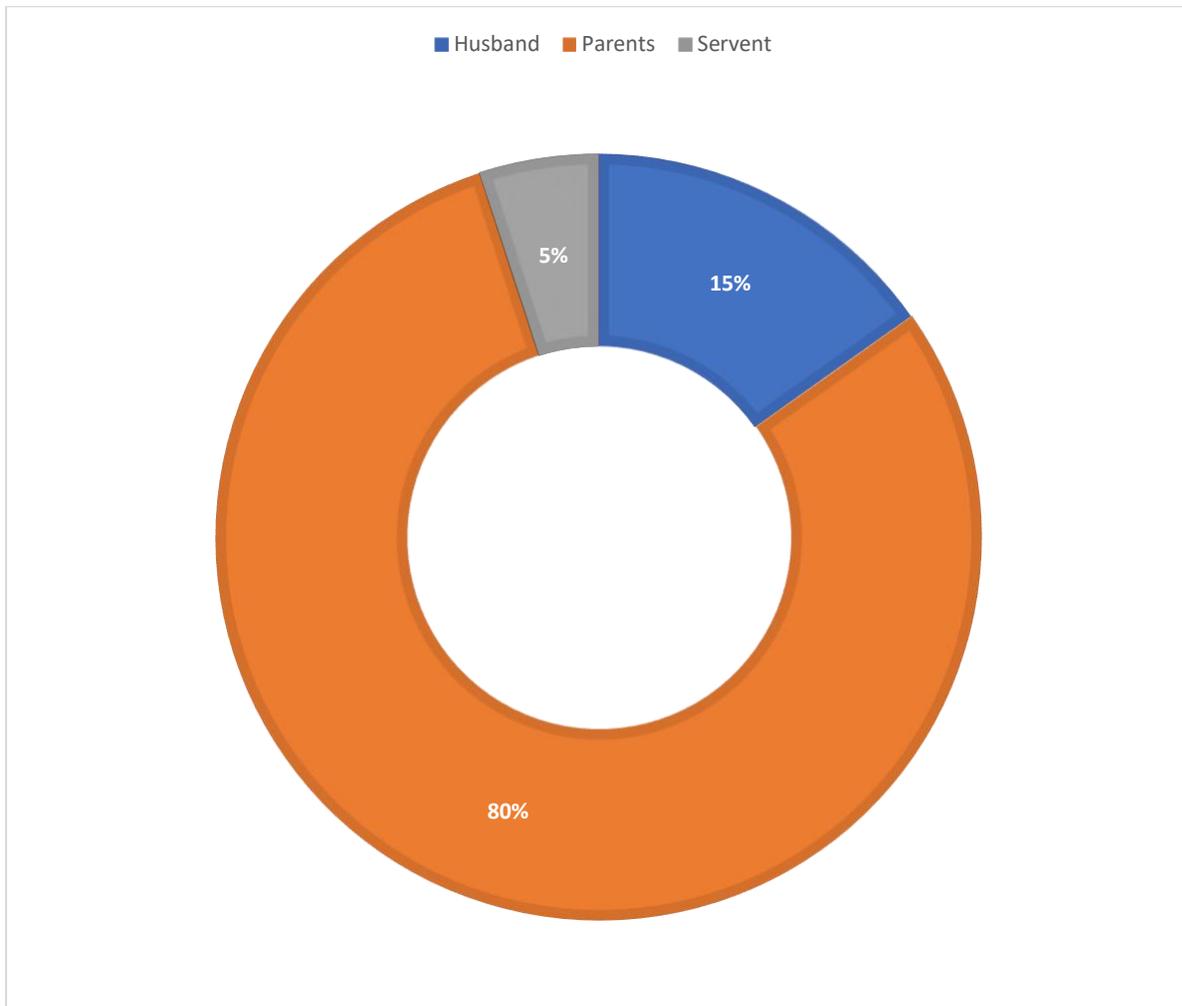
Source of income of the Respondents



From this data we can interpret that most of the nurses were having income support from other family members also. They are not the only means of income to their family. the major support from the husband that we can see in the nuclear family and in join families there is getting support from the parents and brothers also.

Figure 4.16

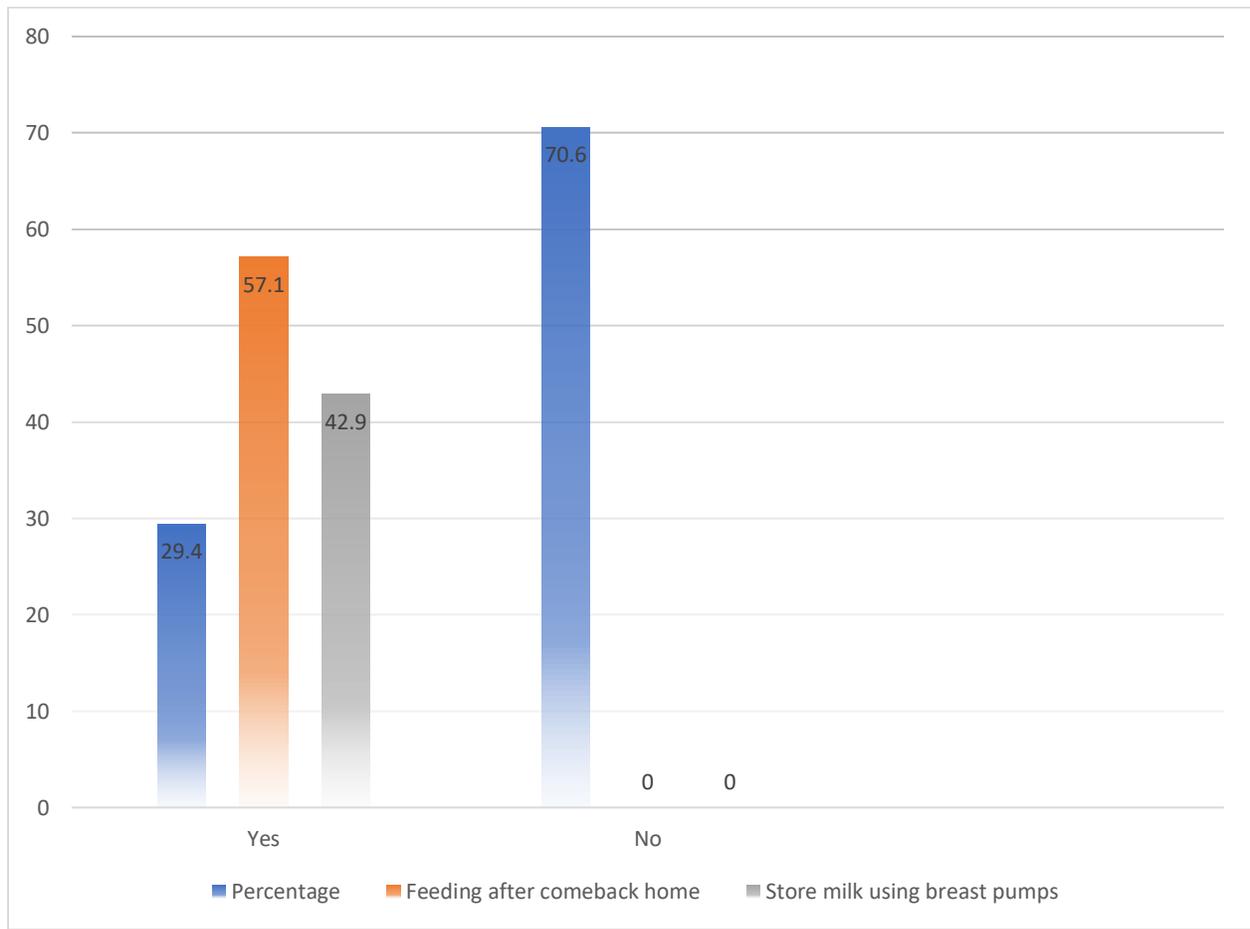
Taking care of children of the Respondents when they are going to work.



From the above data we can see that, the majority of the cases the parents were looking after the children when they were going to work. In case of 15% the husband was looking after their children, in these we can see that they have their own business or they didn't have a proper job. In case of the servants, they were living in a nuclear family and both of them having jobs.

Figure 4.17

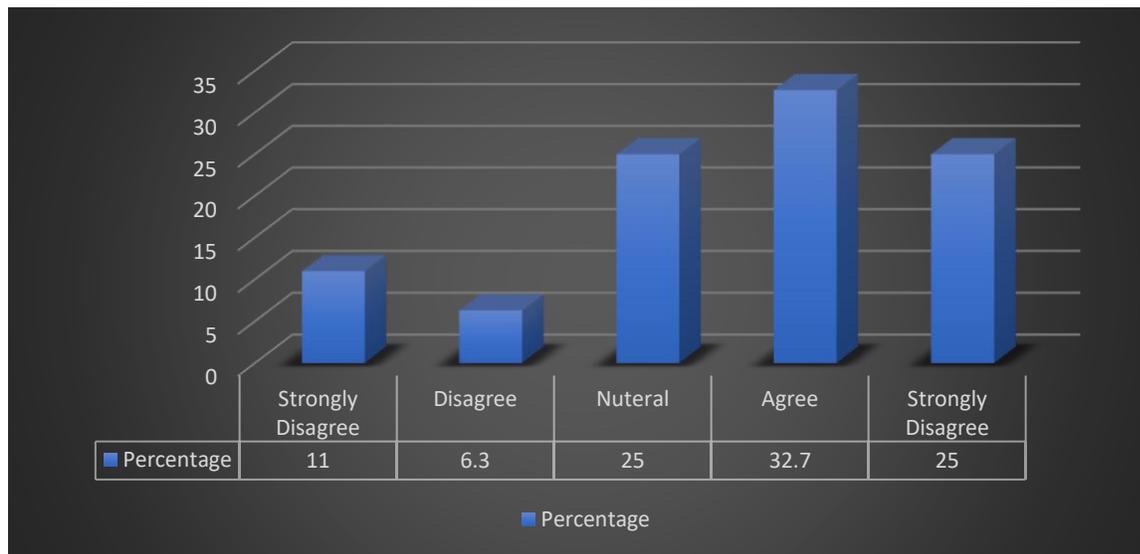
Brest feeding mothers.



From the above graph we can see that 70.6% of nurses are not feeding mothers. But there is 29.4% of nurses are breastfeeding mothers. They were facing lots of issues because of that. They were using Brest pumps for collecting milk for their babies and they also feed after coming back home.

Figure 4.18

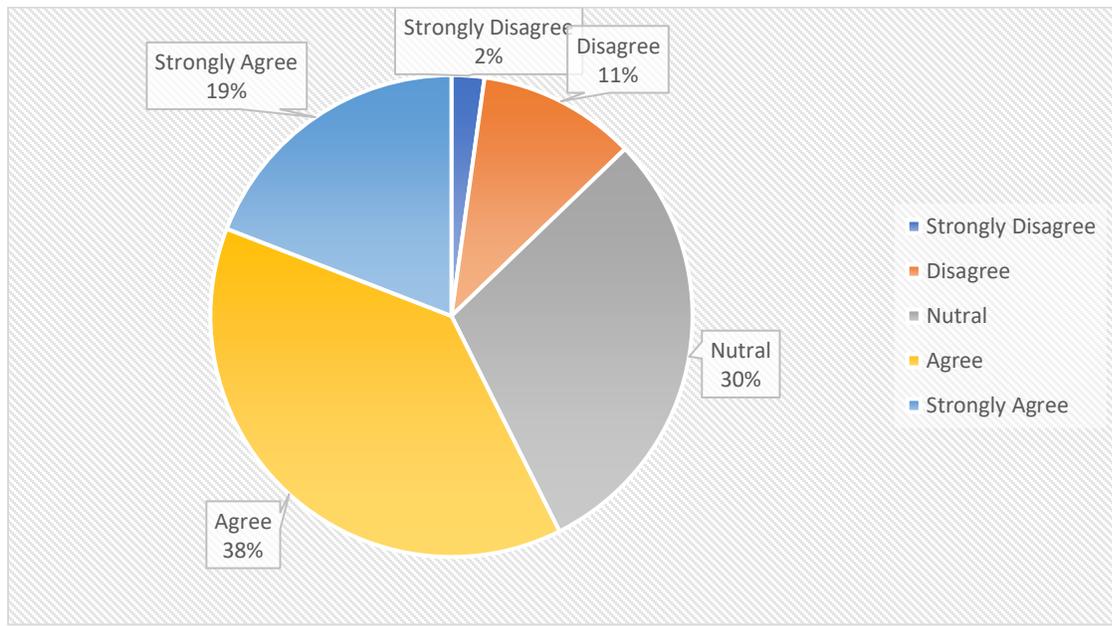
Respondent's difficulties to cope with tasks at home due to shift.



Here we can interpret that, majority of them are ageing that they are facing lots of difficulty to manage their tasks at home due to the shift work and many of them are strongly ageing with statement. but very few of them were dis ageing with this statement, they are belonging to the join family. So, they were having lots of support from the home to manage it.

Figure 4.19

Respondent's attachment with children

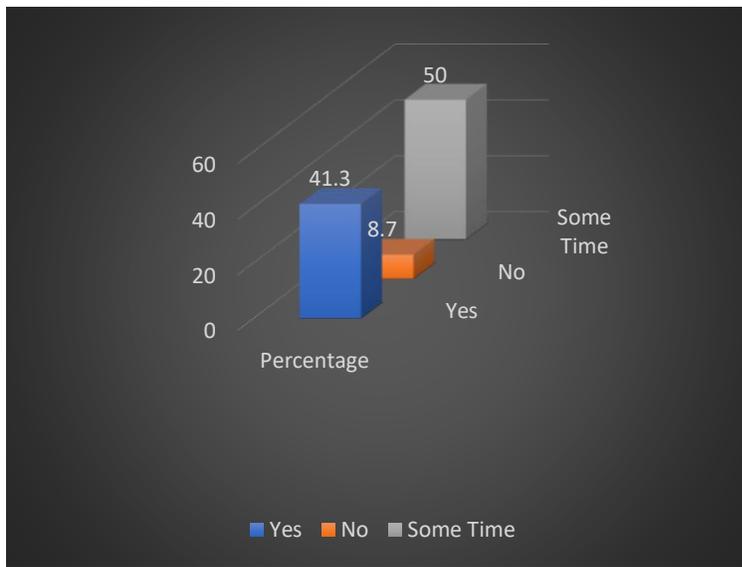


From this above diagram we can see that the children's attachment with their mother was decreases because of their shift duty. They can't be with them all time. more than half of the mothers are agreeing with this statement. That is 38% are ageing and 19% are strongly agreeing with this statement.

Figure 4.20

Emotional issues of Children

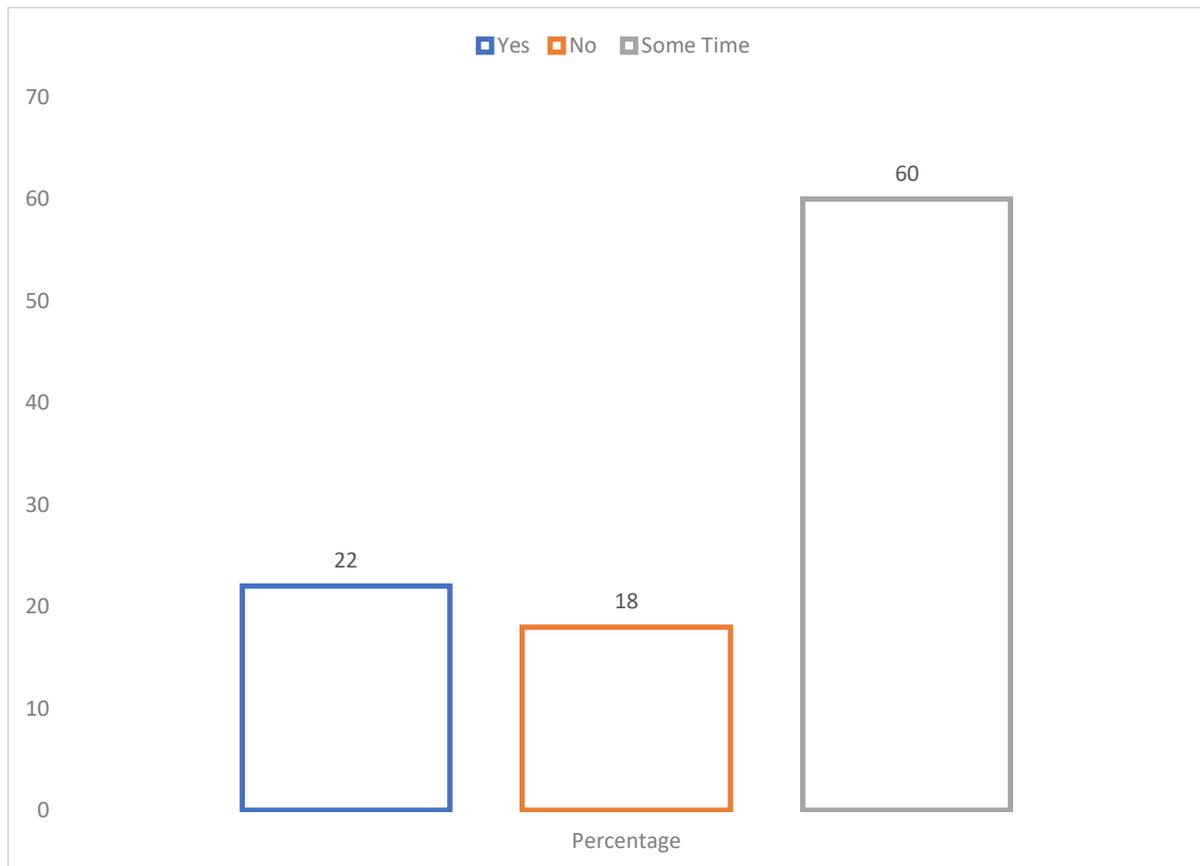
.



From this data we can analyze that most of the nurses may or may not be able to involve in the emotional issues faced by the children are more seen in this data very few of them are not even able to look their children. these are depending on the family situation of these nurse. When they have any one to help them in house hold works, they get time to look their children.

Figure 4.21

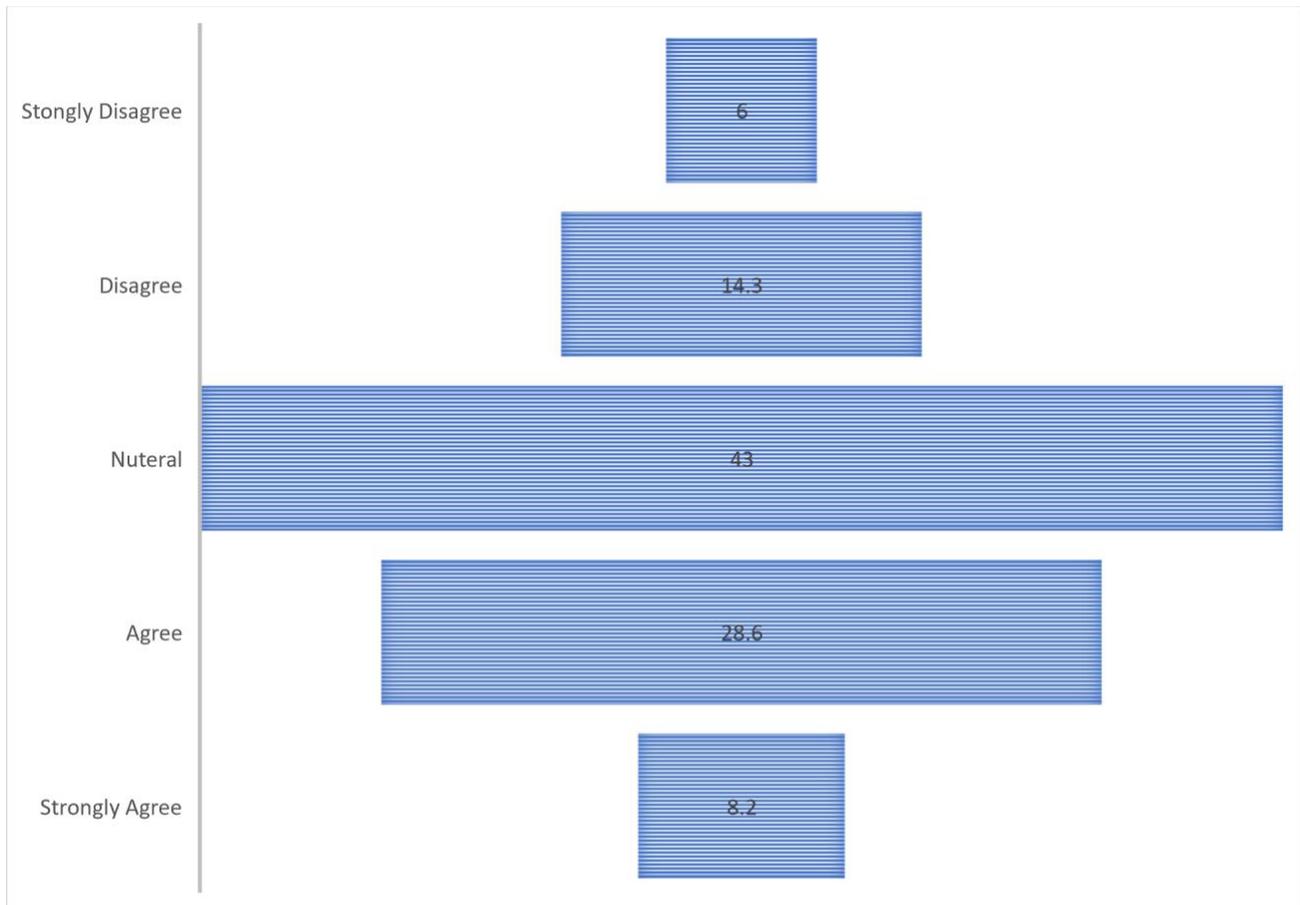
Spending time with family members.



From the above diagram we can see that the time that got to spend with their family is very rarely. It is because of the duty shift and stress.60% of them are like this and we can see that 18% of nurses not even get time to spend with their family due to the same reason. Only few of them are getting time to spend with the family that is around 22%.

Figure 4.22

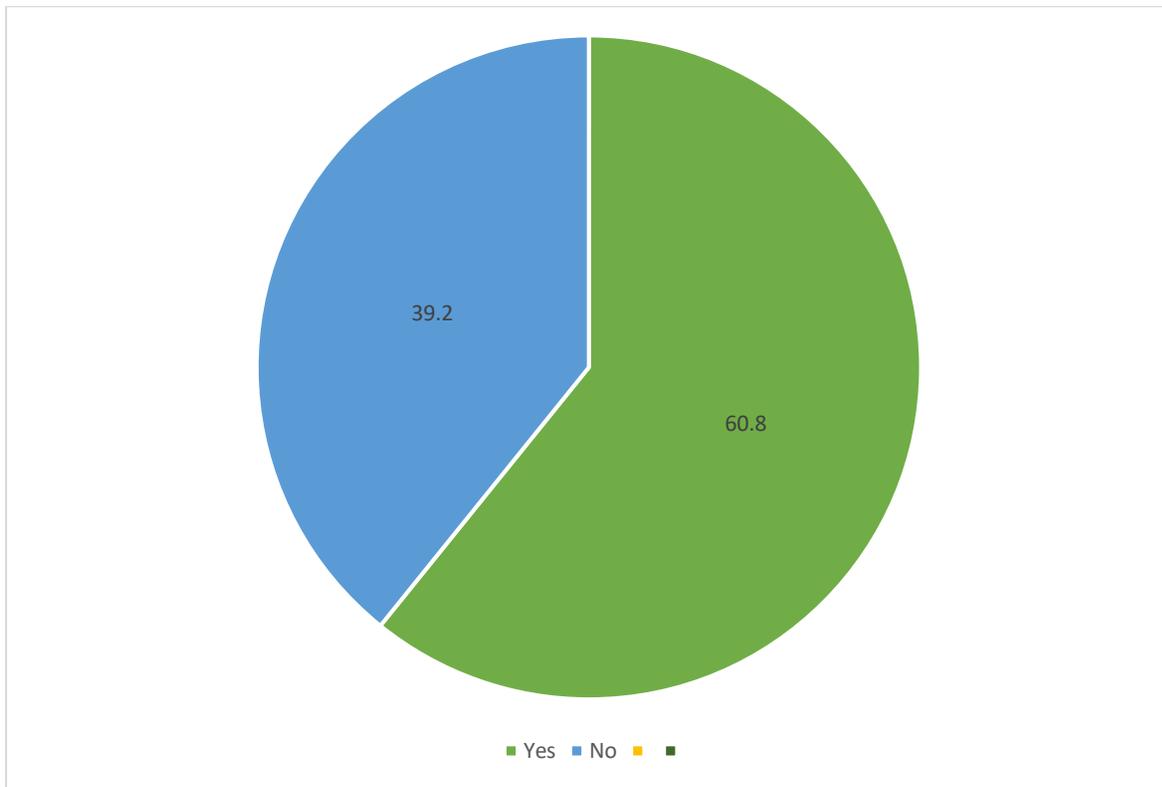
Taking care of elderly at home by the respondents.



From the above table we can see that most of the respondents were neutral. That is they were leading very busy lives. They have to take care of the patients in the hospital at the same time they want to give care to the elderly at home. 20.3% of people were not able to give care for the elderly. It is because of the shift duty and also they didn't get any time to rest, so they become feeling so tired after coming back to home.

Figure 4.23

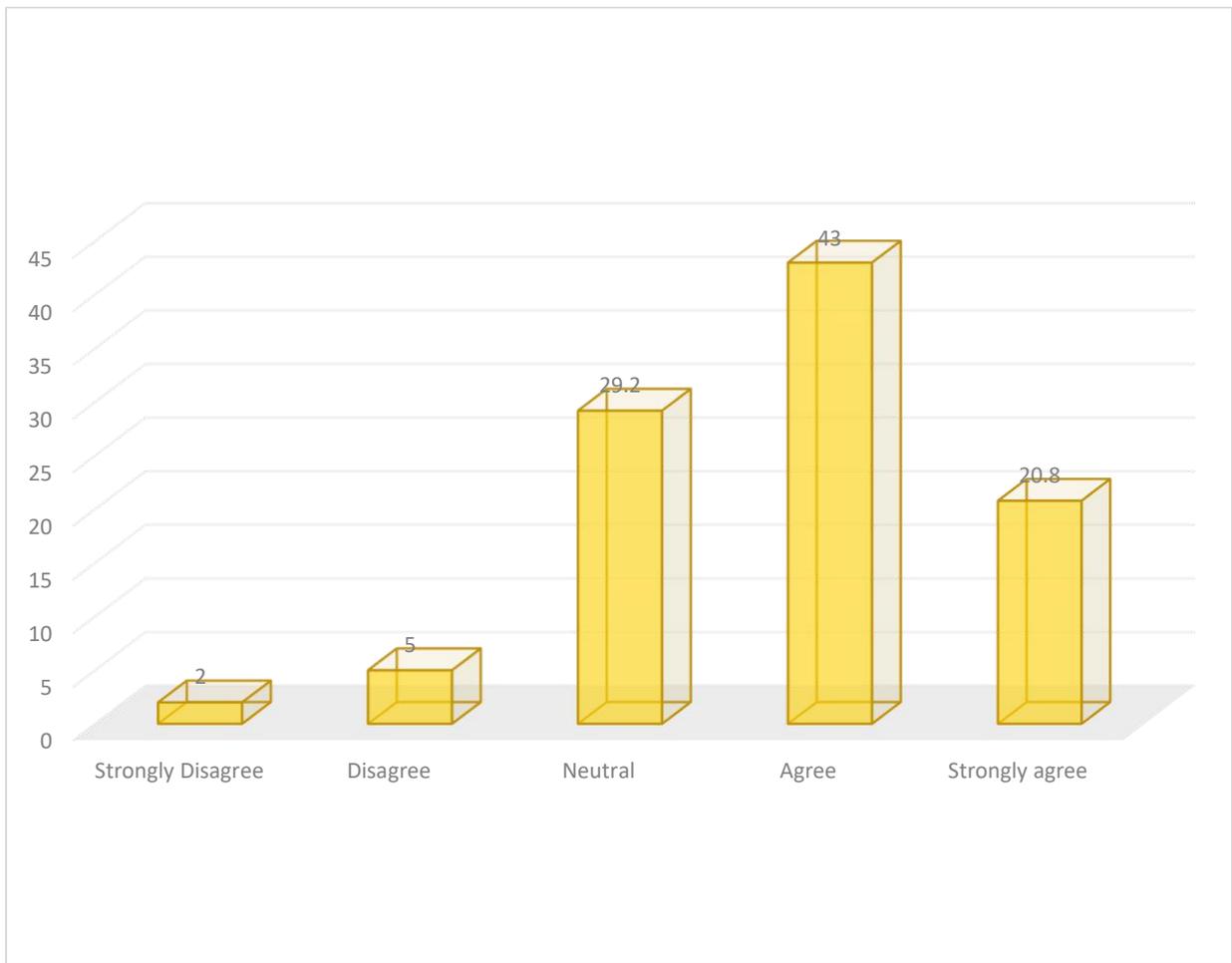
Casual leave taken by the respondents.



From the above graph we can interpret that, 60.8% of the respondents were able to take casual leaves but 39.2% of respondents can't get the casual leaves properly. From these we can say that based on the seniority of the person and also depends on the hospital management can provide leave for them.

Figure 4.24

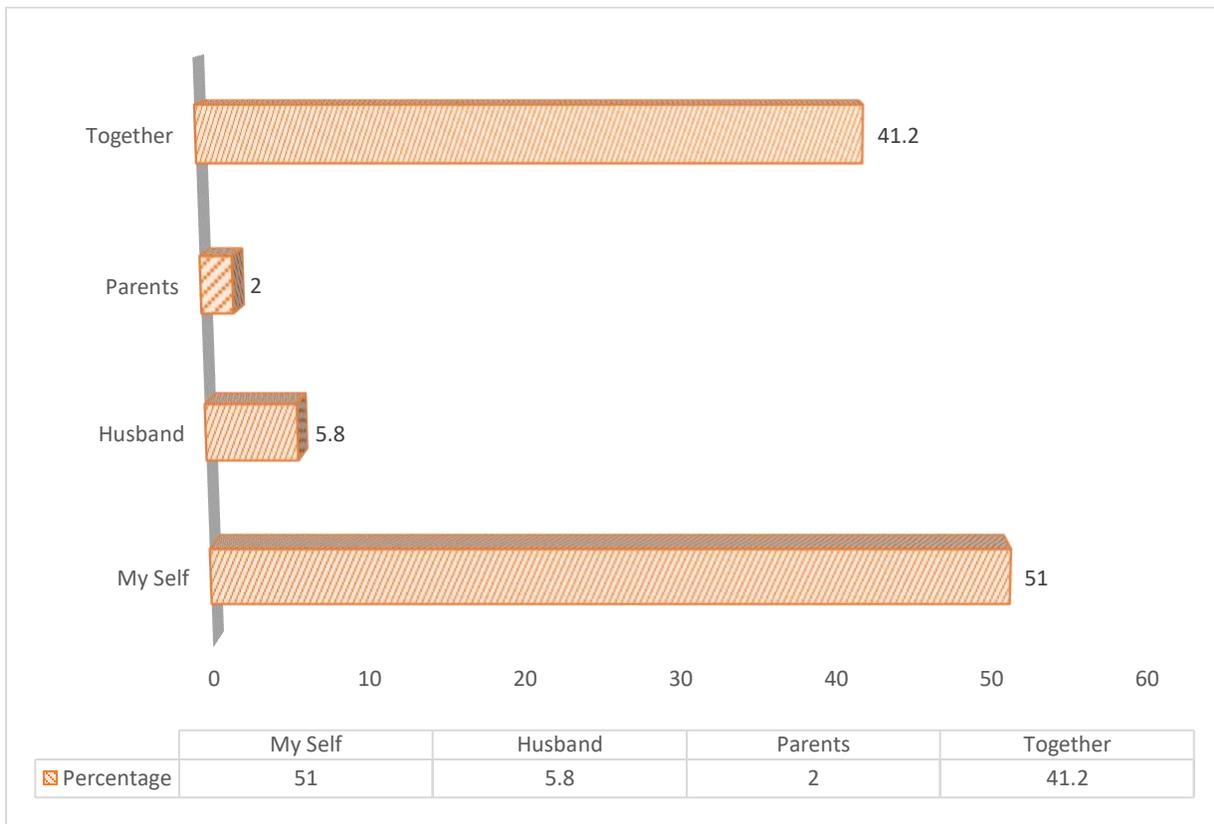
Leave taken for the needs of respondent's children.



From this data we can analyze that majority of the nurses were taking leave for the wants related to their children. Only few of them are disagree with this. The mothers were plays major role of taking care of children. they were getting time to go with them for their wants but they can't take care of them properly because of their shift work.

Figure 4.25

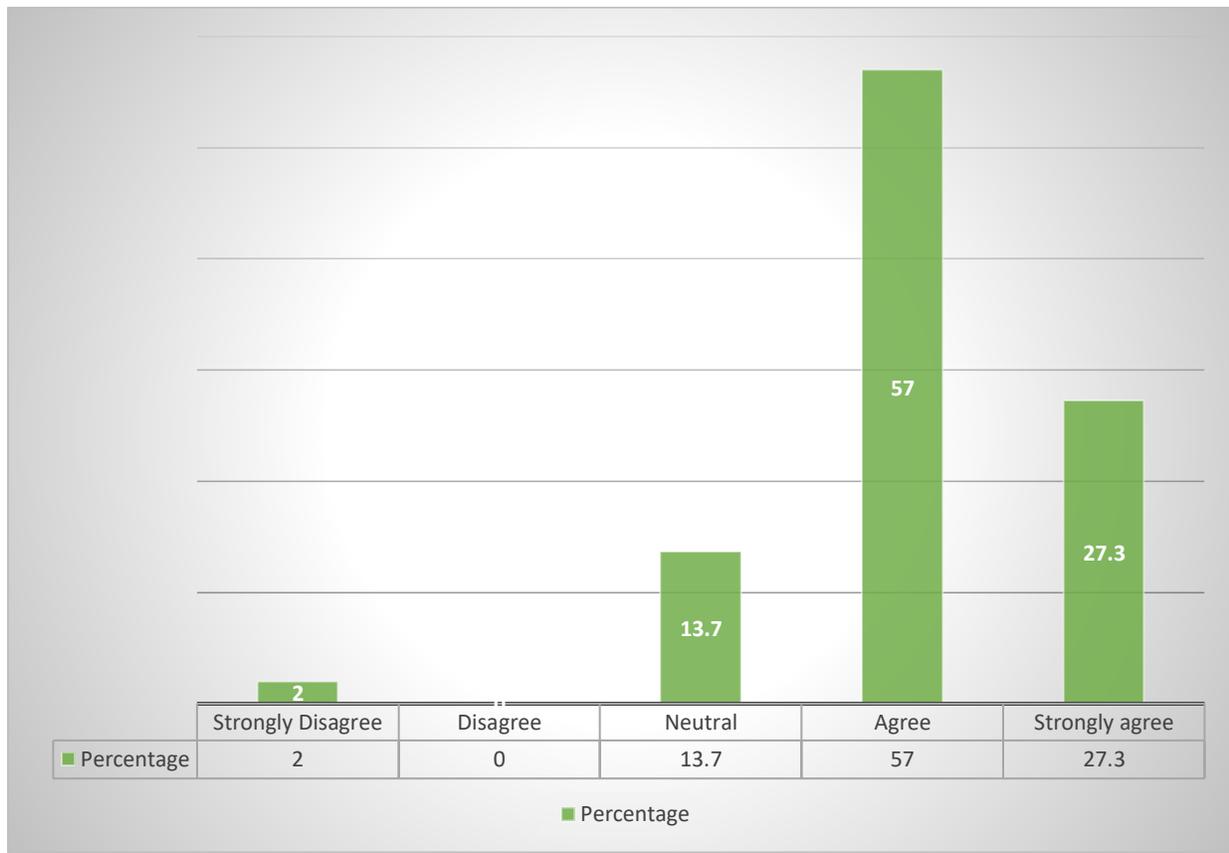
Decision making for taking leave.



In this data we can see that most of them are taking decision by themselves. And also, we can notice that they take decision together. from this data we can analyse they were having independent decision-making freedom and also, they were having great support from the side of husbands.

Figure 4.26

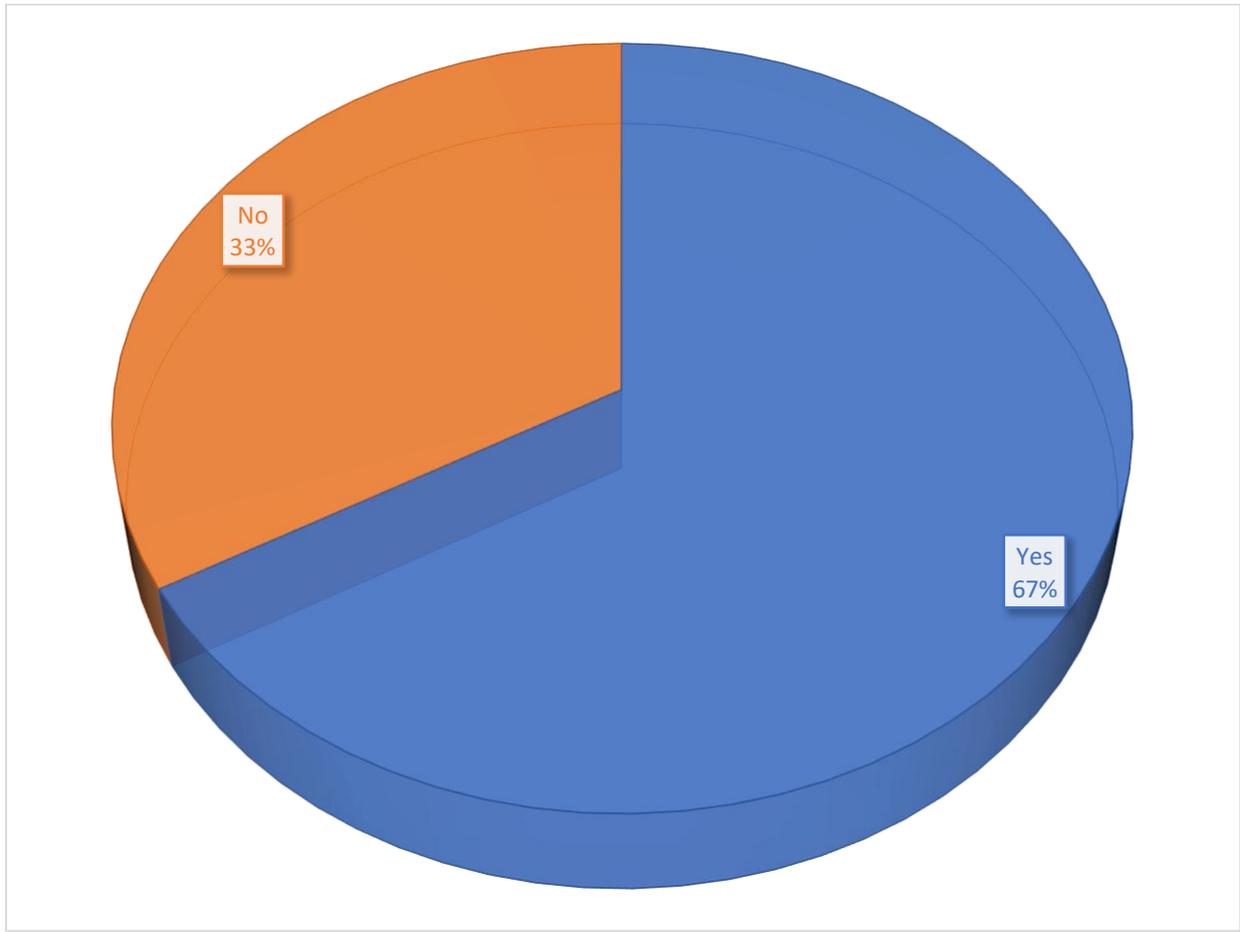
Seriousness of taking leave



From the above diagram we can see that 98% of them are taking leave on the basis of looking in to the seriousness of the matter. There is only 2% of them are taking leave without having reason. So, we can clearly understand that the nurses are giving importance to both the patients and family equally. that is why they didn't take simply leave.

Figure 4.27

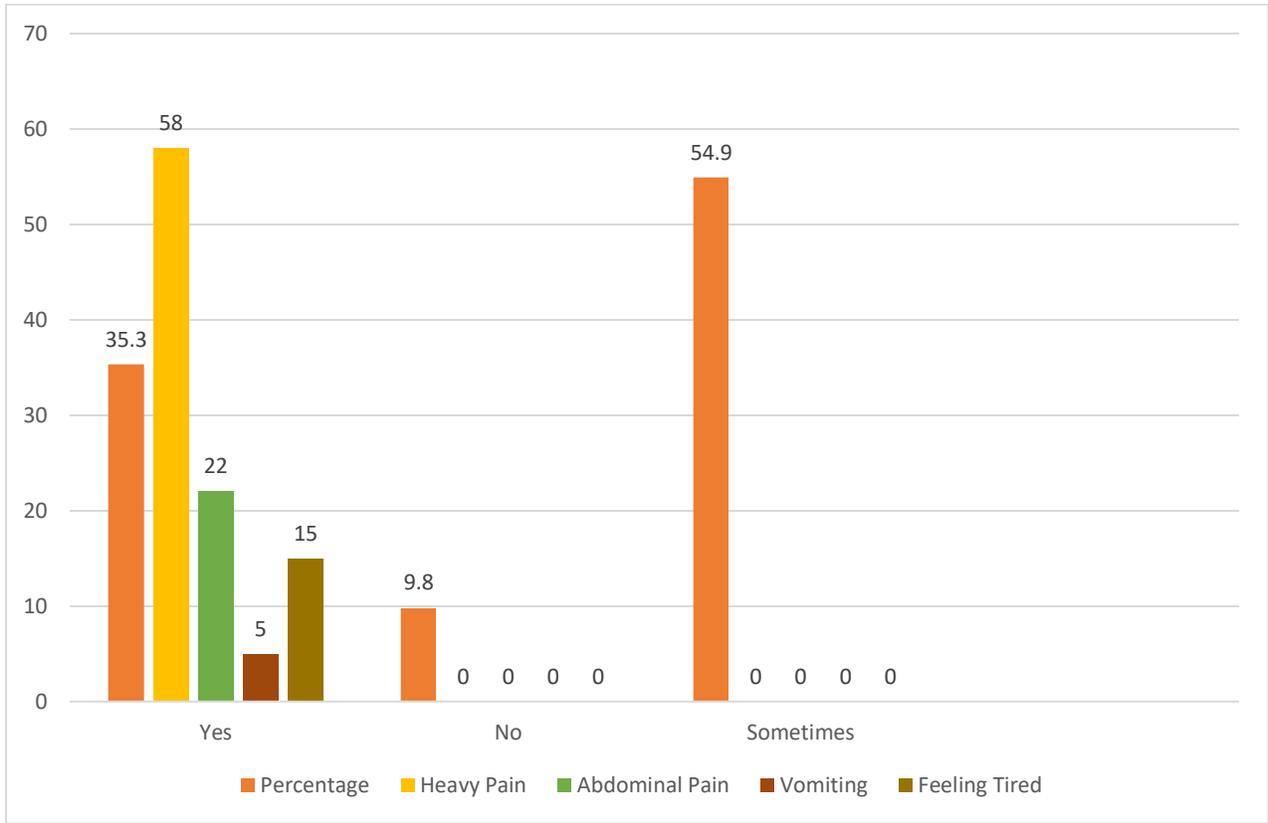
Respondents as a primary care giver



From this above table we can see that when a person in their home got sic the primary care was given by these nurses themselves. They were very knowledgeable as same as the doctors. Very few of them were depending on the hospital facilities.

Figure 4.28

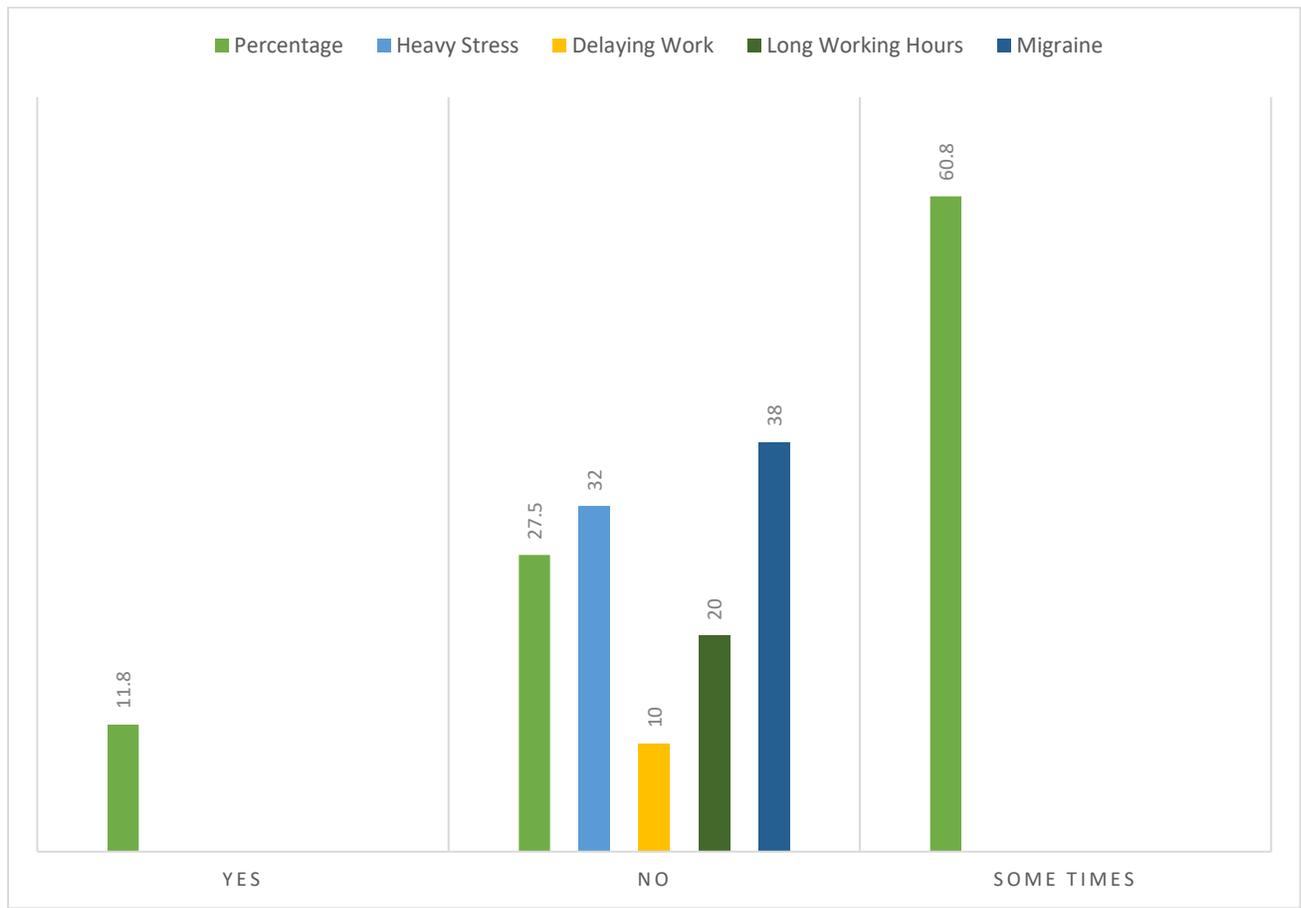
Difficulties during menstrual period of the Respondents



From this table we can find that most of the nurses were facing so much of difficulties during menstrual period. That is heavy pain, abdominal pain and feeling tired are the main problem that they were facing on that time. Very few of them are noticed without any issues during this period. The difficulties faced because of they didn't have proper resting time or break in between their working hours.

Figure 4.29

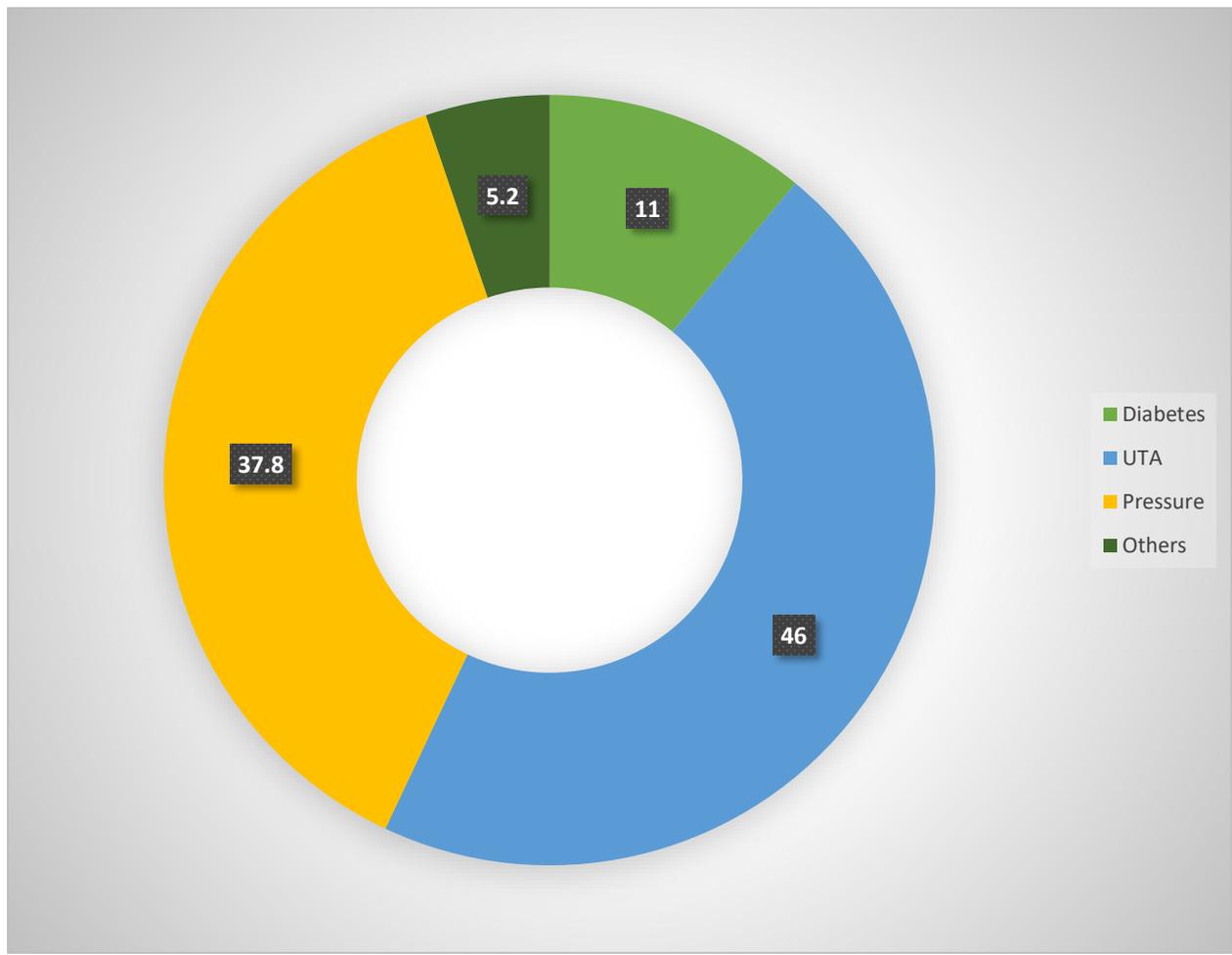
Leisure time in between the working hours of the Respondents



From this table we can find that most of the nurses don't get leisure time in between their work. So, they feel heavy stress and so many of them were having migraine due to long working hours. It delays their work schedule.

Figure 4.30

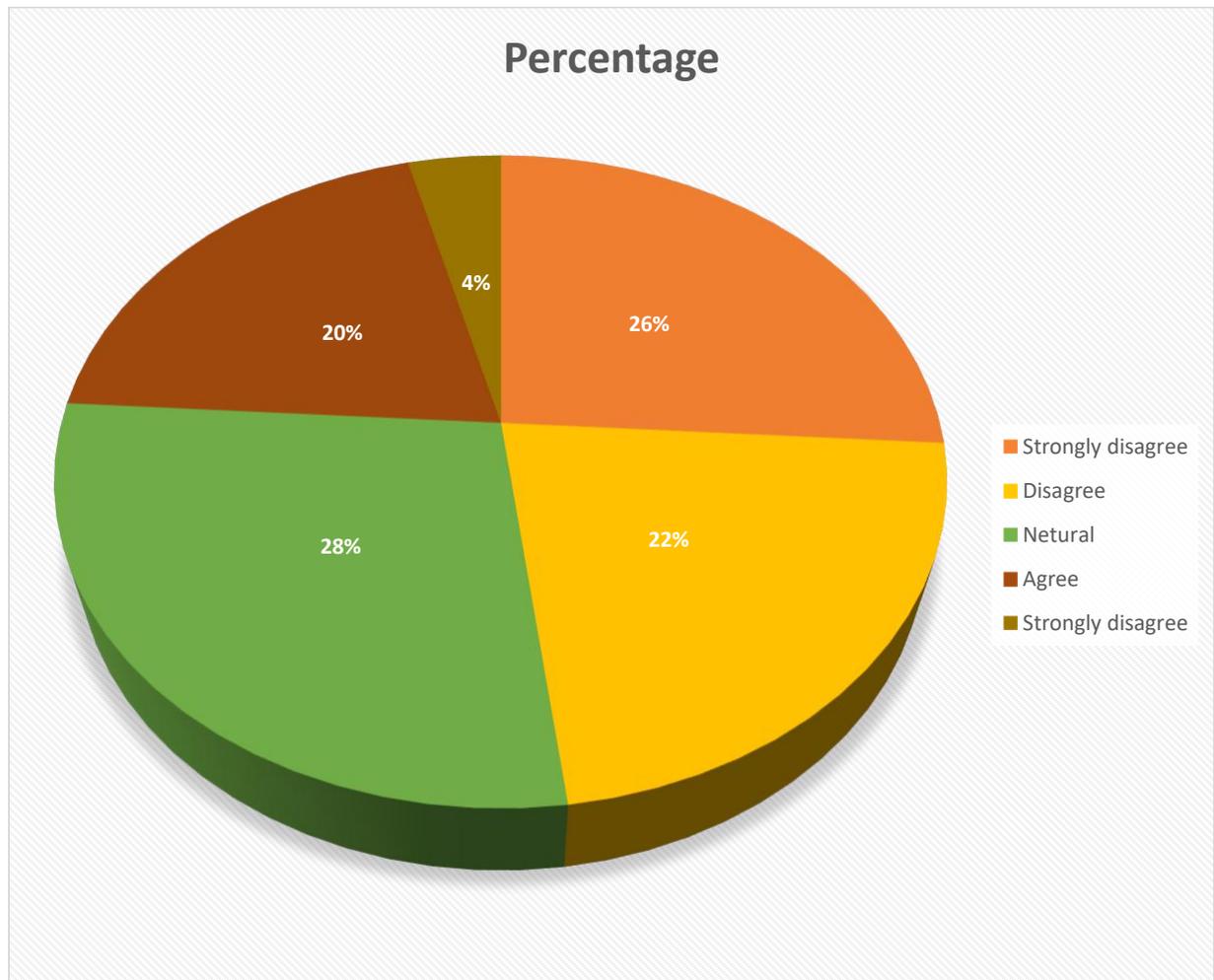
Health issues of the Respondents



The above diagram shows the health issues faced by the nurses. The Major issue faced by them was the UTA and Pressure. From this study we can find that due to the tight scheduled work with no leisure was the main reason or the cause of this health issues.

Figure 4.31

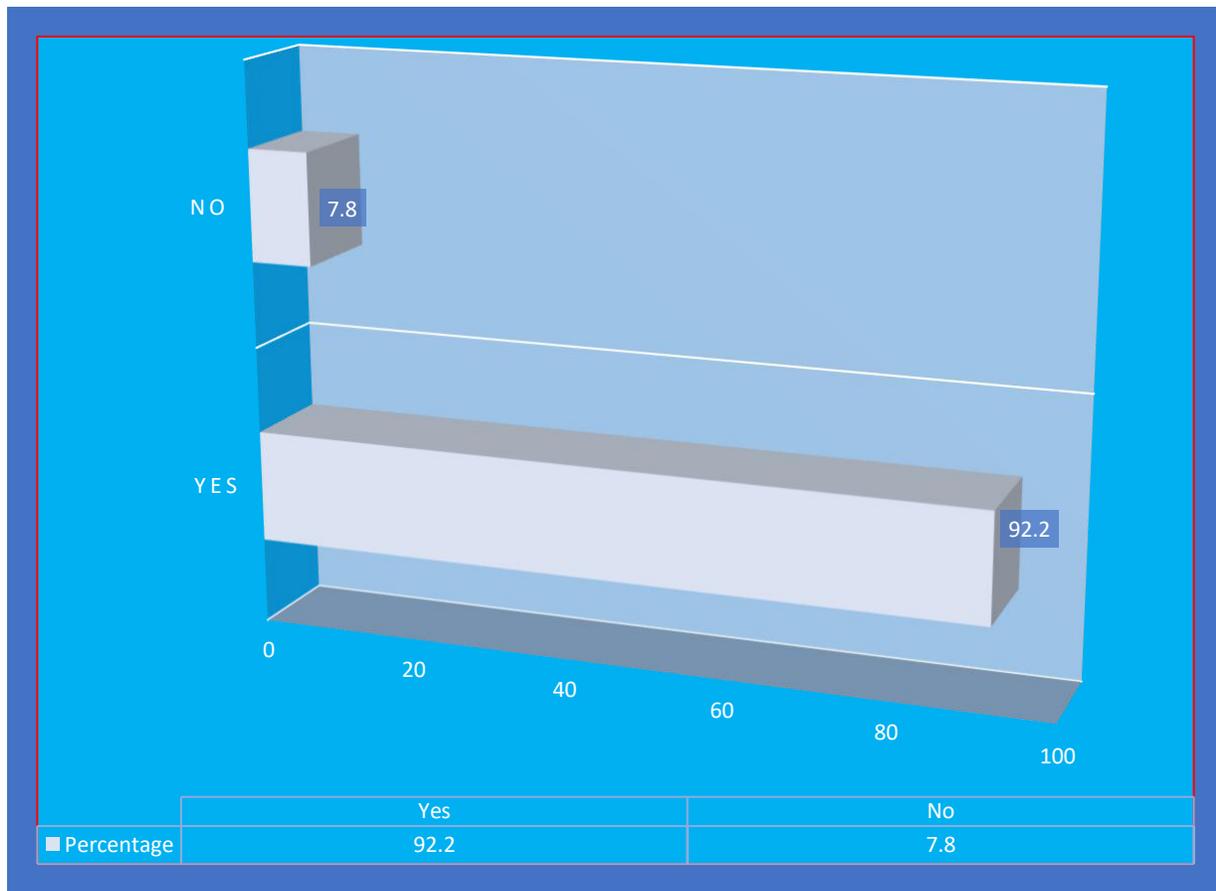
Schedule of having food of the Respondents



The table shows about the fooding habits on the working time. Most of them was not agreeing with this statement because they can't have food at correct time and also, they can't have food properly. That is because there is no proper break for having food. the patients call in between that and they want to go and attend or treat them.

Figure 4.32

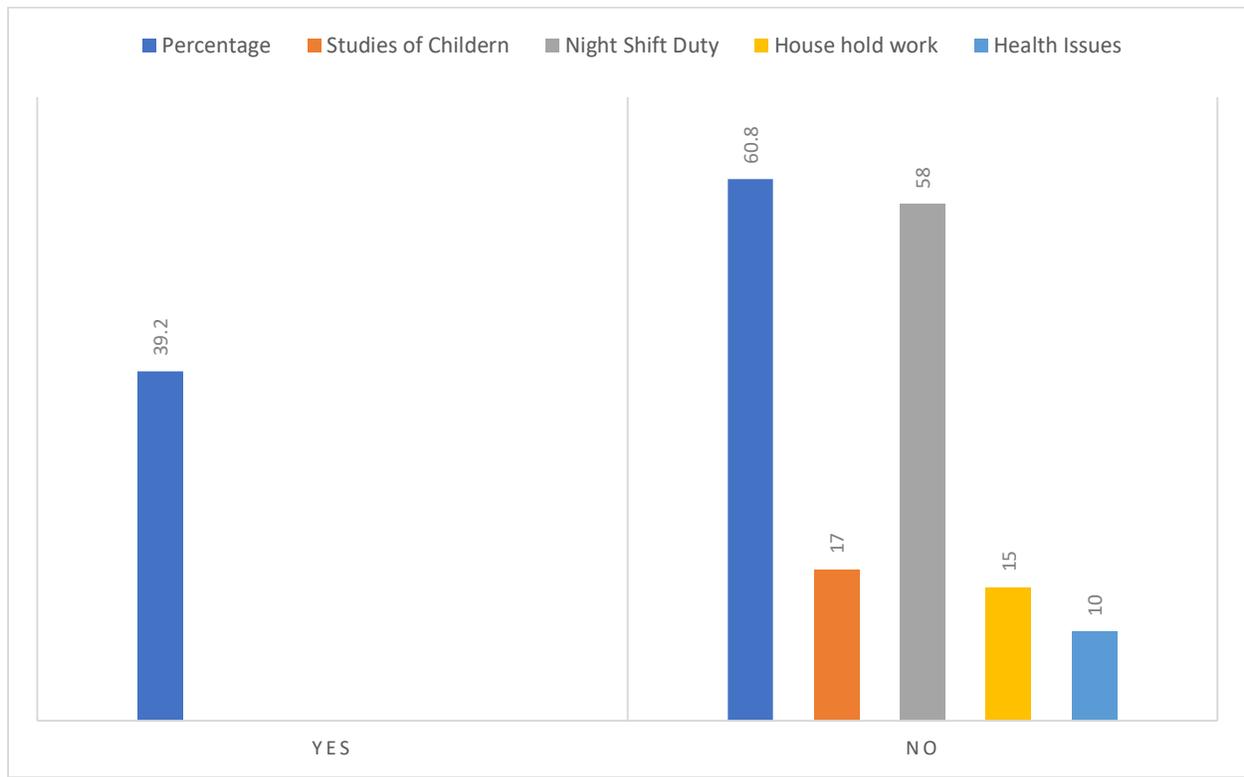
Work pressure stress level of the Respondents



From the above diagram we can see that 92.2% of the response were having lots of stress because of the work pressure. That is because they didn't get proper resting hours in between their work and also, they didn't have food at correct time.

Figure 4.33

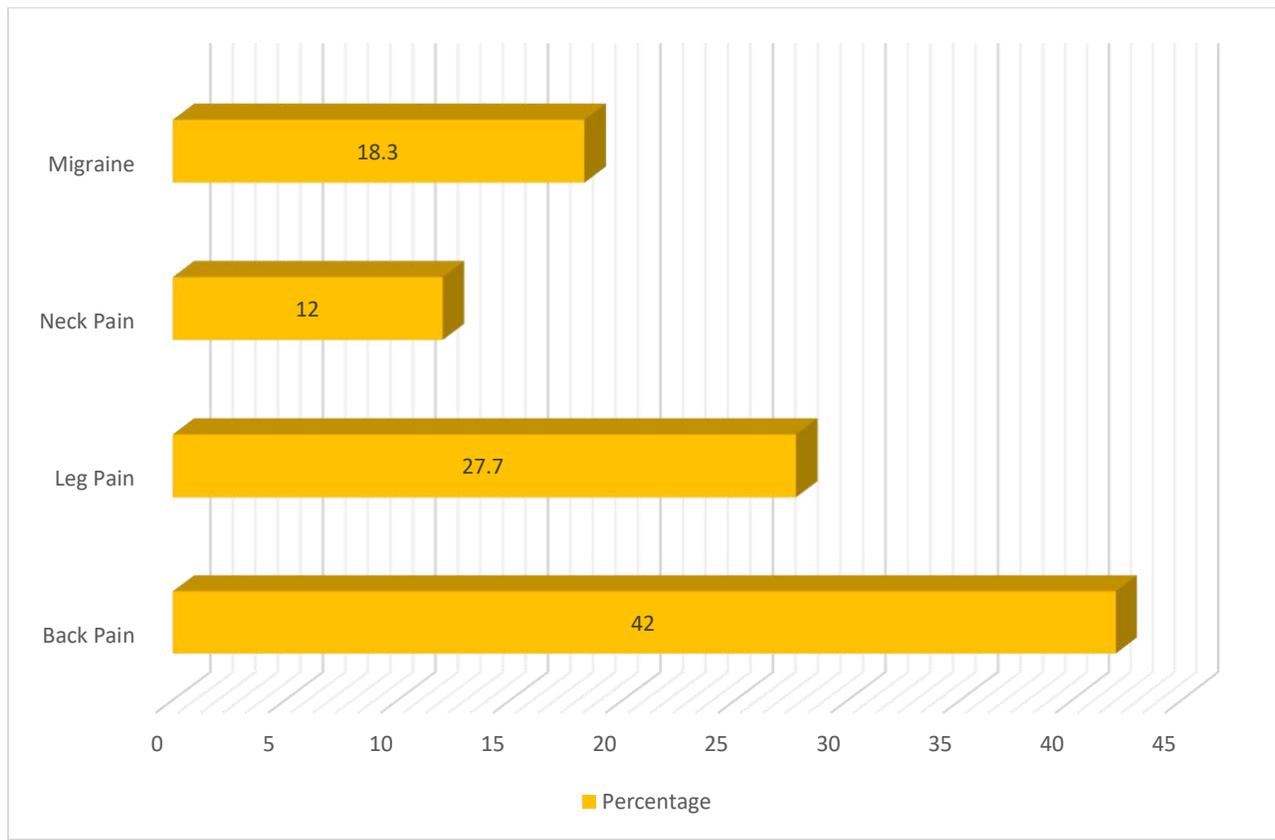
Sleeping habit of the Respondents



The above table showing the sleeping habit of the nurses. From this we can see that more than half of them didn't get proper sleep due to various reasons like, taking care for the studies of their children, night shift duties and house hold work. These all leads to the health issues for these nurses. It is because of the heavy work pressure from the hospital and to maintain house hold duties.

Figure 4.34

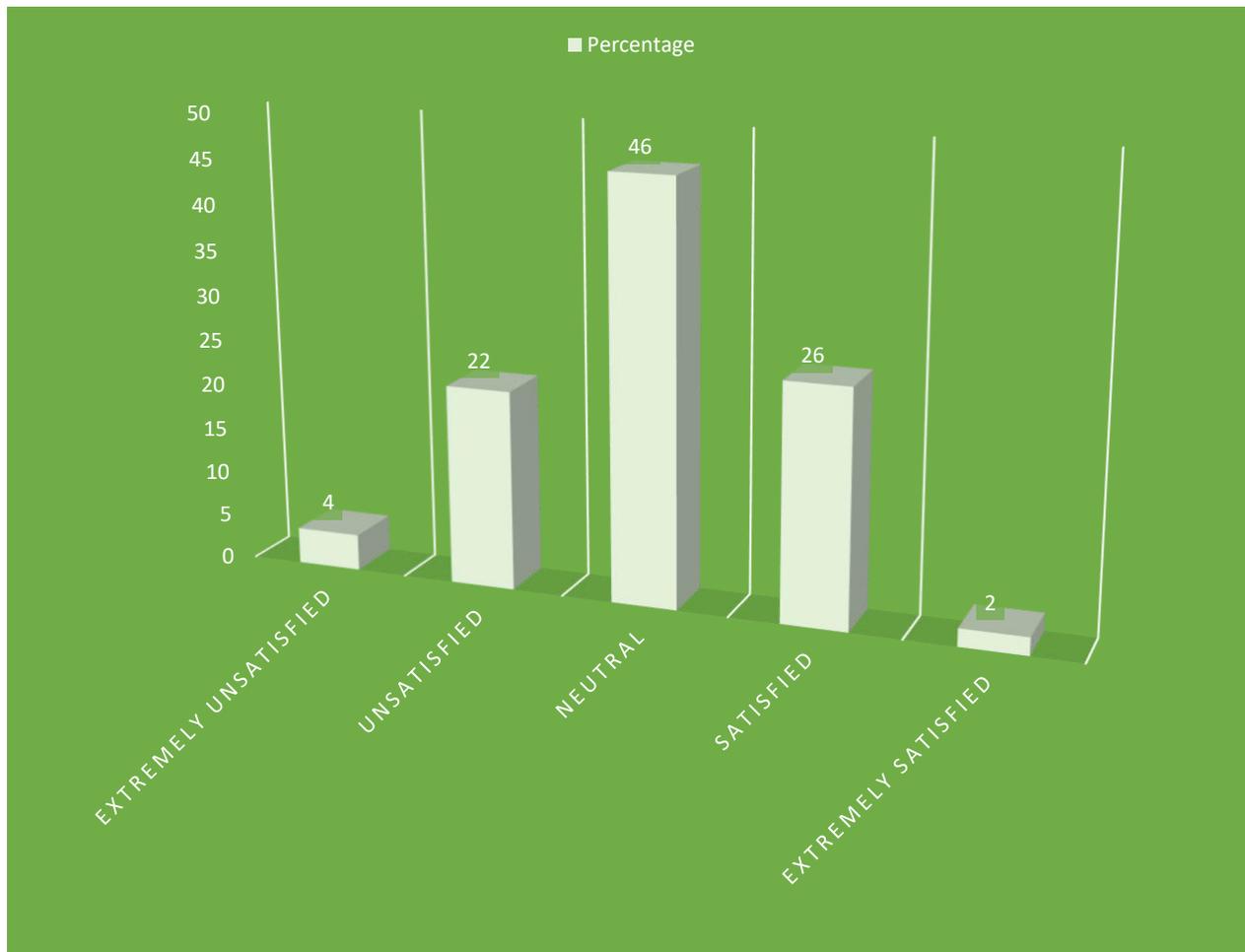
Physical complaints related to the Respondents



The above figure shows that the physical complaints that were belonging to the nurses. Here we can see that the back pain and leg pain are leading complaints of the nurses. It is because of the restless work. they can't get time to sit or taking rest. That is because of these health issues are more seen in nurses.

Figure 4.35

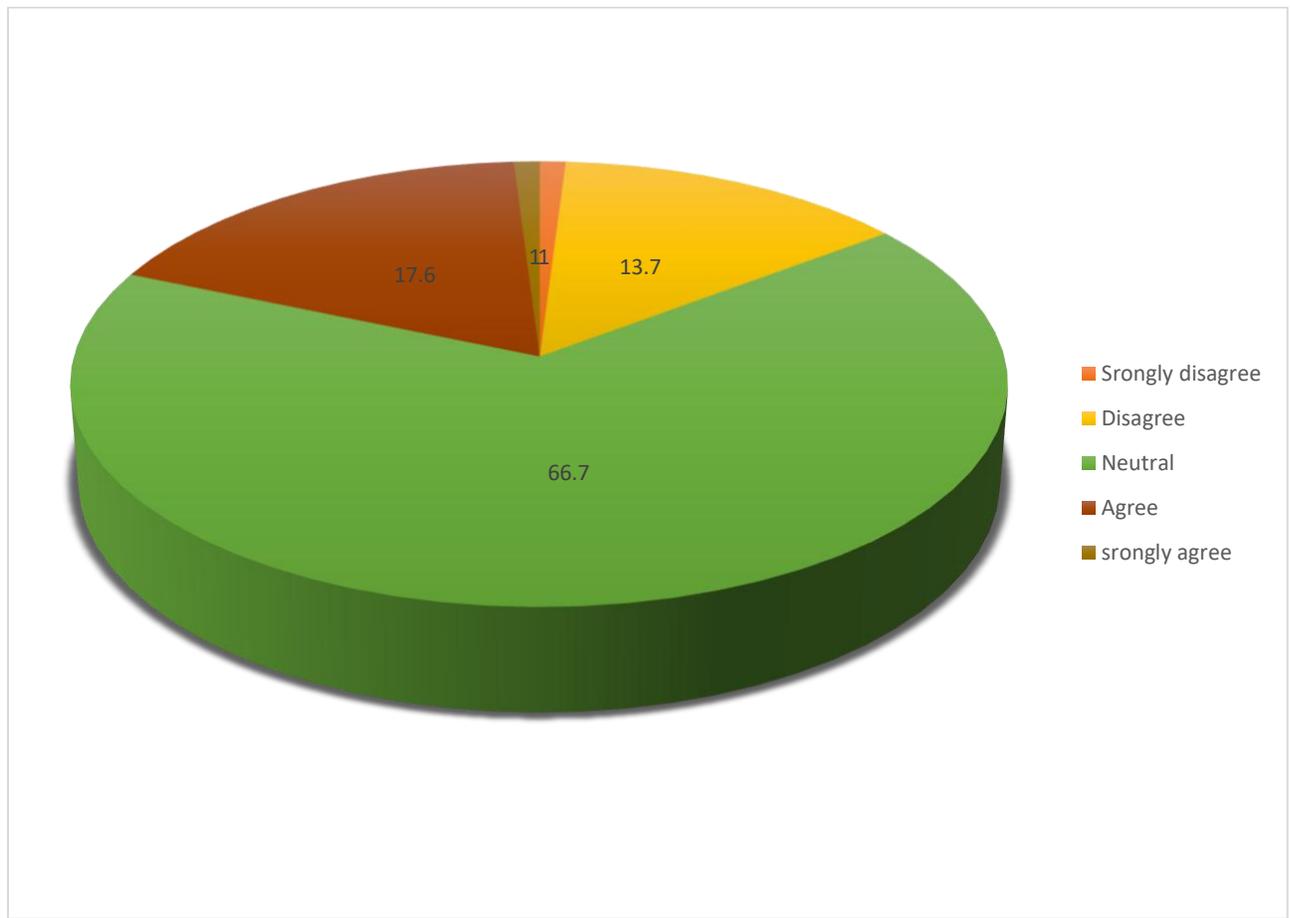
Level of satisfaction based on the attitude of hospital management



Form the above table we can see that the satisfaction level of the attitude of the hospital management was neutral in manner. The level of satisfaction and the un satisfaction are somewhat equal. It is based on the approach towards the nurses in each time being. So, their arguments have variations.

Figure 4.36

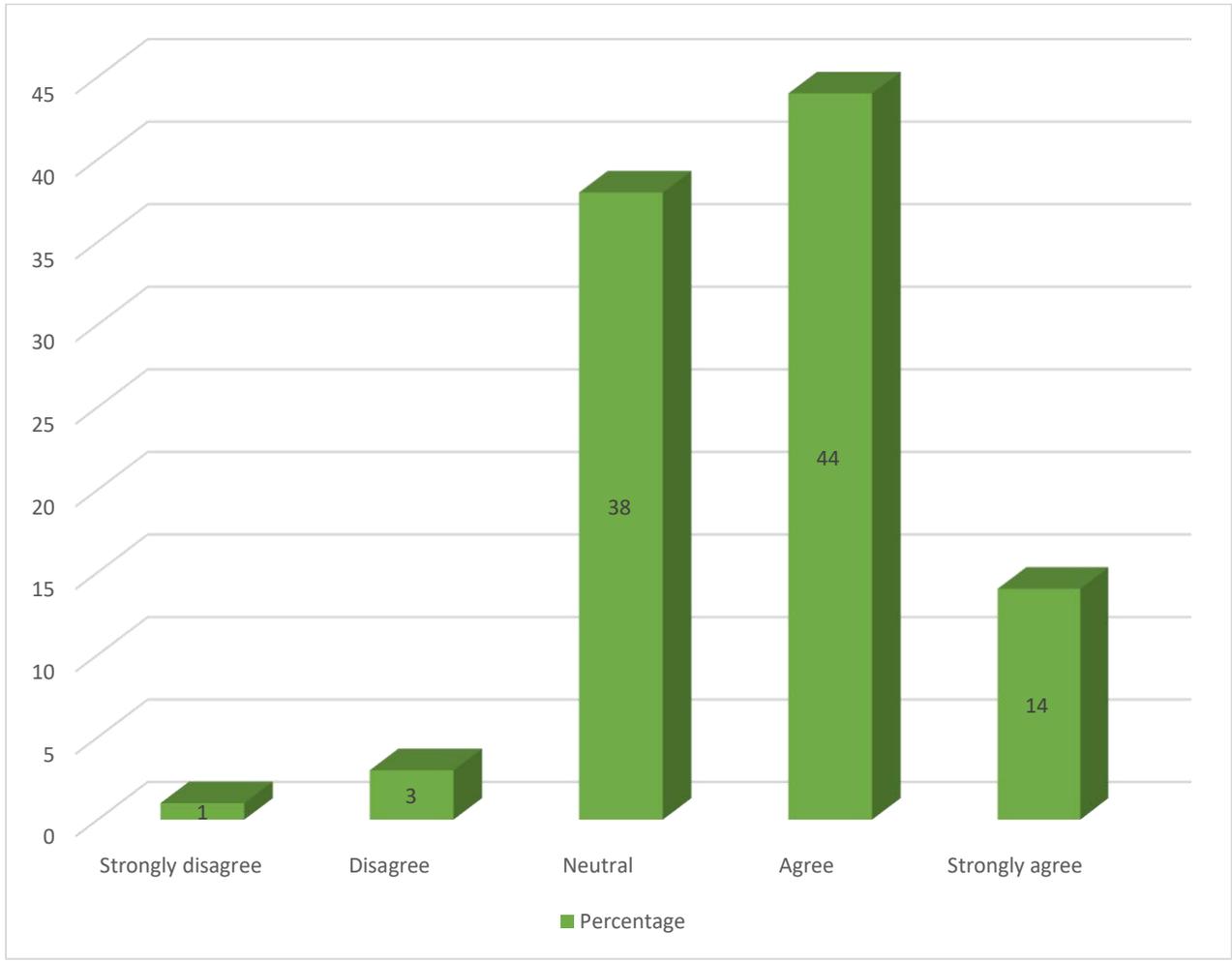
Respondents working satisfaction in the hospital



Here the above diagram shows that the satisfaction in their work. Most of the response were belonging to neutral. They like their profession very much. But they didn't get proper importance to the effort they taken in the hospital.

Figure 4.37

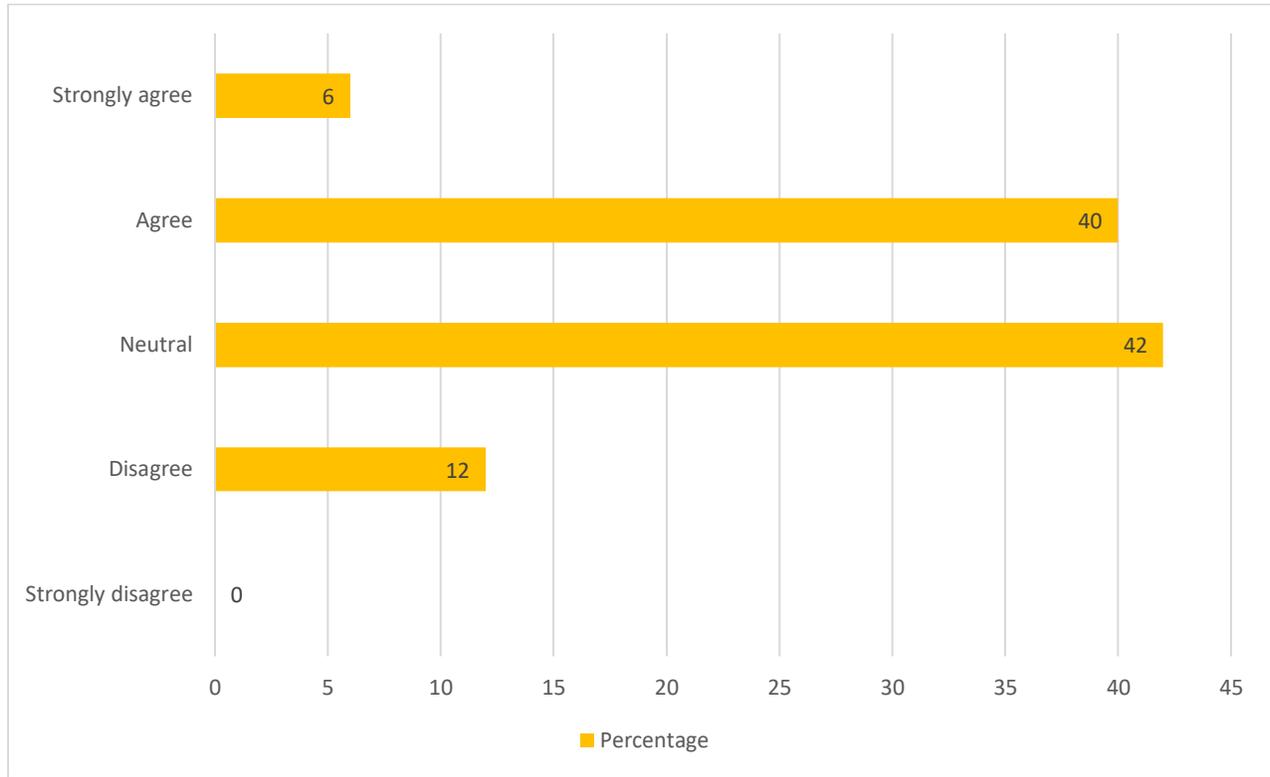
Respondent's relationship level with the colleagues



The above diagram shows the relationship level with the colleagues. Here we can see that most of them were maintain good relationship with others. Only 4% of them were not having good relationship. That is because of heavy stress from the family and all. They were maintaining mutual understanding with each other.

Figure 4.38

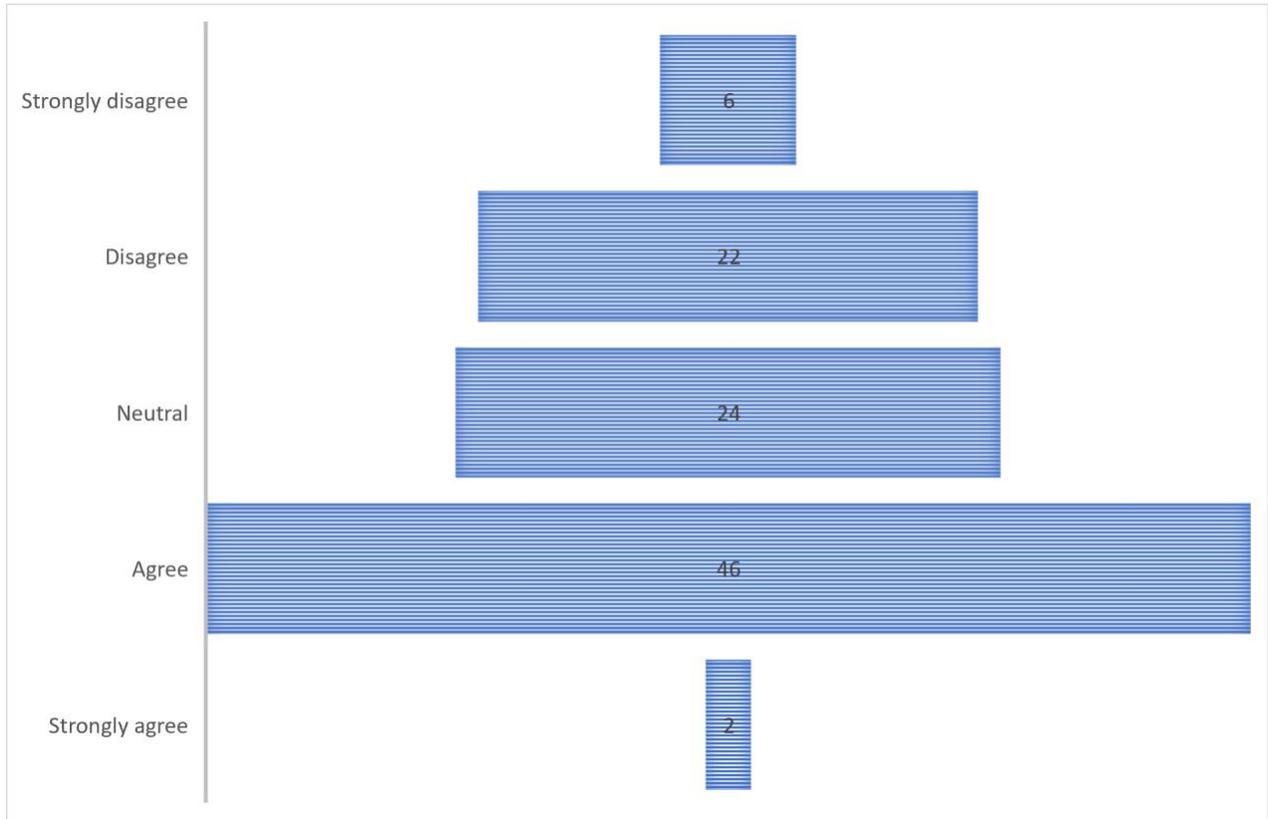
satisfaction level based on the approach of doctors



From the above data we can see that 42% of the respondents are neutral and 46% of respondents are agreeing with the statement that the approach of the doctors towards them is good in manner. But some of them were arguing that the approach of the doctors towards them was not good in manner. It is because they were considered that the nurses are below them and they didn't have much qualification than them.

Figure 4.39

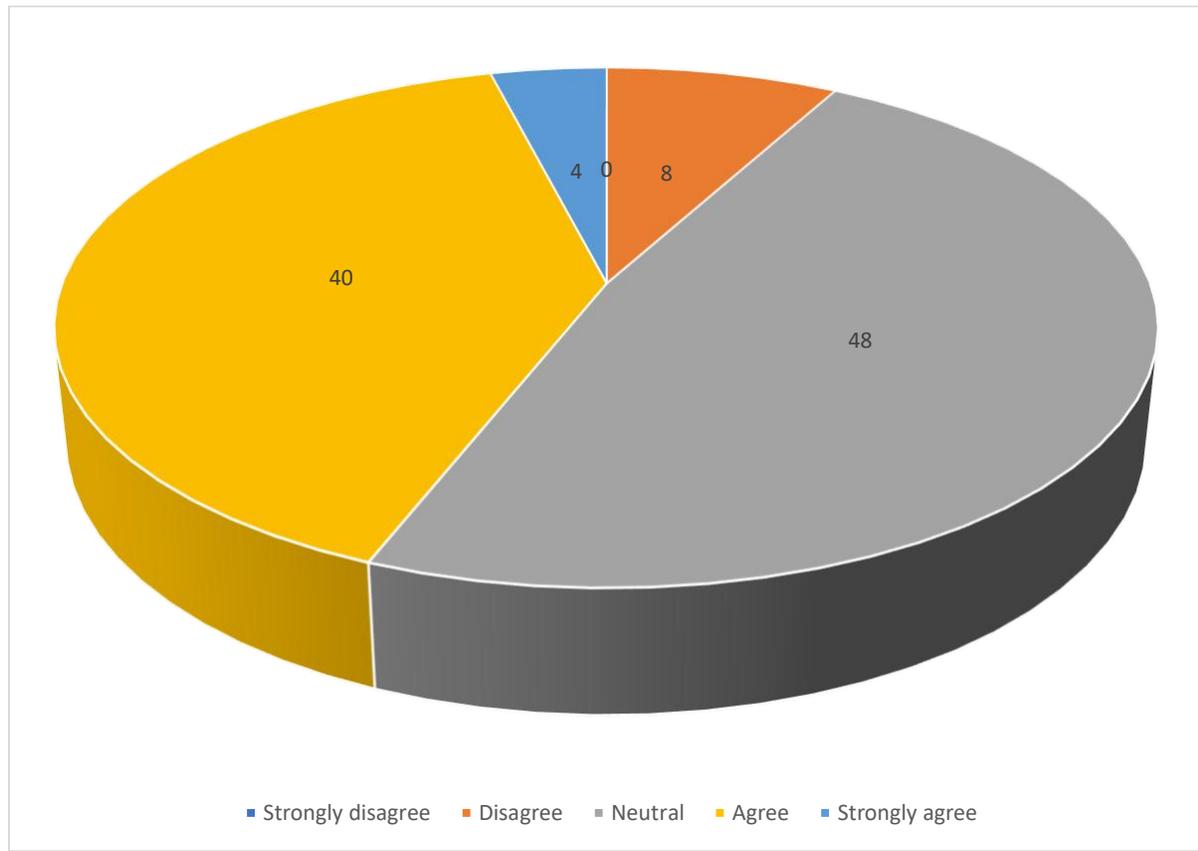
Level of discrimination based on gender



The above table shows the discrimination that faced by the nurses on the basis of gender. Only 28% of the respondent was not agreeing with this. But mostly others were saying that the gender-based discrimination was existed in this field. Especially from the part of hospital management and the patients.

Figure 4.40

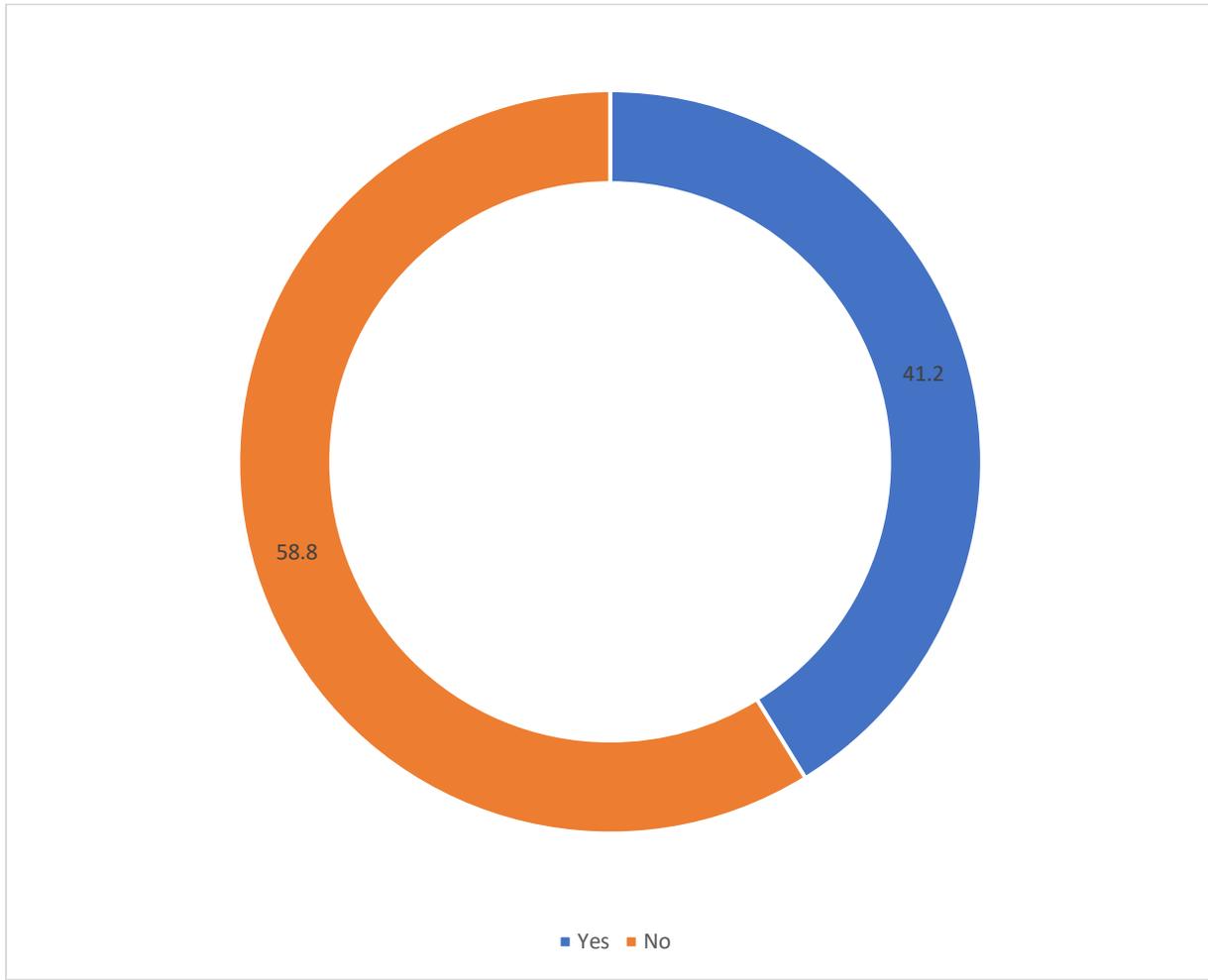
Level of importance that get from the hospital management to the respondents



The above diagram shows that the importance that given by the hospital management to the nurse. They were mostly consisting of neutral in manner. But 40% of the respondents was saying that they were not getting importance. There is no one in strongly disagree because they were didn't provide much facilities for the nurses that is because of they were having physical and mental issues.

Figure 4.41

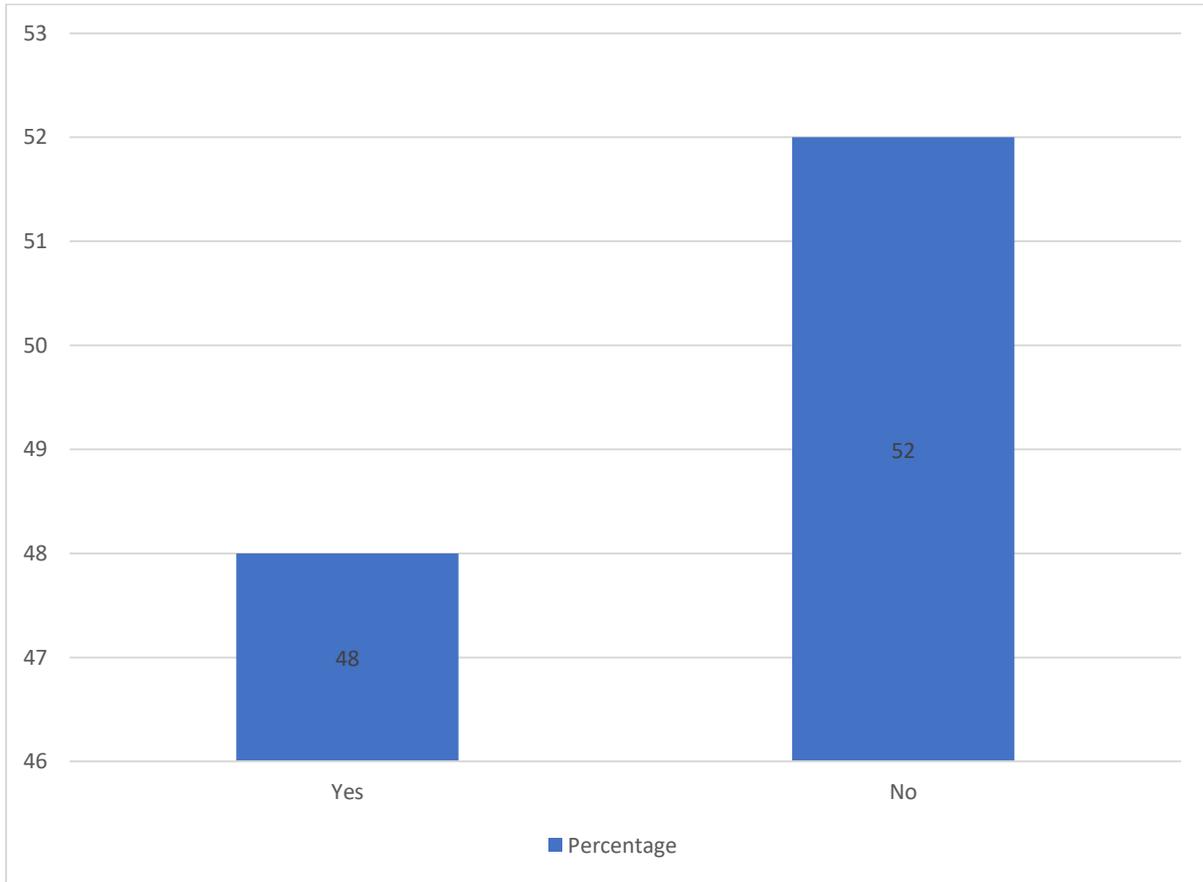
Satisfaction level of the facilities provided by the hospital management



From the above table we can see that the satisfaction level of the facilities provided by the hospital management is good in manner. Because now almost all the hospitals are very hi-tech in manner. In case of the temperature mission itself, earlier they want to check for few minutes but now it become digital. so, it become more easier for them.

Figure 4.42

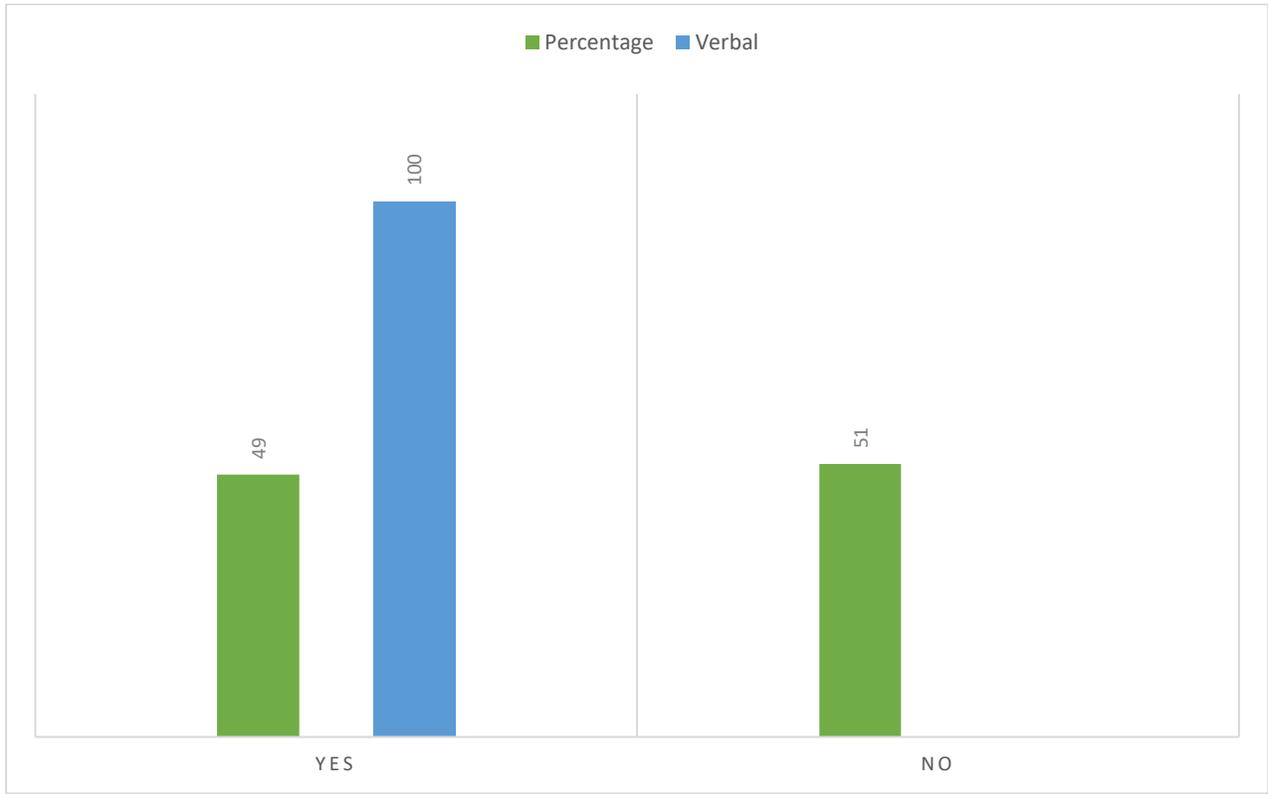
Level of medical assistance provided by the hospital



The above figure shows that the medical assistance that provided by the hospital to the nurses. many of them were not getting any kind of assistance from the hospital. In case of the medicines and treatment there is no considerations and discounts were not given to the nurses from the hospital.

Figure 4.43

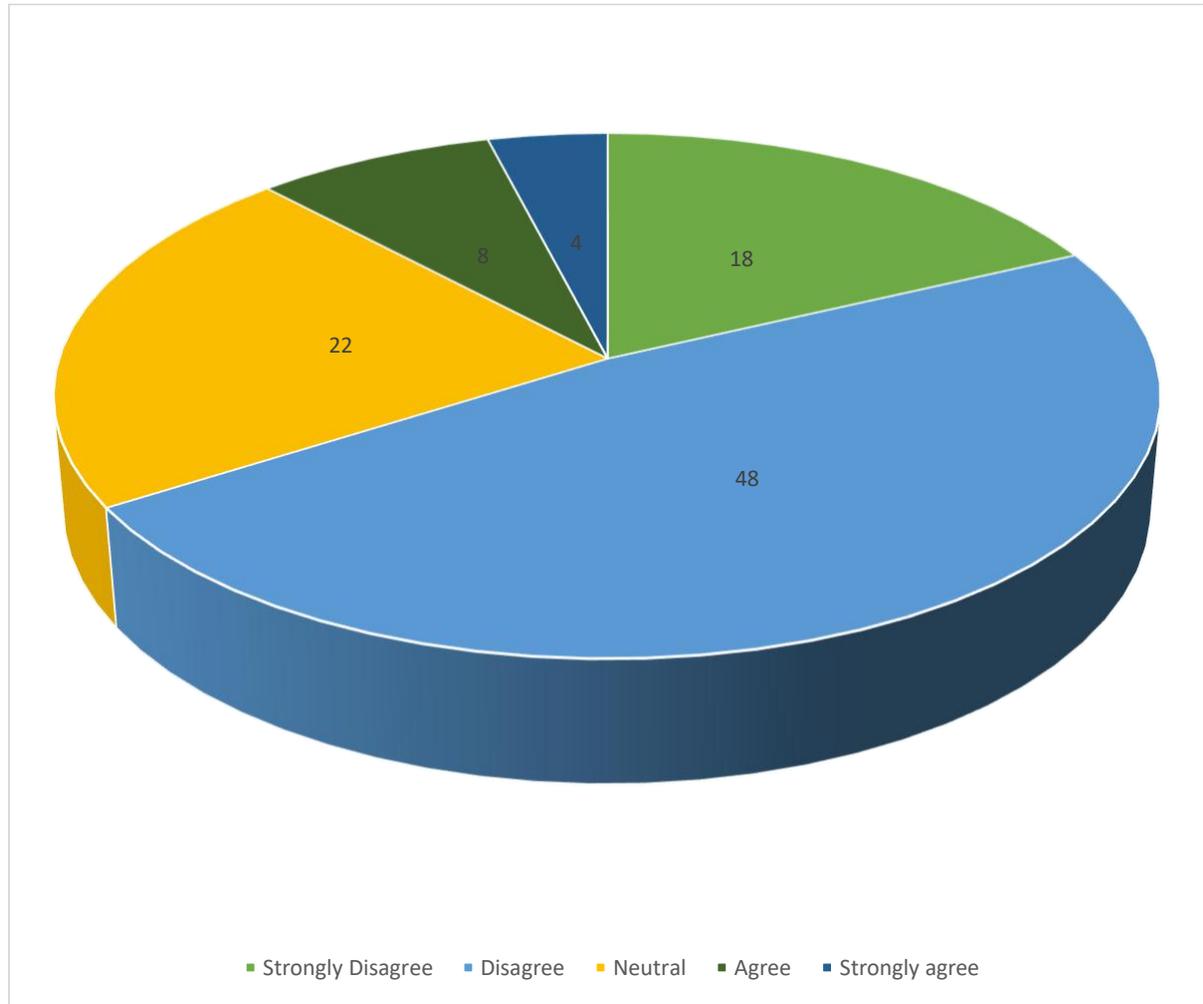
Level of bad experiences from the patient's side



Hear we can see that the bad experience that were faced by the nurses from the side of patients. Comparatively the bad experiences are low for the nurses but there is nearby percentage of having abuses from the side of patients. The verbal abuse was the main thing that the nurses want to face from the side of patients. That is all on the basis of gender and also the fault happens from the side of hospital management.

Figure 4.44

Satisfaction level of increments and promotion for the carer growth



From the above figure we can identify that majority of them were not satisfied with the increments and promotion. They have to work harder and also there is proper rest. It is very stressful work and they were handling it with a sweet smile to every individual that comes for treatment. They didn't show their sorrows and stress that by the hospital management. they played a role of peace. They were the back born of one hospital. Then also they didn't get any kind of support to the career growth.

# **FINDINGS AND**

# **CONCLUSION**

## **CONCLUTION AND FINDINGS**

Beyond the obvious conclusion that nursing is work, conceptualizing nursing as work points to changing social realities that are raising significant ethical issues. As a concept, work inherently conveys value, connects intellectual and manual labour, and recognizes social divisions of labour. Nursing is an ethical job that is needed throughout the world. It exists in the modern age as a way to care for and to help people, and to maximize the way we treat people.

Nursing is also very ethical; each patient is taken care differently and have different choices according to their ethics. Patient and the public have the right to the highest performance from the healthcare professionals and this can only be achieved in a workplace that enables and sustains a motivated and well-prepared workforce. Catering to the needs of nurses and combating their challenges can make nurses empowered, encouraged, challenged and affirmed to continue doing what they do best without any barriers. Inadequate Staffing that is, being short-staffed for brief periods of time is common in most professions, and in many of those situations, it is a minor inconvenience, Mandatory Overtime, Safety on the Job, Workplace Violence, Improving Self-Care. these are the challenging aspect of the nurses.

The findings are that the income that get for the nurses is very low when we compare with the working importance. The 8 hours is the basic working hour of the nurses in cochin city. In the period of corona, they have to work continuously for 12 hours or mor than that for a long period of time. It is because of the shortage of staffs due to quarantine. nurses were responded that they were struggle a lot to manage their responsibilities. they were having lots of support from the home to manage their works. the nurses may or may not be able to involve in the emotional issues faced by the children are more seen, very few of them are not even able to look their children. the time that got to spend with their family is very rarely. It is because of the duty shift and stress. they were leeding very busy life. They have to taking care of the patients in the hospital on the same time they want to give care to the elderly at home. based on the seniority of

the person and also depends on the hospital management can provide live for them. they were having great support from the side of husbands.

The nurses are giving importance to both the patients and family equally. that is why they didn't take simply leave. they didn't have proper resting time or break in between their working hours. most of the nurses don't get leisure time in between their work. The Major issue faced by them was the UTA and Pressure. the tight scheduled work with no leisure was the main reason or the cause of this health issues. there is no proper break for having food...

The health issues for these nurses are because of the heavy work pressure from the hospital and to maintain house hold duties. the back pain and leg pain are leading complaints of the nurses. It is because of the restless work. they can't get time to sit or taking rest. That is because of these heath issues are more seen in nurses. They like their profession very much. But they didn't get proper importance to the effort they taken in the hospital. They were maintaining mutual understanding with their colleagues. Then we can see that the gender-based discrimination was existed in this field. Especially from the part of hospital management and the patients. The verbal abuse was the main thing that the nurses want to face from the side of patients. That is all on the basis of gender and also the fault happens from the side of hospital management.

# **APENDIX**

## INTERVIEW SCHEDULE

1. Name:
2. Age:
3. Religion: Christian  Hindu  Muslim  others
4. Educational qualification: general nursing  BSC (basic)   
BSC (post basic)  MSC
5. Marital status: Married  separated  widow
6. The department in which you are working: general ward  intensive care unit   
public health  others   
If others, specify:
7. Annual income: below 1lack  1to3 lack  3to5 lack  above 5 lack
8. Type of family: nuclear  joint family
9. Type of house: own  rent
10. Type of vehicles you were used to come to hospital: 2wheeler  4wheeler   
Public transport
11. How many hours you have to work per day: 6  8  10
12. If there any changes in the working hours during the period of corona: yes  no   
If yes, specify the working hour:
13. Do you have someone to help you with the household works? Yes  no   
If yes, who will help you? Husband  parents  vants

14. Who is in charge of cooking in your family? My self  parents   
servants
15. Who will do the other house hold activities like cleaning, washing and so on?  
My self  parents  servants
16. Are you able to balance the domestic work and your job? Yes  no
17. Are you the only source of income in your home? Yes  no   
if no, specify
18. Who will take care of your children when you going for work? Husband   
parents  servants
19. Are you a breastfeeding mother? Yes  no   
If yes, how you manage? Feed after comeback home   
store milk using breast pumps
20. Shift schedules at work make it difficult to cope with tasks at home :  
Strongly agree  Agree  neutral  disagree  strongly disagree
21. “Due to the pressure of my work the attachment with children decreases” do you agree  
with this?  
Strongly agree  Agree  neutral  disagree  strongly disagree
22. Are you able to help children with their emotional issues? Yes  no   
sometimes
23. Do you get time to spend with your family members? Yes  no  sometimes
24. “I have a job but I can look after the elderly at home” are you agreeing this statement?  
Strongly agree  Agree  neutral  disagree  strongly disagree
25. Can you able to take casual leaves? Yes  no

26. "I mostly take leave for the needs of my children" are you agree with this statement?

Strongly agree  Agree  neutral  disagree  strongly disagree

27. Who decide whether to take leave or not? Myself  husband  parents   
together

28. "I will take leave, realizing the seriousness of the matter" are you agree with this  
statement? Strongly agree  agree  neutral  disagree  strongly disagree

29. are you the primary care for your family? Yes  no

30. Do you experience any difficulties during menstruation? Yes  no  sometimes

If yes, specify the issue

31. Do you get leisure time in between working hours? Yes  no  sometimes

If no, what are the challenges that you face by it?

32. Do you have any of these health issues? Diabetes  UTA  pressure  others

If others, specify?

33. "I can eat and drink at the right time" are you agree with this statement

Strongly agree  Agree  neutral  disagree  strongly disagree

34. Do you feel stressed up due to the work pressure? Yes  no

35. Do you get proper sleep? Yes  no

If no, why?

36. Do you have any physical complaints? Back Pain  leg Pain  ck Pain

Others

If others, specify?

37. Are you satisfied with the attitude of the hospital management? Extremely satisfied

Satisfied  Neutral  Dissatisfied  Extremely unsatisfied

38. "I'm very happy to working in this hospital" are you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

39. "I have excellent relationship with colleagues" are you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

40. "The doctor treated us very kindly" are you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

41. "I feel discrimination based on gender from the side of hospital and patients" are you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

42. "The importance that I get from the management side in the hospital seems to be low" are you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

43. Are you satisfied with the facilities provided by the hospital management? Yes  No

44. Do you get medical assistance at the same hospital when you sick? Yes  No

45. Have you ever had a bad experience from the part of the patients? Yes  No

if yes, specify? Verbal  Sexual  Others

46. "I get salary increments and promotions by the hospital management for the career growth" do you agree with this statement?

Strongly agree  Agree  Neutral  Disagree  Strongly disagree

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## **BIBLIOGRAPHY**

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13. <https://www.osha.gov/Publications/osha3148.pdf>
14. <http://ajcc.aacnjournals.org/content/26/4/344.full>

**CHANGING MENSTRUAL HABITS AMONG  
COLLEGE STUDENTS IN KERALA  
WITHSPECIAL REFERENCE TO  
THIRUVANANTHAPURAM DISTRICT**



By

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**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM**

**MARCH 2022**



**CHANGING MENSTRUAL HABITS AMONG COLLEGE STUDENTS IN  
KERALA WITH SPECIAL REFERENCE TO THIRUVANANTHAPURAM  
DISTRICT**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in fulfilment of the  
requirements for the award of the degree of Master of Arts in Sociology

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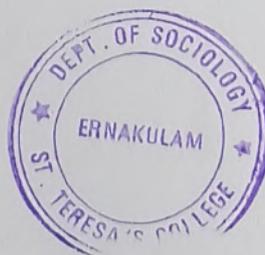
*Dr. Leela P.U. Leel*

Name and Signature of the Staff Supervisor

*Elizabeth*

Name and Signature of the Head of Department

**MARCH 2022**



## CERTIFICATE

I certify that the thesis entitled “**CHANGING MENSTRUAL HABITS AMONG COLLEGE STUDENTS IN KERALA WITH SPECIAL REFERENCE TO THIRUVANANTHAPURAM DISTRICT**” is a record of bonafide research work carried out by **ARATHY B.S**, under my guidance and supervision. The thesis is worth submitting in fulfilment of the requirements for the award of the degree of Master of Arts in Sociology

*Dr. Leela P.V. Leel*  
Name and Signature of the Staff Supervisor

Assistant Professor

Department of Sociology

St. Teresa's College, Ernakulam

Ernakulam

March 2022

## DECLARATION

I, **ARATHY B.S** hereby declare that the thesis entitled “**CHANGING MENSTRUAL HABITS AMONG COLLEGE STUDENTS IN KERALA WITH SPECIAL REFERENCE TO THIRUVANANTHAPURAM DISTRICT** “ is a bonafide record of independent research work carried out by me under the supervision and guidance of **Dr.Leela P.U** further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



ARATHY B.S

## ACKNOWLEDGEMENT

In this humble endeavour I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr.Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Dr.Leela P.U for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

March 2022



ARATHY B S

## CONTENTS

CHAPTER	PAGE
1. Introduction.....	1-11
2. Review of Literature.....	12-23
3. Methodology.....	24-27
4. Data Analysis and Interpretation.....	28-64
5. Findings and Conclusion.....	65-69

Bibliography

Appendix

## **LIST OF TABLES**

<b>Sl.no</b>	<b>Title</b>	<b>Pg.no</b>
4.1	Age of the respondent	29
4.2	Data about respondent satisfaction with the menstrual product they currently use	38
4.3	Data about whether the respondent be recommending eco-friendly menstrual products to more people	44
4.4	Data about various health issues faced by the respondent	52
4.5	Availability of proper menstrual waste disposal facility at respondents' campus	58
4.6	Respondents' opinion on the role of customary practice on menstrual related discrimination respondent face	62

## **LIST OF FIGURES**

<b>Sl .no</b>	<b>Title</b>	<b>Pg.no</b>
4.1	Course in which respondent is studying	30
4.2	Religion of the respondent	31
4.3	Locality in which respondent is residing in	32
4.4	Marital status of respondent	33
4.5	Monthly income	34
4.6	Menstrual product used by the respondent	35
4.7	Preferred menstrual product by the respondent	36
4.8	Reasons for choosing preferred product	37
4.9	Data about whether the respondent has used eco-friendly menstrual products	39
4.10	Respondent satisfaction on using eco-friendly menstrual product	40
4.11	Ways through which respondent came to know about eco-friendly menstrual products	41
4.12	Respondent difficulty in affording eco-friendly menstrual products	42
4.13	Respondent difficulty in finding eco-friendly menstrual products from nearby or reachable stores	43
4.14	Respondent awareness about menstrual cup	45
4.15	Data about whether the respondent is afraid to use menstrual cup	46
4.16	Respondent having stomach cramps during menstruation	47
4.17	Intake of pills to reduce menstrual pain	48

4.18	Whether if respondent is taking pills to reduce menstrual pain with the consultation of doctor or not	48
4.19	Symptom's respondent face during menstruation period	49
4.20	Respondent taking leave from college during menstruation	50
4.21	Respondents regular and irregular period	51
4.22	Whether the respondent ever had any allergies by using menstrual product	53
4.23	Rating availability of clean water at home	54
4.24	Availability of proper menstrual waste disposal at home	55
4.25	Ways through which menstrual waste is disposed	56
4.26	Availability of menstrual product at campus readily and in a convenient manner	57
4.27	Respondent satisfaction on sanitation facility available at their campus	59
4.28	Role cultural acceptance play in respondents' preference and choice of selecting menstrual products	60
4.29	Menstrual hygiene related discrimination respondent face from home	61
4.30	Menstrual related discrimination from public spaces	62
4.31	Respondents stand about influence of customary practice over menstruation , if they believe customary practice have an influence over menstruation	63

# **CHAPTER ONE**

## Introduction

According to the World Health Organization, an adolescent is someone between the ages of 10 to 19. Adolescence is the period of transition between childhood and adulthood, and it is distinguished by the child's growth and development. During this time, the child's physical, psychological, and biological growth takes place. It is acknowledged as a unique stage in a girl's life that necessitates special attention. Menarche is a significant biological milestone in a woman's life because it signifies the start of her reproductive phase. The typical age at menarche is between the ages of 12 and 13, which is very stable among populations. Unfortunately, the situation for girls worsens due to a lack of awareness about menstruation preparation and control, as well as shyness and embarrassment. Menstruation is a normal function, however it is nevertheless regarded as unclean and dirty in Indian society.

Menstruation or period is normal vaginal bleeding that occurs as part of a woman's monthly cycle, your body prepared for pregnancy every month. The uterus, or womb removes its lining if no pregnancy develops. Menstrual blood is made up of both blood and tissue from the uterus. It exits the body via the vaginal canal. Wastes produced by a female throughout the reproductive years are known as menstruation wastes. Menstruation, often known as menses, periods or monthly bleeding cycle, produce these wastes. The follicular phase (proliferative), ovulation phase, and luteal phase are the three phases of the menstrual cycle (secretory). Hormones control menstruation; throughout this process, the endometrium, the uterine lining, thickens and sheds, resulting in bleeding that lasts 3-5 days on average and up to 7 days on rare occasions. Two-thirds of the endometrial lining is lost during menstruation. Menstrual fluid also contains mucus and vaginal secretions in addition to blood.

Menstrual flow differs from woman to woman and it may be heavier or lighter at the start of menstruation or fluctuate during the cycle. Menstrual fluid ranges in colour from red to dark red to dark brown black. When menstrual fluid comes into contact with air, one may or may not have an unpleasant odour. Menstrual flow and duration alter before and after menopause, as well as during gynaecological malignancies. Menstrual flow increases in the presence of fibroids, polyps, and endometriosis, and excessive blood loss via menstruation can lead to anaemia.

To do with this period of time, women have created their own distinctive solutions. Personal preferences, resource availability, economic level, cultural customs and beliefs, educational status, and awareness about menstruation all have a role in how these techniques are implemented around the world. Menstrual hygiene practices are major source of worry since they have a health impact; if ignored toxic shock syndromes Reproductive tract infections (RTI) and other disorders can result. health of an adolescent is harmed by poor genital hygiene. Because most girls are almost uninformed or misinformed about menstruation, they are unprepared for menarche.

This project analyses the changing trends in menstrual habits among college students in Kerala with special reference to Thiruvananthapuram district. Menstruation isn't just a natural occurrence. Menstruation is instead experienced in a social environment. Girls first periods identify them as sexual objects, demonstrating their ability to reproduce and distinguishing them from males in a society that typically presume heterosexuality. Girl's report feeling sexualized by others and more conflicted about their body after their first period. Menstruation is typically frowned upon by both men and women. And it did become a social shame that must be concealed. Times are changing so is the perception towards menstruation and the habits girls follow during the times of menstruation. There is also a great deal of change in the products they use during the time of menstruation.

## **Issues faced during menstruation**

Menstrual cycles are notorious for causing a slew of unpleasant symptoms leading up to your period. Premenstrual syndrome (PMS) includes the most typical symptoms, such as moderate cramps and exhaustion, although the symptoms normally disappear once your periods starts. Other, more serious menstruation disorders may also arise. Menstruation that is excessively heavy or light, the complete lack of cycle, may indicate that there are disorders that affect typical menstrual cycle. Remember that "normal" menstrual cycle might imply various things to different women. A regular cycle for you might be abnormal for someone else, it's critical to listen to your body and seek medical advice if you detect any substantial changes in your menstrual cycle. There are a variety of menstrual difficulties that you may encounter.

Premenstrual syndrome is a condition that occurs before the menstrual period. PMS usually begins one to two weeks before the period. A variety of physical and emotional symptoms might be experienced by certain women. Some experience a little symptom, some don't experience any symptoms at all. PMS is linked to the following symptoms such as bloating, irritability, headaches, backaches, breast soreness, acne, food cravings, excessive fatigue, depression, feelings of stress, insomnia, diarrhoea, constipation and mild stomach cramps. One may have various symptoms every month and the degree of these symptoms can also fluctuate. PMS is unpleasant, but it is usually not a cause for concern until it interferes with your daily activity.

A heavy period is another common menstrual issue. Heavy period is also known as menorrhagia, cause you to bleed more than usual. You can also have a menstruation that lasts longer than the usual five to seven days. Hormone imbalances, particularly progesterone and oestrogen are the most common cause of menorrhagia. Heavy or irregular menstrual bleeding can also be caused by puberty, vaginal infections, inflammation of the cervix, underactive thyroid gland (hypothyroidism), Non-cancerous uterus tumours (fibroid), changes in diet or exercise.

Women could miss their periods in some instances. Amenorrhea is the term of this condition. If you don't receive your first period by the age of 16, you have primary amenorrhea. A problem with the pituitary gland, a congenital abnormality of the female reproductive system, or delay in puberty could all be contributing factors. Secondary amenorrhea happens when you go six months or longer without having your usual period. Primary and secondary amenorrhea in teens can be caused by a variety of factors such as Anorexia, overactive thyroid gland (hyperthyroidism), ovarian cyst, sudden weight gain or loss, stopping birth control, pregnancy. When adults don't menstruate the common causes for that are different. These causes may include. Premature ovarian failure, Pelvic inflammatory disease (a reproductive infection), stopping birth control, pregnancy, breast feeding and menopause. A missed period can also happen due to pregnancy.

It is not only possible for your periods to be lighter or heavier than usual but it's also possible for it to be painful. Cramps are common symptoms of PMS and they can also occur as your uterus contracts and menstruation begins. Some women though are in tremendous discomfort. Extremely painful periods is also known as dysmenorrhea, is most usually the result of an underlying condition, such as fibroids, pelvic inflammatory disease, and abnormal tissue growth outside of the uterus (endometriosis).

## Menstrual Products

Let's look at the usage of sanitary products during periods. Personal preference, cultural tolerance, economic status and availability in local market all influence sanitary protection product and material selection. To manage one's period hygiene along with basic sanitary facilities, soap and menstrual absorbents should be given. Women and girls from rural and urban areas use different absorbents. Reusable cloth pad is most popular absorbent in rural areas, while commercial sanitary pads are chosen by women in urban area. Manufacturers employ coring – bleached Kraft or sulphate pulp to make fluff pulp, which is used to make disposable sanitary goods. The following are different sanitary products used by women – 1) **Reusable and washable cloth pad**-They may be long term sanitary alternative but they must be washed and dried in sun. The sun's heat sterilizes the cloth /cloth pads. Drying them under the sunlight sterilizes it for future usage. Because these cotton pads are reusable, they are inexpensive readily available and environmentally beneficial. To avoid contamination, they must be stored in a clean dry location while not in use.

2)**Tampons** -tampons are one of the well know menstrual hygiene products. Tampons are disposable goods with a cylindrical shape that are made of cotton rayon or the combination of two. Tampons can be inserted into your vaginal canal with a cardboard or plastic applicator, or with one's fingers. Tampons come in a variety of styles, from light to high flow, as well as a scented and unscented alternative. Tampons made of organic cotton are also available. You won't be able to feel tampons if your body tolerates them well. Tampons are easy to transport and allow you to participate in routine activities such as swimming or team sports while wearing them. They are costly, difficult to degrade in nature, and hence not very environmentally friendly in nature. Sea sponge tampons are now available on the market.

3)**Sanitary pads** -aka. sanitary napkins, menstrual pads panty liner or pads are one of the most popular types of menstrual product. They are made with natural or synthetic fibres. Disposable products may be made from cotton or rayon. These pads come in variety of thicknesses depending on one's flow. One may wear a pad externally stuck to the inside of the underwear, which is entirely different from that of using a tampon. Unlike tampons the benefit is that you don't have to worry about getting toxic shock syndrome which makes them a great alternative to tampons. If a person has a heavier period, they'll be more comfortable wearing a sanitary pad. And some may wear it as a backup for tampons or menstrual cups on heavy period days.

4) **Menstrual cup**- The most common type of materials used in menstrual cups are flexible medical grade silicon, latex, or a thermoplastic isomer. They have a stem or a ring and are shaped like bell. The stem is used to insert or remove the cup. Just below the cervix the bell-shaped ring closes against the vaginal wall. The cup is withdrawn emptied and washed every 4-12 (depending on the amount of flow). The cup must be cleaned after each period. Cups unlike tampons and pads, collect rather than absorb menstrual fluid. A single cup can be reused up to than 10 years. Because of these they have cheaper long-term cost than disposable tampons and pads, despite their greater initial cost. Menstrual cups are also marketed as being more convenient and environmentally friendly than pads and tampons. Because the menstrual cup is reusable it reduces the amount of waste produced by the menstrual cycle significantly, as there is no daily waste and number of discarded packings is reduced.

5) **Bamboo fibre pads**- bamboo pulp is employed as an absorbent material in these sanitary pads instead of wood pulp. It has a higher absorption capacity and is therefore safer to use. They are cost effective, easily decomposable, and environmentally friendly pads with antibacterial qualities. This ensure that menstruation is free of infection and discomfort. Bamboo charcoal pads are also available on market, which have the advantage of not showing the blood stains very visibly and are reusable.

6) **Banana fibre pads** – In India low-cost sanitary pads produced from discarded banana tree fibre are being sold under the name “Saathi”. They are eco-friendly and will degrade in six months after being used. Women in rural areas also use natural materials such as cow dung, leaves, dirt in addition to these items

7) **Water Hyacinth pads**- Under the brand named “Jani”, menstrual pads made from water hyacinth are offered. Eco-friendly sanitary napkin using water hyacinth can absorb water 12 times than a regular menstrual pad. They are low cost, easily biodegradable and environmentally beneficial. Water hyacinth is considered as world’s worst aquatic weed. It multiplies rapidly, and forms a dense layer over aquatic surface, making aquatic life impossible. But here human get to use it as benefit.

## **Religion and Menstruation**

In our society, menstruation is frowned upon. Traditional views about menstruation women's impurity, as well as our unwillingness to address it openly, have contributed to this stigma. It is not sure what caused the situation to escalate. Menstruating women are referred regarded as 'unclean' by holy men. However, all the religion (With the exception of Sikhism) faiths refer to a woman who is menstruation as 'ritually impure'. The public does not want to talk about menstruation. This causes a great deal of inconvenient for young people and girls. They aren't well informed; hence they tend to keep a few misunderstandings.

In Judaism, a woman is considered impure until she has had a ritual bath. Many orthodox Christians believe that women should not be allowed to pray or enter religious buildings while they are menstruating. Harvard scientists conducted a study to see whether menstruation blood was harmful or not (Obviously it was found to be non-poisonous).

Menstrual taboo has long been a factor in keeping women out of positions of responsibility in Christianity. Many Catholics, like Judaism, believe that a woman should not have sexual relations during her menses. Menstruation is considered impure in the Eastern Orthodox Christian Church. Menstruating women are not permitted to participate in sacraments, particularly communion, or to touch holy objects such as the Bible or religious symbols. This isn't a ubiquitous practice, but it hasn't completely disappeared either. Menstrual taboos are observed by Russian Orthodox Christians.

During this time, menstruating women must dwell in secluded huts. They are not allowed to attend church services, have any interaction with men, or handle raw or fresh food. The stare of a menstrual lady is also said to have a bad impact on the weather. While western Christian faiths are less harsh, there are still some negative opinions.

"They ask you about menstruation," the Quran says in 2:222. 'It is an impurity, therefore stay away from women during it and do not approach them until they have been cleansed; once they have been cleansed, you may approach them as God has decreed...' This plainly demonstrates that the Quran solely prohibits menstruation women from engaging in sexual behaviour. Some interpreters have taken this concept a step further, stating that menstruation women must avoid their male family members. Also, according to one respondent, one is not permitted to study the Arabic Quran but is permitted to read translations in other languages. The woman is exempted from daily prayers

and fasting; however, she is not offered the option of doing these rites if she so desires. Before a woman may become clean again, she must conduct a ritual bathing, similar to Judaism.

In Buddhism, Menstruation is “a natural physical expulsion that women have to go through on a regular basis, nothing more or less,” according to Buddhists. In practice, however, this is not the case it is as a result of Hinduism’s influence on Buddhism. Women are not permitted to circumambulate the Stupas at several temples. Thailand has a clear example of this rule. According to Buddhism there’s a belief that ghosts consume blood. A menstrual lady is supposed to attract ghosts, making her a danger to herself and others. Menstruating women are not allowed near the area where rice is fermenting, says Buddha Dharma Education, or the rice will rot.

The tradition of seeing women as impure while menstruating was criticised by Guru Nanak, the founder of Sikhism. Menstruating women are permitted to enter Gurudwaras (Sikh sacred sites) and pray. There are no restrictions on movement within or outside the house. Sikh text, the Guru Granth Sahib, outspokenly condemns misogyny. In the social fabric, it affirms women’s creative and natural processes. It denounces the taboos that accompany menstruation and postpartum pollution. Menstruation, on the other hand, is seen as a necessary and natural process. Guru Nanak openly chastises those who impute impurity to women as a result of menstruation, claiming that pollution is caused by a person’s heart and mind, not by the cosmic process of birth.

Women are said to have ‘Rajaswala Dosha’ in Hindu mythology. There are three gunas (or characteristics) in Indian yogic philosophy. These are: tamas (black), rajas (red), and sattva (pure) (white). Anything excreted by the body, such as sweat, blood, tears, and so on, is toxic and thus classed as tamas. Tamas is a word that means “darkness” or “obscurity.” Touching a menstrual woman is thus regarded a ‘Tamasic’ (inappropriate) behaviour by traditional Hindus.

During menstruation, some women are forbidden from entering the kitchen and temples, sleeping during the day, bathing, wearing flowers, having intercourse, touching other males or females, talking loudly, or touching pickles. A pickle touched by a menstrual woman, according to mythology, rots. Menstruating girls are not allowed to touch the basil plant since it is considered holy in Hinduism. They aren’t permitted to let even their shadow fall on it in some severe circumstances, or the plant will die.

While menstruating, women are not allowed to enter temples. ‘Ladies in monthly periods are not allowed,’ says a sign posted outside the temples. Women between the ages of 10 and 50 are not permitted to enter the ‘Sabrimala’ temple in Kerala, India. They perform a rite known as ‘Ashtamangala Devaprashnam’ (ascertaining the lord’s will) to determine whether a female has defied the temple by entering the sanctum sanctorum. If the top priest does not accept the outcomes of the ceremony, it signifies that someone has broken the rule. As a result, women who are menstruating are deemed “ritually unclean” and are not permitted to visit temples or pray to deities.

## **Menstruation and Human Right**

Human rights are the rights that every human possesses as a result of their dignity as a human being. Menstruation is inextricably linked to human dignity; when people lack access to clean bathing facilities as well as safe and effective methods of managing their menstrual hygiene, they are unable to manage their periods with dignity. Teasing marginalization and shame associated to menstruation also violate the notion of human dignity.

Menstruation can become a period of deprivation and stigma for individuals due to gender inequality, extreme poverty, humanitarian crisis and damaging customs all of this can jeopardise their enjoyment of basic human rights. This is true for menstruating women and girls, as well as transgender men and nonbinary persons.

A person who menstruates could easily spend 3 to 8 years menstruating during their lifetime, during which they might endure menstruation related exclusion, mistreatment or discrimination.

The way people are treated during menstruation is influenced by a number of things (and other times when they experience vaginal bleeding, such as during post-partum recovery)

Exclusion from public life – The belief that menstruation is filthy or humiliating is one of these factors. This view point contributes to the restrictions that many, if not all countries impose on women and girls during vaginal bleeding. Some limits are cultural, such as prohibition on touching food or visiting religious locations, or the necessity that women and girls be isolated. Some limitations are self imposed; for example women and girls will be afraid to participate in school

,sports or social events .These activities taken together might perpetuate the notion that women and girls have less claim to public areas and are less able to engage in civic life .

Barriers to opportunities – Another frequent misunderstanding is that women and girls physical and emotional capacities are harmed by their menstrual cycles. These concepts have the potential to create barriers to opportunities, furthering gender inequity. In reality most women and girls’ ability is not hampers by any way by menstruation.

Barriers to sanitation and health – Poverty and humanitarian crisis can make it difficult to women and girls to get culturally appropriate, high quality menstruation products and access to private and safe washing facilities. Vulnerable women and girls in middle- and high-income countries, as well as those in disadvantaged school systems, jails, and homeless shelter may have limited access to safe bathing facilities and menstrual supplies.

Heightened vulnerability – menarche or the start of menstruation might jeopardise a girl’s human rights. Menarche is regarded as a sign that girls are ready for marriage or sexual engagement in many cultures around the world. This exposes females to various kinds of atrocities, including child marriage and sexual violence. To buy menstruation products female have been known to participate in transactional sex.

Widely recognised human rights that can be jeopardised by the treatment of girls and women during menstruation.

- Right to health – When women and girls lack materials and facilities to manage their menstrual health, they may suffer unfavourable health repercussions. Menstruation stigma can also discourage women and girls from seeking treatment for menstruation related disease or pain limiting their access to the best possible health and wellbeing.
- The right to education -Higher rate of school absenteeism and poor educational performance can be caused by a lack of a safe space or ability to manage menstrual hygiene, as well as lack of medication to address menstrual related pain. According to certain research, when girls are unable to manage menstruation well in school, their attendance and performance decline.
- The right to work – Women and girls have limited career options due to lack of appropriate methods of managing period hygiene and medication to address period related problems or

pain. They may be unable to accept particular positions or they may be forced to work fewer hours and for lower pay. Menstrual demands such as toilet breaks may be punished will result in uneven working circumstances. In addition, menstruation taboo may lead to job discrimination for women and girls.

- The right to non-discrimination and gender equality- Discriminatory practices might be reinforced by stigmas and norms associated with menstruation. Gender inequalities are also perpetuated by menstruation related barriers to school, job, health services and public activities.
- The right to water and sanitation – Basic conditions for managing menstrual health management include private, safe and culturally appropriate water and sanitation facilities, as well as sufficient safe and inexpensive water supply.

As we can see menstruation itself has various aspects regarding how menstruation is viewed in our society, biological aspect of menstruation, the issues one face during menstruation, menstrual products used during menstruation, religion and its influence over menstruation, human rights and menstruation etc. In this project we are going to analyse all these above-mentioned various aspects, in regard to 50 college going students from different Arts colleges from district of Thiruvananthapuram in the state of Kerala.

# **CHAPTER TWO**

## Review of Literature

This chapter review of literature deals with the secondary data that is used by the researcher to study and gain more knowledge about menstruation and different aspects that are related to menstruation such as habits followed during menstruation, menstrual hygiene management, public programmes related to menstruation, health during menstruation, how work is affected, how religion and society influence menstruation, knowledge about menstruation, social stigma associated with menstruation, clinical perspective on menstruation, attitudes towards menstruation, menstrual experiences , menstrual related taboos and usage of menstrual cups as such.

Anna Maria van Eijk et al.(2016) in their study menstrual hygiene management among adolescent girls in India : a systematic review and meta-analysis studies about the status of menstrual hygiene management (MHM) among adult girls in India and thereby know there unmet needs .In this project they got the outcome measures such as information on menarche awareness, types of absorbents used ,disposal hygiene, restrictions and school absenteeism .Meta analysis was used to estimate pooled prevalence (PP) and meta regression to examine the effect of setting ,region and time .Data from 138 studies involving 198 subpopulations and 97 070 girls was extracted .The study revealed that there is a need for strengthening of MHM programmes in India and need for addressing .Education on awareness, access to hygiene absorbents and disposal of MHM items .

Maitri Vayeda et al. (2021) in their study they evaluated an intervention to strengthen a public health programme aimed to increase the use of safe, sanitary absorbents and knowledge of MHM among tribal adolescent girls. For one year this project was implemented in 202 villages in two sub districts of Gujarat's Narmada district. Capacity building for 899 government frontline health workers and teachers was followed by supportive monitoring as part of the intervention .Meetings with stakeholders helped to bring interested departments together .To enhance access to menstrual absorbents and information , "MHM- corners" and "MHM- Committed " were established in schools and Anganwadi centres .To assess outcomes , 27 randomly selected villages conducted household surveys of adolescent females using safe sanitary absorbents increased from 69 percent to 79 percent as a key outcome of interest .They concluded the study by finding it is possible to improve MHM knowledge and practices among adolescent girls from tribal communities by

utilising existing government systems. Also, that Awareness and access to safe absorbents can lead to safe and hygienic MHM practices.

Reena V. Wagh et al, (2018) in their study tells according to their research on menstrual hygiene practices in young girls in urban India, some girls still believe menstruation is a curse from God. The study discovered that some girls toss their sanitary pads on the side of the road. Nearly 96% of girls avoid going to temple. In addition, the majority of girls avoid going to the kitchen, family activities, and handling things at home. The study came to the conclusion that young girls should be informed about the myths as well as the significance of keeping hygiene during menstruation to avoid the danger of infections in reproductive system.

Shobha P Shah et al (2013) reported 90 percent of girls in a community-based study on improving the quality of life with new menstrual hygiene practices among adolescent indigenous girls in rural Gujarat used old cloths instead of sanitary napkin. The clothing was culturally acceptable because it was readily available, simple to use, and less expensive than sanitary pads. According to them the Indian government has launched a new initiative targeted at providing subsidised sanitary pads to rural girl, but 68 percent of girls claimed clothing were their first option.

Xanne AK Janse De Jonge (2003) in their work on effects of the menstrual cycle on exercise performances found that fluctuations in female reproductive hormones throughout menstrual cycle do not affect muscle contractile characteristics. like most other researchers also found that most determinants of maximal oxygen consumption do not report any change with menstrual cycle. hence in short, findings suggest regularly menstruating athletes do not need to adjust their routine to fit in the menstrual requirements. the hormonal fluctuations do not pose any difference to the athletic capability or performance of a system

Tomi Ann Roberts (2002) in the essay feminine protection, states that in general, constant reminders of menstrual habits and status of a women leads to furthered objectification and negative reaction towards her. in a generalised experiment, gender schematic participants responded with increased objectification of women. this effect is viewed by them as an effort to protect the 'culturally sanitized' views of feminine identities. authors discuss this in the light of feminist theory.

Aru bhartiya (2013) in menstruation, religion and society emphasises how all religions of the world with the marked exception of Sikhism has discriminated against women, menstruating or otherwise. scriptures force society to view menstruating women as "ritually unclean", and thereby imposing restrictions on them. religions have always portrayed menstruation as dosha, or even an impurity, restricting free movement and very often entry into religious institutions.

Paula J Hilliard (2008) in menstruation in adolescents what is normal and what is not, states how menarche has undergone significant transition through the years. they further state that racial difference is very much expressed in menstrual age and development. they also mention how absence of menarche by 15 or menstrual cycle of more than 40 days indicate impaired reproductive ability etc. in short, they express concerns in the habits and thoughts very often brushed aside as common, and asks to act upon them sooner than later.

Paula J Hilliard (2002) in another of her paper's menstruation in young girls a clinical perspective emphasises on the need for proper clinical attention in young adults. one of the most commonly seen reproductive problems in teenagers like PCOD can undermine fertility by a huge margin. The importance of a clinician lies in the fact that they can provide needed awareness and information not only to the teenager, but also to their parents. they can furnish guidance and needed information through proper counselling and dissemination of information through web and likewise sources.

Johnston Robledo and Joan c Chrysler (2011) in the essay titled the menstrual mark menstruation as a social stigma argues how menstruation acts as a social determinant and stigma for women, adolescent or adult. This stigma further contributes to the lower societal status of the women in question. though predominantly based on the experiences of American women, the essay has a universal extrapolative capacity, which resonates with the experiences of women everywhere. further, they put forward ways to counter this stigma in the form of social activism. this includes increasing vocalisation about menstruation and open forums like project vital sign etc.

Katherine D Hoerster Kather et al (2003) .in the article attitude toward and experience with menstruation in US and India, contacted women university students in southern India and new England. the results they collected were somewhat expected. Indian women scored lower

knowledge about menstruation and cycles. American women also reported high levels of menstrual preparedness prior to menarche. Attitude towards menstruation ranges from menstruating women being highly unpredictable to premenstrual women being dangerous. they also found that mostly men believed menstruation has bearings on thinking capacity, attitude, and even personalities of women. these are often found to be attached to popular culture.

Erbil, Felek & Karakasli, (2015). studied the attitudes concerning menstruation of 600 unmarried college girls from western Rajasthan, aged 18 to 23 were investigated. Menstruation was acknowledged as a natural psychological event by 40.2 percent of the females in this survey. while it was viewed as a necessary evil by 20%. Menstruation was deemed troublesome by 19.7 % of women due to physical discomforts. In 18.8 percent of the sample, the influence of family beliefs was the primary cause of hatred for menstruation. Approximately 97 percent of Hindu women cent of Muslim woman, and 66.8 percent of Christian females adhered to some form of constraint. According to the experts it is past time to remove these barriers so that the women may contribute to making India a really progressive country.

Malusu, Ngayila & Philomena, (2014) used descriptive research design and a naturalistic approach were to evaluate the perceptions of secondary school students concerning menstruation on 32 kids who were purposefully selected from 3 Kenyan schools. The majority of the students in the study had a good view towards menstruation.

Bhattacharjee, Ray, Biswas & Chakraborty, (2013) In a community based cross sectional study ,7908 post-monarchical girls from Siliguri, West Bengal, were interviews about their experiences as adolescent slum dwellers. Menstruation was identified as a debilitating event by 55 percent of the females, while more than 37 percent stated that their periods had no negative impact on them.

Eswi, Helal & Elaraisy,( 2012) Researched menstrual attitude and knowledge of Egyptian female teenagers using the menstruation attitude questionnaire on a random sample of 200 pupils .The participants agreed that menstruation is debilitating (4.22+0.83)., Annoying (4.35+1.20), and a natural event (4.95+1.32 ), according to the studies findings .Participants who had been educated about menarche had a more positive attitude towards menstruation, according to the findings .The

authors believe that the girls knowledge and attitudes have been influenced by their mothers and the media .

Szarewski, Stenglin & Rybowski (2012).In their findings of a global population based online poll of 4039 women aged 15 to 49 years from eight countries in Europe ,North America and Latin America revealed their perspectives toward monthly bleeding .Menstrual bleeding was said to have a serious negative influence on about a third of women's everyday lives .Especially sexual life and athletic activity .The women expressed a variety of emotions , with 60 percent wishing to postpone bleeding at least occasionally and about half wishing to have the ability to choose when their menstrual bleeding should begin .When the women's entire reaction was examined ,roughly 34percent of them preferred to reduce menstruation frequency to once every three months .

Jarrah & Kamel (2012) conducted a descriptive cross-sectional study in various Jordanian districts on a convenient sample of 490 school girls (12-18 years old) to investigate their attitudes and menstruation related practices, as well as to determine the impact of premenstrual preparation on girls' attitude and menstrual rated practices. The study variables were assessed using a menstrual attitude questionnaire and a menstrual practice questionnaire. Descriptive statistics , correlation and chi square tests were used to examine the data .39 percent of the girls had positive view towards menstruation while 49 percentage had a negative perspective .The students menstrual attitude and menstruation practices had a substantial favourable connection ( $r=0.64$ ,  $p=0.04$ ).Inadequate premenstrual preparation was found to be substantially connected with a negative attitude about menstruation and bad menstrual behaviours .They believe that females should be prepared for menstruation before they reach menarche .They also advocate for the dissemination of scientific knowledge through well designed curriculum and we'll trained teachers .Their recommendations also included existing the help of community nurses and school health nurses to enhance the attitudes and knowledge of school aged girls about menstrual hygiene .

Aflaq, Jami (2012)conducted a study in Pakistan undertaken on a group of 245 college students to learn about their menstrual experiences and opinions .Girls between the ages of 16 and 21 were chosen , and McHugh and Wassers initial attitude towards menstruation scale ,created in 1959 ,

was employed .A check sheet was also utilised to collect information about menstruation related experiences .Menstruation began in early adolescence for 96 percent of the participants , according to the study .There was a substantial positive link between attitude and menstruation experience among the participants according to the findings .The results of the study revealed that pupils have a lot of unfavourable attitudes and experiences .Mothers were the primary providers of information for those girls who had significant favourable attitudes and experiences with menstruation , according to the study .Those who had used pre-packaged .Mothers were the primary providers of information for those girls who had significant favourable attitudes and experiences with menstruation , according to the study .Those who had used pre packaged sanitary napkins had significantly more pleasant feelings and experiences than those who had utilised homemade sanitary napkins

Hancock (2010) conducted a study at Warren Wilson College to better understand the effects of menstrual taboo on students' attitudes about menstruation. Menstruation was viewed in a variety of ways, including as debilitating, holistic, annoying and strong. Males and girls displayed the most significant variations in attitudes.

Wong & Khoo, (2010) By using a self – administered semi-structured questionnaire, conducted a cross sectional research of 1092 adolescent girls from 94 schools in the Federal Territory of Kuala Lumpur, Malaysia, assessed their menstruation related attitudes and symptoms. The mean score on the menstrual attitude questionnaire was 2.80 (SD+1.881 out of six) in this study

Anjum, et al.( 2010) conducted descriptive research of 500 women at Isra University Hyderabad to analyse their opinions toward menstruation doing that the majority ( 87.6%) saw it as a normal occurrence , while 12.4% saw it as a disease and a curse from God .The study revealed that young women had wrong perceptions and unsafe practices of menstruation ; it also recommended the need of health education for women in rural regions so that they are emotionally prepared and have fewer negative views on menstruation .

Walker (2008). In western cultures, menstruation is regarded as a private and sometimes secret occurrence, shrouded by euphemism and s menstrual etiquette. Negative attitudes are commonly

expressed in medical. Literature as a loss or inability to reproduce. Even in the field of advertising , secrecy and the avoidance of leaks of messes are maintained .Gelolo McHugh and Judith Wasser conducted the first empirical study on menstruation attitudes in 1959 , delivering a simple questionnaire to 200 students at two women's colleges .There were roughly \_8 statements about menstruation attitudes , ranging from pride menstruation revolting me .Menstrual attitudes are currently seen to multifaceted rather than falling into a single positive or negative category .

Rembeck (2008), studied early adolescent girls' attitudes on menstruation, as well as their thoughts and feelings about their bodies, in investigative research conducted in Sweden in girls aged 12 to 14. The study also looked at how premenarcheal and postmenarcheal girls aged 12 to 14. The study also looked at how premenarcheal and post-menarcheal girls differed in their attitudes and sentiments. This study also looked at how premenarcheal and postmenarcheal girls differed in their attitudes and sentiments. This study included total 309 females who volunteered to take part. The average age of the girls in the study was 12.6 years. The study found that early in childhood, females have absorbed may of the prevalent culture ideas on menstruation, which are typically unfavourable and unprepared for motherhood. The findings show that attitudes before menarche have an impact on menarche, menstruation, and dysmenorrhoea. Those who are completely unprepared have more unfavourable attitude towards menarche than those who are fully prepared.

Anna Van Eijk et.al (2019) through their systematic review and meta-analysis of international studies on menstrual cup leakage, acceptability and safety explored menstrual cup availability to inform programmes. For their studies they searched and analysed PubMed, Cochrane Library, Web of Science, Popline, Cinahl, Global Health database, Emerald, Google Scholar, Science. Gov, etc. They identified 436 records of those 43 studies were taken for their studies. Their studies conclude that the menstrual cups are a safe option for menstruation management and are being used internationally. And also finds that good quality studies in this field are needed. They were on the opinion that further studies on cost effectiveness and environmental effect comparing different menstrual products should also be made.

Chadalawada, & Kala, (2016). In a community- based cross sectional observation study, 150 teenage girls from Govt.Secondary High school in the rural field practise region of Sidhartha Medical College, Vijayawada were asked about their menstrual hygiene practices .72.6 percentage of 150 girls were aware of menstruation before to menarche, with their mothers serving as the predominant source of information. More than 85% of girls used sanitary pads, the majority of the girls cleaned with soap and water, and 66% of them adhered to various limitations

Sangeetha, Nisha & Malathi, (2015). In Sree Gokulam nursing college in Kerala conducted a convenience sample study to assess the knowledge and practise of menstrual hygiene among 150 nursing students .According to the findings , 57.3 percent of girls have a goof level of practise ,43 percent have an average level of practise , and only 0.7 percent have a bad level of practise .There was also a link between educational level and understanding about menstruation hygiene , according to this study .There was no evidence of a link between menstrual hygiene habits and socioeconomic factors .

Ninama & Dund, (2015) conducted a cross sectional study employing a predesigned pretested structures questionnaire on 215 adolescent females in grade 9-12 at a Gujarati school revealed that menstruation was unknown to 68 percent of the participants. During menstruation ,66 percent of them utilised sanitary pads, and 61 percent used soap and water to clean their external genitalia.

Ak penpuun, Rumun & Msuega (2014) In, another non-experimental descriptive survey was used in this cross-sectional investigation. In Makurudi Metropolis, Nigeria, a method was used to assess teenage females ' menstruation knowledge and habits. The girls in the study ranged in age from ten to nineteen years old. The majority of the girls used sanitary pads during menstruation and changed them 24 times each day, according to the findings. Bathing during menstruation was also increased in frequency. This study advised that sex education be implemented in all schools through community organisations and the media, as well as providing a positive school environment.

A quasi-experimental research approach was used by (Rhudhaonkar and Shinde, 2014) to assess knowledge of menstrual hygiene habits among 100 adolescent girls. Only 23% of those polled said they had dried their dirty clothing in the sun. More than 58 percent of the people in the study kept their sanitary garments hidden and reused them for more than a month. They didn't go to holy places when they were menstruating. Traditional rituals bound them socially and culturally

In Bangladesh, a cross sectional descriptive research approach was used by Parvin & Haque. (2014) to investigate the hygienic practises of 240 girls during menstruation. A modified questionnaire and interview were employed, which had been pre- tested. According to the study ,18% of women used sanitary napkins ,33% used cloth pads, and 49 % utilised old fabric. Around 24% changed the used material four times per day, and 73 percent cleaned with soap and water. Only 44% of the material was dried in the sun; the rest was dried in dark, wet conditions.

(Kumar & Singh, 2014). In Uttarakhand, India conducted a cross sectional study to determine the state of menstrual hygiene among the adolescent females. A respondent was chosen from each of 400 consecutive households and questioned according to a predetermined timetable .According to the findings ,51 percent of the participants used sanitary napkins ,22 percent utilised cloth pads ,and the other participants used both types .Only about a third of people changed their pads four times a day , and oy about a third of people cleansed their perineum after each urine and defecate .Food (24.6 percent ),social activities (75.4 percent ), temple visits ( 67.6% ) touching stored food (6.5 percent ), and attending social events were among the many limits observed by the respondents ( 25.7 percent ) .Menstrual blood was deemed impure by 18% of the participants .Approximately 6% thought menstruation was a sickness, and only 22% correctly identified the source of menstrual blood .And Regarding the gathering of information on menstruation Television was used by roughly 16 percent of women ,27 percentage from their mom,47 percent from friends ,6 percentage from relatives and 5 percentage from literature .

Sreedhar and Syed (2014) analysed the state of menstrual hygiene among 180 school girls studying in government school in Hyderabad. An Institution based cross sectional survey was used for this. According to the findings 23% of the girls were unaware of menstruation until it happened. During menstruation, more than 52 percent of girls wore old garments and, about half of them reused them .62 percent of girls reported experiencing various forms of restrictions.

Mutunda ( 2013) used focus groups interviews to perform qualitative exploratory study among 51 teenage school girls in Zambia to determine their perceptions , practices , and experiences related to menstrual hygiene .Menarche induced Panic, anxiety and shame in the study group because they were unaware of it beforehand .Menstrual hygiene was negatively influenced by poverty insufficient water availability a, gender – insensitive sanitation facilities in schools and residences , and gender discrimination .

According to Yasmin et al., (2013) descriptive cross section study conducted among 147 adolescent girls at a Kolkata secondary school using a predesigned questionnaire , roughly 92 percent of the girls washed their hands regularly , but only 16 percent washed their hands with water .Approximately 77 percent of the females cleansed their private areas on a regular basis during menstruation, according to the survey .The provision of a constant supply of water and a toilet facility was found to have a statistically significant relationship with sanitary practices .Almost all of the girls were found to adhere to certain taboos and unnecessary limitations .According to the study poor menstrual hygiene is a risk factor for urinary infections .

In the study conducted by Jogdand (2011), 53.7 percent of 360 adolescent girls used sanitary pads during menstruation, 34.63 percent utilised old garments, and the remaining (11.67%) used both sorts. Approximately 79 percent of the girls were not permitted to attend religious events. The females were also barred from doing home chores (22.97percent) and from practising sports (20.63 percent). During menstruation, more than 10% of the girls in this study were unable to attend school.

Sudha.G and Ramajyothi (2015) has conducted a study in Andhra Pradesh which revealed many of the research participants habits. Sixty six percent of the girls said they used sanitary napkins while 34 percent said they used clothing. A better supply of napkins, health education and regular monitoring were advised in this study as ways to improve dormitories. Humming (48%) was used to dispose the soiled pads, followed by burial in pits (16%) tossing away in bushes (14%), putting in drains (12%), and placing in dustbins (6%).

Adhikari et al. (2007) investigated the knowledge and practise of menstrual hygiene in rural adolescent girls in Nepal They included 150 girls aged 13 to 15 years. According to the findings, the girls were not practising proper menstruation hygiene. During menstruation ,98 percent of the girls used cotton pads and 88.78 percent of them reused them according to the study. Only 29% of the females said they changed pad on a daily basis .96 percent of the girls said they don't bathe until their period

In the study of Das et al. (2015), Menstrual hygiene behaviours, wash availability and the risk of urogenital infections were investigated in a hospital-based case control study of 486 women. A syndromic strategy was used to recruit cases and controls. All of the subjects' vaginal swabs were taken and analysed for bacterial vaginosis. Urine samples were also cultured to see if they were infected. The socio-economic level, clinical symptoms, reproductive history, MHM and access to water and sanitation practises were all investigated using a standardised questionnaire. The study discovered that women who used reusable absorbent pads were more likely than women who used disposable pads to experience urogenital infection symptoms. And also, UTI was linked to a lower level of schoolings.

As we can see several studies have been conducted in relation with menstruation such as studies on menstrual hygiene ,menstrual habits ,menstruation religion and society, menstruation in adolescents ,clinical perspectives of menstruation, menstruation and social stigma ,experiences on menstruation, perceptions on menstruation, opinions towards menstruation, knowledge on menstruation, menstrual attitudes ,menstrual related practices effects of menstrual taboo, symptoms related to menstruation, studies on menstrual cup, menstrual products used, sanitation facility available. All these studies have helped gain deeper sociologically knowledge on the process of menstruation.

## **CHAPTER THREE**

## **Methodology**

Theoretical analysis of both procedures and principles linked with a discipline of knowledge is known as methodology. It's a broad - based research strategy. It is a set of approaches that are employed in a specific field of study or activity. In a research paper, the methodology section allows the reader to critically evaluate a studies overall validity and reliability. The methodology section answers two main questions: how was the data collected or generated? how was it analyzed? This chapter explains the methodology that has been followed in this study.

### **STATEMENT OF THE PROBLEM**

Menstrual habits among college students are changing in rapid pace now. There are also several factors such as religion, culture, superstitions, norms, folkways, taboos in society which create hindrance for women in several areas of life. This study I am trying to focus and understand more about the menstrual habits that the college students from Kerala follows. And also, to analyze the problems faced by students using menstrual products during menstruation time.

### **General Objective**

To study about the changing menstrual habits among college students in Trivandrum.

### **Specific Objectives**

- To know about the Socio-Economic background of students
- To understand more about menstrual habits students follow
- To analyze the problems faced by students using menstrual products during menstruation time.
- To analyze menstrual hygiene related issues
- To analyze eco- friendly products and its usages

## **Operational definition**

**Menstrual habits:** Habits that are being followed during the time of menstruation by college students in Kerala with specific reference to Thiruvananthapuram district

**College students:** in this study about menstrual habits, we are focusing on students studying in colleges from Trivandrum district

**Research Design:** In this research Quantitative approach is used for the study. The research design used in this study is descriptive in nature. A descriptive research design is a type of research design which is widely use to obtain information which systematically explain the phenomenon or population. The descriptive research design helps to understand the different factors on changing menstrual habits among college students in Trivandrum district of Kerala.

## **Variables**

### **Independent Variables:**

- Income of family
- Marital Status
- Type of family (rural urban)
- Education
- Availability of product
- Knowledge about product

**Dependent variable:** Menstrual habits

### **Sample size and method of sampling:**

To enable the study 50 college students from Trivandrum district of Kerala were selected by means of snowball sampling method

### **Tools for data collection**

In this study questionnaire is used as the tool for data collection

**Pre-test:** A pre-test was conducted among the few respondents before the actual test of filling the questionnaire. This was in order to know whether the respondent was interpreting questions as indented and also to check whether the order of questions was in right manner.

In conclusion the research design is descriptive in nature, method of data collection done via snowball sampling, and the tool for data collection used is questionnaire.

## **CHAPTER FOUR**

## DATA ANALYSIS AND INTERPRETATION

Chapter four of this project deals with Data analysis and interpretation. This study is aimed at measuring the changing menstrual habits among college students in Kerala with special reference to Thiruvananthapuram district. The changing menstrual habits among college students is analysed by various factors such as their socio economic background, preferred menstrual product, menstrual product they currently use ,satisfaction with the menstrual product they currently use, knowledge about eco-friendly menstrual product ,symptoms that occur during menstruation, health issues respondent face ,sanitation facilities ,menstrual waste management, cultural factors affecting menstruation and menstrual hygiene related discrimination.

**Table 4.1**

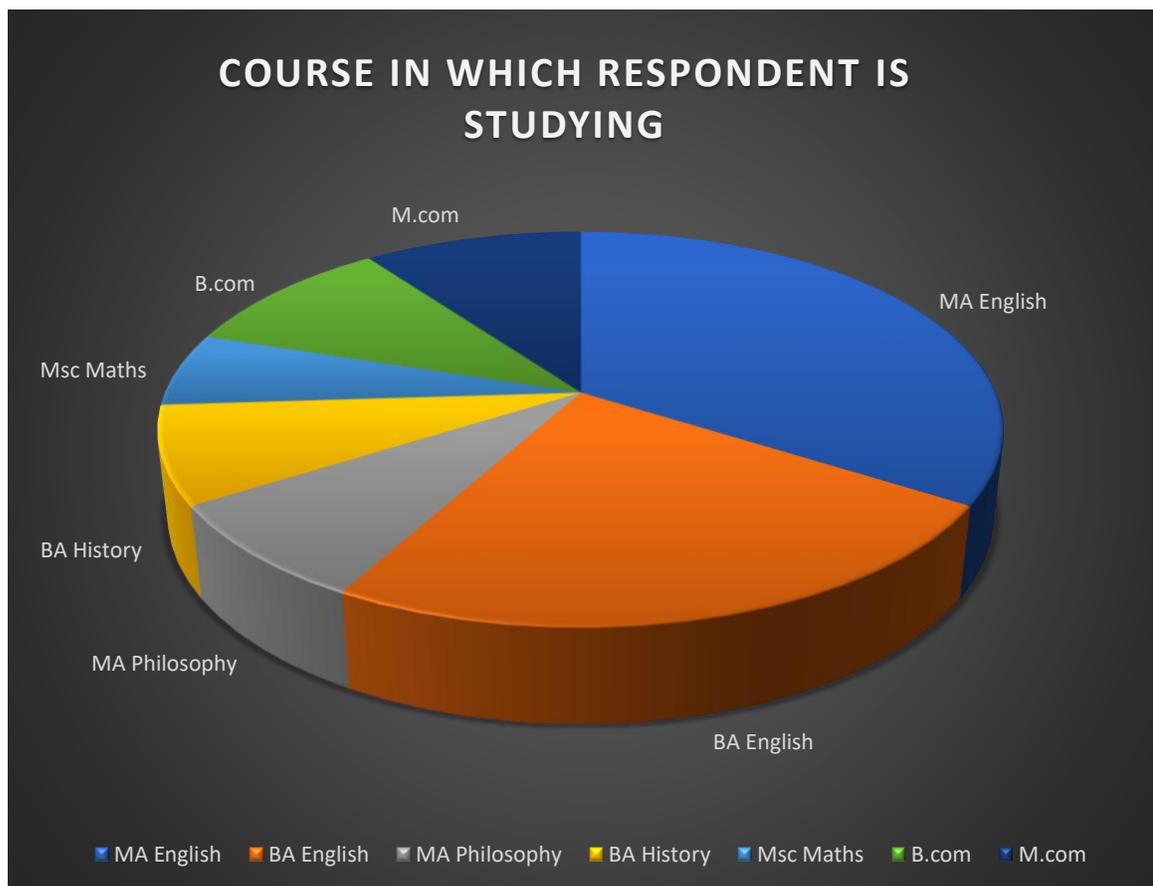
### **Age of the respondent**

Age	No of Respondent's	Percentage
18	4	8
19	2	4
20	11	22
21	5	10
22	18	36
23	10	20
Total	50	100

Total 50 students from age of 18 to 23 years have participated in this survey. Age category of 22 have the greatest number of respondents that is 36%. The second the greatest number of respondents are of 20 years old they are 22%. The least number of respondents

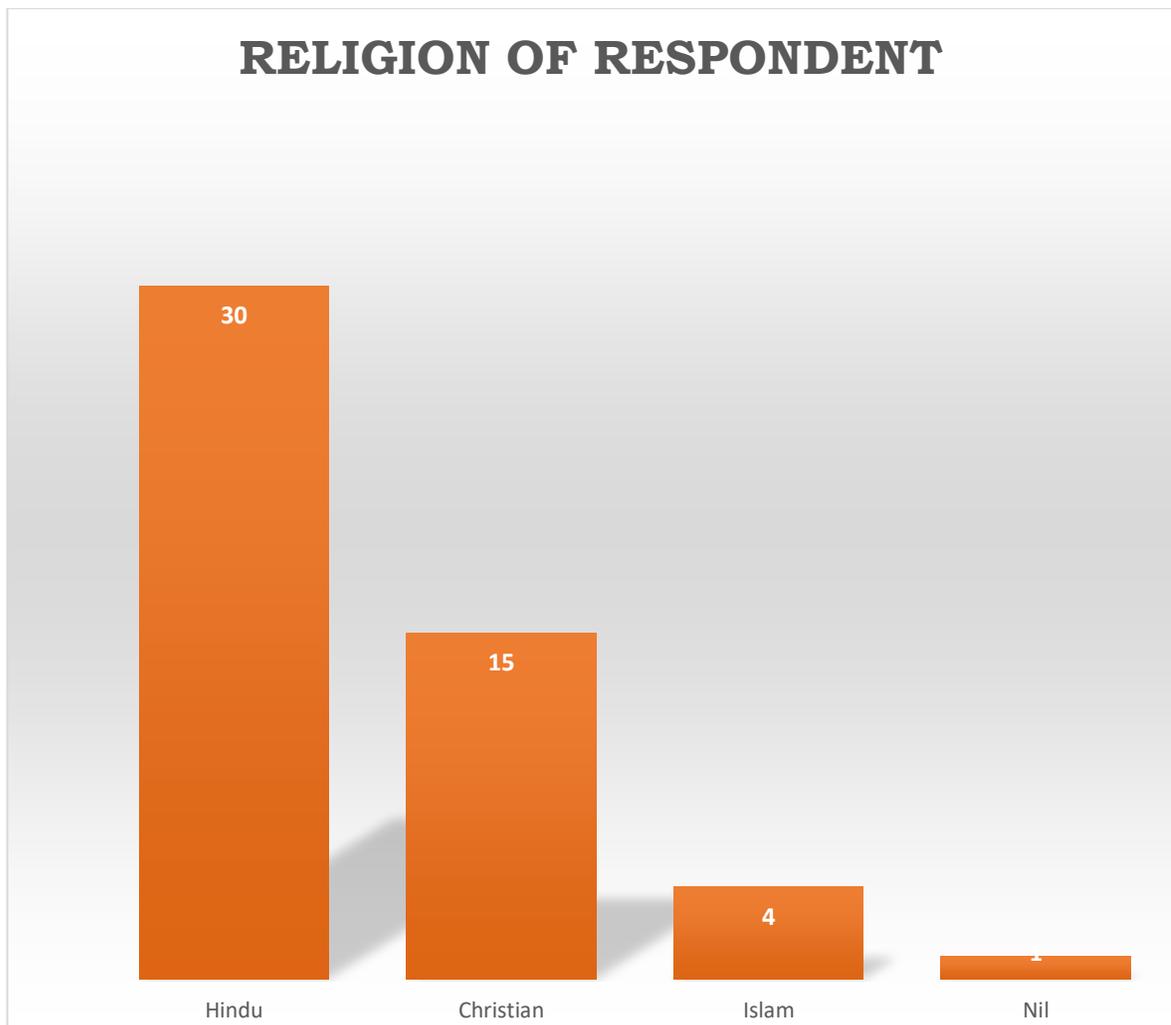
participated are of age 19 they are only 4 %. Second least number of respondents are of age 18 they are only 8%. Age category of 21 has 10% respondent and 23 has 20% respondents.

**Figure 4.1**



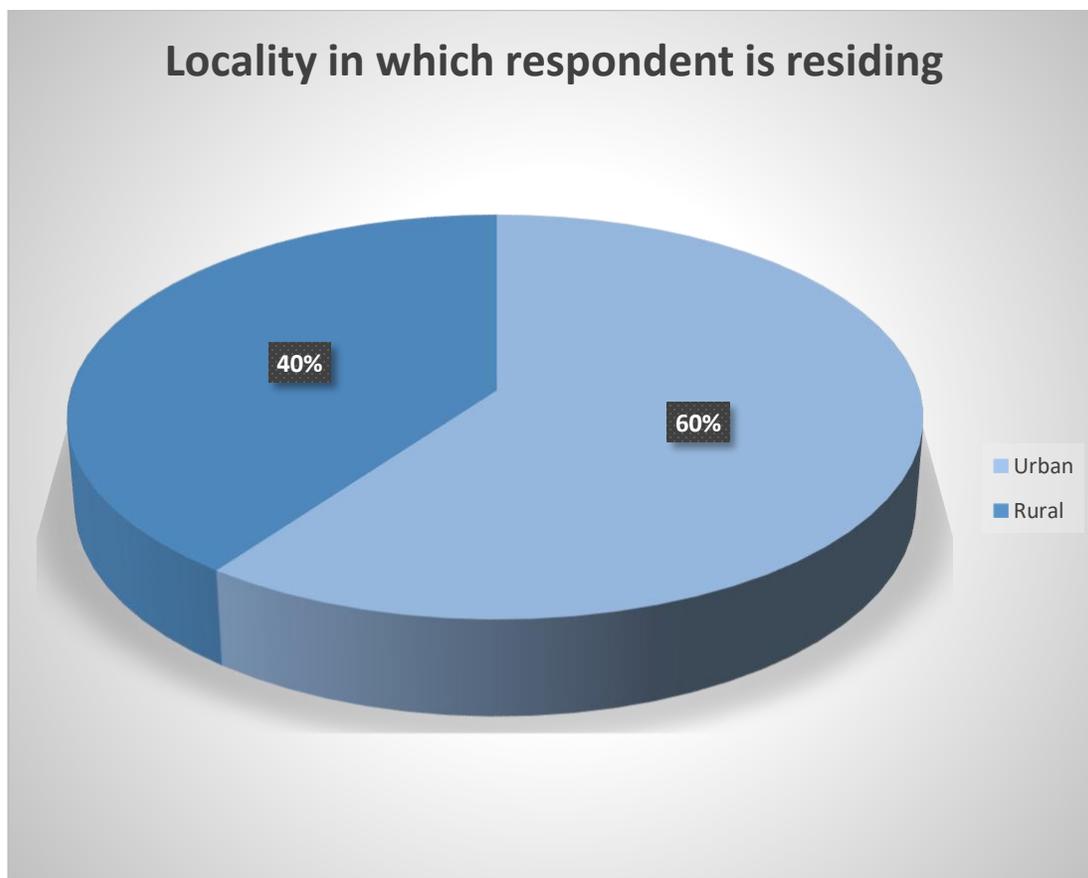
The figure 4.1 represent the courses in which respondents are studying in participants of this questionnaire are from Arts stream but of different course backgrounds such as MA English, BA English, MA Philosophy, BA History, MSc Mathematics, B.com, M.com. Most number of students are from MA English that is 34 %, BA English - 24%, B. Com -10%, M. Com - 10%, MA Philosophy - 8 %, MA History- 8 %, MSc Mathematics 6% respectively.

**Figure 4.2**



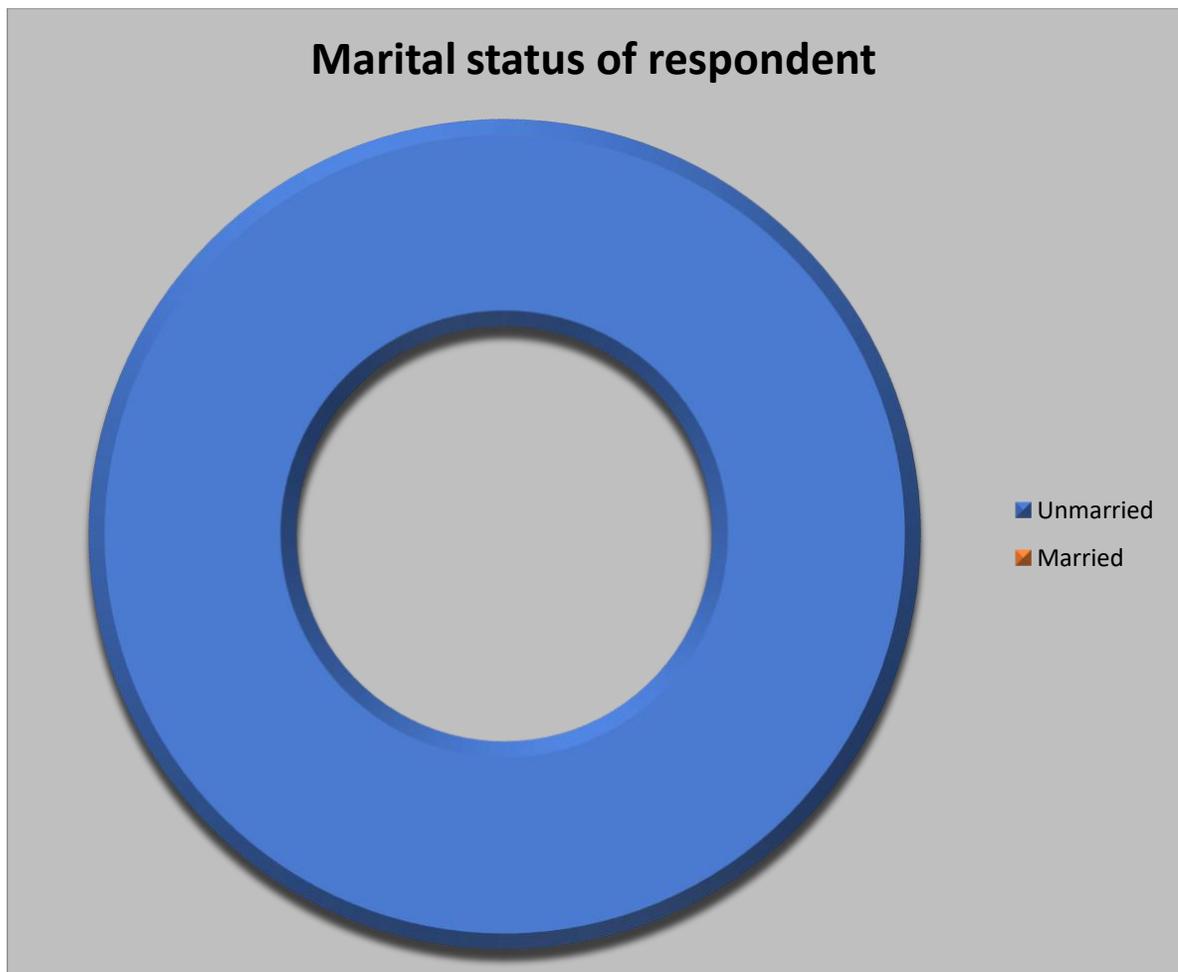
The above-mentioned figure 4.2 a bar diagram shows the religion in which the respondents belong to. Of the 50 respondents 30 respondents that's is 60% belong to the religion Hinduism ,15 (30%) belongs to Christianity and 4 (8%) in Islam. And we also have a respondent who answered that she/they doesn't belong any religion.

**Figure 4.3**



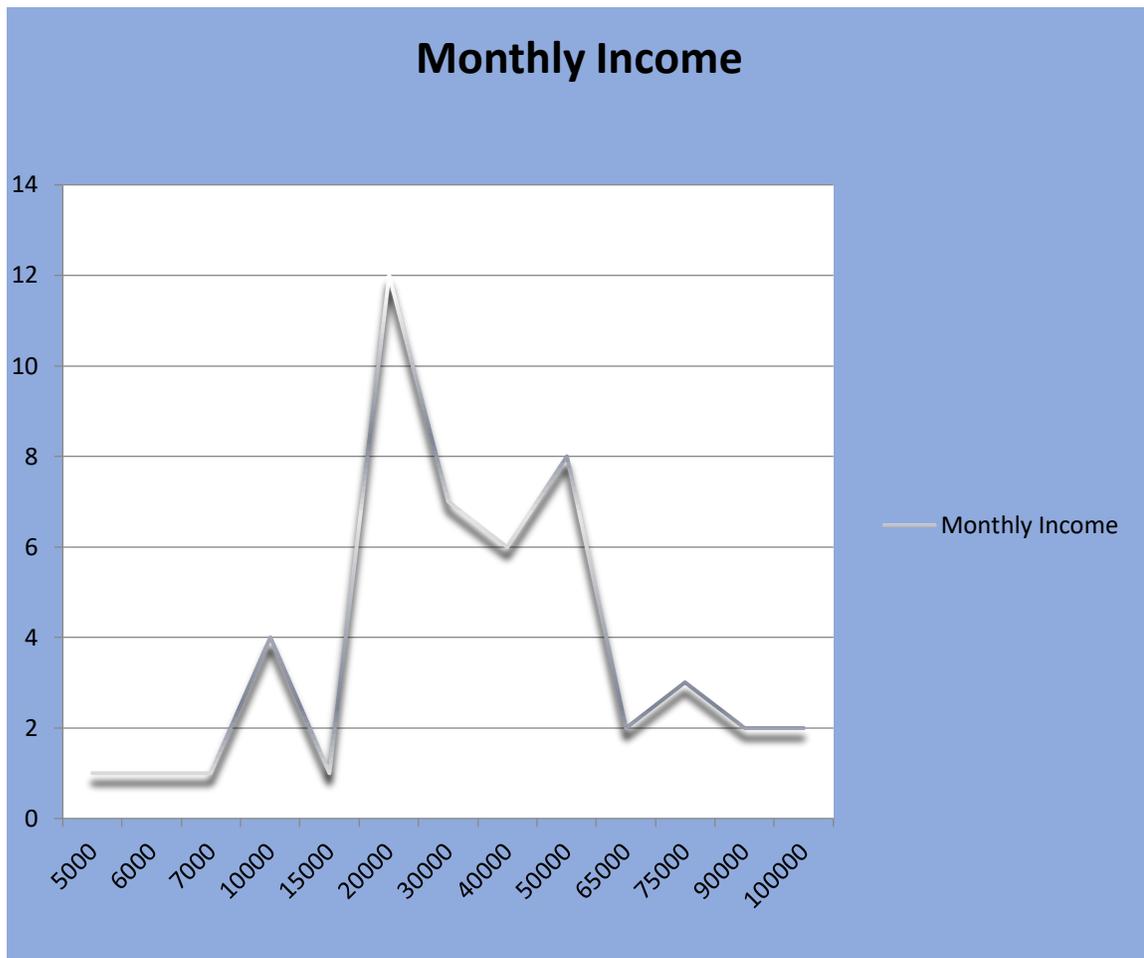
The figure 4.3 represent the locality in which respondents is residing. The options of Urban and Rural were given to choose from, the majority of population whom attended this questionnaire are from urban area and minority population are from rural area. Urban area consists of 60 % and Rural area constitutes 40 %.

**Figure 4.4**



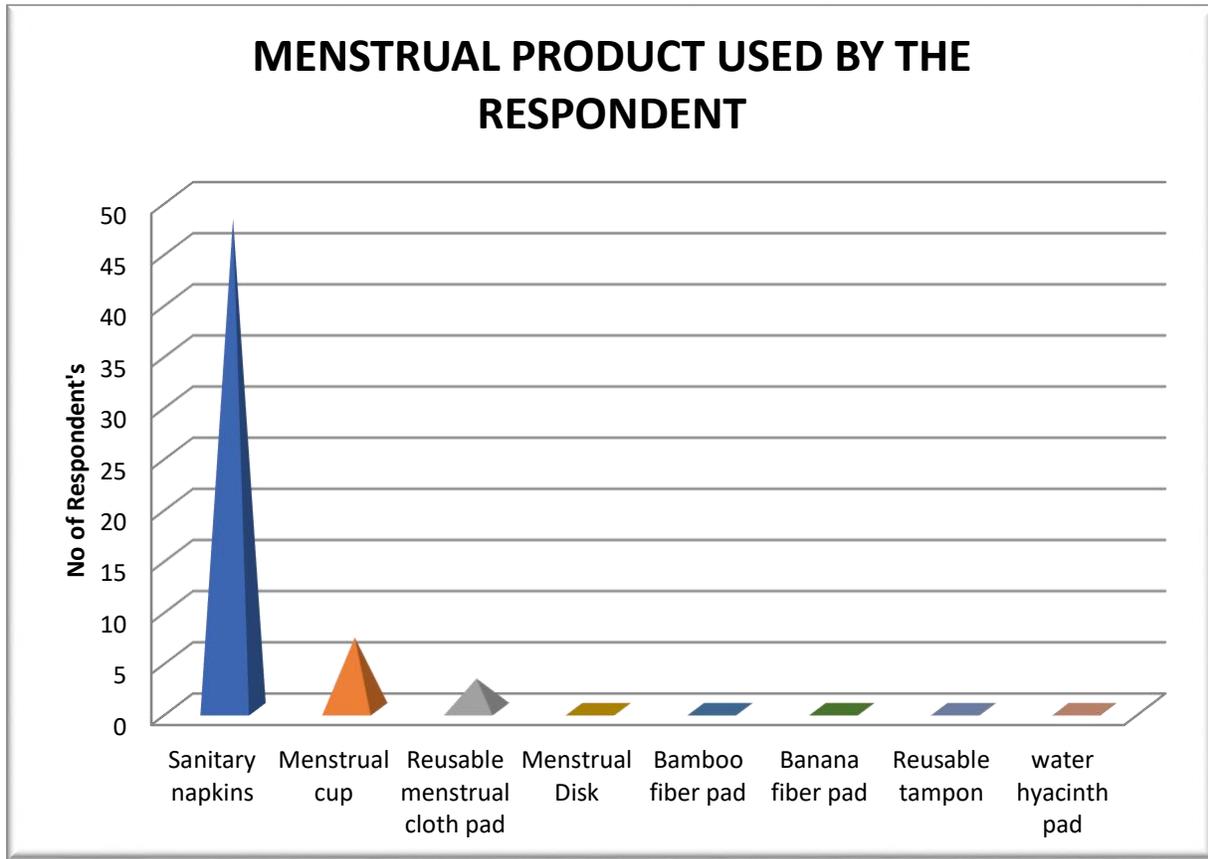
The figure 4.4 depicts the marital status of the respondents. Here hundred percentage that is 50 out of 50 respondents' marital status is unmarried. Therefore, this questionnaire was attended by 50 unmarried college going students from the city of Trivandrum.

**Figure 4.5**



The figure 4.5 Represent the monthly income status of respondent's parent or spouse. Rupees 20000 is the income category which the greatest number of respondents are from that is 24% of respondent are of this category .16% respondent have monthly income of 50000 ,14% have 30000rs ,12% has 40000rs, 8% have 10000rs ,6% has 75000rs, Rupees 100000, 90000 and 65000 are of 4% each. The least number of respondents are from the income of rupees 15000, 7000,6000, and 5000, they are of 2% each.

Figure 4.6



The figure 4.6 depicts the collected data about the menstrual product used by the respondents and what we can conclude is that 48 of the students still use sanitary napkins That is 98 percentage. Only 7 students use eco-friendly menstrual product such as menstrual cup that is 14 percent of entire population. Number of students which use reusable sanitary cloth pad are 3(6%). And coming to Menstrual Disk, Bamboo fibre pad, Reusable tampon, and water hyacinth pad the number of respondents who use these menstrual products are Zero. This might be showing their attitude towards menstrual products other than sanitary napkins especially eco -friendly menstrual products or the respondent having zero awareness about eco-friendly products. Data collected also detect the unchanged trend of using sanitary pads which are to a great extend very bad of the environment, still on going in the capital city of most literate state in India. This data also shows

the unpopularity of eco- friendly menstrual product among respondents. This may be due to various reasons such as having no knowledge or awareness about eco-friendly products, difficulty in affording eco-friendly products, unavailability of eco-friendly products in nearby or reachable stores, impact of cultural background on usage of eco-friendly menstrual products etc.

**Figure 4.7**



Figure 4.7 depicts the preferred menstrual product by the respondents. The menstrual product used by the respondent might not always be the preferred product by the respondent due to various causes said or unsaid like economic aspect, and affordability and all .33 of the respondents (66%) answered that they also prefer sanitary napkin. 22 respondent (44%) prefers menstrual cup. When

this data compared to the earlier one what we can notice is that only 7 of respondents uses menstrual cup but it is preferred by 22 students. That is a positive possibility of change that might occur. Not same but menstrual cloth pad is preferred by 4 students but is only used by 2 of them. 2 of the respondent prefer bamboo fibre pad. 1 respondent prefer banana fibre pad and another a tampon. Menstrual disk, Reusable tampon and Water hyacinth are not preferred by anyone.

**Figure 4.8**

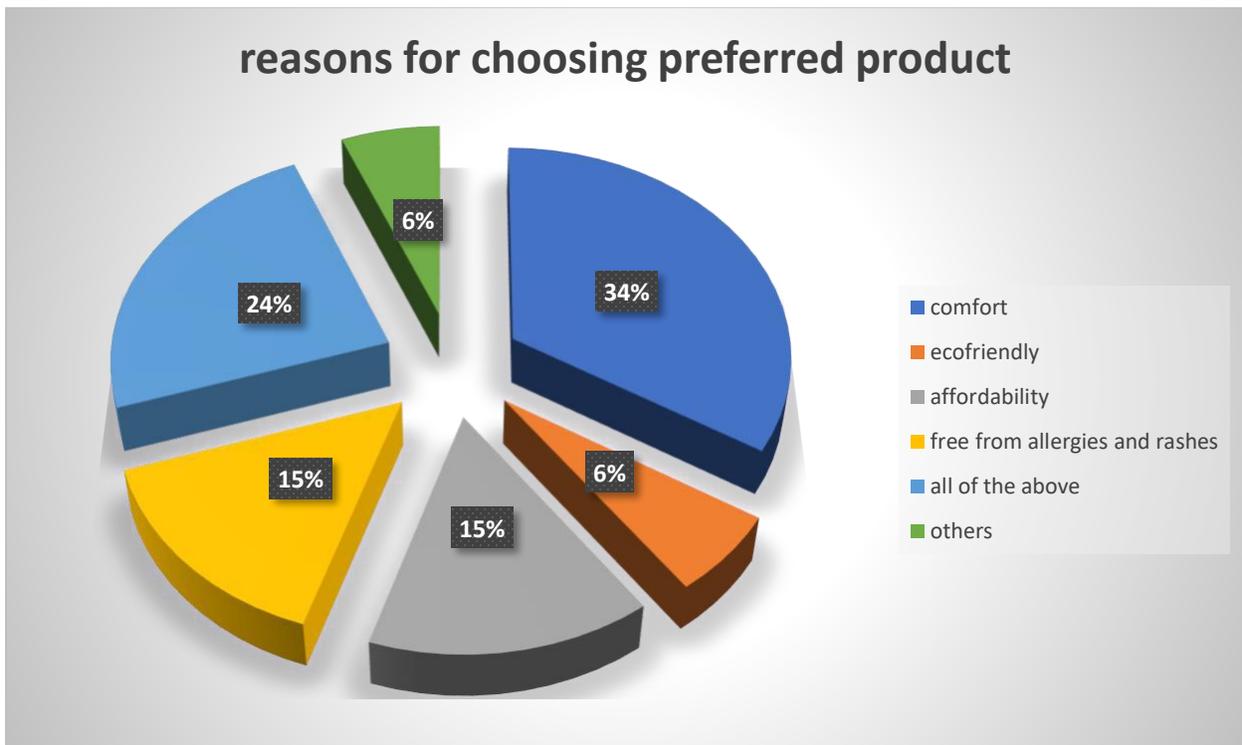


Figure 4.8 depicts various reasons for choosing their preferred product by the respondent. There are various reasons for choosing a preferred menstrual product. They might be comfort they get while using it. Eco -friendly nature of the product. The affordability or cause the product is free from allergies and rashes. In this data majority of the respondents, that is 34% of them have chosen comfort as a reason for selecting their preferred product. 24% has chosen the option all of the above, which includes comfort, eco-friendly, affordability, free from allergies and rashes. 15% was

considering and choosing affordability and free from allergies and rashes .6 % choose eco- friendly nature and other 6 % chose other reasons which aren't mentioned in the questionnaire respectively.

**Table 4.2**

**Data about respondent satisfaction with the menstrual product they currently use**

Response	No of respondents	Percentage
<b>YES</b>	40	80
<b>NO</b>	10	20
<b>Total</b>	50	100

Table 4.2 depicts the data of Respondents satisfaction with the product they use .Here among 50 respondents 40 Respondents are satisfied with the menstrual product they currently use And the remaining 10 respondents aren't satisfied with the product they currently use .Before we saw that about 48 students out of 50 students use sanitary napkin during their menstruation .we could say that all of them are not satisfied using napkins .The decline can also be analysed by comparing the product respondent use and product they prefer . When 48 of respondent use sanitary napkins and 7 of respondent use menstrual cup, coming to their preferred product the number changes to 33 in case of sanitary napkin and 22 in case of menstrual cup.

Figure 4.9

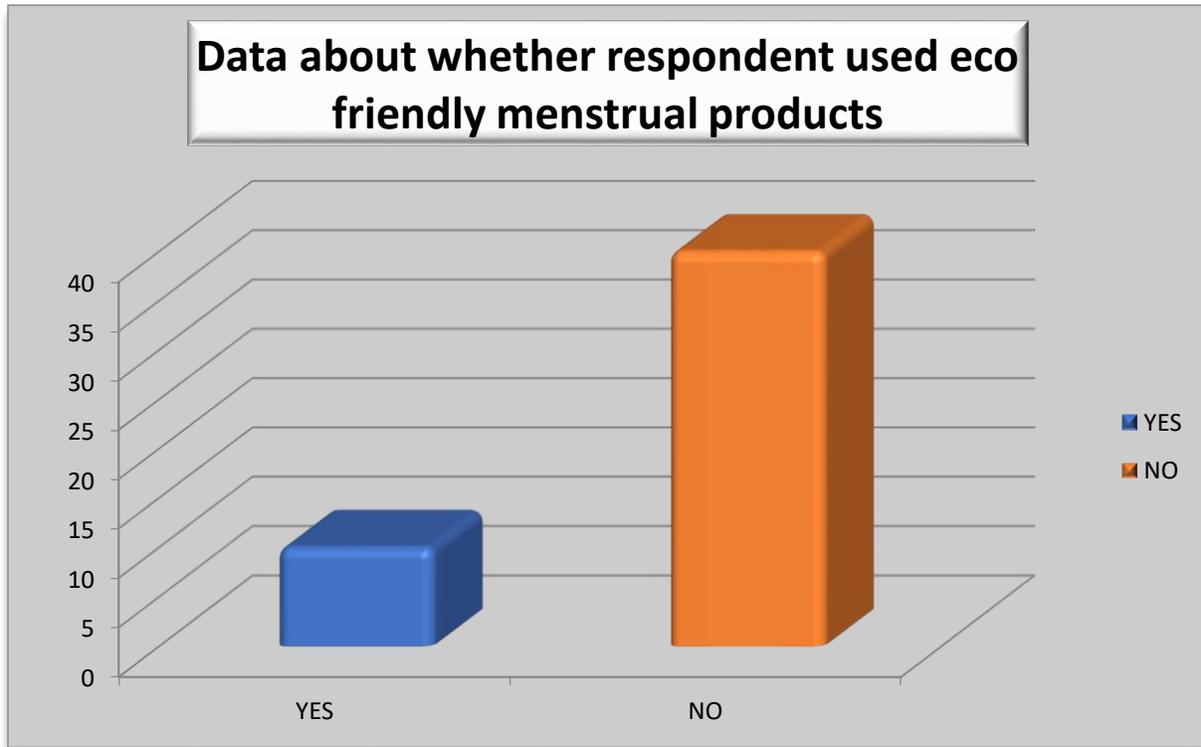
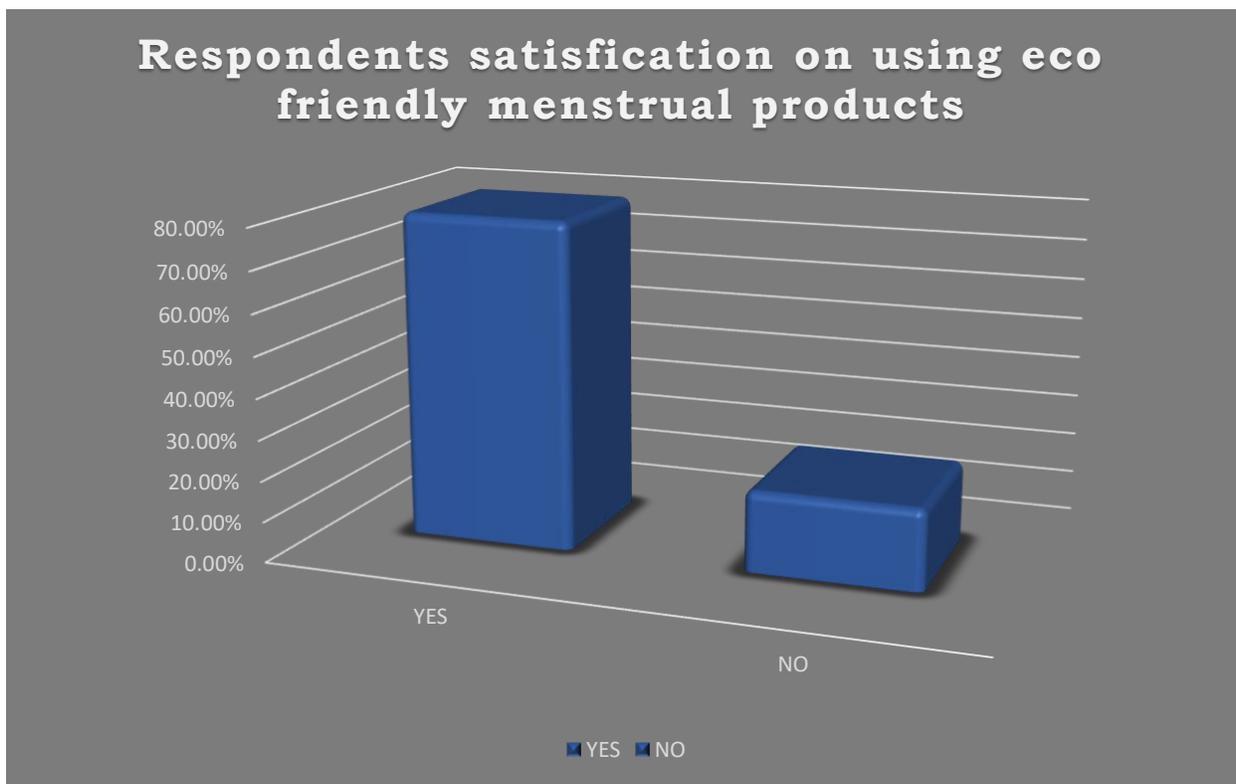


Figure 4.9 depicts data about whether respondent has used eco-friendly menstrual products or not. Majority of the students that is 80 percent of the respondent answered no for the question and 20% have answers yes. Here we could see that even after being a college student in the current modern society this many students haven't come across using an eco-friendly menstrual product. This is something which should be taken into account to cause the relevance of eco-friendly menstrual products are on an increase in this age. Not using eco-friendly menstrual products can also be related with the unaffordability caused by the price ranges in which these products are available. Compared to the menstrual product sanitary napkin which most of the respondent use eco-friendly products like menstrual cups are a little bit costlier to buy. But thinking about the long run we could say menstrual cups are the best choice. There will not be need of spending money for menstrual cup for the next 5 years.

Figure 4.10



The figure 4.10 depicts the respondent's satisfaction on using eco-friendly menstrual products. Of the responses received majority of the students (77 percent) said that they were satisfied on using eco-friendly menstrual products .and only (23 percent) of students said they were not satisfied in using eco-friendly menstrual product. Here compared to the dissatisfaction rate the satisfaction rate is very high in number.

**Figure 4.11**



Figure 4.11 depicts data on the ways through which respondent came to know about eco-friendly menstrual products. Respondent might get awareness about eco-friendly menstrual product through a number of sources or even from only one source. Most number of students came to know about eco-friendly menstrual products through their friends they constitute half of the respondents that is 50 percentage of them. Next is through awareness classes 42% .26 % percentage through family ,16% from medical health professionals, social media 2%, Instagram 2%, Ads 2%, Media 1% respectively.

**Figure 4.12**

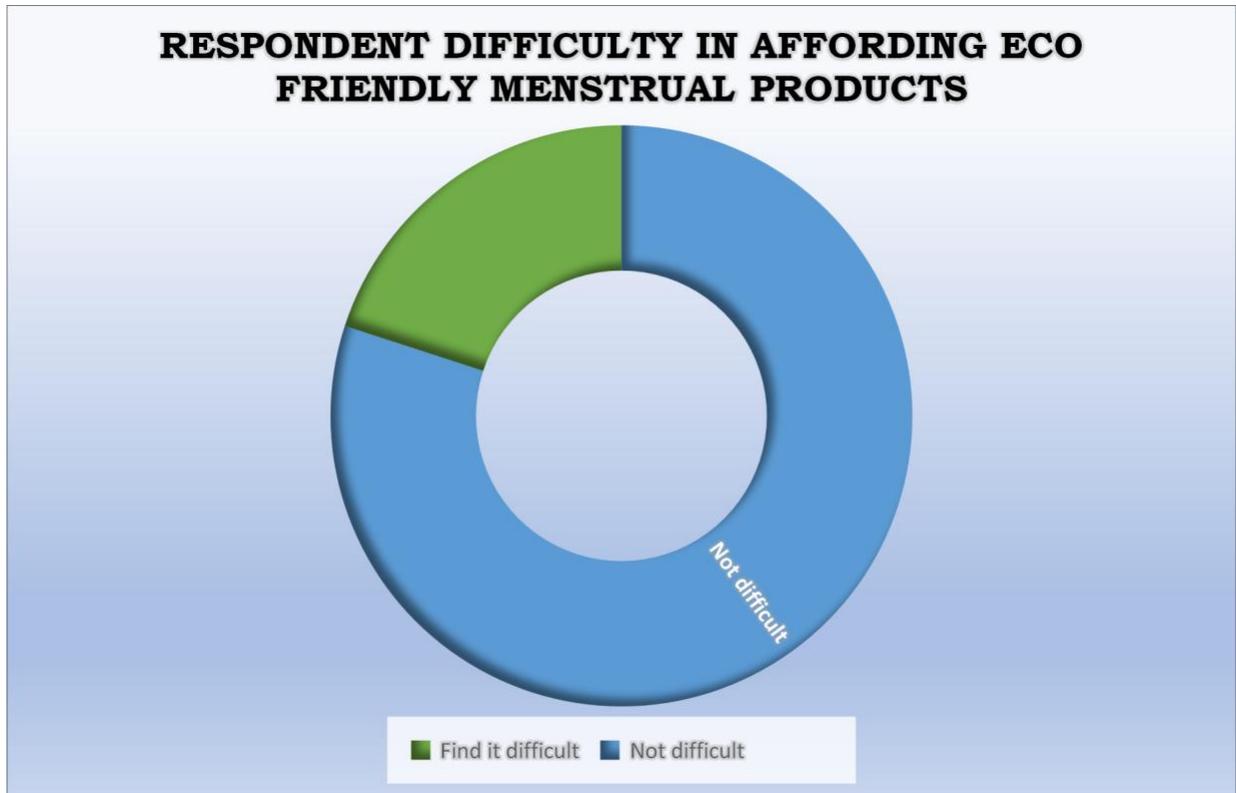


Figure 4.12 depicts the respondent difficulty to afford eco-friendly menstrual product. Majority of the respondent find it difficult to afford eco-friendly menstrual product. Majority of the respondent whom find it difficult to afford eco-friendly menstrual product constitute 80% of the total population. The remaining 20% find eco-friendly menstrual product affordable for them.

Figure 4.13

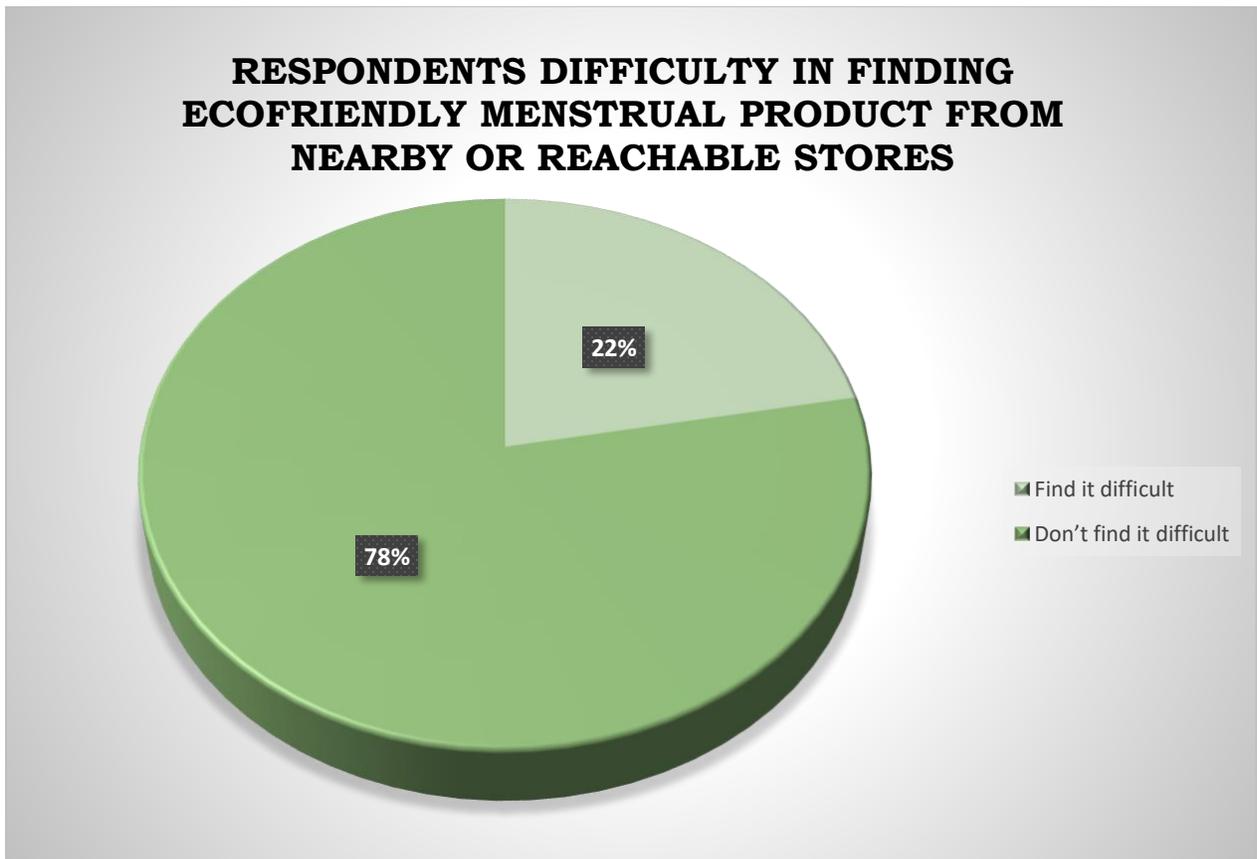


Figure 4. 13 depicts the respondent's difficulty in finding eco-friendly menstrual product from nearby or reachable stores. Majority of the respondent. Majority of the respondent don't find it difficult to find eco-friendly menstrual products from nearby or reachable stores. The majority of respondent consist of 78 percentage of the total population The remaining 22% find it difficult to get eco-friendly menstrual products from nearby or reachable stores. The very important finding that we have here is even though it is not difficult to find eco-friendly menstrual products students are not purchasing them. In previously shown data also we could see (figure 4.12) majority of the respondent that is 80% of them find eco-friendly menstrual product affordable. There is something more than we could comprehend, affecting the mentality of respondents. It might or can be age old tradition they follow, culture they have, influence of family members, religious influence,

conservative nature, fear in using eco-friendly menstrual products such as menstrual cup, having no awareness about eco-friendly menstrual products, ignorance etc...

**Table 4.3**

**Data about whether the respondent be recommending eco-friendly menstrual products to more people**

RESPONSES	No of respondents
YES	33
NO	0
MAY BE	17

The table 4.3 which show above depicts the whether the respondent will be recommending eco-friendly to more people. majority of the respondent said that they'll be recommending it to me people. That is 66% of the total population. None of the respondent have said that they won't be recommending eco-friendly menstrual products to more people. 17 that is 34% of the respondent said they might be recommending it to more people. This data shows the positive attitude of the respondent towards eco-friendly menstrual product. And their willingness to share the knowledge about eco-friendly products to more people even though they are not purchasing and using them

**Figure 4.14**

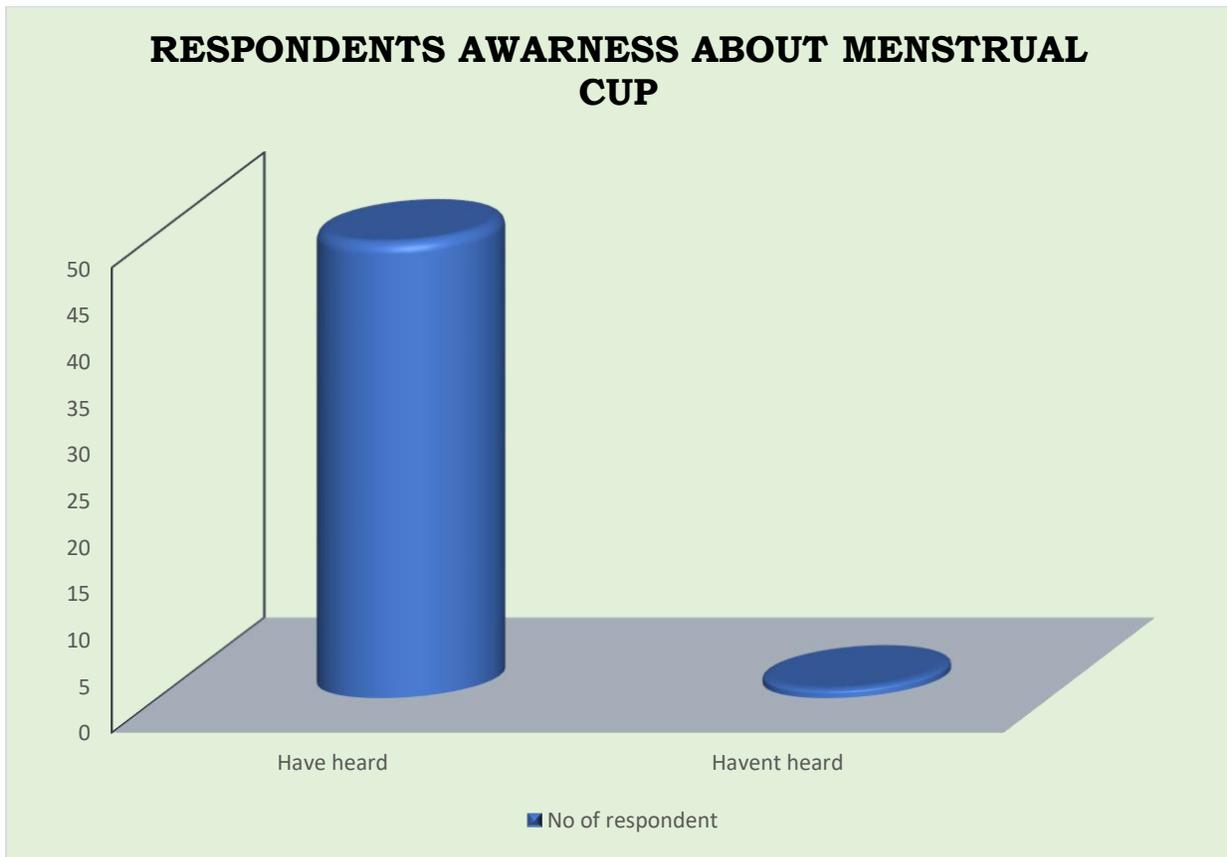


Figure 4.14 depicts the data about respondent knowing about menstrual cup. Here in this data, we can see 98% (49 students) have heard about menstrual cup and only 2% that constitute only one student who haven't heard about menstrual cup. It is notable that Alappuzha municipality in Kerala launched "Project thinkal with the objective of encouraging the use of menstrual cups instead of non-biodegradable sanitary pads. It was probably the first civic body in the country distributing menstrual cups for women -for free. Another initiative by Thinkal on 2021 Oct 8 on menstrual hygiene management was inaugurated by Kerala health minister Veena George. In that they termed cup as a "gamechanger" in helping women to travel during periods. Even after these kinds of programmes being implemented by government, we could see students don't have proper awareness about menstrual cup.

Figure 4.15

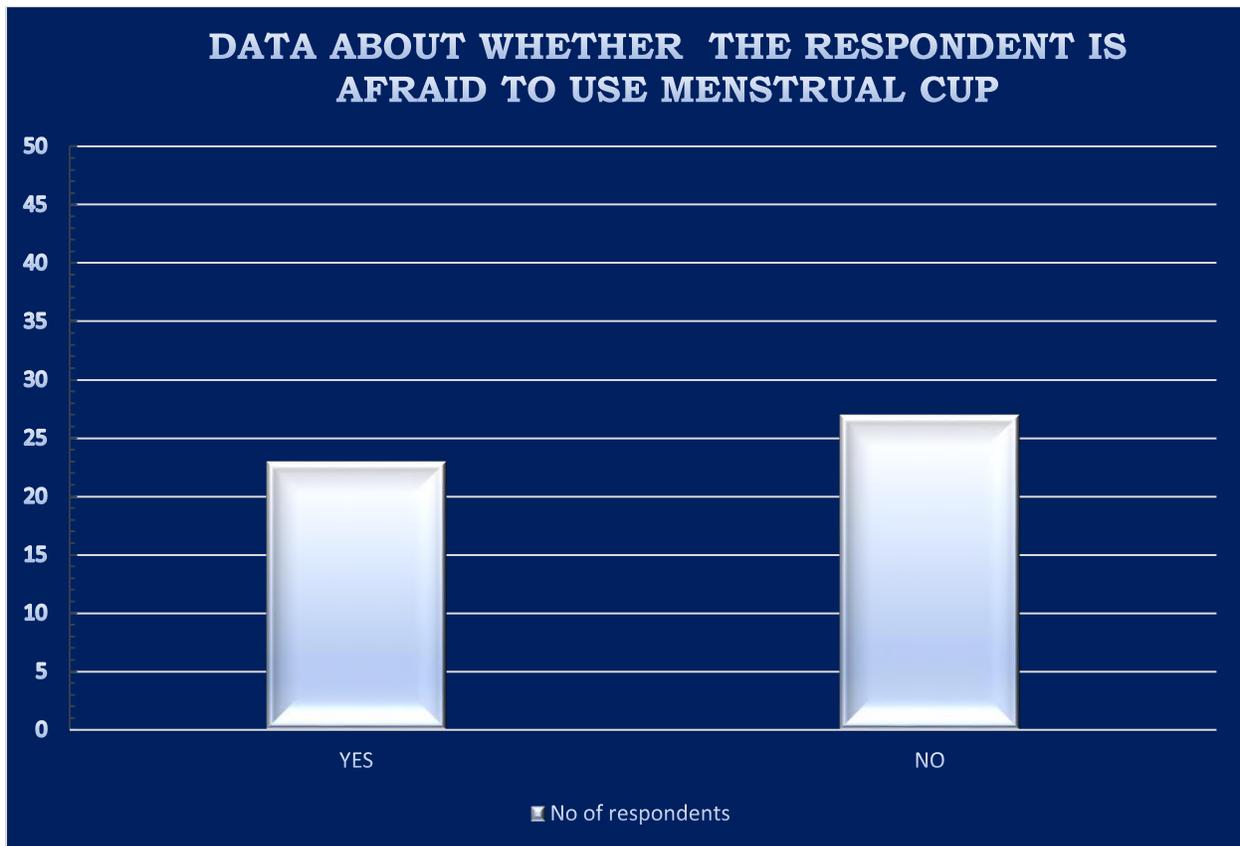
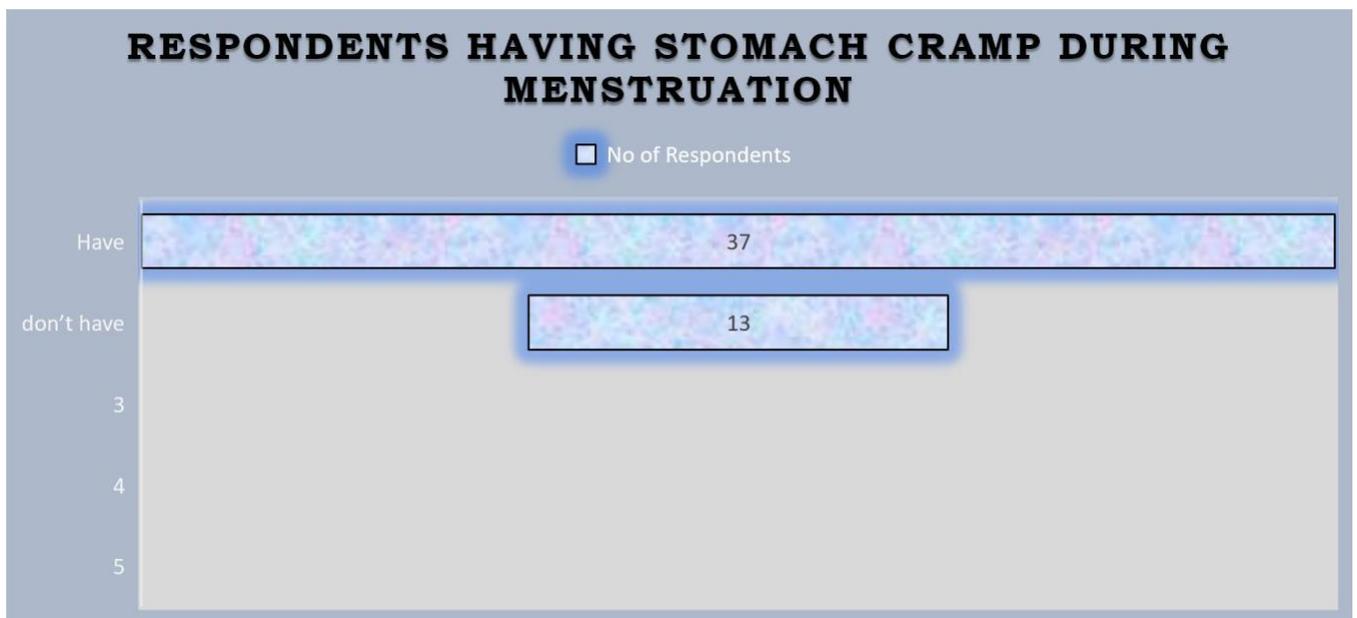


Figure 4.15 shows data about whether the respondent is afraid to use menstrual cup. In this data, a majority of the respondents answered that they were not afraid of using menstrual cups. The number of respondents who answered no for the question is 27 (54%) and the number of respondents who said they were afraid to use menstrual cups are 23 (46%). Here we could see the factor of being scared of using menstrual cups being a problem among college students to use or change into eco-friendly menstrual product alternatives. And this also adds up to the data on high usage of menstrual products like sanitary napkins and less usage of eco-friendly menstrual products such as menstrual cups (see figure 4.6)

## REASONS FOR WHY RESPONDENT IS AFRAID OF USING MENSTRUAL CUP.

Some of those respondents whom answered that they were afraid to use menstrual cup in the above-mentioned figure (figure 4.15) also stated the reasons for why they are afraid .one respondent said it's because they haven't used it yet.4 respondent said they didn't know how to use the menstrual cup in a correct manner.3 respondent said they were afraid of the pain. 2 responded that they were afraid to insert it into the vagina .2 of the respondent were afraid of the thought of fixing the cup inside the vagina .another 2 said they were afraid because they don't feel safe .Comfortability, afraid of getting wounds ,possibilities of leakage ,traditional way of life are other reasons respondents point out .We could say there is a huge void of knowledge here .There is a need for the giving them a proper awareness on usages of menstrual cup how it works properly .And debunking the myths and taboos they have about menstruation.

**Figure 4.16**



The figure 4.16 depicts data on respondent having stomach cramp during menstruation .Majority of the students have stomach cramp during menstruation. Number of students who have menstrual related stomach cramp is 37 ( 74%) . And the remaining 13 (26%) student does not have menstrual

related stomach cramps .Comapareing the data collected we could see there is a huge difference between the two responses and can see how common a menstrual related pain among students are.

**Figure 4.17**

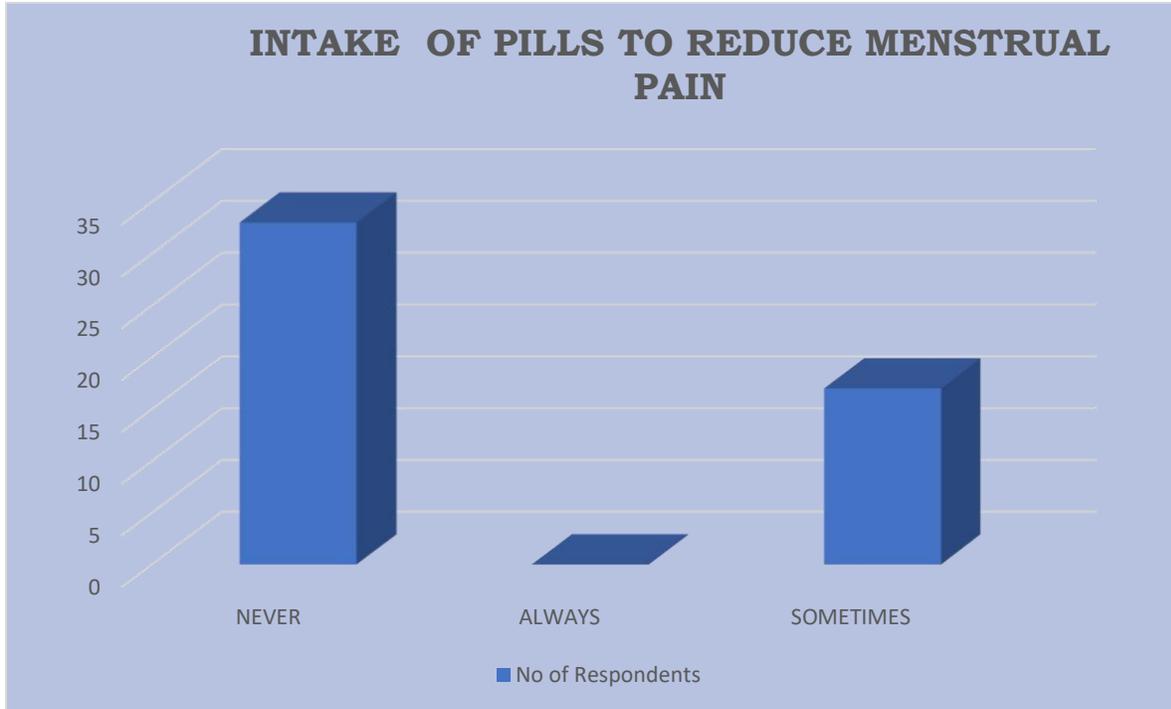
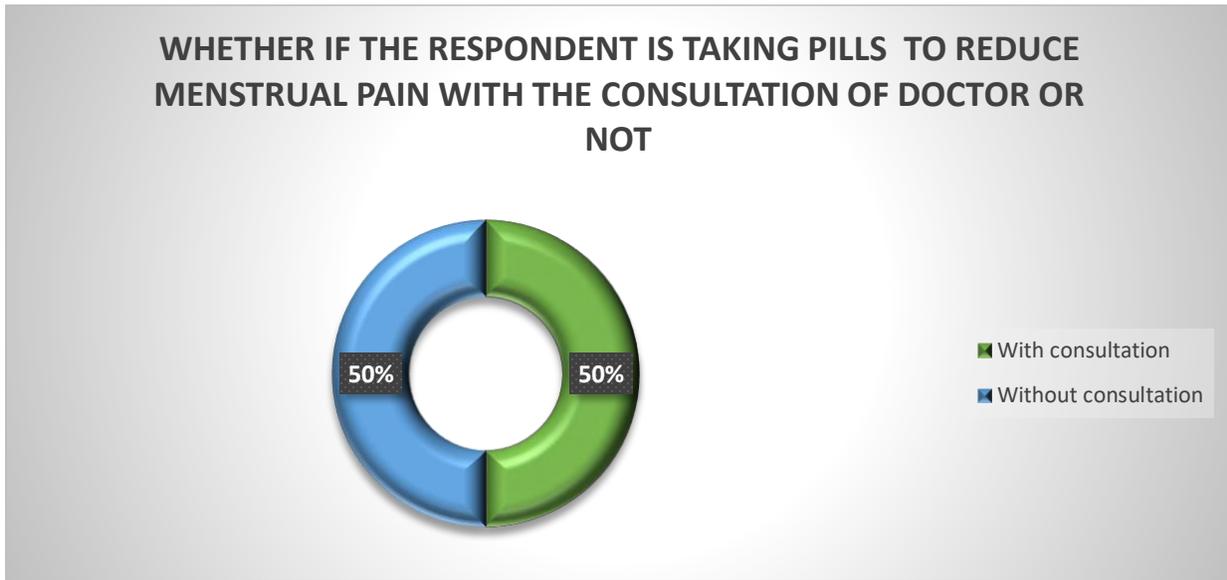


Figure 4.17 shows the data about Intake of pills during menstruation period to reduce pain .Three options were provided .In that most of the students said they never take any pills to reduce menstrual pain . Some said they sometimes take pills to reduce pain and there is no one who take pills all the time during each period. 66 % dosent take pills during menstruation and 34% sometimes take pills to reduce pain . students not takes pills during mesnstrual pain maybe due to taboo they withhold in them like women are meant to suffer pain or cause they have less awarness about medication ,even though everyone is educated .

**Figure 4.18**



The figure 4.18 depicts the data on whether the respondent is taking pills to reduce menstrual pain with the consultation of doctor or not. About half of the respondent who take pills do it with the consultation of the doctor and the other half takes pills without the consultation of doctor

**Figure 4.19**

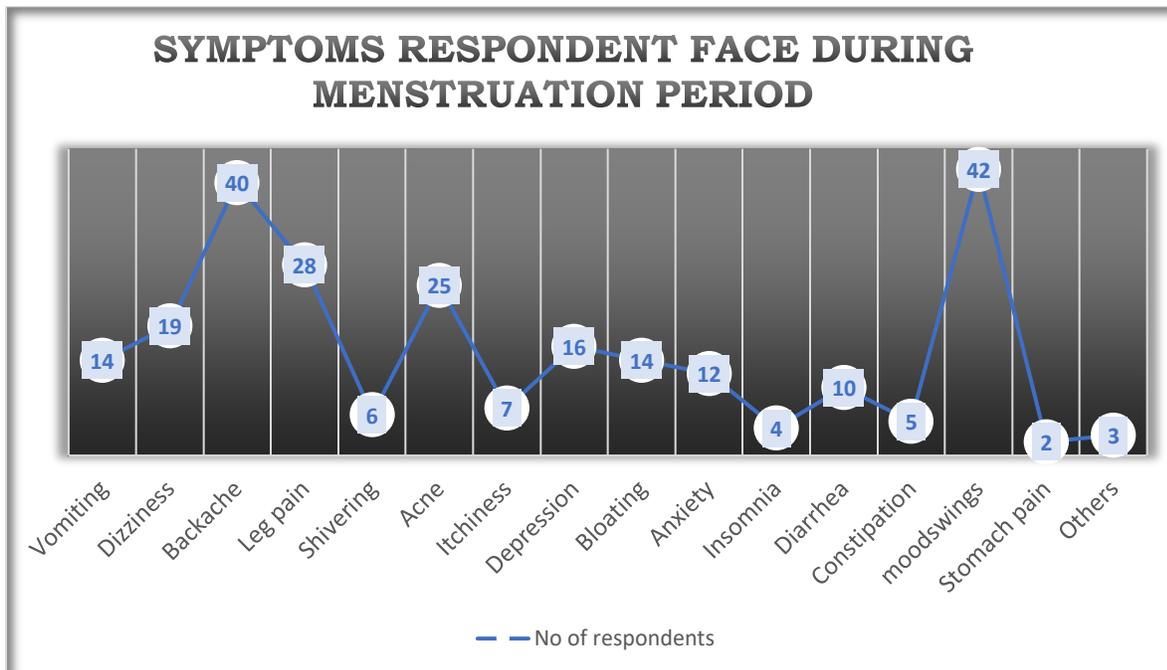


Figure 4.19 Represent various symptoms respondent face during the menstruation period. There are a lot of symptoms that are associated with menstruation and most of it are mentioned above in the chart. The most common symptom respondent face is the moodswings that occur during menstruation. In this data 42 (84%) students deal with mood swings. The second most symptom associated with menstruation is Backache 40 students (80%) are affected with backpain during menstruation. 28 (56%) have leg pain, 25 (50%) have acne, 19 (38%) dizziness, 16 (32%) have depression, 14 (28%) have vomiting another 28% have Bloating, 12 (24%) have anxiety, 10 (20%) have diarrhea, 7 (14%) experience itchiness, 6 (12%) experience shivering, 5 (10%) experience constipation, 4 (8%) have insomnia, 3 (6%) have other symptoms which are not mentioned in the questionnaire, 2 (4%) have stomach ache respectively. This data not only shows which all symptoms are there in respondent but also points out how one person experience multiple symptoms.

**Figure 4.20**

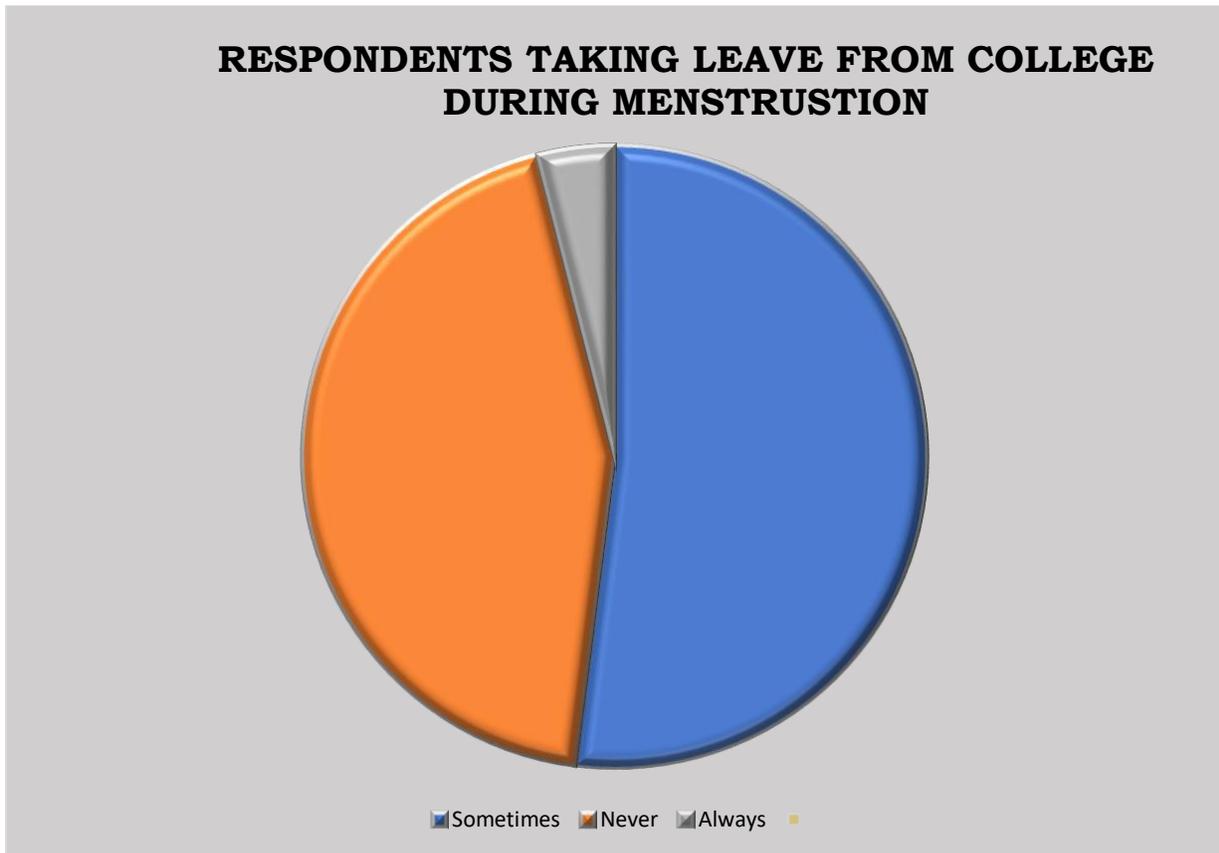
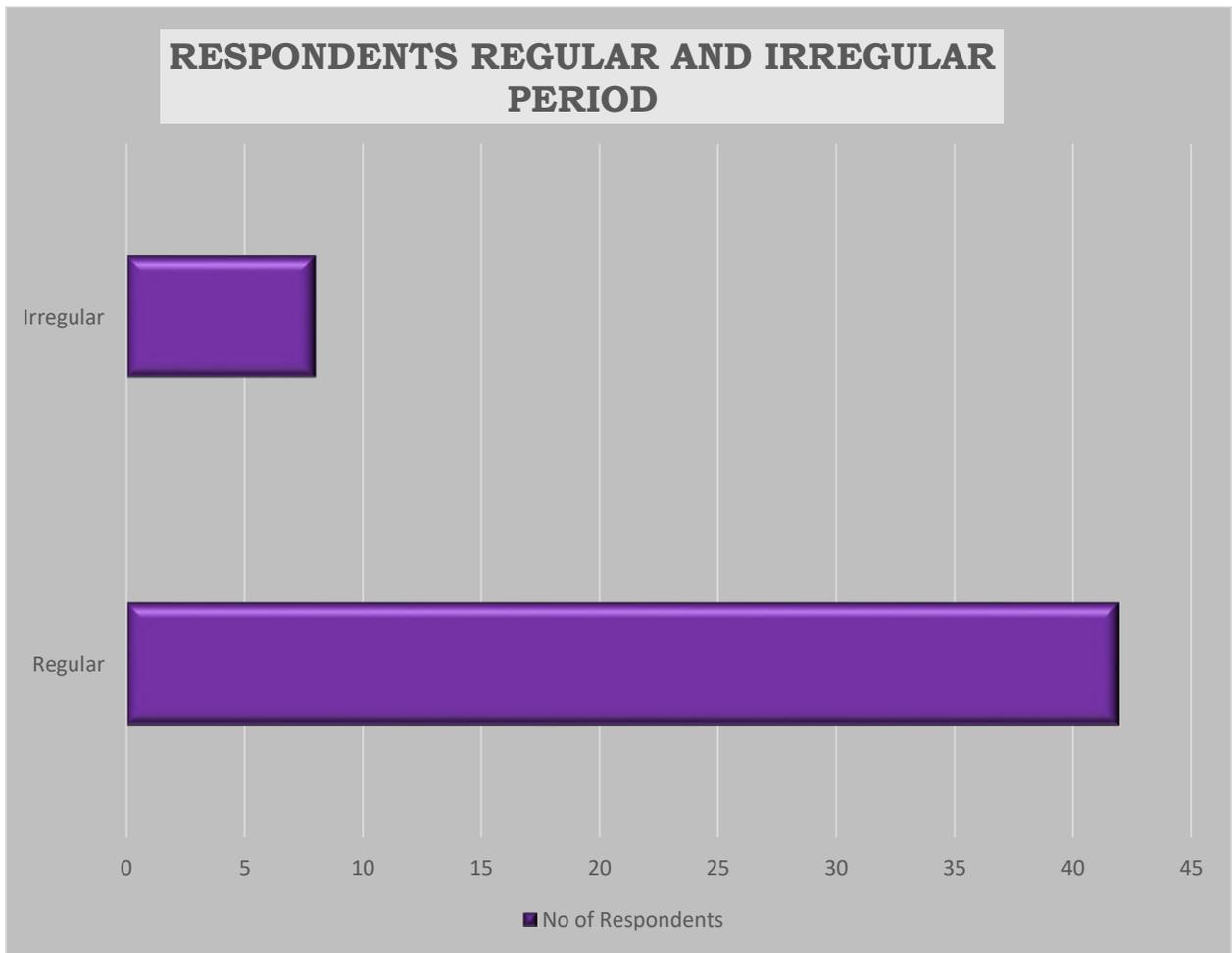


Figure 4.20 depicts the data about respondent taking leave from college during the time of menstruation. Majority of the respondents sometime take leave during the time of menstruation. The data collected are following those who take leave sometimes constitute 26 students (56%) those who never take leave are 22 in number (44%) and the remaining 2 students (4%) Always take leave during their time of menstruation.

**Figure 4.21**



The figure 4.21 represents the data on respondents having regular and irregular periods ... Majority of the students have a regular period. only some students experience irregular periods. Numerical data gathered are following 42(84%) of student have a regular period during the menstruation. And the remaining 8 (16%) have an irregular period.

**Table 4.4**

**Data about various health issues faced by the respondent**

Health Issues	No of respondents
PCOD	4
PCOS	0
ANEMIA	4
OTHERS	2
DON'T HAVE ANY	40

The Table 4.4 shows the data on various Health issues faced by the respondent. Majority of the student that is 80 percentage of the student don't have of face any health-related issues. Remaining 20 percent constitute of 8% affected with PCOD, another 8% affected with anaemia and remaining 4 % has some other health issues which was not mentioned in the questionnaire. Of all the responses nobody was affected with PCOs.

Figure 4.22

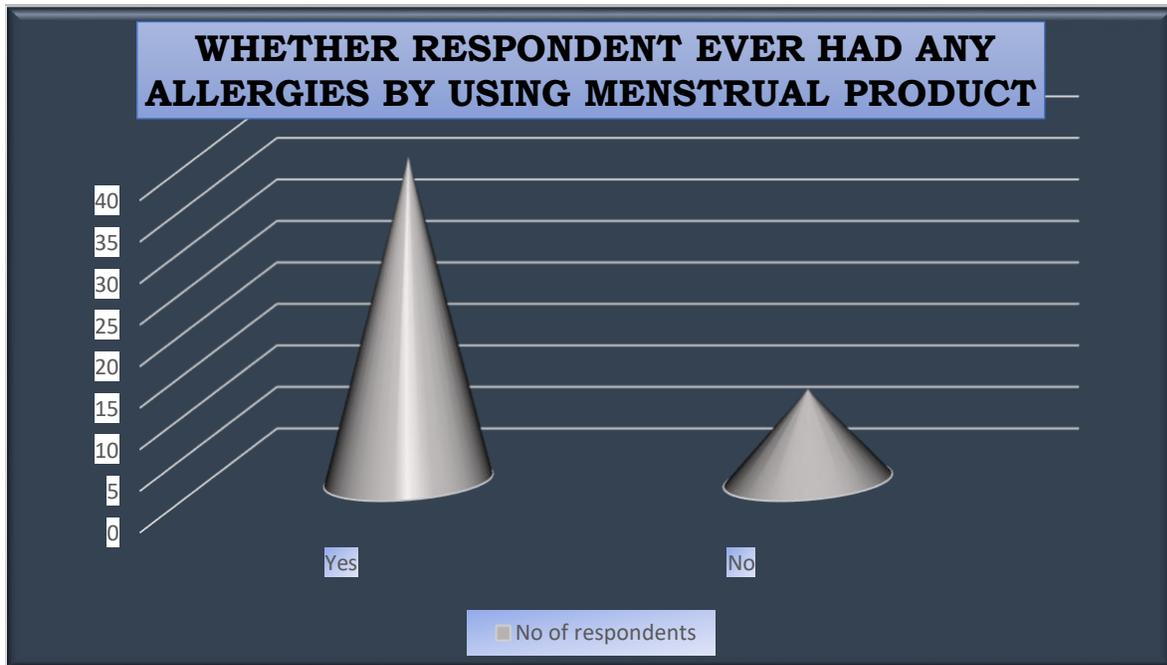


Figure 4.22 shows data on whether the respondent ever had any allergies by using menstrual product. A large majority of the response to the question was yes. The respondents who said they have had allergies by using menstrual products are and those who said they didn't have any are 22%. This data gathered shows the commonality of allergy issues faced by college students. We could see even after getting allergy respondents aren't looking for other alternatives.

### Menstrual Product which caused allergy among respondents

All of the respondent whom answered the question in one voice have said sanitary napkin is the product which caused allergy in them. This is also very interesting fact or can consider as an irony, even though sanitary napkin is the one which causes them allergy it is the same menstrual product which is used by almost all or a large majority of respondent .96% of the respondent whom attended this survey uses sanitary napkins. (See figure 4.6) . As we' already said a variety of factors may be a reason for that.

Figure 4.23

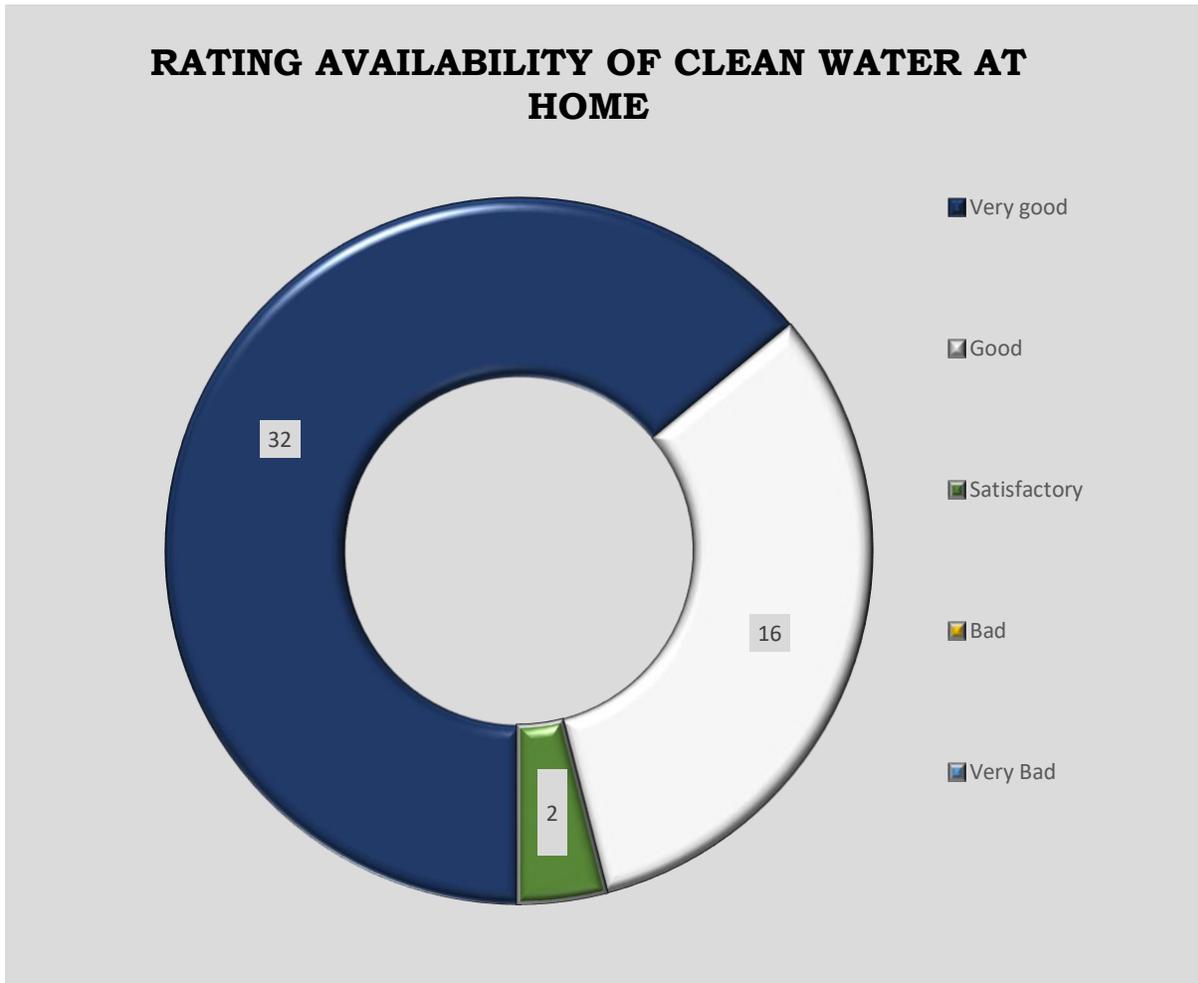


Figure 4.23 depicts the data about rating of availability of clean water at home. Four options were given to choose from they were .Very good,good, satisfactory ,bad and Very bad .Majority of the respondents said they have very good availability of clean water at home .The data's are as following , 62% have very good availability of clean water at home ,32% had good availability of clean water at home and the least number that is 4% had satisfactory level availability of clean water at home .Something which should be noted is that none of the respondent have bad or very bad condition of availability of clean water at home .

Figure 4.24



Figure 4.24 depict the data collected about the availability of proper menstrual waste disposal at home. Here the respondent's data portray that a large majority of them have proper waste disposal facility at their homes. And only a small amount of respondent is of those categories who font has a proper menstrual waste disposal at home. The percentage data are following those who have proper menstrual waste disposal constitute 88% of the total data collected. The remaining 12% constitute of those who don't have proper menstrual waste disposal at home.

Figure 4.25

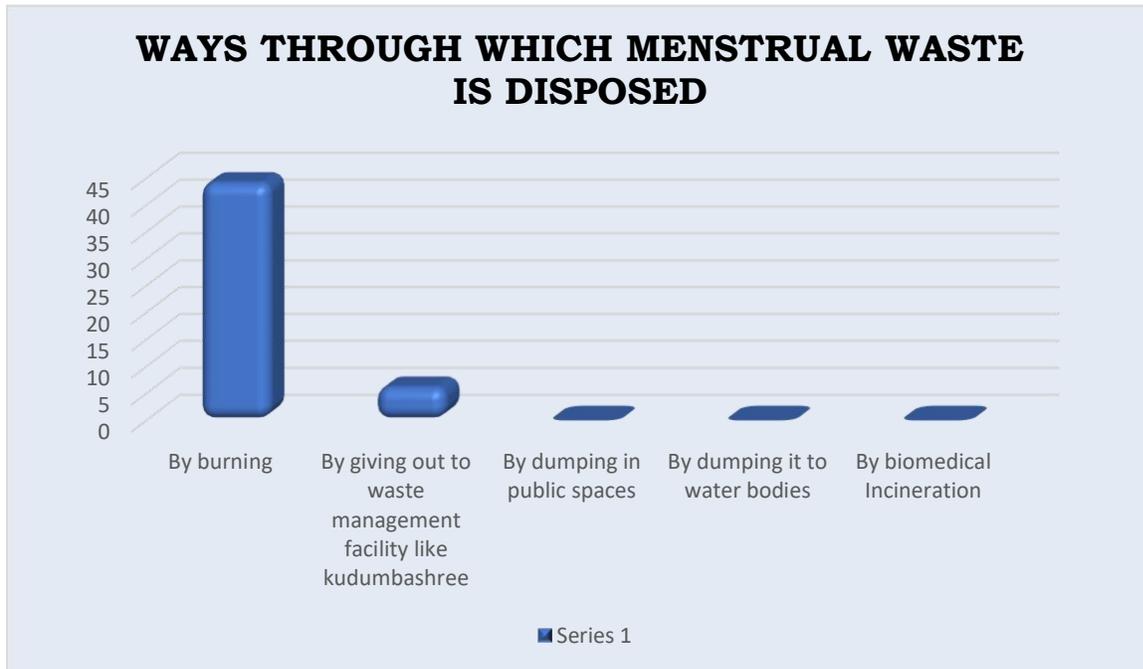


Figure 4.25 shows data about the ways through which menstrual waste is disposed. A large Majority of the students have said that they dispose menstrual waste by burning. Only a small number of students has chosen the option of giving out to waste management facility like kudumbashree and the remaining options such as dumping in public spaces, dumping it to water bodies and by biomedical incineration wasn't chosen by anyone. The respective data collected are the following. Disposal by burning 88 %, by giving out to waste management facility like kudumbashree 12% and by dumping in public spaces, by dumping it to water bodies, by biomedical incineration wasn't chosen by anyone. Burning as we can see being the highest menstrual waste disposal method is a very anti-environmental thing to do. Especially the most commonly used menstrual product have a lot of plastic component in it. Burning plastics causes high environmental problem such as air pollution which in turn affect the nature and cause respiratory diseases in human beings.

### **Difficulties respondent face during menstrual waste disposal.**

There are various kinds of difficulties which are faced by respondents during the menstrual waste disposal. Even though 28(56%) of the respondent says they don't face any difficulty in menstrual waste disposal. The remaining 44% talked about various difficulties they face during menstrual waste disposal. They are the following.

- Concern for air pollution
- Inability to dispose sanitary napkins in a proper manner
- Stinky smell comes out form the sanitary napkin
- Unavailability of proper sanitary napkin disposal facility while travelling
- Smoke that comes while burning
- Difficulty in getting the whole napkin burned to ashes
- Environmental concern for plastic waste formed from napkins
- Lack of effective eco-friendly means of menstrual waste disposal
- Lack of availability of space.
- Left over burned cloth
- Never have heard about any waste management facility who collect used pads.
- Difficulty of menstrual waste disposal at public toilets
- No waste management facility in and around their locality

**Figure 4.26**



Figure 4.26 depicts the data about the availability of menstrual product at campus readily and in a convenient manner. Most of the respondent said they get menstrual product at campus in a convenient manner. Data gathered is as following those who said they get menstrual product in a convenient manner constitute 68% of the total respondent and the remaining 32 said they are not getting menstrual products in a convenient manner

**Table 4.5**

**Data on availability of proper menstrual waste disposal facility at respondents' campus**

RESPONSE	No of students
YES	42
NO	8

Table 4.5 shows the data about the availability of proper waste disposal facility at respondents' campus. Here majority of the respondent said they have a proper waste disposal facility at their campus. Data collected shows 84% of the respondent answered yes to the question about if they have proper menstrual waste disposal facility at respondents' campus. The remaining 16% said that they don't have any proper menstrual waste disposal facility at campuses

Figure 4.27

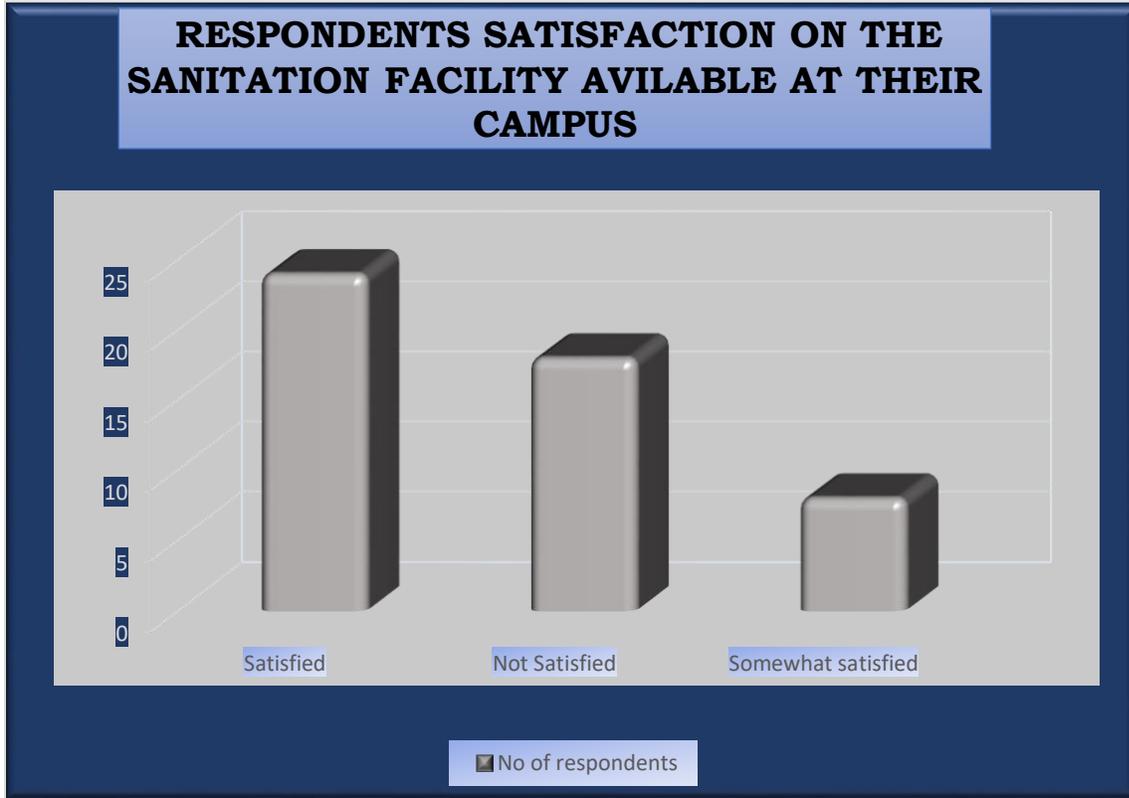


Figure 4.27 depicts respondents' satisfaction level on the sanitation facility available at their campuses. the majority of the respondent is satisfied with the sanitation facility available at their campus They constitute 48 percentage of the total population. 36% of the respondent weren't satisfied with the sanitation facility available at their campuses. The remaining 16% percent was somewhat satisfied with the sanitation facility available. Sanitation being one of the important aspects of personal hygiene is something that should be taken into consideration very seriously. Here in this data, we can see how even this important basic need isn't fulfilling.

**Figure 4.28**

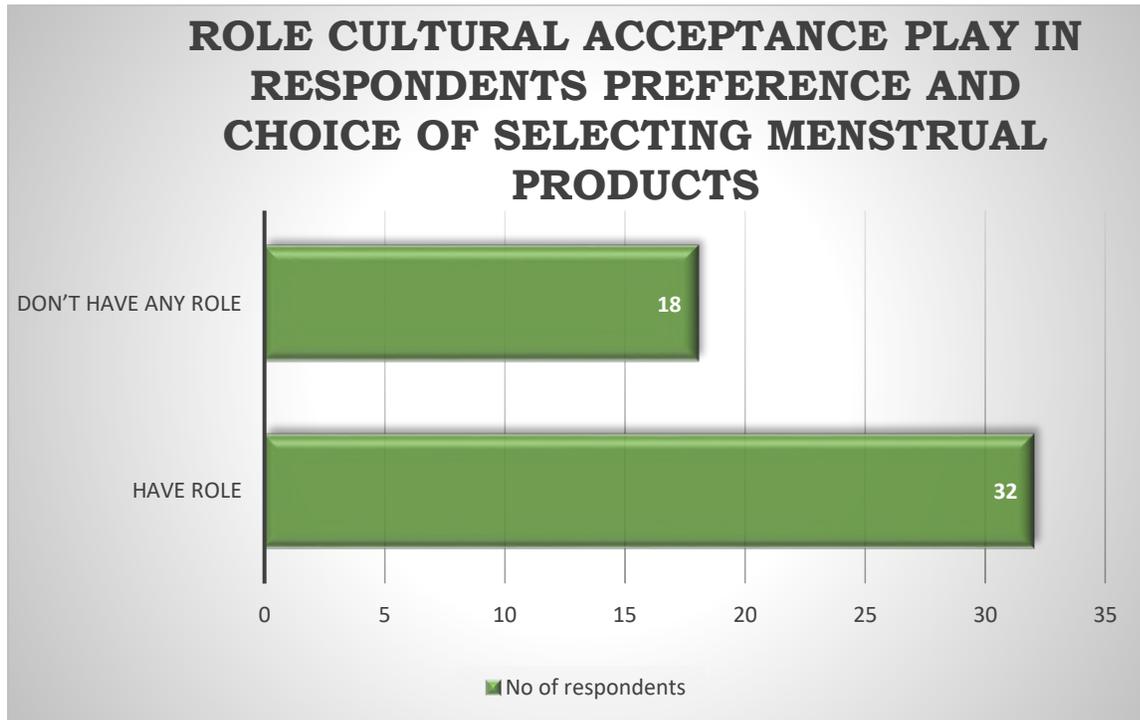


Figure 4.28 shows data on the role cultural acceptance play in respondents' preference and choice of selecting menstrual products. Of the total respondent's majority of the students believe that there is a role for cultural acceptance in respondents' preference and choice of selecting menstrual product. They constitute 64 % of the total respondents. The remaining 36% think that cultural acceptance does not have any role in respondents' preference and choice of selecting menstrual products.

Figure 4.29

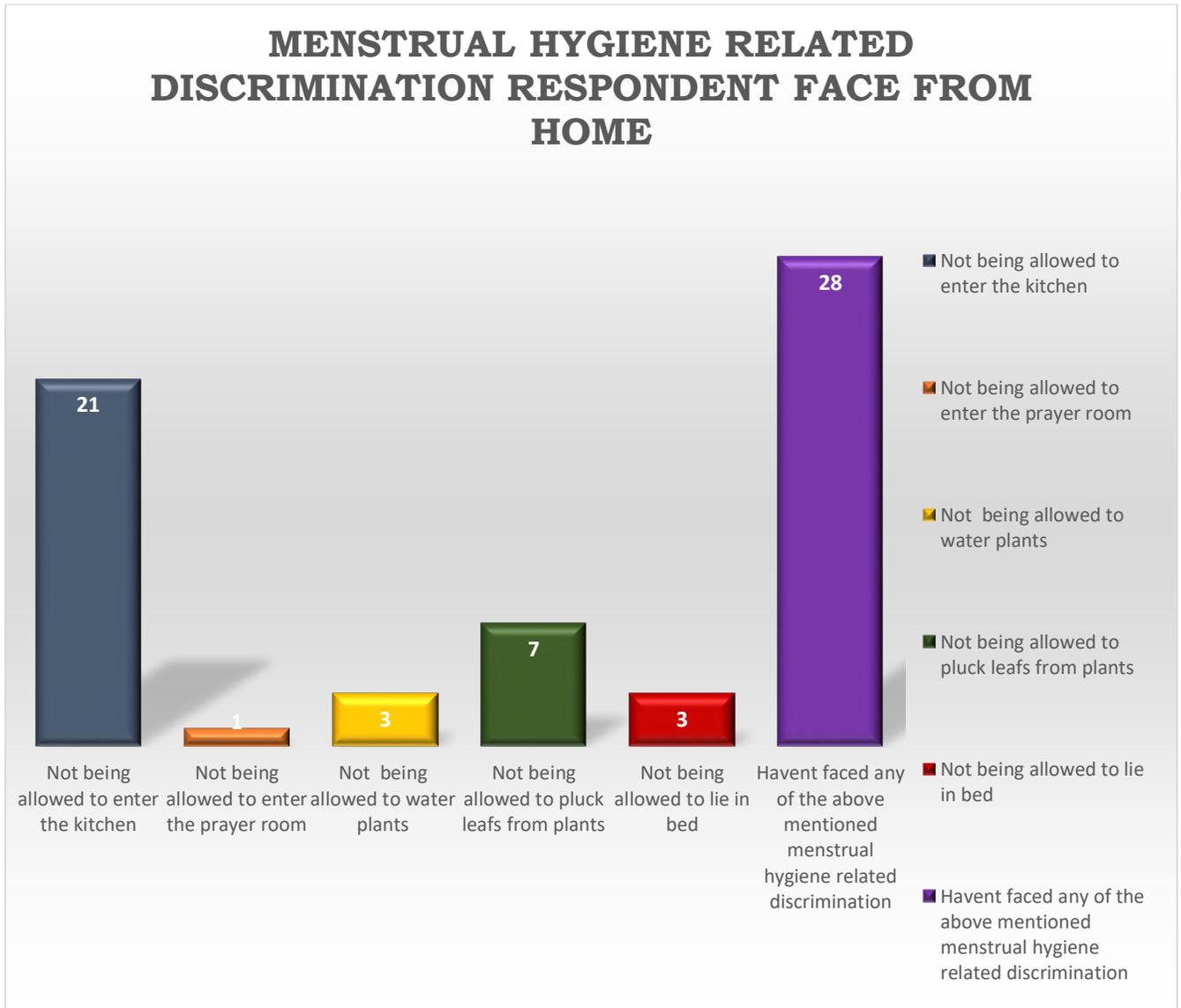


Figure 4.29 shows menstrual hygiene related discrimination respondent face from home. In this data we could see that majority of the respondent haven't face d any menstrual hygiene related issue that was mentioned in the questionnaire. Here in the chart we could see 42 % respondents aren't allowed to enter kitchen during menstruation, 14% were not allowed to pluck leaves from plants .6% weren't allowed to water plants , another 6% weren't allowed lay in bed during this period of time and 2% weren't allowed to enter the prayer room .It is very shocking to look at this data cause even during this period where everything is so advance and technically marvellous .There are still this brainless practices going on in a state such as Kerala.

**Figure 4.30**

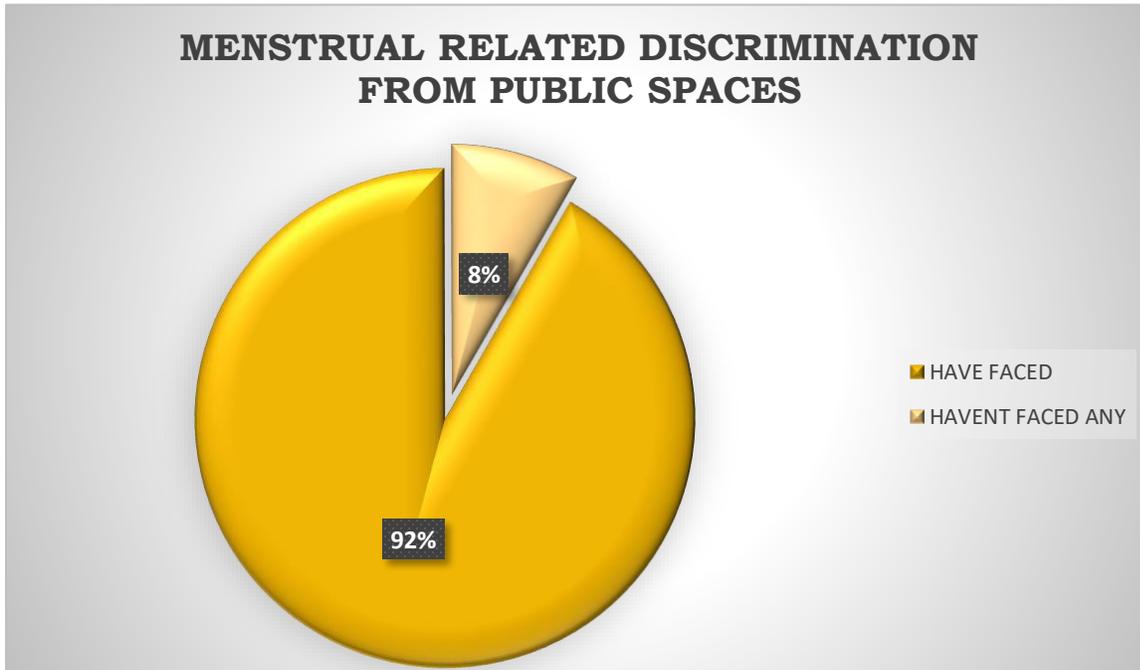


Figure 4.30 depicts the data about menstrual related discrimination at public spaces. In this data it is so evident that majority, that is 92% of the respondent have faced menstrual related discrimination from public spaces. Only the remaining 8% haven't had any menstrual related discrimination from public spaces. This data somewhat also shows the attitude of public about menstruation. Which in turn also represent our society.

**Table 4.6**

**Respondents' opinion on the role of customary practice on menstrual related discrimination respondent face**

RESPONSE	No of respondents
Have role	32
Don't have any role	18

The table 4.6 above shows respondents opinion on role of customary practice on menstrual related discrimination respondent face .Here most of the students which constitutes 64 % of the total polpulation said customary practice have a role on menstrual related discrimination respondent face .And the remaining 36 % think customanry practice doesn't have any role in the discrimination respondent face .

**Figure 4.31**

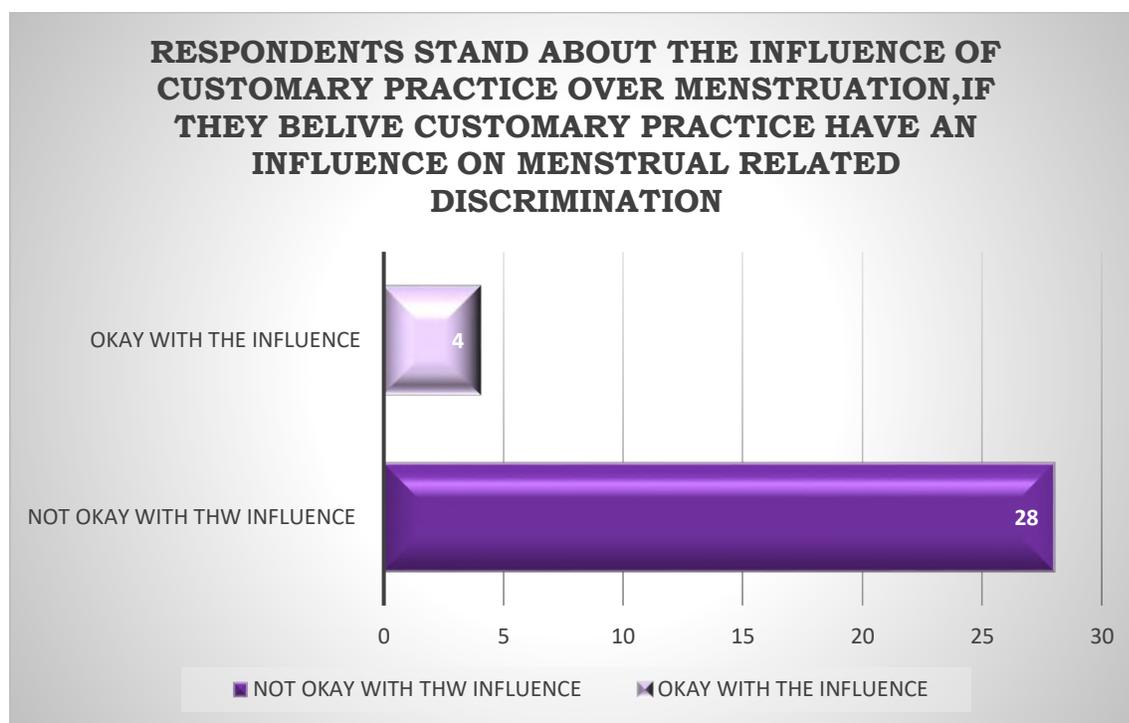


Figure 4.31 shows respondents stand about the influence of customary practice over menstruation ,if they belive customary practice have an influence on menstrual related discrimination. Of the 32 respondent whom said customary practice have a role in menstrual related discrimination respondent face(see table 4.6) .Majority of 32 respondent said they weren't okay with the influence customary practice have over menstruation.only the remaining 4 respondent said they were okay with the influence .We could relate this data with the kind of educational status Kerala state have achived over the years.The responses are the indication that people are thinking and

they are not okay to settle for any less .There are lot of unhealthy practices we still follow to this day cause its been a part of our culture which weve born into . And its not something to be blindly followed.People should have the right to chose own decissions regardring their life choices and should not be influenced by anything. We could not afford to give up our choices for the sake of culture or customary belives .

## **CHAPTER FIVE**

## Findings and Conclusion

Menstrual habits among college students are changing in rapid pace now. There are also several factors such as religion, culture, superstitions, norms, folkways, taboos in society which create hindrance for women in several areas of life. This study I am trying to focus and understand more about the menstrual habits that the college students from Kerala follows. And also, to analyze the problems faced by students using menstrual products during menstruation time.

- In this study we could see almost all of the respondent's that is 98% of them still use sanitary napkin as their menstrual product. Even though that it is not the preferred by all of them.
- Important thing to notice is that eco-friendly products like menstrual cup is only used by 14% Even though 49 % of the students have awareness on what menstrual cup is. Reusable cloth pad is used by 3% of the respondents. Eco-friendly menstrual products such as menstrual disc, bamboo fibre pad, banana fibre pad, reusable tampons, water hyacinth pad aren't used by anyone of the respondents. This shows the unpopularity of various menstrual products that are available in the market. The percentage of respondents whom have used eco-friendly products is 20%. The remaining 80% haven't used any eco-friendly menstrual products.
- The preference towards menstrual cup is more in number than those who actually use menstrual cup. Can be taken as an indication of increasing popularity of menstrual cup among college students in Thiruvananthapuram district.
- Respondents have said that, comfortability in using a product is the thing that they look while preferring menstrual product. Satisfaction level of those who use eco-friendly menstrual products are found to be high. Most of the students came to know about eco-friendly products from their friends .and they don't find difficult to afford eco-friendly menstrual products
- One of the things which can contemplate the less usage of menstrual cup is fear towards using menstrual cup. 46% od respondents answered that they are afraid to use menstrual cup. Reasons such as pain, fear of insertion method, thought of menstrual cup in vagina,

feeling unsafe, discomfort, getting wounds, possibilities of leakage, traditional way of life are the pointed by the respondents.

- 76% of the students has pain during menstruation. And 66% don't take pills during menstruation. Half of those students who take pills does it without consultation of a doctor. Mood swings and backpain are the most common symptoms students face. Other symptoms include vomiting, dizziness, leg pain, shivering, acne, itchiness, depression, bloating, anxiety, insomnia, diarrhoea.
- About half of the students, sometimes take leave during time of menstruation only a very little always take leave. What we notice here is, unlike the current trend only 16% of the students are having irregular period and the remaining are having regular period. Only 20% students have health issues like PCOD, Anaemia.
- 78% of the students have suffered from allergies and all of the students who have answered to the question which product have caused the allergy have answered in one voice that sanitary napkin has caused the allergy, It is very interesting fact or we can consider it as an irony even though that the sanitary napkin is one that caused them allergy it is the same menstrual product it is used by the large majority of the students. It is 96% of them. And even after all these 66% also prefer using them, it is something to be considered seriously.
- Burning is the most commonly used technique for disposing the menstrual waste. Various types of difficulties which are faced by the respondents during disposing menstrual waste include, concern for pollution, inability to dispose sanitary napkin in a proper manner, stinky smell come out from sanitary napkin, unavailability of proper sanitary napkin disposal while travelling, difficulty in getting the whole napkin into ashes, environmental concern, plastic waste formed from napkin, lack of availability of space, never hearing about any waste management facilities which collect used pads, menstrual waste disposal in public places, no waste management facilities in and around your locality.
- Coming to the condition of the campuses, 68% of student get menstrual products in their campus in a readily and in a convenient manner. 84% of the respondents are having proper menstrual disposal facilities at their campuses. Only 48% of the respondents are satisfied with the sanitation facilities available at their campus. 62% of the students believe that culture acceptance has a role in their preference of choice in selecting their menstrual product. 56% haven't faced any menstrual hygiene relate discrimination from their home,

the remaining have some way or other have faced discrimination from home. Coming to public place the percentage is high for those who have menstrual hygiene related discrimination.

- Kerala is a society which follows and have a lot of customary practices. There is a high chance of menstrual related discrimination to occur. Among those respondents who believe customary practice have an influence on menstrual related discrimination, majority of the students aren't okay with the role customary practice have on menstruation.

## **Suggestions**

1. Students should be using eco-friendly menstrual products.
2. There is need of giving the respondents a proper awareness about eco-friendly products
3. Most scientifically proven and hygienic way of destroying the pads by burning and converting it in ash in Sanitary napkin incinerator should be encouraged.
4. Menstrual products should be made available in campuses in a more effective and convenient manner
5. Campuses should be the places of change. Campuses should initiate, encourage, implement the use of eco-friendly menstrual products among students.
6. Sanitation facilities in campuses have to be improved to meet the needs of the students.
7. Students should be granted leave and should be given attendance on days which they take off from college due to severe period pain.
8. Pain killer pills should only be taken with the prescription of doctor.

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# **APPENDIX**

Changing menstrual habits among college students in Kerala with special reference to Trivandrum. This is a general survey conducted among arts college students in Thiruvananthapuram as per the project requirement of a sociology student. This gathers information on changing menstruation habits and related hygienic practices. so kindly fill in the necessary details.

(\* Required)

1) Age of student \*

\_\_\_\_\_

2) Course and college \*

\_\_\_\_\_

3) Class and year in which respondent is studying \*

\_\_\_\_\_

4) Religion of respondent \*

\_\_\_\_\_

5) Caste of respondent \*

\_\_\_\_\_

6) Locality in which respondent is residing \*

(Mark only one oval)

Urban

Rural

7) Marital status of respondent \*

Married

Unmarried

Widowed

Divorce

8) Monthly income of parent / spouse \*

9) Among the below mentioned menstrual products, which ones does the respondent use \*

Check all that apply.

Sanitary napkin  
menstrual cup  
Reusable menstrual cloth pad  
Menstrual disk  
Bamboo fibre pad  
Banana fibre pad  
Reusable tampon  
Water hyacinth pad  
Others

10) Which is most preferred menstrual product by the respondent? \*

Check all that apply.

Sanitary napkin  
menstrual cup  
Reusable menstrual cloth pad  
Tampon  
Menstrual disk  
Bamboo fibre pad  
Banana fibre pad  
Reusable tampon  
Water hyacinth pad  
Other

11) Reason for choosing your preferred product?

Check all that apply.

Comfort  
Affordability  
Eco-friendly

Free from allergies and rashes

All of the above

Other

12) Is the respondent satisfied with the menstrual product the respondent currently uses?

Mark only one oval.

Yes

No

13) Has the respondent used eco-friendly menstrual products? \*

Mark only one oval.

Yes

No

14) if yes, was the respondent satisfied using eco-friendly menstrual products?

Mark only one oval.

Yes

No

15) How did the respondent come to know about eco-friendly menstrual products? \*

Check all that apply.

Friends

Family

Awareness classes

Medical health professional

Other

16) Does the respondent find it difficult to afford eco-friendly menstrual products?

Mark only one oval.

Yes

No

17) Does the respondent find it difficult to get eco friendly menstrual products from nearby/

reachable stores? \*

Mark only one oval.

Yes

No

18) Will the respondent be recommending eco-friendly products to more people?

Mark only one oval.

Yes

No

May be

19) Has the respondent heard about menstrual cup? \*

Mark only one oval.

Yes

No

20) Is the respondent afraid to use menstrual cup? \*

Mark only one oval.

Yes

No

21) If yes, why? (Just mention reason)

22) Does the respondent have severe stomach cramps during menstruation? \*

Mark only one oval.

Yes

No

23) Is the respondent taking pills to reduce menstrual pain? \*

Mark only one oval.

Always

Sometimes

Never

24) If yes, is it with the consultation of a doctor?

Mark only one oval.

Without consultation

With consultation

25) Which all of the below mentioned symptoms does the respondent face during menstruation?

\*

Check all that apply.

Vomiting

dizziness

backache

Leg pain

Shivering

Acne

Itchiness

Depression

Bloating

Anxiety

Insomnia

Diarrhoea

Constipation

Mood swings

Others

26) Does the respondent take leave from college during menstruation? \*

Mark only one oval.

Always

Sometimes

Never

27) Is the respondent's period regular or irregular? \*

Mark only one oval.

Regular

Irregular

28) Which ones of the below mentioned menstruation related health issues does the respondent face? \*

Check all that apply.

PCOD

PCOS

Anaemia

Others

Don't have any

29) Has the respondent ever had any allergies by using menstrual products? \*

Mark only one oval.

Yes

No

30) If yes, mention the product which had caused the allergy?

31) Rate the availability of clean water at home \*

Mark only one oval.

Very good

Good

Satisfactory

Bad

Very bad

32) Does the respondent have proper menstrual waste disposal facility available at Home? \*

Mark only one oval.

Yes

No

33) How does the respondent dispose menstrual pads? \*

Check all that apply.

By burning

By giving out to waste management facility like kudumbashree

By dumping in public spaces

Dumping it to water bodies

By biomedical incineration

Others

34) What are the difficulties the respondent face during menstrual waste disposal? specify \*

35) Are menstrual products readily available at your campus in a convenient manner? \*

Mark only one oval.

Yes

No

36) Does the respondent campus have proper menstrual waste disposal facility? \*

Mark only one oval.

Yes

No

37) Is the respondent satisfied with the sanitation facility available at their campus? \*

Mark only one oval.

Yes

No

Somewhat satisfied

38) Does cultural acceptance play a role in the respondent preference and choice of selecting menstrual products? \*

Mark only one oval.

Yes

No

39) Does the respondent face any of the below mentioned menstrual hygiene related discrimination(s) from your home? \*

Check all that apply.

Not being allowed to enter the kitchen

not being allowed to enter the prayer room

not being allowed to water plants, not being allowed to pluck leaves from a plant

not being allowed to lie in bed

not being allowed to pluck leaves from a plant

No, I haven't faced any of the above-mentioned menstrual hygiene related discrimination

40) Has the respondent ever faced any menstruation related discrimination(s) in public spaces? \*

Mark only one oval.

Yes

No

41) Does the respondent think customary practices play a major role in menstruation related discrimination the respondent face? \*

Mark only one oval.

Yes

No

42) If yes, is the respondent okay with the influence of customary practices over menstruation?

Mark only one oval.

Yes

No

THANK YOU

**A SOCIOLOGICAL ANALYSIS OF THE PROBLEMS FACED BY THOZHILURAPPU WOMEN  
WORKERS INVOLVED IN MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT  
GUARANTEE SCHEME WITH SPECIAL REFERENCE TO THE VYPIN ISLAND**



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ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM  
MARCH 2022**



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GUARANTEE SCHEME WITH SPECIAL REFERENCE TO THE VYPIN ISLAND**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of Master of Arts in Sociology*

**By**

**ARSHYA SOMAN**

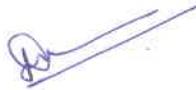
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## CERTIFICATE

I certify that the thesis entitled “A SOCIOLOGICAL ANALYSIS OF THE PROBLEMS FACED BY THOZHILURAPPU WOMEN WORKERS INVOLVED IN MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE SCHEME WITH SPECIAL REFERENCE TO THE VYPIN ISLAND ” is a record of bonafide research work carried out by ARSHYA SOMAN, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology

Dy. Dora Dominic



Name and Signature of the Staff Supervisor

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Ernakulam

March 2022

## DECLARATION

I, **Arshya Soman** hereby declare that the thesis entitled “**A SOCIOLOGICAL ANALYSIS OF THE PROBLEMS FACED BY THOZHILURAPPU WOMEN WORKERS INVOLVED IN MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE SCHEME WITH SPECIAL REFERENCE TO THE VYPIN ISLAND**” is a bonafide record of independent research work carried out by me under the supervision and guidance of **Dr. Dora Dominic**. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



ARSHYA SOMAN

## ACKNOWLEDGEMENT

In this humble endeavor I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Vinitha CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Dr. Dora Dominic for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

March 2022



Arshya Soman

# CONTENTS

CHAPTER	PAGE
1. INTRODUCTION.....	1-17
2. REVIEW OF LITERATURE.....	18-24
3. METHODOLOGY.....	25-32
4. DATA ANALYSIS AND INTERPRETATION.....	33-94
5. FINDING, SUGGESTIONS AND CONCLUSION.....	95-103

BIBLIOGRAPHY

APPENDIX

## LIST OF FIGURES

<b>FIGURE NO:</b>	<b>TITLE</b>	<b>PAGE NO:</b>
4.1	FIGURE SHOWING THE AGE OF RESPONDENTS	35
4.2	FIGURE SHOWING THE EDUCATIONAL QULIFICATION OF RESPONDENTS	36
4.3	FIGURE SHOWING THE RELIGION OF RESPONDENTS	37
4.4	FIGURE SHOWING THE CAST CATEGORY OF RESPONDENTS	38
4.5	FIGURE SHOWING THE TYPE OF RATION CARD OF RESPONDENTS	40
4.6	FIGURE SHOWING THE MARITAL STATUS OF RESPONDENTS	41
4.7	FIGURE SHOWING THE NUMBER OF FAMILY MEMBERS	42
4.8	FIGURE SHOWING THE NUMBER OF EARNING FAMILY MEMBERS OF RESPONDENTS	44
4.9	FIGURE SHOWING INCOME OF HUSBAND OR OTHER FAMILY MEMBERS OF RESPONDENTS	45
4.10	FIGURE SHOWING THE MODE OF RESIDENCE OF RESPONDENTS	46
4.11	FIGURE SHOWING THE WORK EXPERIENCE OF RESPONDENTS IN THOZHILLURAPPU PADHATHI	49

4.12	FIGURE SHOWING, FROM RECONDENTS HOW MANY MATE (LEADER) ARE IN THOZHILURAPPU PADHATHI.	50
4.13	FIGURE SHOWING THE WORK PRESSURE EXPERIENCED BY RESPONDENTS	52
4.14	FIGURE SHOWING THE FACILITY TO REST	54
4.15	FIGURE SHOWING THE SATISFACTION OF RESPONDENT ON FIRST AID MEASURES OF THOZHILLURAPPU PADHATHI.	58
4.16	FIGURE SHOWING THE SANITATION FACILITIES IN THE WORKPLACE	59
4.17	FIGURE SHOWING THE SATISFACTION OF RESPONDENTS IN GETTING HELP AND FACILITY FROM GRAMA PANCHAYAT	60
4.18	FIGURE SHOWING THE NUMBER OF RESPONDENTS PAYING RENT FOR THE TOOL AND EQUIPMENT	61
4.19	FIGURE SHOWING THE NUMBER OF RESPONDENTS COMPLETED 100 DAYS OF WORK OF THOZHILURAPPU	64
4.20	FIGURE SHOWING THE NUMBER OF RESPONDENTS FACE HOSTILITY WITH OWNER OF PLOT	71
4.21	THE FIGURE SHOWING THE FAMILY SUPPORT FOR GOING TO WORK	76
4.22	THE FIGURE SHOWING ,HOW MANY RESPONDENTS GET EMPLOYMENT BONUS FROM GOVERNMENT	78
4.23	THE FIGURE SHOWING THE PENSION FROM GOVERNMENT	79
4.24	THE FIGURE SHOWING , HOW MANY RESPONDENTS HAVE HARMONIOUS RELATIONSHIP WITH CO-WORKERS	81
4.25	THE FIGURE SHOWING THE ECONOMIC CONDITION OF RESPONDENT DURING LOCK DOWN OF COVID 19 PANDEMIC	86-87

4.26	THE FIGURE SHOWING NATURE OF IMPACT FROM COVID 19 PANDEMIC	92
4.27	THE FIGURE SHOWING SUGGESTION OF RESPONDENTS REGARDING THOZHILURAPPU PADHATHI	93-94

## LIST OF TABLES

<b>TABLE NO:</b>	<b>TITLE</b>	<b>PAGE NO:</b>
4.1	TABLE SHOWING THE INCOME OF RESPONDENTS (PER DAY)	39
4.2	TABLE SHOWING THE TYPE OF FAMILY	43
4.3	TABLE SHOWING THE NATURE OF WORK AMONG RESPONDENTS	47
4.4	TABLE SHOWING THE TYPE OF THOZHILURAPPU WORK DONE BY RESPONDENTS	48
4.5	TABLE SHOWING THE WORK DURATION OF RESPONDENTS IN A DAY	51
4.6	TABLE SHOWING THE REST INTERVALS	53
4.7	TABLE SHOWING THE TIME INTERVEL FOR HAVING FOOD	55
4.8	TABLE SHOWING THE NUMBER OF RESPONDENTS VACCINATED FOR TT VACCINE	56
4.9	TABLE SHOWING THE NUMBER OF RESPONDENTS GETTING DOXYCYCLINE TABLET	57

4.10	TABLE SHOWING THE NUMBER OF RESPONDENTS DOING OTHER EMPLOYMENT ALONG WITH THOZHILURAPPU PADHATHI WORK	62
4.11	TABLE SHOWING THE NATURE OF OTHER EMPLOYMENTS	63
4.12	TABLE SHOWING THE LIFESTYLE DISEASES OF RESPONDENTS	65
4.13	TABLE SHOWING THE NATURE OF LIFESTYLE DISEASE AMONG RESPONDENTS	66
4.14	TABLE SHOWING THE HEALTH PROBLEMS AS A RESULT OF THOZHILURAPU PADHATHI WORK	67
4.15	TABLE SHOWING THE TYPE OF HEALTH PROBLAMS AS A RESULT OF THOZHILURAPPU PADHATHI WORK	68
4.16	TABLE SHOWING THE ACCIDENTS WHILE WORKING IN THOZHILURAPPU PADHATHI WORK	69
4.17	TABLE SHOWING THE TYPE OF ACCIDENTS FACED BY RESPONDENTS WHILE WORKING IN WORKPLACE	70
4.18	TABLE SHOWING THE ANTISOCIAL BEHAVIOR WHILE WORKING IN THE THOZHILURAPPU PADHATHI WORK	72
4.19	TABLE SHOWING THE NATURE OF ANTISOCIAL BEHAVIOR FACED BY RESPONDENTS	73
4.20	TABLE SHOWING THE JOB PREFERENCE AMONG RESPONDENTS	74
4.21	TABLE SHOWING THE SATISFACTION OF RESPONDENTS ON JOB AND WORKPLACE	75
4.22	TABLE SHOWING THE CAPACITY OF RESPONDENTS TO MANAGE HOUSEHOLD AND EMPLOYMENT ACTIVITY	77
4.23	TABLE SHOWING THE SATISFACTION OF RESPONDENTS ON INCOME	80

4.24	TABLE SHOWING THE EXPECTATION OF RESPONDENS TO INCREASE THE NUMBER OF EMPLOYMENT DAYS	82
4.25	TABLE SHOWING THE NUMBER OF RESPONDENTS RECEIVED COVID 19 VACCINATION	83
4.26	TABLE SHOWING THE NUMBER OF RESPONDENTS BECOME COVID 19 POSITIVE(AFFECTED)	84
4.27	TABLE SHOWING THE POST COVID 19 HEALTH ISSUE AMONG RESPONDENTS	85
4.28	TABLE SHOWING THE NUMBER OF RESPONDENTS GET GOVERNMENT FREE FOOD KIT	87
4.29	TABLE SHOWING THE NUMBER OF RESPONDENTS PRACTICE SOCIAL DISTANCING	88
4.30	TABLE SHOWING THE NUMBER OF RESPONDENTS GET COVID19 PROTECTIVE EQUIPMENT	89
4.31	TABLE SHOWING THE TYPE OF PROTECTIVE EQUIPMENT USED BY RESPONDENTS	90
4.32	TABLE SHOWING THE NUMBER OF RESPONDENT FACED COVID 19 PANDEMIC IMPACT IN THEIR LIFE	91

**CHAPTER - I**  
**INTRODUCTION**

# **CHAPTER- I**

## **INTRODUCTION**

The Mahatma Gandhi National Rural Employment Guarantee Act has aimed to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. The significance of MGNREGA is that it is bottom –up, people centered, demand driven, self-selecting and rights based. Moreover, it provides a legal guarantee for wage employment by providing allowances and compensation both in case of failure to provide work on demand and delays in payment of wages for work undertaken. In MGNREGA plans and decisions regarding the nature and choice of works to be made, the order in which each worksite selection etc. are all to be made in open assemblies of the Gram Sabha and ratified by Grama Panchayat.

### **Mahatma Gandhi National Rural Employment Guarantee ACT**

Mahatma Gandhi National Rural Employment Guarantee Act was implement to strengthen the commitment towards livelihood security in rural area. The Act was pass on 7<sup>th</sup> September 2005, the significance of Mahatma Gandhi National Rural Employment Guarantee Act is to provide wage employment program and make Government legally accountable for providing employment to those people seeking for job. In this way, the legislation goes beyond providing social safety by guaranteeing the right to employment.

Mahatma Gandhi National Rural Employment Guarantee Act aim to increase the livelihood security of the people in rural area by guaranteeing hundred days of wages employment in a financial year, to a rural household whose members volunteer to do manual unskilled work .The objective of the Act is to strengthen the livelihood resource of the rural poor .

The choice of works suggested in the Act portrayed the cause of chronic poverty like drought , deforestation , soil erosion , so that the process of employment generation is on a sustainable basis works suggested in the Act addresses cause of chronic poverty like drought , deforestation and soil erosion , so that the process of employment generation is maintained on a sustainable basis .

The government implemented an antipoverty program that promises 100 days of employment every year to the rural poor. The MGNREGA extends to all rural area of India, including fifth and sixth schedule area, except the state of Jammu and Kashmir .The Mahatma Gandhi National Rural Employment Guarantee Act ensure the legal right of poor people, who are willing to work at the stipulated minimum wage rate in the rural area as to work for 100 days. The MGNREGA addresses mainly rural poor and their fundamental right to work with dignity in a financial year.

The MGNREGA has made a paradigm shift from all precedent wage employment programs operating in the country since 1980. The early employment programs were allocation based, whereas MGNREGA is demand driven. The Act is implement to provide employment within 15 days of application received from citizen. As per data, provided by MGNREGA website 4,048 crore households were employee during the financial year 2014-2015. .In states like Kerala and Karnataka there were strong demands from the workers for increasing the workdays to 200 days per household. The Mahatma Gandhi National Rural Employment Guarantee Act helped a rural population to attain a sustainable base job.

## **History of Mahatma Gandhi National Rural Employment Guarantee Act**

The Indian Parliament passed the National Rural Employment Guarantee Act on 23<sup>rd</sup> August 2005. The Act was first propose in 1991 by P.V . Narasimha Rao .It was finally accept in the parliament and commenced implementation in various districts of India. The National Rural Employment Guarantee Act 2005 (NREGA ) later renamed as the Mahatma Gandhi National Rural Employment Guarantee Act or MGNREGA in 2009 .The Indian labor law and social security measure that aims to guarantee the right to work . This act was pass in 23 August 2005 under the UPA government of Prime Minister Manmohan Singh by following tabling of the bill in parliament by the Minister for Rural development Raghuvansh Prasad Singh.

On 7 September 2005, the Mahatma Gandhi National Rural Employment Guarantee Act was notify through the Gazette of India's notification. This act came into force on 2 February 2006. Initially this act focused mainly on 200 backward district.

The Mahatma Gandhi National Rural Employment Guarantee Act has aimed to enhance livelihood security in rural area by providing at least 100 days of wage employment in a financial year, as to uplift every household whose members volunteer to do unskilled manual work

The National Rural Employment Guarantee Act 2005 was amend on 2<sup>nd</sup> October 2009, to change the nomenclature of the Act from NREGA to MGNREGA. The section 1(1) was amend and it was rename as the Mahatma Gandhi National Rural Employment Guarantee act.

The Mahatma Gandhi National Rural Employment Guarantee Act implemented in all rural districts of the country . This act implemented in 200 backward district in the first phase from February 2006 and extended subsequently , to additional From April 1<sup>st</sup> 2007 and May 15<sup>th</sup> 2007 this act has implemented in 113 and 17 districts .The remaining district were become part of this Act with effect from April 1<sup>st</sup> 2008 . Currently, the Act is implement in 644 districts of the country, especially in the rural population.

The central Government may delegate the power to the state Government can delegate the powers to subordinates. The implementation of MGNREGA has made a paradigm shift .The MGNREGA Is demand driven wage employment program and resource transfer from central to state based on the demand for employment in each state.

The MGNREGA is a bottom –up, people centered, demand driven, self-selecting and rights based scheme. It help to strengthening the livelihood resource base of the poor and proactively ensuring Social inclusion. The MGNREGA help in protecting the environment, empowering rural women, reduce rural urban migration and ensure social equality. The ACT was introduced as a social measure that guarantees “the right to work” .The MGNREGA provides a legal guarantee for wage employment by providing allowances and compensation both in case of failure to provide work on demand and delays in payment of wages for work undertaken. In MGNREGA plans and decisions regarding the nature and choice of works to be made, the order in which each worksite selection etc. are all to be made in open assemblies of the Gram Sabha and ratified by GP.

The new feature of MGNREGA is social audit is a new feature, which creates accountability of performance, especially towards immediate stakeholders. The MGNREGA also marks a break from the relief program of the past towards an integrated natural resource management and livelihood generation perspective. The Grama panchayat is responsible for the activity of Mahatma Gandhi National Rural Employment Act. The MGNREGA has helped many rural poor people to lead an independent life especially it helped rural women.

### **The function of MGNREGA**

MGNREGA guarantees hundred days of wage employment in a financial year, to rural households whose adult members volunteer to do unskilled manual work to earn money for meeting their basic needs. Through the MGNREGA individual get benefit, thus beneficiary oriented work are taken up on the card of scheduled caste and schedule tribes, small or marginal farmers or beneficiaries of land reforms or beneficiaries under the Indira Awas yojana of the Government of India.

The *thozhilurappu* workers has a prominent role in society ,within 15 days of submitting the application or from the day work is demanded , wage employment will be provided to the applicant .At the same time right get unemployment allowance in case employment is not provided within fifteen days of submitting the application or from the date when work is sought . *Thozhilurappu* workers will get a receipt of wage within fifteen days of work. The gram panchayats give a variety of permissible work to them. The main aim of MGNREGA is economic and social empowerment of women

MGNREGA provided a 'Green 'environment and 'decent' work to *thozhilurappu workers*. Social development of MGNREGA works is mandatory, which lends to accountability and transparency. MGNREGA works climate change issues and they are working for conserve natural resources.

The gram Sabha is the principal forum for wage seekers to raise their voice and make demands. It is the Gram Sabha and the Gram panchayat, which approves the work under MGNREGA and fix their priority.

## **Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)**

NREGA transform the wage employment programme into a right –based scheme, where people can demand work. It was a help the rural poor access public employment through legislation. The NREGA was enact in 2005, and the scheme has subsequently named ‘Mahatma Gandhi National Rural Employment Guarantee scheme (MGNREGS)’. The MGNREGS is a scheme, which is based on the MGNREGA (Act).

The MGNREGS has implemented through three phases, starting with the 200 most backward districts in 2006 , another set of 130 districts were covered during 2007-2008, and the whole nation was covered in the third phase which is in 1<sup>st</sup> April 2008 . Mahatma Gandhi National Rural Employment Guarantee scheme (MGNREGS) added to the strengthening of ADS. ADS representatives are commonly become ‘Mate’ and at the same time many other members who are not as ADS are also becoming Mate for scheme implementation. In MGNREGS, about two lakhs of women has trained to work as ‘Mate’. This started emerging as a cadre developing knowledge on identification and estimation of works, and in work supervision .MGNREGS and its link with collective farming lead to the rejuvenation of the entire structure , and it benefited ADS the most.

When MGNREGS was implement at Kerala in 2005-2006, kudumbashree emerged as a major organization in the implementation process within the panchayat Raj framework .At the time of introduction of MGNREGS, there was skepticism on its feasibility given the relatively higher level of wages existed in the state. The Census of 2011 indicate that work participation ratio among women in Kerala was 18.23%. The state overcome the lukewarm response to MGNREGS and the scepticism that dominated the public opinion by Kudumbashree taking the lead and mobilizing women through the community network to take up work. The Concept of women’s labor groups, and the kudumbashree NHGs transforming into labor collectives give a much –needed impetus to the program.

The entire community structure of Kudumbashree had role in planning and implementation of MGREGS .The Sarada Muraleedharan said, “Taking an active role in MGNREGS and linking it with our collective farming programme, an advantage for us was that it made the three tier system active like never before; the Neighbourhood Group, ADS, CDS, all become active in the

programme". Among the MGNREGS workers in Kerala, 94% are women. ADS nominating the mate for MGNREGS as a factor that contributed to the quality of the programme in Kerala.

The District collector is the District Programme Co-ordination of Mahatma Gandhi National Rural Employment Guarantee Scheme in the district. Block programme officers co-ordinates and supervises the activities in the Grama panchayats. Grama Panchayats are the basic units for implementing the Mahatma Gandhi National Rural Employment scheme and the secretaries act as Registration officers of Mahatma Gandhi National Rural Employment Guarantee Scheme

### ***Thozhilurappu Padhathi***

The Mahatma Gandhi National Rural Employment Guarantee Act was implement in 200 district of the country on 2<sup>nd</sup> February 2006. In Kerala the Wayanad and Palakkad was the only district that included in the first phase of Act. The Second phase of the scheme was implement on 1<sup>st</sup> January 2007, Idukki and Kasaragod were included in the second phase of Act. On 1 April 2008, the scheme was aim to extended to the remaining district.

The Mahatma Gandhi National Rural Employment Guaranteed scheme is denoted as *thozhilurappu padhathi* in Kerala .The major aim of *thozhilurappu padhathi* is to strengthening the livelihood resource base of the poor, protectively ensure social inclusion and it strengthen the panchayat raj institutions. The MGNREGS is under the supervision of Mission Director. The Kerala government always evaluate various project of *thozhilurappu padhathi* as to ensure quality and accountability of scheme. Each workers is required to open a bank /post office /cooperative Bank Account and the wage are create to members account.

In *thozhilurappu padhathi*, each ward has an inspection and monitoring committee to examine the working of the Act. The Grama panchayat secretary is the registration officer under MGNREGS of a panchayat. The Grama Panchayat secretary will get help from Assistant secretary in the implementation of MGNREGA. In addition, the accountant and one section clerk in the Grama panchayat fully deals with the day-to-day affairs of the *thozhilurappu padhathi* in Grama panchayat level.

The Grama panchayat has two village extension officers, who are also supporting the Grama panchayat secretary in the implementation of Mahatma Gandhi National Rural Employment Scheme. In Grama panchayat, the *thozhilurappu padhathi* work is coordinate by accredited engineer, overseer, and accountant cum Data entry operator. The Kerala state is utilizing the service of reputed training institution like SIRD, KILA, ETCs, and IMG etc. for conducting training program in a cascading method.

The Government directed all Gram panchayats to publish the citizen's charter. The charter should clearly spell out the responsibility and duty of the Grama panchayat and the services available to the workers. In *thozhilurappu padhathi* all estimate are to be prepared in the local language so that anybody can understand the provision in the estimate are to be prepared in the local language so that anybody can understand the provision in the estimate . The Government of Kerala notified the Grievance Redressal Rule under Mahatma Gandhi National Rural Employment Guarantee Act. In *thozhilurappu padhathi* helpline number are available of wages. A delay compensation Mechanism is now developed which is under consideration of Government.

### **The role of Grama panchayat in *thozhilurappu padhathi***

The Grama panchayat has major role in MGNREGS as to receive applications for registration, Verifying registration applications, registering household, issuing job cards, receiving application for work, Issuing dated receipt for these applications for work.

They also allot work within fifteen days of submitting the application in Grama panchayat .The authority of Grama panchayat has to conduct periodical surveys to assess demand for work. They also identify and plan work, developing a shelf of projects including determining the order of their priority. Forward the list of works to the program officer for scrutiny and preliminary approval.

The Gram panchayat is responsible for recording as specified in the MGNREGA operational Guidelines, 2013.They also maintain accounts and provide utilization certificates in formats prescribed by central and state governments.

The Authority of Grama panchayat will prepare annually a report containing the data and achievements relating to the implementation of the scheme within its jurisdiction and, copy of the same will provide to the public on demand and on payment of such fee as may be specified in the scheme.

### ***Thozhilurappu women workers***

In 2005, the UPA Government launched the world largest and most comprehensive poverty alleviation program Mahatma Gandhi National Employment Guarantee scheme implemented by the government. The uniqueness of the scheme is that it Guarantees work to those who voluntarily applied to Mahatma Gandhi National Rural Employment Guarantee act, will receive 100 days of employment and wages in annual year, which make 100 days employment a fair right.

The Mahatma Gandhi National Rural Employment Guarantee act is denote as *thozhilurappu padhathi* in Kerala. This Act ensures a small but accurate income to all members engaged in work. This has been an important link in the economic and social empowerment of India and has since been an important link in the economic and social empowerment of Indian villagers, especially women.

The central Government has increased the guaranteed wage by Rupees 20 in Kerala, which means 291Rs per day for *thozhilurappu* workers. The increase will benefit to 15 .65 lakh workers. 89% of them are women. Kerala is a state with the highest representation of women workers.

The *thozhilurappu* women workers has played a vital role in creating ‘a *pachathuruthu*’ of *haritha* Kerala mission in Kerala government. In Vypin Island *thozhilurappu* workers mainly clean the environment by cutting down the unwanted plants in a plot .Then they will plant sampling in the place where they worked. *Thozhilurappu* workers can take the plants from the plot for lease with the permission of owner. At the same time, they will plant sampling for the owner of the plot and that plants can take by owners.

The Kerala state had better performance under the MGNREGS last year .The expenditure had more than double compared to 2010 -2011. Though there were only 72343 families that had

worked for more than 100 days in 2010 -11, their number had risen to 3.5 lakhs last year. In current society 836 lakhs workdays has generated, when compared to 493 lakhs in 2010 -11.

### **Women independency through *thozhilurappu padhathi***

In Vypin island women are getting a wide range of independence by being a part of *thozhilurappu padhathi* .The economic instability of the family can create many problems among each family member. The women members of *thozhilurappu padhathi* get a salary of rs.291 and rs.700 for the leaders of the *thozhilurappu* for their manual work. This salary gives the women independence and freedom.

In Vypin Island women who become the part of *thozhilurappu padhathi* get their own financial decision or being able to sustain herself financially .For a homemaker, it helps to spend money whenever she wants or being able to sustain herself during emergencies. At a basic level, financial independence make women feel more secure and respected irrespective of their socio-economic background. This automatically has a relay effect not just on women but also a more progressive society, which is healthier.

In Vypin Island the *thozhilurappu* women workers gets the financial independence which leads to higher self-respect , better living standard, financial security and less prone to discrimination . These major individual benefits are available to *thozhilurappu* women workers.

The *thozhilurappu* women workers get social benefits since they work for progressive society. In Vypin Island, less gender bias is create with the active participation of women in *thozhilurappu padhathi*. The *thozhilurappu* women workers have a major role in creating a healthier society by doing paid manual work, which gives them a social status in society.

### **The Duty of mate (*thozhilurappu padhathi* leader)**

In *thozhilurappu padhathi* majority of mates are women .The mate is selecte through the mate election .In that mate election the ward member play a prominent role. The ward member is the one who declare the name of members for mate election.

The mate had to verify the name and signature of members engaged in work and about the details of the plot in which they worked .The mate will hand over the register to the authority of Gram panchayat.

The mate is the one who direct and assign the *thozhilurappu padhathi* worker to each member .The mate also has duty to divide the work among members .If there is 45 or above members are presented in work then the mate does not need do work in the field . If there is only 20 or less number of workers then the mate has to do the work along with other *thozhilurappu padhathi* workers.

All the *thozhilurappu padhathi* workers have to obey and respect the mate. Under the supervision of mate, all the members had to write their name and signature in the register at the time of arrival and departure from the working plot. The members get salary based on the participation details filled in the Muster roll. The Muster roll is a wage register and it is filled by Mate .All the *thozhilurappu padhathi* workers had an employment card; each member kept it personally. The mate has to mark the attendance in the employment card of *thozhilurappu padhathi* workers. Mates collect cheques for the payment of wages and credit to the bank accounts of the workers.

The duty of a mate in *thozhilurappu padhathi* is to supervise work sites .The daily attendance and muster roll details are fill by mate. They also facilitate application for job cards .The filled muster roll are submit to the gram panchayat by mate and they facilitate participatory identification of work in the panchayat.

### **Health condition of *thozhilurappu* women workers**

The *thozhilurappu* women workers in Vypin Island are doing a tremendous job .The *thozhilurappu* women are actively working for the clean environment and for the planting of new plant saplings. They are dedicatedly working for sustainable development.

Most of the *thozhilurappu* women members in Vypin Island are middle aged. These middle-aged women are facing various health problems. Knee pain, headache, leg pain, asthma and joint pain are some of the common health problems faced by them. Most of them also suffer from cholesterol, blood pressure, diabetics, kidney stones, thyroid, and fatty liver.

The Thozhilurappu workers are vaccinated with TT vaccine, which will prevent the poisoning of snakebite. Since they usually engage in cleaning of ponds the vaccination is necessary. The *thozhilurappu* workers have taken vaccine with an interval of 2 years.

Doxycycline tablets have been used to prevent rat fever. The tablet helps to prevent bacteria, which can cause malaria. The respondent claims that there is a high chance of having direct contact with contaminated water so it is necessary to have Doxycycline tablets to prevent malaria. Primary health centers and Asha workers provide it for two weeks.

The women engage in *thozhilurappu* work after doing their household works and when they are back home they are forced to do household chores that make them more tired. Some of them also face the crucial condition of menopause. They survive these difficulties by taking a rest with no salary. At the time of menstruation, the lack of bathroom facility is another problem faced by them.

The lack of bathroom facilities is a major problem faced by the workers. Thus, many of the women workers suffer from urinary tract infection. The *thozhilurappu* workers also have the problem of kidney stone due to lack of proper drinking water. The lack of bathroom facility is the major factor that leads them to consume less water.

Covid 19 has also created health issues among *thozhilurappu* women workers. The post covid 19 health illness is hindering their active participation in *thozhilurappu padhathi*. While working they face health issues such as breathing problems and fatigue of hands and feet. They also feel tired while working. Most of them have been affected with Covid 19 (become positive) and they suffer a lot due to the post Covid 19 health issues. Asthma is the major health issue that occurs while working. Many of the workers already have diseases like cholesterol, diabetes and related diseases. Covid 19 virus makes it worse by creating more physical and mental health problems.

### **Working condition of *thozhilurappu* women workers**

The *thozhilurappu* workers play a major role to maintain the sanitation of environment and to maintain *Haritha* Kerala. The *thozhilurappu* workers are facing lots of problems in their working circumstances. Even with the salary of Rs291 they still need to pay rent or buy the tools that are

required for the work . The Gram panchayat is not providing tools and equipment that are required for the work.

The *thozhilurappu* women works are getting adequate rest interval, which help them to relax from stress. They have to get into work by 9: 30 am to 10:30am .At 10:30 am they can have tea and snacks. From 11:00 am to 1 pm they have to engage in work .At 1 pm they can have lunch. By 2:00 pm everyone should come back to the field for work .Then from 2:00pm to 5: 00pm they have to work. At 5:00pm they can go back home.

Under the supervision of mate, every *thozhilurappu* workers had to write their name and signature in the register at the time of arrival and departure from the working plot.

The *thozhilurappu* workers usually carry two plastic sheet as to make a temporary shelter. During the rest interval, they can take rest under this shelter. In the rainy season, they face high problems to settle in a small shelter with 45 or above members. The toilet facilities available to *thozhilurappu* women workers are mainly from the neighborhood house.

Any problems that arise among *thozhilurappu* workers has to be solved and rectified by the mate (leader of *thozhilurappu* members).If the mate is not able to solve that problem then it will be informed to Gram panchayat authorities.

The major work in *thozhilurappu padhathi* are the water conservation and water harvesting, drought proofing include afforestation and tree plantation, irrigation canals, land development. They also work for renovation of traditional waterbody including desilting of tank and provision of irrigation facility to land owned by household belonging to the schedule Castes and Schedule tribes or to land of beneficiaries of land reform or that of the beneficiaries of Indira Awas Yojana Programme.

The *thozhilurappu* workers has the duty to cut down the unwanted plants and grass in a plot. The land tax paid receipt from the owner of the plot is need for *thozhilurappu* workers to work in that plot. They also plant saplings, which can take by *thozhilurappu* workers, as if the workers take that plot for lease .The *thozhilurappu* women worker are getting family support to engage into work .The financial problem is major reason for the members to engage in *thozhilurappu padhathi*.

## **Salary of *thozhilurappu padhathi* workers**

In Kerala, the central Government has increased the guaranteed wage by Rs 20, so Rs 291 per day for *thozhilurappu* workers. The increase will benefit to 15 .65 lakh workers. 89% of them are women. Kerala is a state with the highest representation of women workers. In the current financial year Kerala was allotted seven crore working days but it created 7.82 crore working days. The additional day pay will also be available from the central government. In the next financial year 8 crore working days have been allotted. Kerala ranks third in the country for guaranteed wages. The highest is Haryana (RS309) and Sikkim ((RS308)

The *thozhilurappu* women workers get a salary of 291 for mate and subordinate *thozhilurappu* women workers .The mate with SSLC certificate will get 700 rupees. Some respondents claim that there is a chance to increase the salary of a mate (leader) from 291 to 700. Moreover, they also said that this provision would be applicable only to the mate (leader) who has an SSLC pass. However, many of the workers in this field do not have SSLC certificates so they are facing economic problems due to less work in this modern world. The daily life needs are not satisfied with less amount of *thozhilurappu*.

The government has declared to introduce a pension for *thozhilurappu* workers registered under Mahatma Gandhi National Employment Guarantee scheme and having worked under the MGNREG scheme for at least 100 days a year. The minister for rural development and culture K.C Joseph told the media that the pension scheme would be implement with contribution from state and central government. This is the first pension scheme to be launch for Mahatma Gandhi National Employment Guarantee scheme workers on the country, he added

This pension was announce only for *thozhilurappu* workers with age of 60, but that declaration did not come into action. Still *thozhilurappu* women workers with age more than 60 years old are not getting pension.

The Kerala state government had provided a bonus of Rs 1000 to *thozhilurappu* workers for education of their children. This bonus is provide only to the *thozhilurappu padhathi* workers who completed 100 days of work within a year.

This year the government claims that the amount can be contributed for the pension scheme. Besides, Rs1000 per work from the Swalamban scheme of the central government would be deposited as the center's contribution to the pension scheme. The contribution of the workers would be decided later in consultation with their Authority in Gram panchayat .

Mr. Joseph said that the minimum age to enter into the scheme is 18 years the maximum age for joining in Scheme would be 50 years. The pension would be provided to the workers on their attaining 60 years of age in proportion to the contribution on their credit.

The *thozhilurappu* workers who had worked for 100 days during 2012 -13, had given 'Onakodi' coated Rs.400 per piece. The majority of workers under the MGNREGS were women and there were 340 families eligible for the Onam gift. The Government had allocated Rs 13.61 crore for 'Onakodi' as announced in the Budget for the current year.

In a year *thozhilurappu* workers have to complete 100 days of work .If they complete a muster roll in a week then they will get a salary for that muster roll of work. They don't have paid leave thus salaries are only for those who have gone to work .SC members of *thozhilurappu padhathi* will get salary after the sanction of SC fund . This fund will be sanctioned within five days from the date of Muster roll. The muster roll refers to the list of workers working on *thozhilurappu padhathi* for attendance management.

The *thozhilurappu* workers do not have bonus, insurance, or compensation. The one year of *thozhilurappu* starts in May and the *thozhilurappu* workers have to complete the 100 days of work in March .Thus they will get 1000 rupees as bonus only for the workers who had completed 100 days of work within a year.

*thozhilurappu padhathi* is a part of government scheme .In the initial period the *thozhilurappu* workers have to pay rent for hoe tool with price of 10 Rs and spade tool has price of 8Rs to Gram panchayat .The current authority of panchayat is not providing tools and equipment's . So *thozhilurappu* workers have to bring tools and equipment from their home, but at the same time some members were paying rent for tool and equipment especially for measuring tape'. . The *thozhilurappu padhathi* women workers desire for getting increased salary.

## **Covid 19 pandemic and Mahatma Gandhi National Rural Employment Guarantee Act**

In India, the Covid 19 pandemic is not an epidemic that is spreading day by day, but also the biggest socio – economic crisis that independent India has ever seen. At the same time, not only the public health system paralyzed across the country, but also the complete lockdown announced led to mass exodus of millions of workers to the villages and the deaths of many by the wayside due to starvation and thirst.

The Mahatma Gandhi National Rural Employment Guarantee scheme was an important factor that served as the livelihood of Indian villagers who are willing to work when all other sources of incomes are closed. Therefore in 2020, 10.32 crore people benefited from the Mahatma Gandhi National Rural Employment Guarantee scheme. In 2019 it was 7.89 crore. This means the number of beneficiaries of the employment Guarantee Act has increased by 30.79 percent in a single year. It paints a grim picture of unemployment and lack of income in rural India .The Mahatma Gandhi Employment Guarantee scheme saved millions of rural families from starvation during the epidemic .Naturally, in this union budget, it was necessary to have more funds for the Mahatma Gandhi National Rural Employment Guarantee Act to stimulate the economically vulnerable rural sector. Unfortunately the central government has estimated in this budget only about 38500 crore, which is less than last year.

On 26<sup>th</sup> March 2020, the financial minister Nirmala Sitharaman announced that the workers under the MGNREGS would get a hike of Rupees 2000 each on an average. It was also announced that three crore senior citizens , persons with disabilities and widows will get a onetime additional amount of Rupees 1,000 in two installments which will be provided through DBT (Direct Benefit Transfer ) over three months . This announcement has made an initiative towards the loss caused by the Covid 19 pandemic. The lockdown has expected to cost the Indian Economy a cost of around nine lakh crores. Funds worth Rupees 31,000 crore are provide to augment medical testing, screening and providing better healthcare facilities to those who have been affected financially due to the Covid 19 pandemic.

## **Covid 19 impact on *thozhilurappu padhathi* women workers**

The Covid 19 pandemic did not hinder the work of *thozhilurappu padhathi* workers, though they work by keeping social distancing, still some members affected by Covid 19 pandemic (become Covid 19 positive) and they has quarantined. The quarantine includes Covid positive patients, quarantine for primary contact people, and quarantine of secondary contact members with Covid 19 patients. Many of the workers were unable to get a salary in those quarantine days. The quarantine had affected the psychological, economic and social condition of people. Still quarantine was a major solution from the spread of deadly virus coronavirus.

The covid 19 has created financial problem to *thozhilurappu padhathi* women workers .The salary 291Rs was not sufficient to meet the daily life needs .So the *thozhilurappu padhathi* women members has requested to authority as to increase the total number of working days to 150 rather than 100 days of work .

Covid 19 has also created post Covid 19 health issues among *thozhilurappu padhathi* women works .While working they face breathing problems and fatigue of hands and feet .They also feel tired of going to work and also while working .Many of the works already has disease like cholesterol ,diabetics and aligned disease. Therefore, along with this disease Covid 19 virus has created physical and mental health problems.

The COVID 19 pandemic had created society more rigid and strict by regulation based on the Kerala epidemic diseases, COVID 19 regulations. In exercise of the power conferred by sections 2, 3 and 4 of the Epidemic Diseases ACT, 1897 (Central Act 3 of 1897). The lockdown, quarantine and post Covid 19 health issue are the major problem faced by *thozhilurappu padhathi* women workers during the Covid 19 pandemic period.

## **SIGNIFICANCE OF THE STUDY**

The Mahatma Gandhi National Rural Employment Guarantee scheme has aimed to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year, as to uplift every household whose members volunteer to do work. The study seeks to present detail of the problems faced by *thozhilurappu padhathi* women workers involved in Mahatma Gandhi National Rural Employment Guarantee scheme with special reference to the Vypin Island.

The Vypin Island is a rural area and the Gram panchayat plays a prominent role in administration .The Grama panchayat has initiated many projects for the upliftment of society. The Mahatma Gandhi National Rural Employment Guaranteed scheme is denote as *thozhilurappu padhathi* in Kerala .The study is providing information about the impact of Covid 19 pandemic in the life of *thozhilurappu* women workers. The economic condition and the post Covid 19 health issues also focused in this study. This study finds the satisfaction of respondents on facilities that are available for them. This study also finds health issues such life lifestyle diseases and health problems.

**CHAPTER - II**

**REVIEW OF LITERATURE**

## **CHAPTER - II**

### **REVIEW OF LITERATURE**

The review of literature is one of the important aspects in any research work. It is a measure for starting the recent output on a particular area of research and organized in a helpful sequence to strengthen the present research techniques. The main objective of the review of literature is to understand the research activities that have taken place in a particular discipline in general and in the area of research in particular. In this study, the review of literature help to find out the research gaps related to the topic. The researcher search literature published in different E -book, E-journals, web sources has used in this study .It is clear that many of these studies were focus on the functioning of MNREGA, critical evaluation of the scheme, controversies of the scheme, progress of the scheme, progress of the scheme in different states, etc.

K. B. Saxena (2015) claim that The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) is a major program of the Ministry of Rural Development (MORD) implemented since February 2006. She analyzed that for addressing chronic poverty, wage employment must be expand besides natural resource management for sustainable development. This is the largest rights based social protection. She also said that this report is most important assessment of the implementation of MGNREGS. It helps to bring out the ideal and promising aspects along with weaknesses. These reports help to improve planning and conduction of the program. This information helps researchers and activists for implementing it.

Cynthia Bantilan, Madhusudan Bhattarai, P. K Vishwanathan, Rudra N. Mishra (2018), they proposed that The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) helps to give conclusion of the performance and impact . They concluded that the book gives the deeper analysis of the program and its impact.

Priti Darooka (2016), she made it clear that social security provide whole security for a person within the family, workplace and society. The right to social security is very essential for realization of all human rights. This helps to bring attention to the issues faced by specific vulnerable groups, such as female domestic workers, sex workers etc.

Annita Ranjan (2020) suggested that The Mahatma Gandhi National Rural Employment Act (MGNREGA) has been implemented, established landmarks, attained criticism in all these years. She concluded that we should present different aspects of the act and provide a common knowledge about the significance and credibility of this scheme.

Madhusudan Bhattarai, R.Sakthivaidivel, Intizar Hussain (2001), their study explains the policy issues related to the impact on crop production, farm income poverty alleviation etc. It also focused on poverty issues in irrigation.

Jean Dreze and Amartya Sen (2002), they studied the role of public action in expanding human freedoms in India. They also clarified that the analysis is based on broad view of development, which focus on wellbeing.

Reetika Khera (2011) in her book she had explained that The National Rural Employment Guarantee Act (NREGA) is a unique aspect in the history of social security. She also suggested that it is not just an employment scheme, it is also a potential tool of economic and social changes in rural areas. This deals with wide range of issues such as entitlements, corruption, people's perception of NREGA, women's empowerment etc. These are based on the field studies of NREGA by the qualified researchers who have been actively involved in the campaign.

Klaus Deininger and Yanyan Liu (2013), tells that the impact of NREGS and the pathway through which its impacts are identified thus has important policy implications. They used a three round, 4000- household panel from Andhra Pradesh. It was record that the participants increased consumption (protein and energy intake) in the short run and accumulate more nonfinancial assets in the medium term. It has noted that direct benefits exceed program –related transfers and are mostly consider scheduled caste, tribes, and households supplying casual labor.

Sudha Narayanan and Upasak Das (2016), attempt to explore the consequence of poor implementation in public workfare programs, focusing on the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India. It also came to notice that using nationally representative data, we test empirically for a discouraged worker effect arising from two

mechanics. They concluded that, the relevance of public programs over their lifecycle need to factor in implementation quality.

Sheahan, Megan, Liu, Yanyan, Barrett, Christopher B, Narayana, and Sudha (2014), proposed that it is important to first study trends in the allocation of funds, particularly as they relate to the susceptibility of the program to political clientelism rather than government spending on poor community asset creation and income transfers could have compounding positive effects on poverty reduction. They also explained the fact by focusing on one state where accountability and transparency mechanisms have been applauded, even though the authors do not find evidences.

Arun Jacob and Richard Varghese (2006) made a case study to know of how the government's employment guarantee scheme is being implemented in one Kerala district reveals the vital role played by local bodies. While implementation has been largely fair and corruption – free, the scheme needs to be more efficiently. It has effectively use, to meet the long-term requirements of the state and its people.

Krishnamurthy (2006) confirmed that the National Employment Guarantee Act and related program from the perspective of responding to sudden (and rapid) beginning of events like economic crises and natural and manmade disasters. It suggests using the NREGA as part of the rapid response to crises and disasters particular attention is focus on the impact of localized disasters/crises, which may be large and need to be disaster management strategies in India.

Lalit Mathur (2007) stated that the National Rural Employment Guarantee Act is into its second year of implementation. It is easy to criticize the Act and its execution. The Employment Guarantee has evidently begun well. There is, of course, great scope for improvement, as indeed, can only be expect in a new program. A system of regular and continuous flow of authoritative information is essential – more than just sporadic reports and studies, as at present, dependent on the initiative of individuals and groups. Government could take up concurrent evaluation (as was done for integrated Rural Development program (IRDP) and Jawahar Rozgar Yojana (JRY) in the mid-1980s), more effective monitoring, time –series studies, and focused reports on critical aspects like minimum wages, muster rolls. Not just by the center, but also by the states: not by the departments of rural development alone, but by others as well-labor, agriculture, forests planning, agriculture,

forests, planning, the CSSO and its network, This is an important time for the NREGA for it is one of learning as well.

Devesh Kapure, et al (2008) discover that continuing the debate on direct cash transfer, the authors of the article “The Case for Direct Cash Transfers to the Poor” (12 April 2008) respond to Mihir Shah’s criticism (23 August 2008) tells that the six points of contestation by Mihir Shah, including those on the public distribution system and the National Rural Employment Guarantee Scheme has refuted. The argument in essence is that seeing the problems with anti-poverty programs as faulty design and limited availability of resources does not recognize the weak capabilities of local government.

Mehrotra (2008) examines the performance of the National Rural Employment Guarantee program since its launch in mid-2005. It gives a summary of progress in certain areas and then highlights specific weaknesses. It also describe the challenges that lie ahead and suggests how these can be overcome.

Reetika Khera (2008) has identified the experience of the jagrut Adivasi Dalit Sangathan in Madhya Pradesh shows the power of grassroots organizational work in activating the National Rural Employment Guarantee Act. Levels of NREGA employment in the Sangathan areas are as high as 85 days per household per year, and nearly half of all working households has got 100 days of work. They also earn the minimum wage. The Act can also be an opportunity to promote overall rural development and alter the balance of power in village society.

Siddhartha and Vanaik (2008) studied that the draft report of the Comptroller and Auditor General on the working of the National Rural Employment Guarantee Act has used by many section of the media to strongly criticize this employment program. What did the CAG actually say? Where did the CAG fall short in its investigation? In addition, what can we learn from the CAG to improve the functioning of the NREGA? The paper explained these points.

Vanaik (2008) describe about Tapas Soren, a tribal of Birakhap in Jharkhand, committed self-immolation recently, impoverished by the constant demand for bribes .The local officials for work done under the National Rural Employment Guarantee Act. His death soon after the murder of Lalit Mehta who had exposed corruption in NREGA schemes in Palamu shows how the scheme is being implement in Jharkhand.

Gopal (2009) proposed that about the social audits conducted in Andhra Pradesh under the National Rural Employment Guarantee Act. However, these audits have achieved much less than advertised and they have been ignore. Many important aspects of implementation of NREGA. The social audit process has a long way to go before it can claim to have contributed to transparency, empowerment and good governance.

Khera and Nayak (2009) highlighted the National Rural Employment Guarantee Act in which entitles rural households to 100 days of casual employment on public works at the statutory minimum wage, contains special provisions to ensure full participation of women. This paper, based on fieldwork in six states in 2008, examines the socio-economic consequences of the NREGA for women workers. In spite of the drawbacks in the implementation of the legislation, significant benefits have already started accruing to women through better access to local employment, at minimum wages, with relatively decent and safe work condition. The paper also discusses barriers to women's participation.

Ambasta (2009) in his article stated that a humongous programme like NREGA needs an independent body that looks after it, human resource development, evaluation, social audit and grievance redress, without which quality outcomes will remain elusive.

Adhikari and Bhatia (2010) in their research paper stated that the Government of India has shifted from cash payment of wages under the renamed Mahatma Gandhi Employment Guarantee Scheme to settlement through bank accounts. It is done in order to prevent defrauding of workers and to give them greater control over their wages. Based on a survey in December 2008 in one block each in Allahabad (Uttar Pradesh) and Ranchi (Jharkhand) districts, this article probes questions related to payment of wages through bank.

Chowdhury (2011) has identified the 66<sup>th</sup> round National Sample Survey Organization data (2009-10) regarding the employment situation gives a picture of a limited creation of jobs between 2004-05 and 2009-10. It also mention widespread withdrawal from the labor force (especially by women) and slow growth of employment in the nonagricultural sector. The shift to education among the youth is a positive development but it does not explain the decline of the participation rate of labor force.

Ghormade (2011) writes on “A study of performance of MNREGA for BPL families with special reference to Nagpur district” published in Indian job guarantee scheme, which has responsibility for providing 100 days of job guarantee to inform of unskilled manual work to members of a locality. This programme is one of the challenging project by government of India. Through its ambitious working it has helped lakhs of people and has attracted the same number of criticism.

Kamala sankaran (2011) stated that while for several decades now there has been an unresolved debate about the effective of having a national minimum wage. The National Rural Employment Guarantee Act with its provision for a countrywide wage rate has played the possibility to do so squarely on the agenda. The NREGA wage rate must logically be a need-based national minimum wage rate must logically be a need based national minimum wage rate under NREGA that is link to the schedule of rates allows adequate flexibility to account for regional /geographical variation.

Shylashri Shankar, et al in their paper examined the relationship is investigated between possessing information on, gaining access to and the efficacy of delivery of India’s national rural employment guarantee scheme in three states. The results suggest that the link between information, access and the delivery of the scheme is not straightforward. Information can increase the propensity for the straightforward. Information can increase the propensity for the programme to be accesse by those who are not its primary target population, and can enhance efficiency of delivery to such beneficiaries. Lack of information, on the other hand, decreases the ability of citizens, particularly the acutely poor, to benefit from the schemes

Rakesh Tiwari et al, presented research paper and stated that the activity undertaken under the Mahatma Gandhi National Rural Employment Guarantee Act in Chitradurga district, Karnataka, were assessed for their potential to enhance and provide environmental service. Key programmes started in 20 village during 2009 were studied using rapid scientific assessment method. An indicator approach was for irrigation and improvement in soil quality. The status of environment service before and after implementation of the activities was examine and vulnerability indices were constructed and compared. The activity were found to have reduce the vulnerability of agricultural production, water resources and livelihood to uncertain rainfall, water scarcity and poor soil fertility.

# **CHAPTER-III**

# **METHODOLOGY**

## **CHAPTER - III**

### **METHODOLOGY**

Social research covers a wide range of phenomena. Any relationship involving two or more phenomena constitutes a legitimate topic for social research. By “Methodology” we mean the philosophy of the research process. This includes assumptions and values that serve as a rationale for research and standard of criterion the researcher uses for interpreting data and conclusion. In the chapter the researcher briefly presents the main objectives, variables used, the methods and the techniques of tools employed for the collection of data.

This chapter discusses in detail about the method that was adopted by the researcher. The research methodology that has been adopted in this study entitled a sociological analysis on the problems faced by *thozhilurappu* padhathi women workers involved in national rural employment scheme with special reference to the Vypin Island. This chapter also explains every component involved in conducting research from sample and sampling techniques used for the research.

#### **Statement of the problem**

The major objective of the Act is to provide not less than one hundred days of unskilled manual work as a guaranteed employment in a financial year to every person of rural area as per demand. The *thozhilurappu* padhathi also aims to strengthen the livelihood resource base of the poor, ensure social inclusion, and strengthen panchayat raj institutions.

This research focuses on the *thozhilurappu* women workers of Vypin island .The main aim of the study is to find the socio economic and familial problem faced by them. Their health condition, especially the lifestyle disease and after effects of Covid 19 are analyzed in this study. This study also focuses on the impact of Covid 19 on *thozhilurappu* women workers. Their satisfaction on 100 days of work salary and working conditions has also analyzed in this research.

## **General Objective**

To study the problems faced by thozhilurappu women workers involved in the national rural employment scheme with special reference to Vypin Island.

## **Specific objectives**

- ❖ To evaluate the socio economic conditions of *thozhilurappu* women workers.
- ❖ To understand the working condition of *thozhilurappu* women workers.
- ❖ To analyze the job satisfaction among *thozhilurappu* women workers.
- ❖ To analyze the impact of Covid 19 on *thozhilurappu* women workers.

## **Clarification of concept**

Thozhilurappu women workers involved in Mahatma Gandhi National Rural Employment Generation Scheme. The MGNREGS has aimed to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year. The Mahatma Gandhi National Rural Employment Guaranteed scheme is denoted as *thozhilurappu padhathi* in Kerala.

## **Operational definition**

This study is focusing on the thozhilurappu women workers of Vypin Island.

*Thozhilurappu padhathi*: - In this study, the term *thozhilurappu padhathi* is refer to the 100 days of job guaranteed by Mahatma Gandhi National Rural Employment Generation Scheme.

TT vaccine: - TT vaccine can increase the immunity of the body. The TT is necessary for *thozhilurappu* workers because they are doing physical work in an environment even having reptiles like serpents. Therefore, through the TT vaccine the workers get immunity to overcome the poison from serpents. The vaccine has to take with an interval of 5 years.

## **Identification of variable Variables**

The variable used in this study are Age, Religion, Caste, nature of family , Monthly income ,Marital status ,Venue period ,Educational qualification ,Locality.

## **Research design**

Research design used is descriptive research design. Since research is used to describe characteristics of a population or phenomena being studied .It is a fact finding investigation .The descriptive research design is a scientific method, which involves observing and describing the behavior of a subject without influencing it anyway.

## **Universe**

The universe of the study consists of all the thozhilurappu women workers in Vypin Island.

## **Sample size**

In this study 50 respondent are selected from the thozhilurappu women workers involved in MGNREGS with reference to the Vypin Island

## **Sampling method**

The sampling technique intended to use is simple random sampling .The tool used for data collection is the interview schedule.

## **Tools of data collection**

In this study Interview schedules are used as a tool of data collection. The interview schedule contain questions related to the personal data, working condition, job satisfaction, impact of Covid 19 among *thozhilurappu* women workers .The statistical tool like SPSS will also be used for the analysis.

## **Pilot study**

In order to conduct pilot study on the topic sociological analysis on the problems faced by *thozhilurappu* women workers involved in national rural employment scheme with special reference to the Vypin Island. The researcher collected data from six respondents in pilot study .Thus a pilot study was conducted to check the feasibility of the study. The respondent ensures support for the future research to be conducted.

## **Pre-test**

A study was conducted with five respondents and found that some of the questions were not clear and unnecessary .The repetitive questions were discarded or modified.

## **Fieldwork**

The fieldwork was conducted in the months of January and took 3 weeks to complete the data collection.

## **Data Analysis and interpretation**

The data collected was duly analyze and interpretation .In this study researcher particularly focused on *thozhilurappu* women workers involve in Mahatma Gandhi National Employment Guarantee Scheme, which ensure 100 days of employment its members .In this research researcher focused on various physical, social, economic, health and familial problem, and analyze the impact of Covid 19 on *thozhilurappu* women worker.

## **Limitation of the study**

In this research, researchers face some difficulty in interviewing the respondent. Many of the respondents cooperated with researchers in collecting information but some were reluctant to share their information because of their busy time schedule and also some feel tired after their *thozhilurappu* work so they will take rest instead of communicating with others, this limited the researcher to collect information from some tired people .

## **Plans of the study**

Chapter I:

This chapter consists of an introduction that gives a wide range of information to the study. It provides a clear picture about health problems , economic instability that faced by *thozhilurappu* women workers .And also explain about the impact of Covid 19 on *thozhilurappu* women workers.

Chapter II:

This chapter Include review of literature. It involve the secondary material, which are relate with the topic. Article, journals, internet are used as source in the research.

Chapter III:

This is the methodology part. This chapter includes the methodology that was adopted by the researcher.

Chapter IV:

This chapter include the data analysis and interpretation

Chapter: V

This chapter include the finding, suggestions and conclusion

The methodology chapter mention the research design employed in this study and about the sample study used in the research. In this study, the data collected from primary and secondary sources. The secondary data has collect from library; internet and field research .The primary data are collect from respondents in the field. In the research the quantitative method is adopted , in which the survey method is applied for the study .The sample is selected through simple random sampling in which lottery method adopted in the study .The collected data was analyzed hence results are displayed .

## **THEORETICAL FRAMEWORK**

A dual role conflict is inter-role conflict that arises because someone plays many roles at once, and those roles have conflicting expectations and different responsibilities (Tsuei, Lai-I, 2002). Job stress is a condition that arises from interactions between humans and work and is characterize by human changes that force them to deviate from their normal functions. Factors causing work stress can be divide into four, namely individual stressors, group stressors, organizational stressors, and extra organizational stressors. (Luthans, 2006).

Conflicting dual roles has three dimensions, namely: Times-based conflict that is the conflict caused by time pressure, because the time held is use to fulfill certain roles resulting in difficulties in fulfilling other roles. Strain-based conflict, namely conflict caused by tension, pressure, or confusion of roles by a role that interferes with other roles (work and family pressure). Behavior-based conflict that is the difficulties in changing behavior resulting from one role to another.

Job stress experienced by married women workers is cause by the emergence of a dual role performed by these workers, which in turn causes role conflict and triggers stress. This stress is cause because of expectations in the performance of one role caused difficulties in fulfilling the performance of the other roles. As stated by Luthans (2006) one of them is an extra-stressor family, where workers find it difficult to balance responsibilities between work and family. Personality is a set of stable characteristics and tendencies, which determines a person's general nature or characteristics and is a difference in a person's behavior. This is often depict in the form of

attributes that can be measure and display by someone. . The Multiple role conflict is a conflict that occurs simultaneously as a result of pressure from two or more expected roles, but can occur in the fulfillment of one role will conflict with other roles. (Utaminingsih, 2017).

The *thozhilurappu* women workers has a dual role conflict in their life. Women who were in the early period had only the roles of wives who took care of their households and children, but nowadays many of them have second roles as employed women. Despite being employed women, many of them struggle to balance their roles in households and their roles in the *thozhilurappu padhathi*. Many of the women are trying to manage different role in their life. Many *thozhilurappu* women workers has faced dual role conflict but they are try to overcome such circumstance in their life.

**CHAPTER- IV**

**DATA ANALYSIS AND**

**INTERPRETATION**

## CHAPTER- IV

### DATA ANALYSIS AND INTERPRETATION

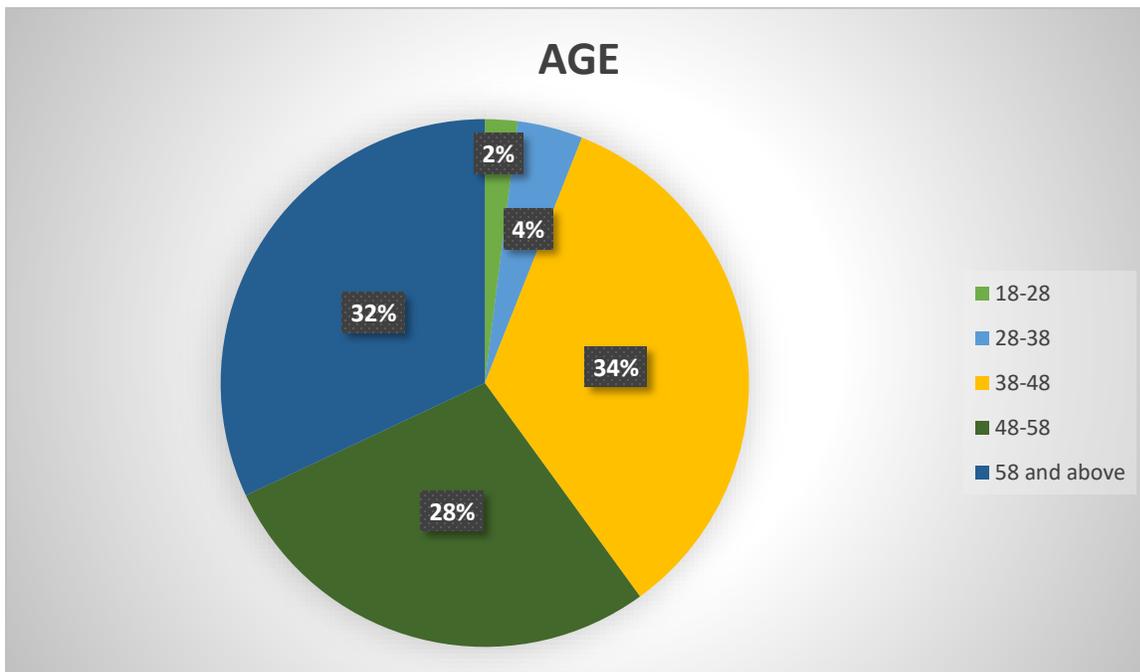
This chapter deals with analysis and interpretation. The study aims to measure the problem faced by *thozhilurappu* women workers of Vypin Island. The purpose of collection and interpretation is to acquire useful and usable information regarding the objective of study. Based on the analysis and interpretation, a desirable decision can be take solve the problems related to the topic. It provides limitless benefits for a wide range of institutions and individuals. It includes data identification and explanation, comparing and contrasting of data, identification of data outliers, future predictions. It helps to improve and identify problems.

In this present study, my first objective is to understand socio economic conditions, which had a prominent role in *thozhilurappu* women workers life. The second objective is to understand the working condition of *thozhilurappu* women workers. The third objective is to analyze the job satisfaction among *thozhilurappu* women workers. The fourth objective is to analyze the impact of Covid 19 on *thozhilurappu* women workers.

❖ To evaluate the socio economic conditions of *thozhilurappu* women workers

FIGURE: 4.1

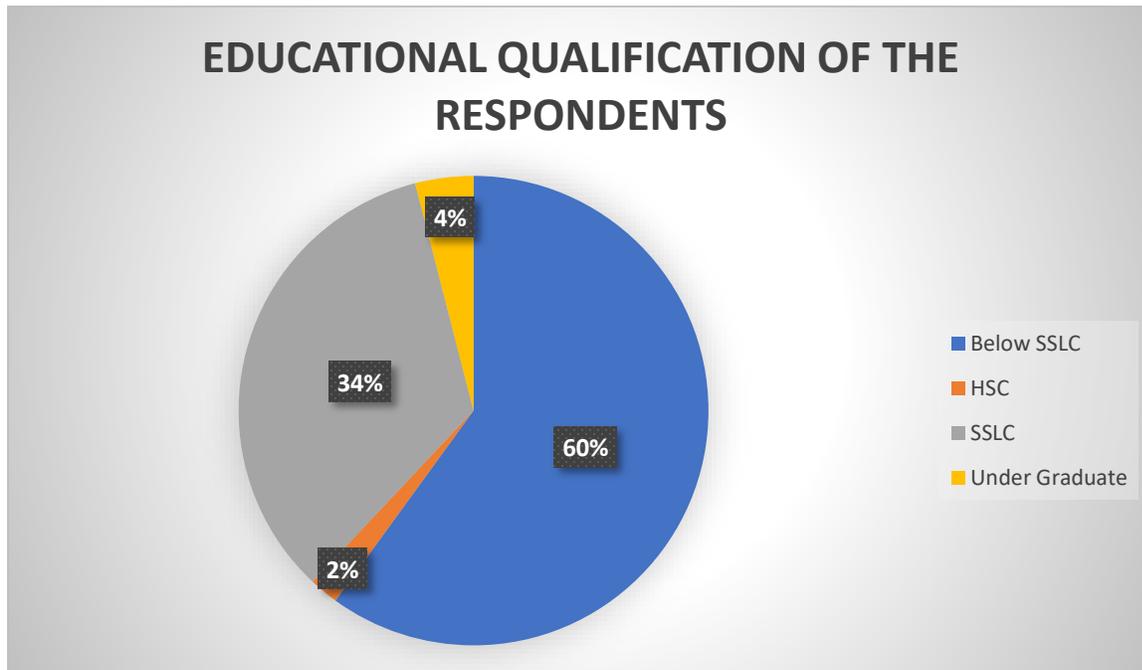
FIGURE SHOWING THE AGE OF RESPONDENTS



From this study, it is found that 34 percentage of respondents are from the age group 38 to 48 age slot, this consecutive largest age category. 32 percentage are from the age group 58 and above, people of old age are engaging in *thozhilurappu padhathi* because of the economic instability in the family. The 28 percent are from the age group 48-58, the 4 percentage of respondents are from the age group 28-38. The 2 percent are from the age group 18 to 28, there is less participation from the younger age in *thozhilurappu padhathi* because many of them were working in white-collar jobs. Therefore, from this diagram it is evident that most of the respondents are between the age group 38 – 48 years.

FIGURE 4.2

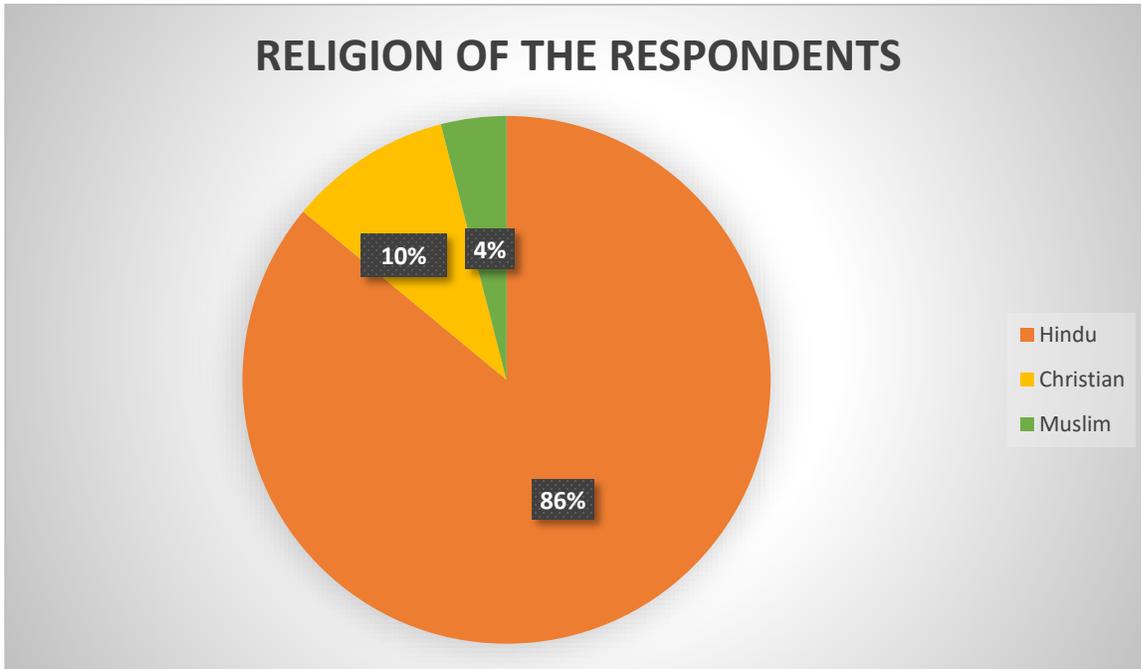
FIGURE SHOWING THE EDUCATIONAL QUALIFICATION OF RESPONDENTS



The study reveals that the majority of respondents have not completed SSLC, 34 % of respondents had completed SSLC, about 4% have completed graduation, and 2% have studied up to HSC.

FIGURE 4.3

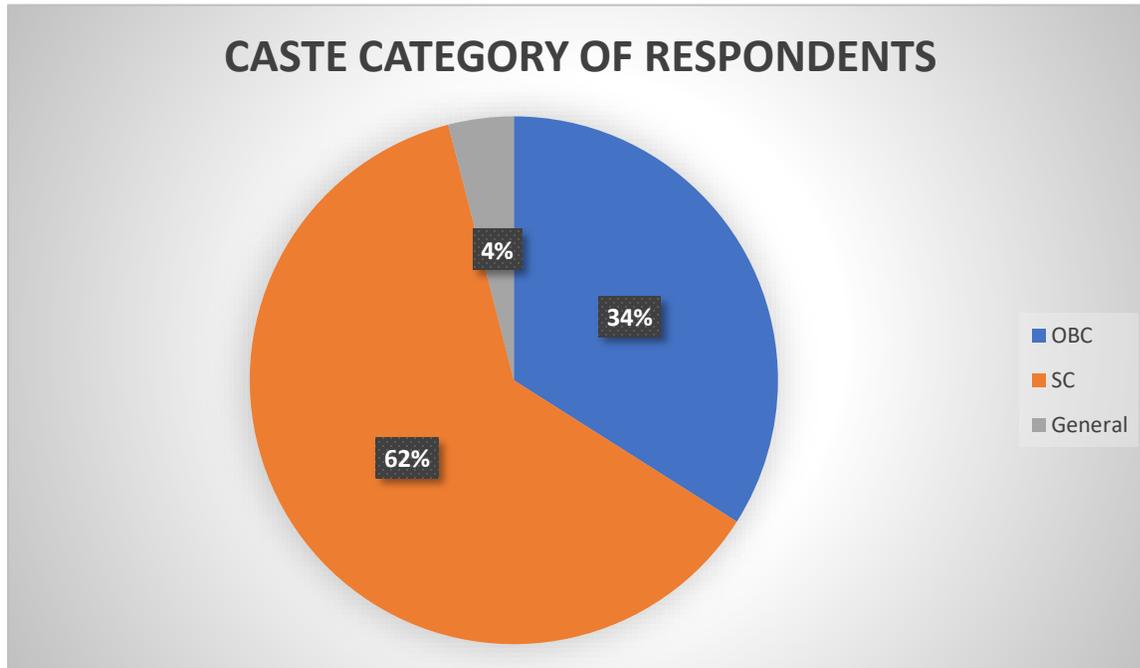
FIGURE SHOWING THE RELIGION OF RESPONDENTS



The religion of the respondents can be categorized into Hindu, Christian and Muslim. It is obvious from the figure that most of the respondents are Hindus making 86% of the respondents. Rest of the respondents are Christians and Muslims at 10% and 4% respectively. Majority workers of *thozhilurappu padhathi* are from Hindu religion.

FIGURE 4.4

FIGURE SHOWING THE CAST CATEGORY OF RESPONDENTS



From the figure, it is evident that 62 percent of the respondents belong to the SC category. 34percent of respondents belong to OBC category and 4percent of respondents are from General category.

A large majority of women participation in *thozhilurappu padhathi* is mainly from SC category. The social and economic condition of SC category is forcing them to do menial jobs and blue-collar jobs with low payment.

TABLE 4.1

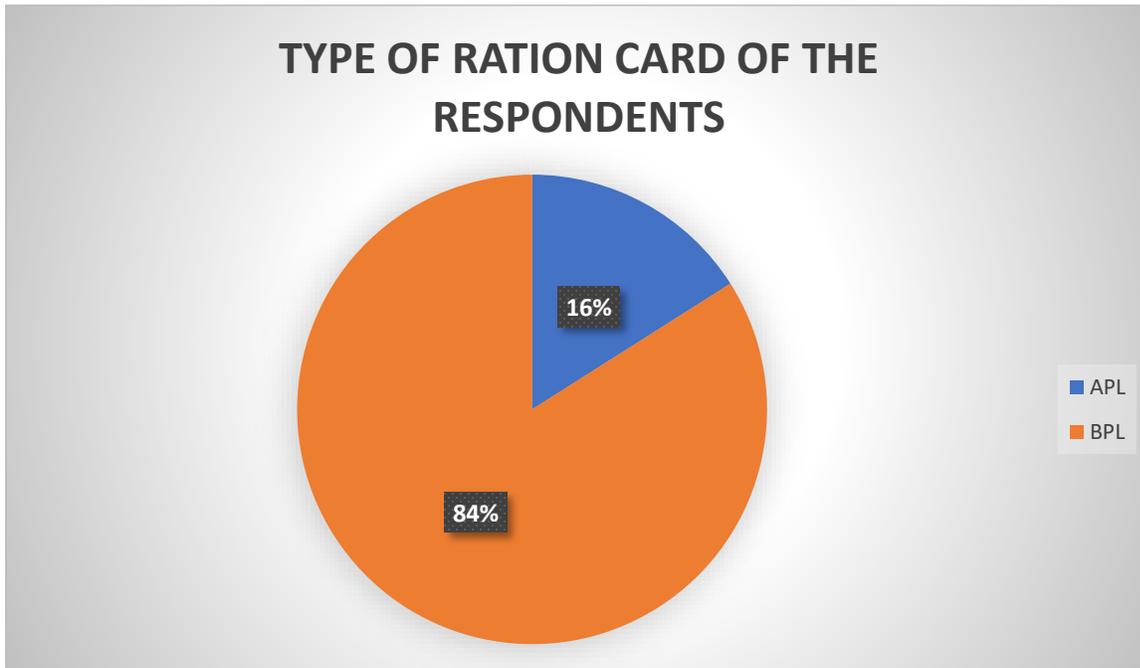
TABLE SHOWING THE INCOME OF RESPONDENTS (PER DAY)

<b>INCOME</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>291Rs PER DAY</b>	50	100%
<b>700Rs PER DAY</b>	0	0
<b>TOTAL</b>	50	100%

All respondents are getting 291 rupees as a per day salary from gram panchayat .So 100% of respondents claim that they have 291 rupees as per day salary .According to MGNREGS the government has fixed salary as 291Rs . Some respondents claim that there is a chance for increase the salary of a mate (leader) from 291 to 700, they also said that this provision would be applicable only to the mate (leader) who have SSLC pass.

FIGURE 4.5

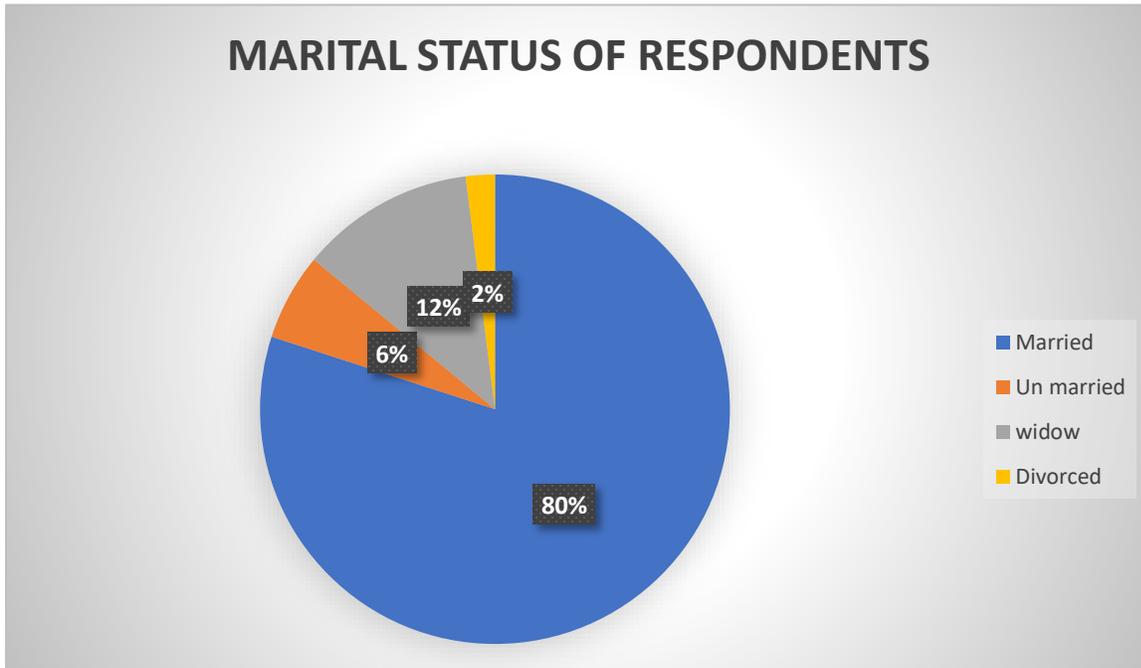
FIGURE SHOWING THE TYPE OF RATION CARD OF RESPONDENTS



From the figure, it is clear that 84% of the respondents belong to the BPL category and 16% of the respondents belong to APL. A huge majority of people belong to BPL category due to their poor economic condition. For 84% of respondents the salary of *thozhilurappu padhathi* is a major factor for meeting their basic needs of life.

FIGURE 4.6

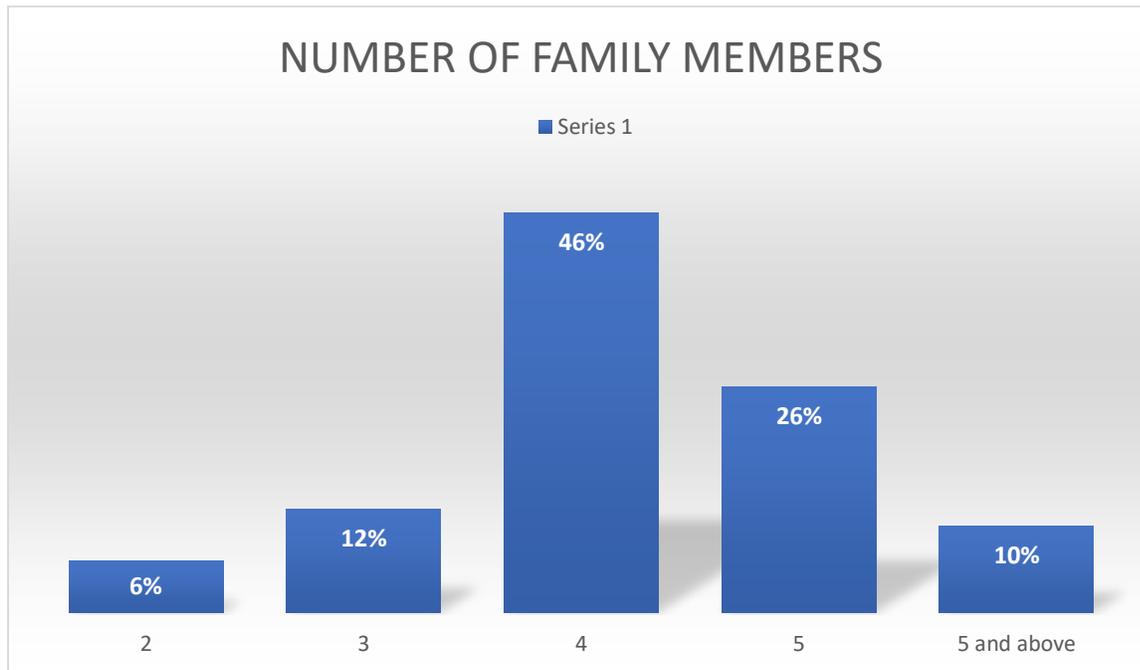
FIGURE SHOWING THE MARITAL STATUS OF RESPONDENTS



From the figure, we can observe that 80% of the respondents are married and 6 % of them are unmarried .The remaining 12 % are widows and 2% are divorced. This figure reveals that the majority of respondents are married.

FIGURE 4.7

FIGURE SHOWING THE NUMBER OF FAMILY MEMBERS



From the figure, it is clear that 46% of the respondents have four members in their family. 26 % have five members in their family. 12% of respondents have three members in their family. 10% have five and above members in their family. 6% of respondents have two members in their family. The majority of respondents are living in a nuclear family, which consists of 4-6 members. The joint family system in rural areas is changing into a nuclear family pattern. In this study, most of the families have four members and it is because of the influence of modernization.

TABLE 4.2

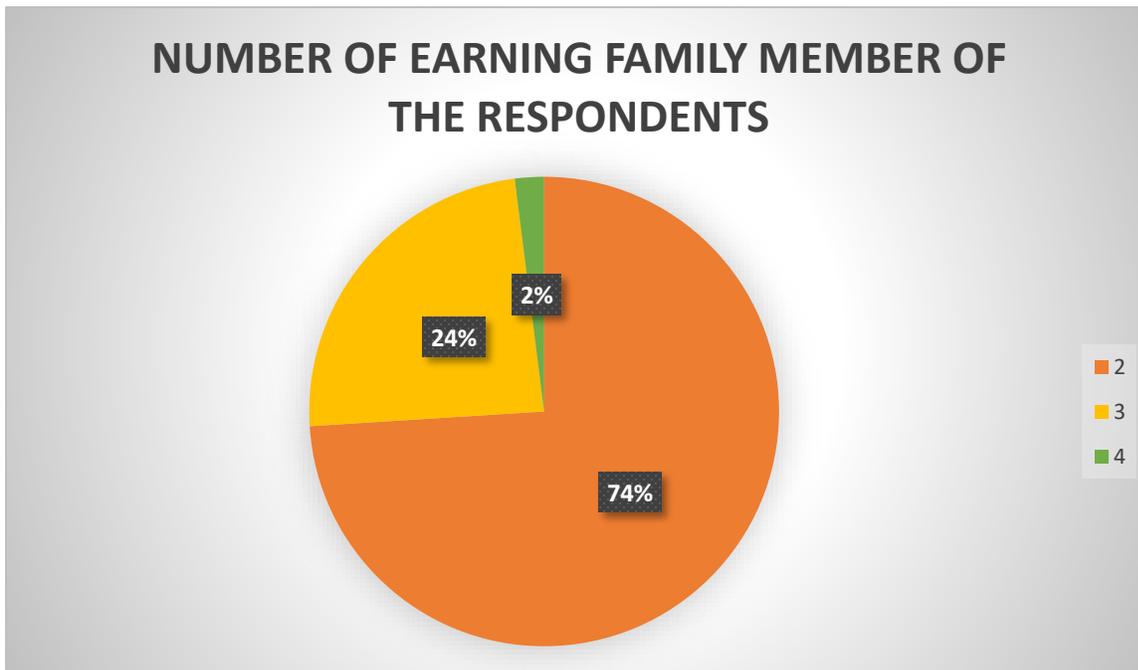
TABLE SHOWING THE TYPE OF FAMILY

TYPE OF FAMILY	NUMBER OF RESPONDENTS	PERCENTAGE
NUCLEAR FAMILY	48	96%
JOINT FAMILY	2	4%
TOTAL	50	100%

The table reveals that 96% of respondents are living in a nuclear family. 4% of respondents are living in a joint family. As per the table, the majority of the respondents are living in nuclear families, this is because of the influence of urbanization in rural area families. A nuclear family is a social unit, which consists of parents and their children. Thus in a nuclear family the number of earning members will be only one or two. This factor is influencing the women to go for work to maintain an economic stability in the family.

FIGURE 4.8

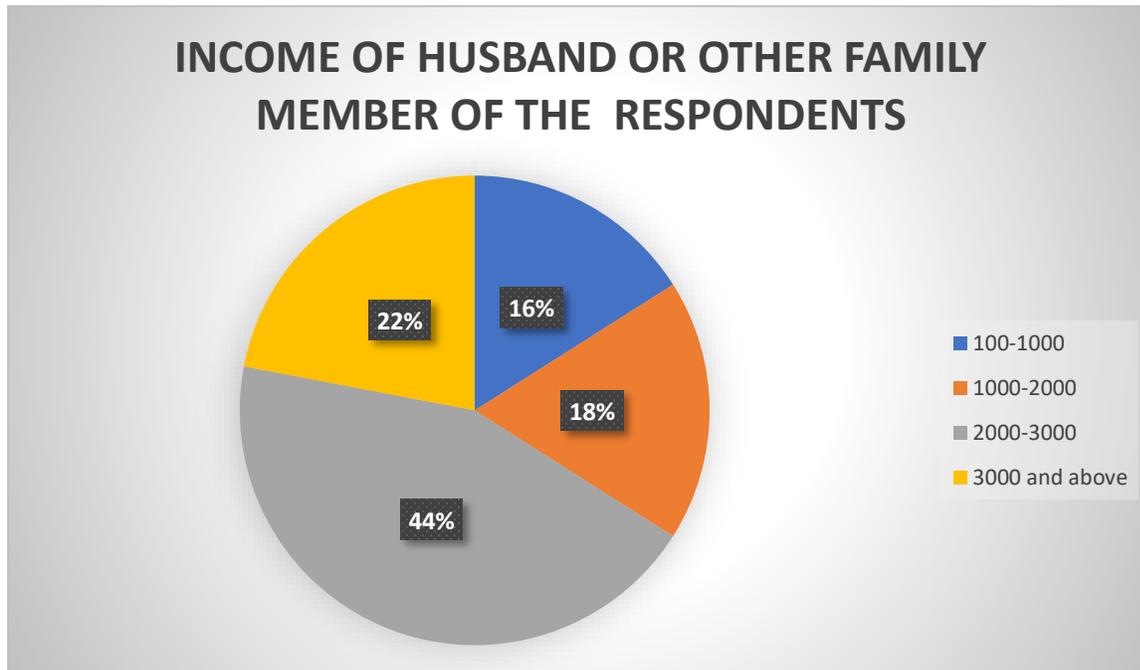
FIGURE SHOWING THE NUMBER OF EARNING FAMILY MEMBERS OF RESPONDENTS



From the figure, we can understand that 74% of the respondents have two earning members in their family. 24% of them have three earning members in their family. Only 2% of the respondents have four earning members as the earning member of the family. From the figure we can understand that majority of family have 2 earning family members

FIGURE 4.9

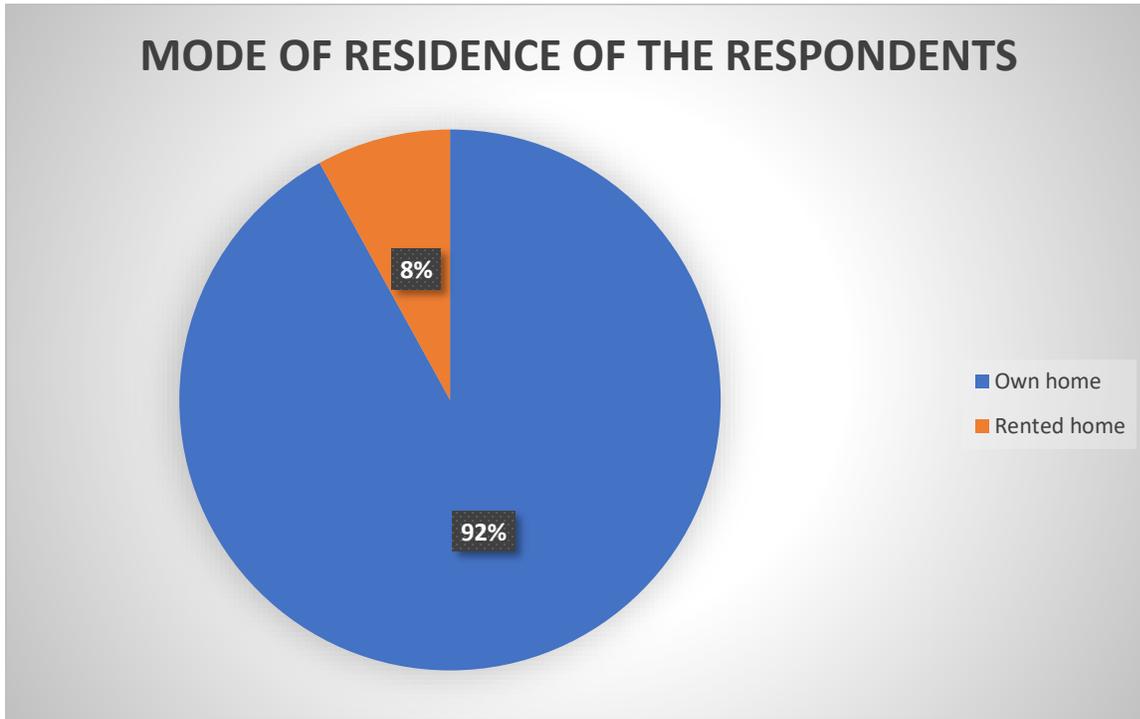
FIGURE SHOWING INCOME OF HUSBAND OR OTHER FAMILY MEMBERS OF RESPONDENTS



The figure shows that 44 % of the respondents have 2000-3000 as income of husband or other family member. 22% of them have 3000 and above. It is noticed that 9% of them have 2000-3000 and 8 % have 100-1000 as income of husband or other family member. From this figure, it is clear that the majority of respondents have 2000-3000 as the income of their husband or other family member. Many of the respondents claim that their family members have seasonal jobs with per day income. Therefore, during the rainy season it is very difficult to meet the basic needs of a family.

FIGURE 4.10

FIGURE SHOWING THE MODE OF RESIDENCE OF RESPONDENTS



The above figure shows the mode of residence of the respondents. 92% of the respondents have their own home. Only 8% of them stay in rented homes. From the figure it is clear that the majority of respondents are living in their own home. This social reality reveals that the land reform act of 1969 has proper implementation in the Vypin Island. Moreover, the Government life mission project had provided a concrete house to the majority of respondents.

❖ **To understand the working condition of *thozhilurappu* women workers**

TABLE 4.3

TABLE SHOWING THE NATURE OF WORK AMONG RESPONDENTS

NATURE OF WORK	NUMBER OF RESPONDENTS	PERCENTAGE
NONSEASONAL	50	100%
SEASONAL	0	0
OTHER	0	0
TOTAL	50	100%

The working nature of the respondents are non-seasonal. Thus, they are working in all climate conditions even in adverse circumstances. Therefore, 100% of the respondents are working all season. The financial problems of members is provoking them to do work without considering the climate condition. Respondents claim that they use to carry plastic sheets in the work site, and during the rainy season the plastic sheets are tied as a roof to prevent rain.

TABLE 4.4

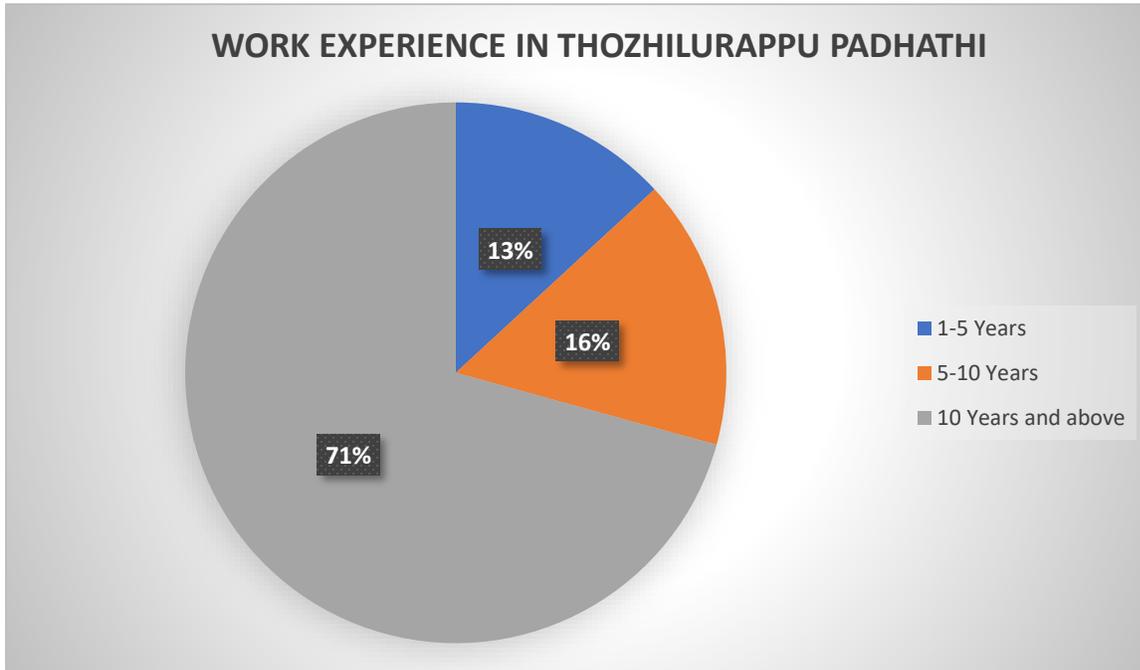
TABLE SHOWING THE TYPE OF THOZHILURAPPU WORK DONE BY RESPONDENTS

TYPE OF THOZHILURAPPU WORK	NUMBER OF RESPONDENTE	PERCENT
AGRICULTURAL WORK	0	0
CLEANING	0	0
BOTH AGRICULTURAL AND CLEANING WORK	50	100%
OTHER	0	0
TOTAL	50	100%

Every respondents are working both on agricultural and cleaning work. They also increase the depth of the wetland. Therefore, 100% of the respondents are working both at agricultural and cleaning fields. With the initiative of Kerala Government, the *thozhilurappu padhathi* workers are entrusted to do many environmental friendly projects like the pachathuruthu scheme implemented by Haritha Kerala mission. *Thozhilurappu padhathi* workers aim at spreading green spaces in the state to combat the adverse effects of climate change .The saplings of indigenous trees and plants will be planted in fallow land and vacant spots as to create sustainable environment.

FIGURE 4.11

FIGURE SHOWING THE WORK EXPERIENCE OF RESPONDENTS IN THOZHILLURAPPU PADHATHI

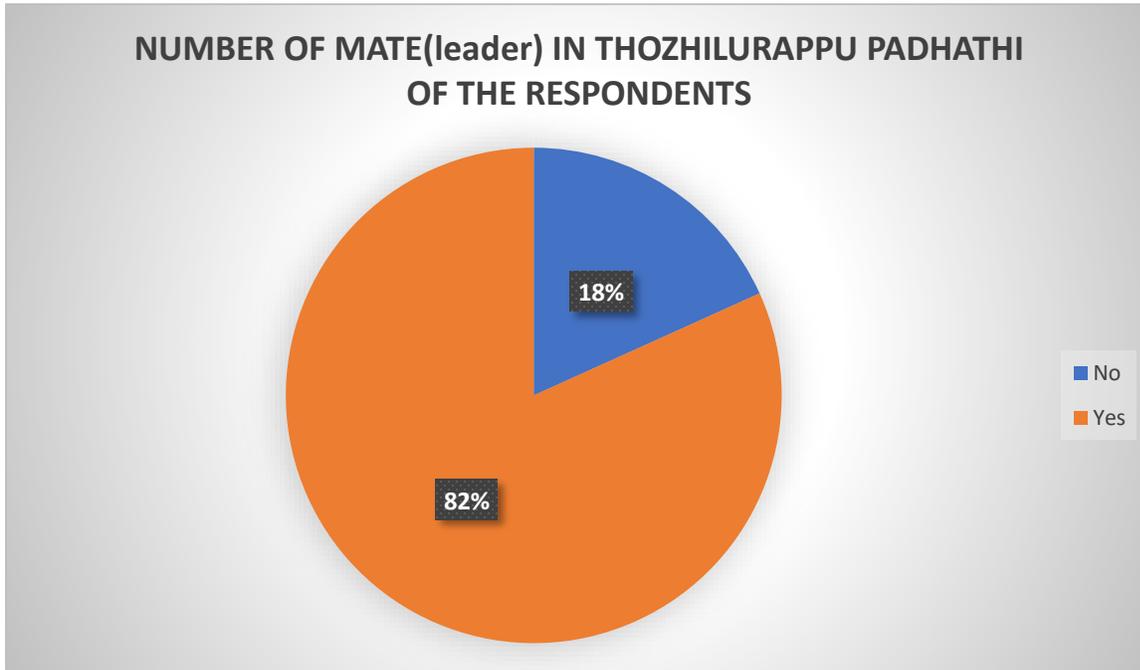


Work experience in Thozhilurappu padhathi is mentioned in this figure. From the above distribution, it is clear that 71% of the members have 10 years and above work experience. 16% of the respondents have 5-10 years of work experience. The rest of 13% of them have 1-5 years of work experience. From the figure it is clear that the majority of respondents have a 10 and above years of work experience in the field of *thozhilurappu padhathi*.

On the 2<sup>nd</sup> of February 2006, Wayanad and Palakkad districts were included in the first phase of implementation of *thozhilurappu padhathi*. The Idukki and Kasaragod were included in the second face, which was notified as on 1<sup>st</sup> April 2007. As on 1<sup>st</sup> April 2008, the scheme was extended to the remaining districts. By 2008, *thozhilurappu padhathi* was implemented in Ernakulam district and many of the respondents joined in the initial period itself.

FIGURE 4.12

FIGURE SHOWING, FROM RESPONDENTS HOW MANY MATE (LEADER) ARE IN THOZHILURAPPU PADHATHI.



Leader of thozhilurappu padhathi in a ward is known as *mate*. Thus 18% of respondents were mates and 82% were not mates. The mate has a prominent role in *thozhilurappu padhathi*. A ward can have more than five mates, but duty of mate is entrusted to a single person during the period of work. After finishing 100 day's work, each mate will hand over her duty to the other mate.

The mate fills the attendance details of MGNREGA in employment card. This card is the personal card of each member in *thozhilurappu padhathi*. The mate also has to fill the Muster roll and it will be hand over to Gram panchayat. Through this process, the salary will be credit to their bank account .

Table 4.5

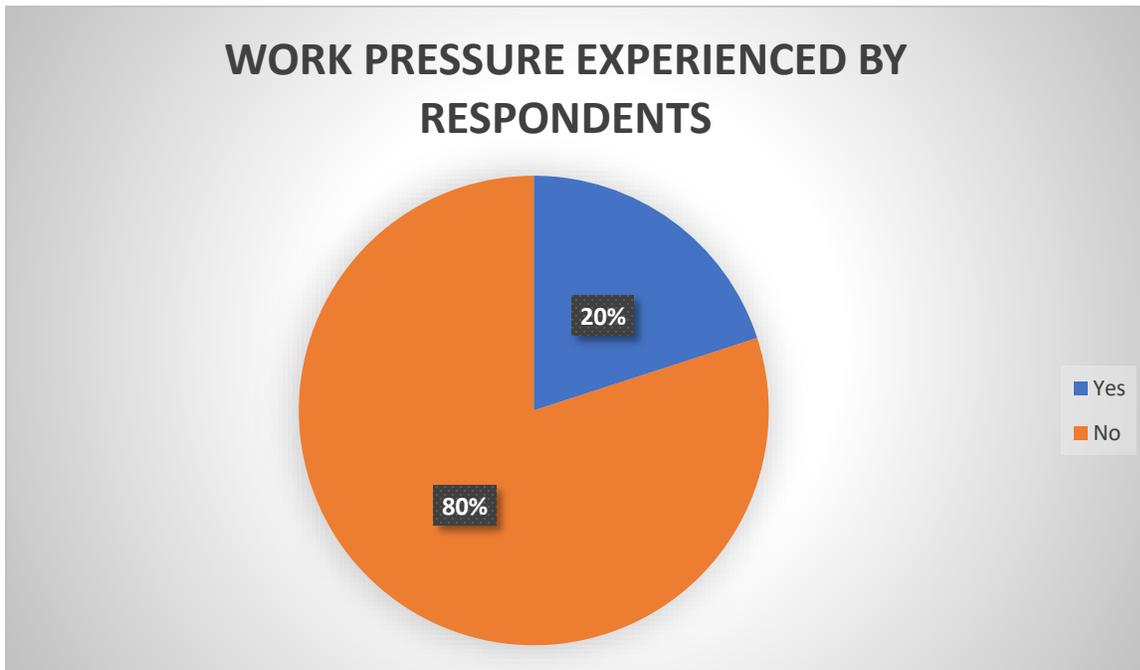
TABLE SHOWING THE WORK DURATION OF RESPONDENTS IN A DAY

WORK HOURS	NUMBER OF RESPONDENTS	PERCENTAGE
5 AND ABOVE HOUR	50	100%
5 HOUR	0	0
4 HOUR	0	0
3 HOUR	0	0
2 HOUR	0	0
1 HOUR	0	0
TOTAL	50	100%

Every respondents are working five and above hours. So 100% of the respondents are working five and above hours. The respondents claim that they have to reach in work site by 9:00 am and will start work by 9:30 am to 10:30 am. At 10: 30, they have a tea break until 11: 00 am. At 11:00am, they have to do work until 1:00 pm. At 1: 00 pm, the members can have lunch. By 2: 00 pm the members have to reach the field and work will start at 2:30 pm. This work will extend until 5:00 pm. This is the time schedule of *thozhilurappu padhathi*.

FIGURE 4.13

FIGURE SHOWING THE WORK PRESSURE EXPERIENCED BY RESPONDENTS



From this figure, it is evident that 20% of the respondents experienced work pressure. 80% of the respondents do not experience work pressure. Increasing the depth of water bodies like ponds is creating work pressure. The time bound to complete the work of *thozhilurappu padhathi* is also creating pressure on the 20% of the respondents.

TABLE 4.6

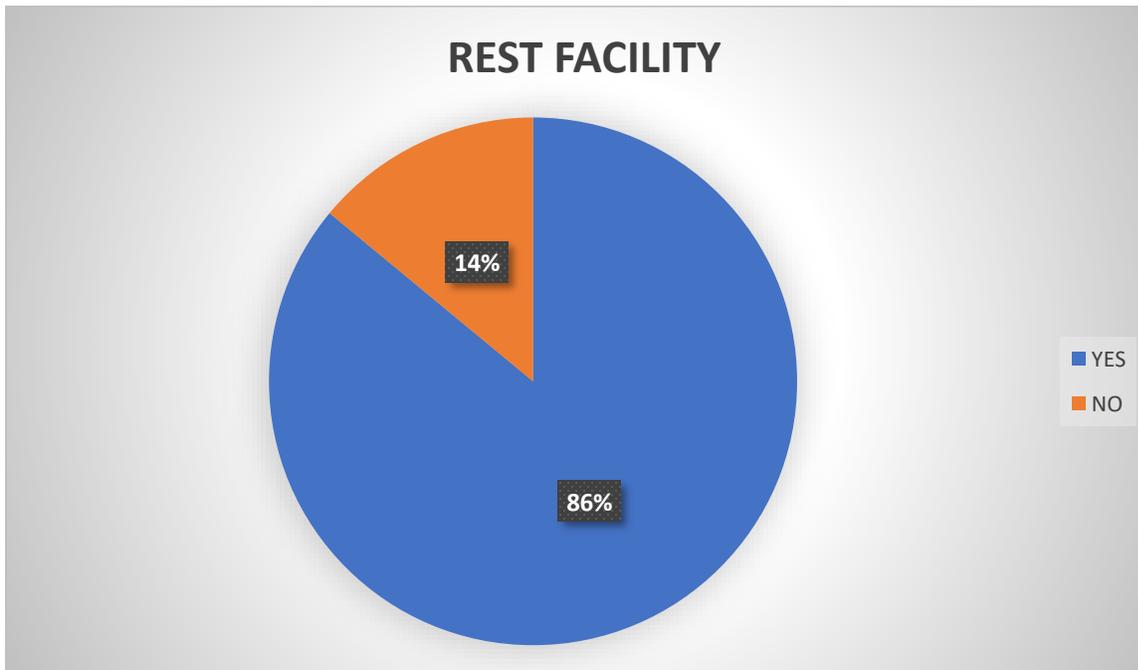
TABLE SHOWING THE REST INTERVALS

REST INTERVAL	NUMBER OF RESPONDENTS	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

Every respondent is satisfied with the rest interval. Therefore, 100% of the respondents are satisfied. The government is providing a proper time interval in *thozhilurappu padhathi*. The respondents claim that they are taking rest in plastic sheets and to all the worksite, they carry a plastic sheet and it will be use during the rest interval for rest. The Time schedule for the rest interval is satisfying among all respondents.

FIGURE 4.14

FIGURE SHOWING THE FACILITY TO REST



From the figure, it is evident that 86% of respondents are satisfied by the facility to take rest while 14% of them are not satisfied. The respondent's claim that the Gram panchayat is not providing a facility for rest but they are satisfied by the facility that they brought from home. The respondents desire to get good rest materials such as beds or mats and rest rooms from the Gram panchayat to overcome the rainy season and sunshade.

TABLE 4.7

TABLE SHOWING THE TIME INTERVAL FOR HAVING FOOD

TIME INTERVAL FOR HAVING FOOD	NUMBER OF RESPONDENTS	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

From the table it is clear that every respondent is satisfied with the time interval for having food. Therefore, 100% of the respondents are satisfied. The respondent claims that tea break and lunch break during *thozhilurappu padhathi* work is sufficient for having food.

TABLE 4.8

TABLE SHOWING THE NUMBER OF RESPONDENTS VACCINATED FOR TT VACCINE

VACCINATE WITH TT	NUMBER OF RESPONDEND	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

Every respondent is vaccinated with TT. TT vaccine is a tetanus toxoid and it is a toxoid vaccine to prevent disease caused by clostridium Tetani. So 100% of the respondents are vaccinated by the TT vaccine.

All respondents received TT vaccine from the public health center with collaboration of Gram panchayat. The TT is necessary for *thozhilurappu* workers because they are doing physical work in an environment even having reptiles like serpents. Therefore, through the TT vaccine the workers get immunity to overcome the poison from serpents.

TABLE 4.9

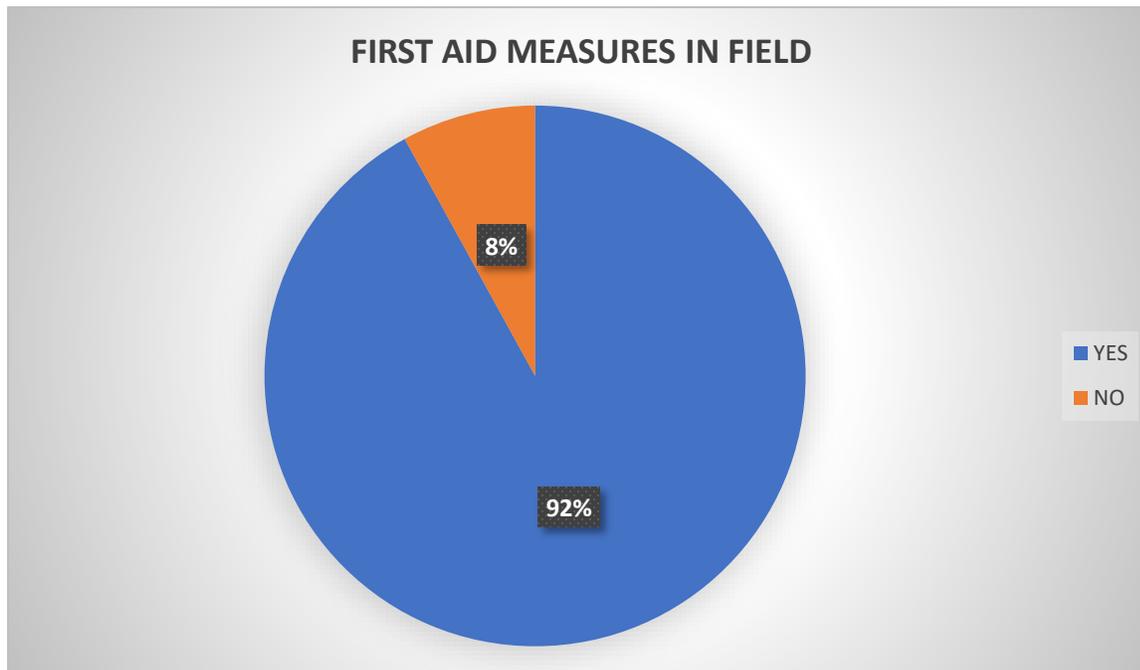
TABLE SHOWING THE NUMBER OF RESPONDENTS GETTING DOXYCYCLINE TABLET

DOXYCYCLINE TABLET	NUMBER OF RESPONDENTS	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

Every respondents is getting a doxycycline tablet from gram panchayat. Primary health centers and Asha workers provide it for two weeks. Doxycycline tablets are used to prevent rat fever. Therefore, 100% of the respondents are getting doxycycline tablets. The tablet helps to prevent bacteria, which can cause malaria. The respondent claims that there is a high chance of having direct contact with contaminated water so it is necessary to have Doxycycline tablets to prevent malaria.

FIGURE 4.15

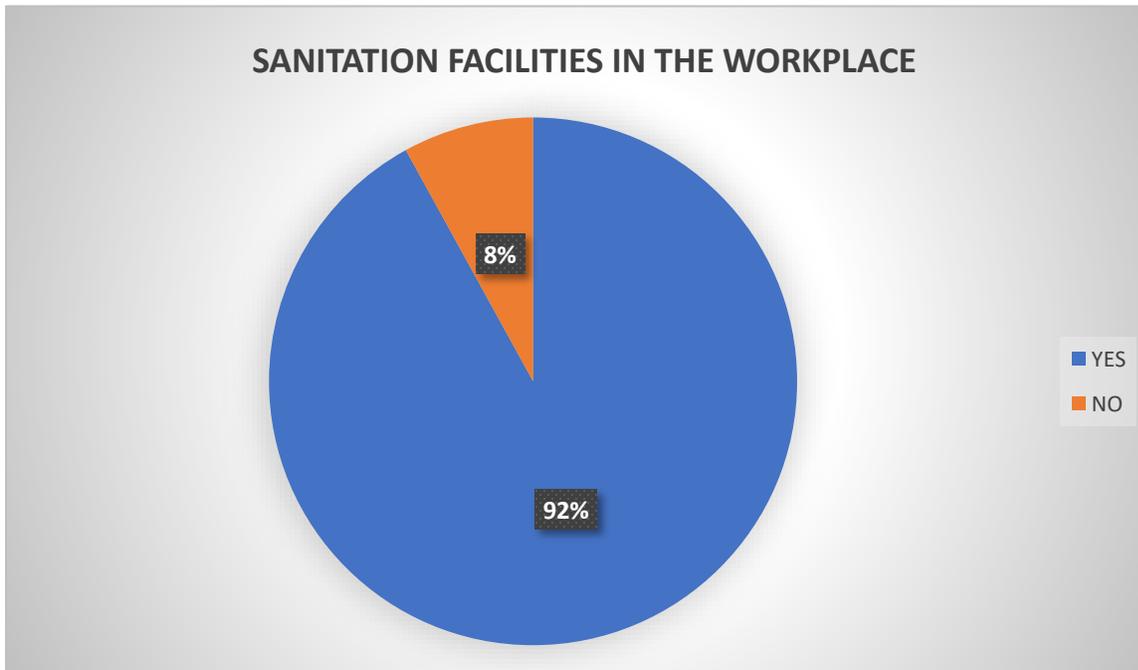
FIGURE SHOWING THE SATISFACTION OF RESPONDENTS ON FIRST AID MEASURES OF THOZHILLURAPPU PADHATHI.



From this figure, it is evident that 92% of the respondents are satisfied. 8% of them are not satisfied with the first Aid measures in the field. The respondents claim that the mate of the worksite has to carry a first aid measure box in the field. Therefore, the majority of respondents are satisfied with the first aid measures in the fields.

FIGURE 4.16

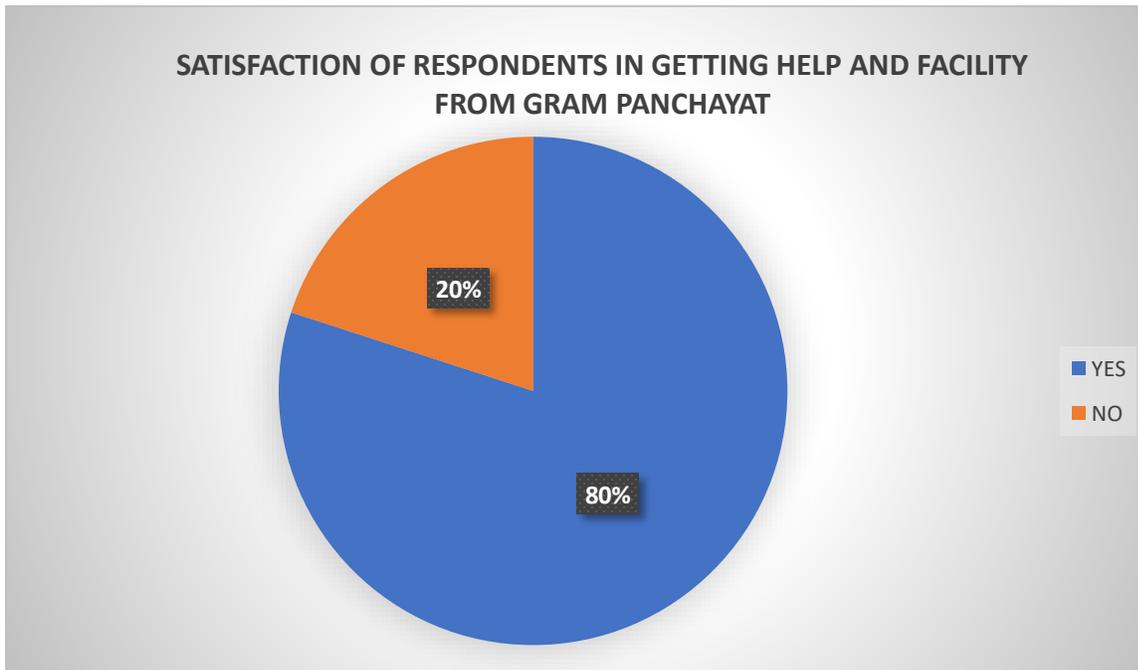
FIGURE SHOWING THE SANITATION FACILITIES IN THE WORKPLACE



From the figure it is clear that 92% of the respondents are satisfied, 8 percent of them are not satisfied with the sanitation facilities. The respondents claims that they carry one container in the field to sanitize their hand after their work. The toilet facility is not practical in *thozhilurappu padhathi* because the worksite of members will change after completing the work in a field, still some respondents claim that lack of toilet facility is resulting in urinary tract infection.

FIGURE 4.17

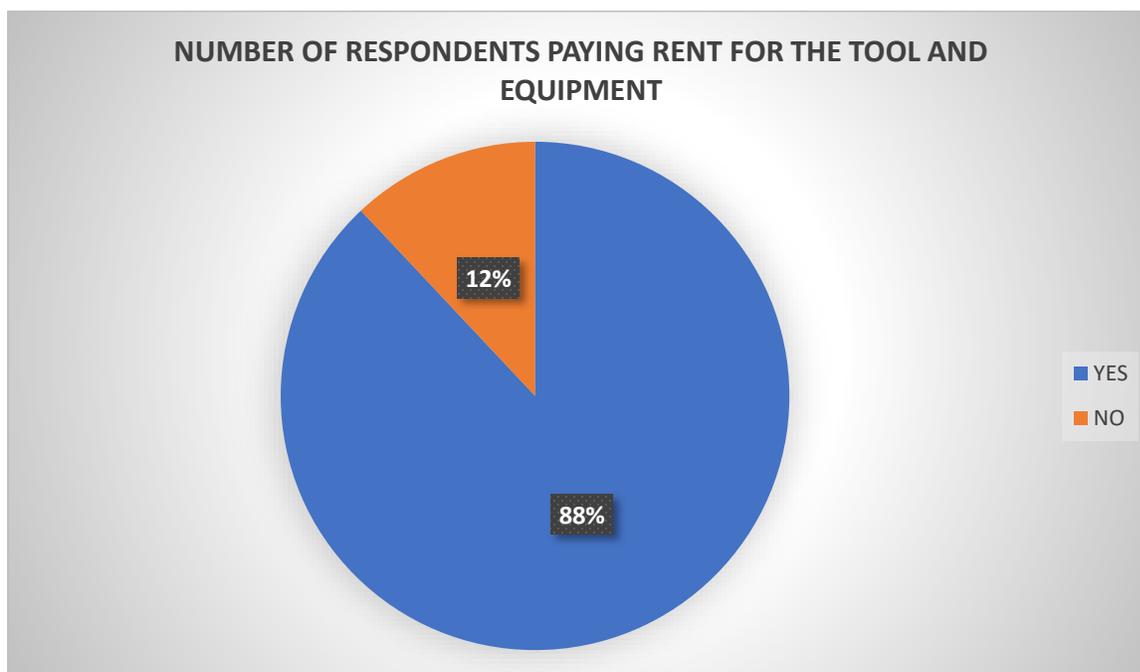
FIGURE SHOWING THE SATISFACTION OF RESPONDENTS IN GETTING HELP AND FACILITY FROM GRAMA PANCHAYAT



From the figure, it is evident that 80% of the respondents are satisfied with facilities and help from Gram panchayat. 20% of them are not satisfied with the facilities and help from gram panchayat. The respondents claim that they are expecting more help and facilities such as tool and equipment availability from Gram panchayat.

FIGURE 4.18

FIGURE SHOWING THE NUMBER OF RESPONDENTS PAYING RENT FOR THE TOOL AND EQUIPMENT



The figure reveals how many respondents are paying rent for the tool and equipment. 88% of the respondents are not paying rent for tools and equipment .12 percent of respondents are paying rent.

The respondents said that, ‘in the initial period the *thozhilurappu* workers had to pay rent for hoe tool with price of 10 Rs and spade tool has price of 8Rs to Gram panchayat .The current authority of *panchayat* is not providing tools and equipment . So *thozhilurappu* workers has to bring tools and equipment from their home, but at the same time some members were pay rent for tool and equipment especially for measuring tape’.

TABLE 4.10

TABLE SHOWING THE NUMBER OF RESPONDENTS DOING OTHER EMPLOYMENT ALONG WITH THOZHILURAPPU PADHATHI WORK

OTHER EMPLOYMENT ALONG WITH <i>THOZHILURAPPU</i> WORK	NUMBER OF RESPONDENTS	PERCENTAGE
YES	12	24%
NO	38	76%
TOTAL	50	100%

From the table it is clear that 24% of respondents are doing other employment along with *thozhilurappu padhathi* work due to their financial problem. 76% of respondents are only doing *thozhilurappu padhathi* work.

The 12 respondents are not satisfied with the salary of *thozhilurappu padhathi* and they are struggling to meet daily needs so they are doing other employment along with *thozhilurappu padhathi* work. Therefore, it is very well clear that the majority of *thozhilurappu padhathi* women workers are not doing any other employment, thus they are totally depending on the salary of *thozhilurappu padhathi*.

TABLE 4.11

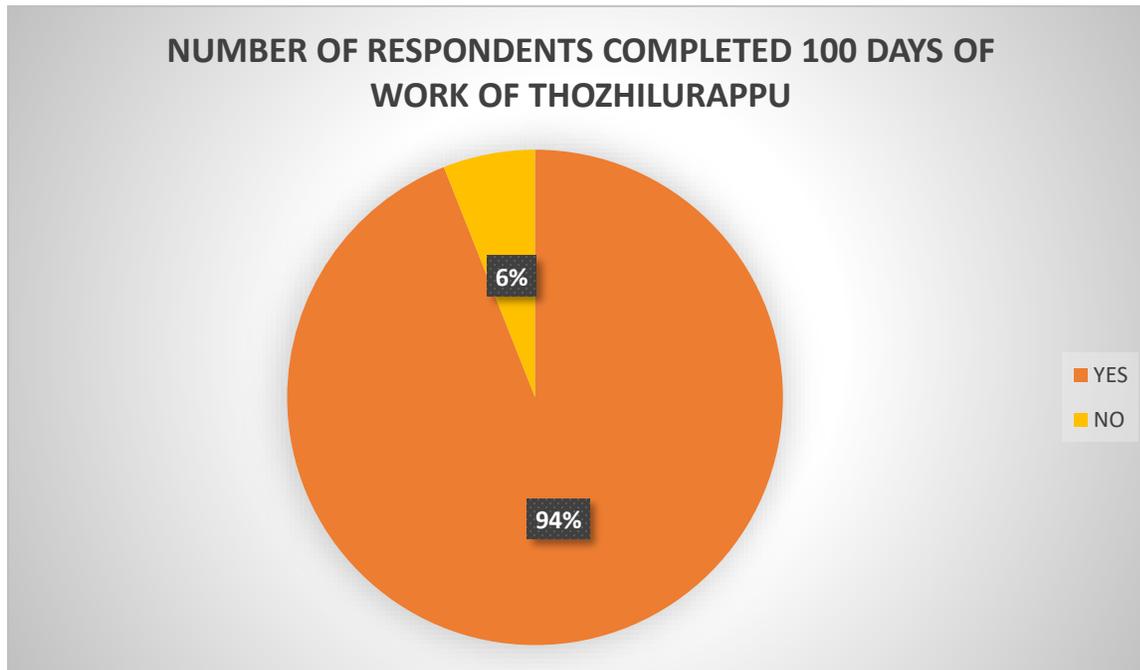
TABLE SHOWING THE NATURE OF OTHER EMPLOYMENTS

NATURE OF OTHER EMPLOYMENT	NUMBER OF RESPONDENTS	PERCENTAGE
PRAWN PEELING	7	58.3%
TAILORING	3	25%
DUTY OF HARITHA KARMA SENA	2	16.7%
TOTAL	12	100%

The nature of work done by the respondents along with *thozhilurappu* work is mentioned in this table. This table 4.11 is based on table 4.10, where 24 percent of respondents (twelve members) are doing other employment along with *thozhilurappu* work due to their financial problem. From 24 percent 58.3 percent of the respondents (Seven members) engage in prawn peeling, while 25percent (three members) do the tailoring work. The 17 percent of respondents (two members) are doing the duty of Haritha karma sena along with *thozhilurappu padhathi* work.

FIGURE 4.19

TABLE SHOWING THE NATURE OF ANTISOCIAL BEHAVIOR FACED BY RESPONDENTS



This figure shows how many respondents has completed 100 days of work in *thozhilurappu padhathi* .94% of the respondents have completed 100 days of work while the other 6%have not completed .The hindering factor for respondents to complete the 100 days of work is health problems and also unable to manage both thozhilurappu work and other employment . From this figure, it is clear that the majority of respondents are able to complete 100 days of work.

TABLE 4.12

TABLE SHOWING THE LIFESTYLE DISEASES OF RESPONDENTS

<b>LIFESTYLE DISEASES</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>YES</b>	31	62%
<b>NO</b>	19	38%
<b>TOTAL</b>	50	100%

The figure shows the lifestyle disease of the respondents. 62% of the respondents (thirty one members) have lifestyle diseases .38% of respondents (nineteen members) do not have any lifestyle disease. The lifestyle disease is associated with the way a person lives. These diseases are non-communicable diseases and it is caused mainly by lack of physical activity and unhealthy eating, a stressful lifestyle. From this figure, it is clear that the majority of respondents have lifestyle diseases.

TABLE 4.13

TABLE SHOWING THE NATURE OF LIFESTYLE DISEASE AMONG RESPONDENTS

<b>NATURE OF LIFESTYLE DISEASE</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>DIABETICS</b>	14	43.8%
<b>CHOLESTEROL</b>	11	34.4%
<b>PRESSURE</b>	7	21.9%
<b>CANCER</b>	0	0
<b>OTHER</b>	0	0
<b>TOTAL</b>	32	100%

The figure shows the lifestyle disease among respondents. This table is based on table 4.12, where 62percent of respondents (thirty one members) have lifestyle disease .From 62 % of respondents, 43.8% of them suffer from diabetes. 34.4 percent of the respondents have cholesterol. 22% of the respondents suffer from hypertension. From this table it is clear that majority of respondent have diabetics

TABLE 4.14

TABLE SHOWING THE HEALTH PROBLEMS AS A RESULT OF THOZHILURAPPU PADHATHI WORK

HEALTH PROBLEMS	NUMBER RESPONDENTS	PERCENTAGE
YES	14	28%
NO	36	72%
<b>TOTAL</b>	50	100%

This table shows how many respondents have health problems because of *thozhilurappu padhathi*. 28 % of respondents have health problems. 72% of respondents do not have health problems because of *thozhilurappu* work. The respondent claims that allergies, backache, urinary tract infection, and leg pain are the major health problems because of *thozhilurappu padhathi*.

TABLE 4.15

TABLE SHOWING THE TYPE OF HEALTH PROBLEMS AS A RESULT OF THOZHILURAPPU PADHATHI WORK

HEALTH PROBLEMS	NUMBER OF RESPONDENTS	PERCENTAGE
ALLERGIES	3	21.4%
BACK ACHE	5	35.7%
URINARY TRACK INFECTION	2	14.3%
LEG PAIN	4	28.6%
TOTAL	14	100%

The nature of health problems because of *thozhilurappu padhathi* is mentioned in this table. This table is based on table 4.14, where 28 % of respondents (fourteen members) are suffering from health problems .From 28 % of respondents, 21.4 %of the respondents are (three members) suffering from allergies. 35.7 % (five members) of them have back ache.14.3 % of the respondents (two members) have issues related to urinary tract infection. 29% of them suffer from leg pain.

The respondents claim that they have skin allergies caused by insect venom and nasal polyps due to the dust. The toilet facility is not practical in *thozhilurappu padhathi* because the worksite of members will change after completing the work of a field, still some respondents claim that lack of toilet facility is resulting in urinary tract infection.

TABLE 4.16

TABLE SHOWING THE ACCIDENTS WHILE WORKING IN THOZHILURAPPU PADHATHI WORK

ACCIDENTS WHILE WORK IN FIELD	NUMBER OF RESPONDENTS	PERCENTAGE
YES	6	12%
NO	44	88%
<b>TOTAL</b>	50	100%

The table shows accidents while working in the field .88% of people do not face accidents while working in the field, but about 12% of respondents faced accidents while working in the field. From this table it is able to understand that the majority of respondents did not face any accident while working in the field.

TABLE 4.17

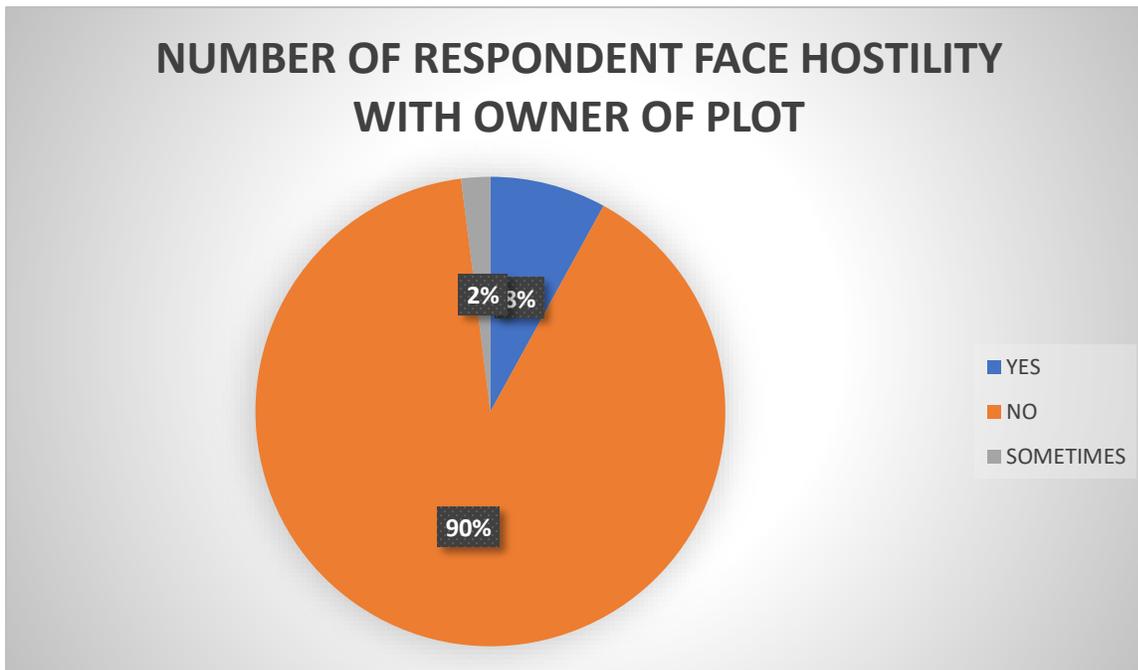
TABLE SHOWING THE TYPE OF ACCIDENTS FACED BY RESPONDENTS WHILE WORKING IN WORKPLACE

NATURE OF ACCIDENT FACED	NUMBER OF RESPONDEND	PERCENTAGE
SLIP AND FALL ACCIDENTLY	2	33.3%
INJURY'S FROM EQUIPMENT	4	66.7%
<b>TOTAL</b>	6	100%

Nature of accidents faced by respondents while working in the field is mentioned in the table. This table is based on table 4.16, their six members have experienced accidents while working in the field. From six members, 67% of the respondents have experienced slip and fall accidently and 33% of them suffered injuries from equipment. The *thozhilurappu padhathi* workers working out in the sun can lead to fatigue. Thus, unconsciously falling from height is possible due to the work circumstances.

FIGURE 4.20

FIGURE SHOWING THE NUMBER OF RESPONDENTS FACE HOSTILITY WITH OWNER OF PLOT



The number of respondents who face hostility with the owner of the plot is mentioned in this table. 90 % of the respondents have a harmonious relationship with owners and 3% of them have hostility with some owners of plots. 2% of them responded that sometimes they have hostility with owners and it is depending upon the circumstance. From this figure, it is clear that only few respondent have hostility with owners of the plot.

TABLE 4.18

TABLE SHOWING THE ANTISOCIAL BEHAVIOR WHILE WORKING IN THE THOZHILURAPPU PADHATHI WORK

ANTISOCIAL BEHAVIOR	NUMBER OF RESPONDENTS	PERCENTAGE
YES	6	12%
NO	44	88%
TOTAL	50	100%

From the table it is evident that 80% of the respondents (44 members) did not face any antisocial behavior. 12% of respondents (6 members) had faced anti-social behavior. Majority of respondents had not faced antisocial behavior while working in the field. The *thozhilurappu padhathi work* is a group work so the unity among workers can prevent from antisocial behavior.

TABLE 4.19

TABLE SHOWING THE NATURE OF ANTISOCIAL BEHAVIOR FACED BY RESPONDENTS

<b>NATURE OF ANTISOCIAL BEHAVIOR</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>SMOKERS</b>	2	33.3%
<b>DRUG ADDICTS</b>	3	50%
<b>ALCOHOLIC PEOPLE</b>	1	16.7%
<b>TOTAL</b>	6	100%

The nature of antisocial behavior faced by respondents is mentioned in the table. This table is based on table 4.18, where six members had faced antisocial behavior while working in the field. From six members, 50 % of respondents (three members) had faced antisocial behavior from drug addicts and 33 % (two members) faced from smokers. 7% of them (one member) had faced antisocial behavior from alcoholic people while working in the field.

❖ To analyze the job satisfaction among *thozhilurappu* women workers.

TABLE 4.20

TABLE SHOWING THE JOB PREFERENCE AMONG RESPONDENTS

JOB PREFERENCE	NUMBER OF RESPONDEND	PERCENTAGE
INTEREST	6	12%
FINANCIAL CRISIS	42	84%
COMPULSION	2	4%
OTHER	0	0
TOTAL	50	100%

From the table it is clear that 84% of respondents joined *thozhilurappu padhathi* because of the financial crisis. 12% of them joined because of interest. 4% of them joined due to the compulsion from family, and this family is forcing them to work because of the economic problem.

A huge majority respondent are joined *thozhilurappu padhathi* because of their financial crises and this problem can be rectify through the salary of *thozhilurappu padhathi*. 12% are joined because of their interest .Through the social interaction among respondent can give relief from psychological stress.

TABLE 4.21

TABLE SHOWING THE SATISFACTION OF RESPONDENTS ON JOB AND WORKPLACE

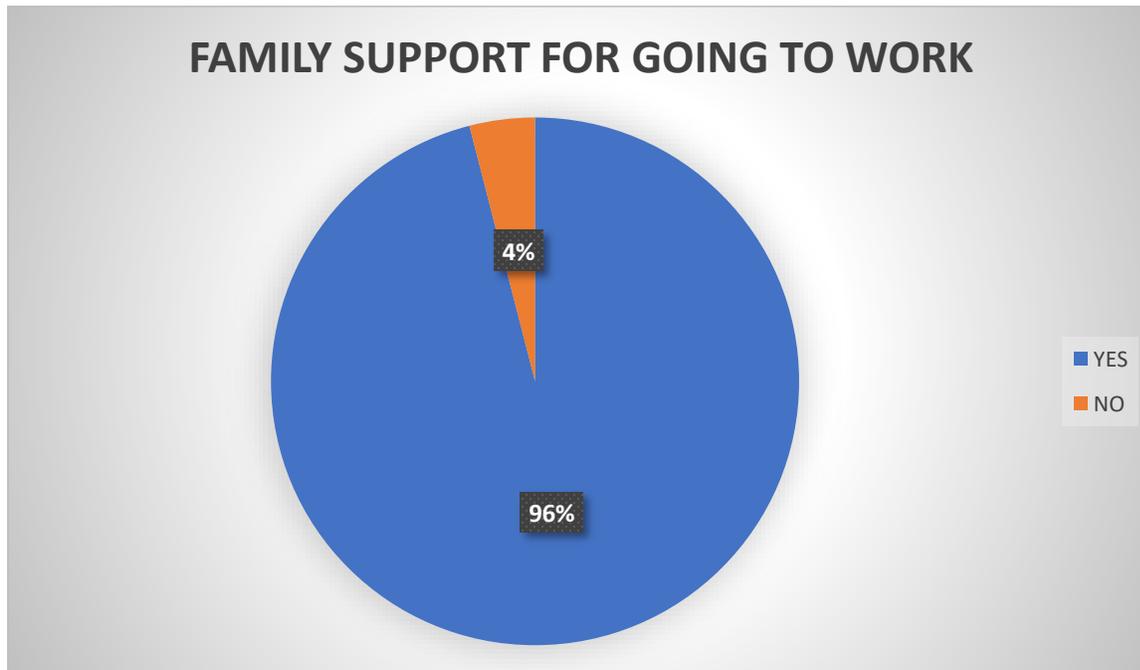
SATISFACTION ON JOB AND WORKPLACE	NUMBER OF RESPONDENT	PERCENT
YES	39	78%
NO	7	14%
SOMETIMES	4	8%
TOTAL	50	100%

From the table it is clear that 78% of respondents are satisfied with their job and workplace but 14% of respondents are not satisfied with their job and workplace. 8 % of respondents are sometimes satisfied and sometimes not satisfied with their job and workplace.

7 % of respondents are working in *thozhilurappu padhathi* because of their poor economic condition these respondents claim that their health problems are hindering them to do physical work in *thozhilurappu padhathi*. That is the factor for dissatisfaction among 7% of respondents on job and workplace. It is possible to analyze from the table that the majority of respondents are satisfied with the workplace and job.

FIGURE 4.21

THE FIGURE SHOWING THE FAMILY SUPPORT FOR GOING TO WORK



From the figure, it is clear that 96% of respondents are getting family support, while 4% of them do not get family support to go for work. The preexisting patriarchal mentality of family prevents their women members from going for work. Even though this 4% of women are working in *thozhilurappu padhathi* as for economic independency in family .Therefore, Majority of respondent is getting family support

TABLE 4.22

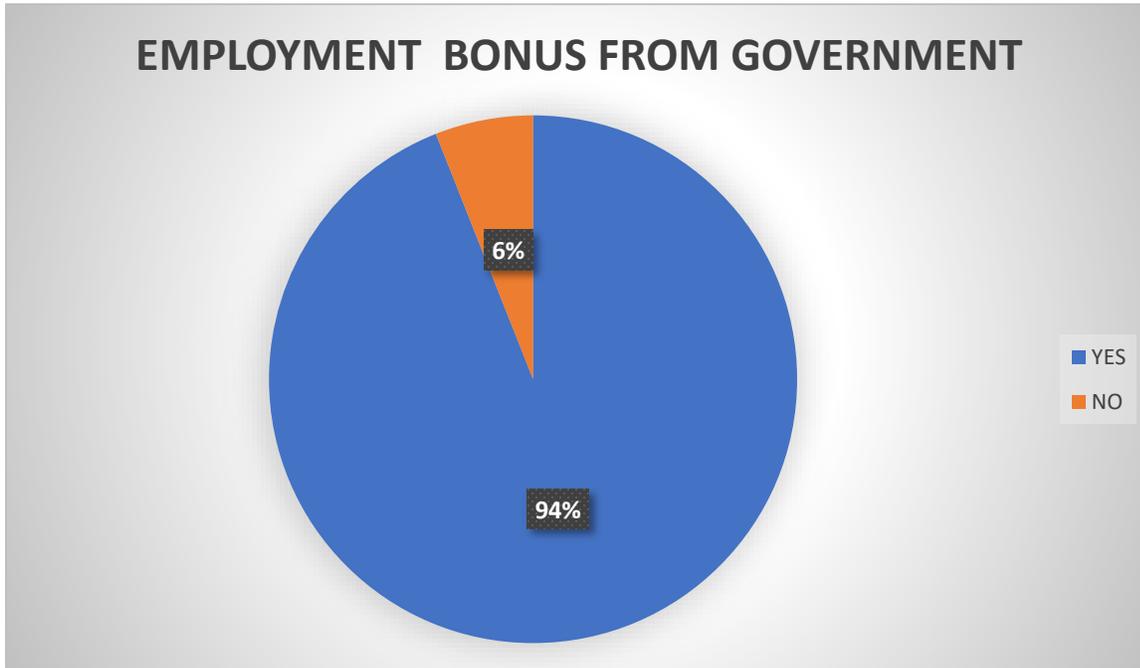
TABLE SHOWING THE CAPACITY OF RESPONDENTS TO MANAGE HOUSEHOLD AND EMPLOYMENT ACTIVITY

<b>CAPACITY TO MANAGE HOUSEHOLD AND EMPLOYMENT ACTIVITY</b>	<b>NUMBER OF RESPONDENT</b>	<b>PERCENTAGE</b>
<b>YES</b>	41	82%
<b>NO</b>	6	12%
<b>SOMETIMES</b>	3	6%
<b>TOTAL</b>	50	100%

From the table it is clear that 82% of respondents have the capacity to manage both household and employment activity. 12% of them do not have the capacity to manage both household and employment activity because of their health problems. 6 % of the respondents claim that sometimes they will be able to manage both work and some other time they are unable to manage both household and employment activity

FIGURE 4.22

THE FIGURE SHOWING, HOW MANY RESPONDENTS GET EMPLOYMENT BONUS FROM GOVERNMENT



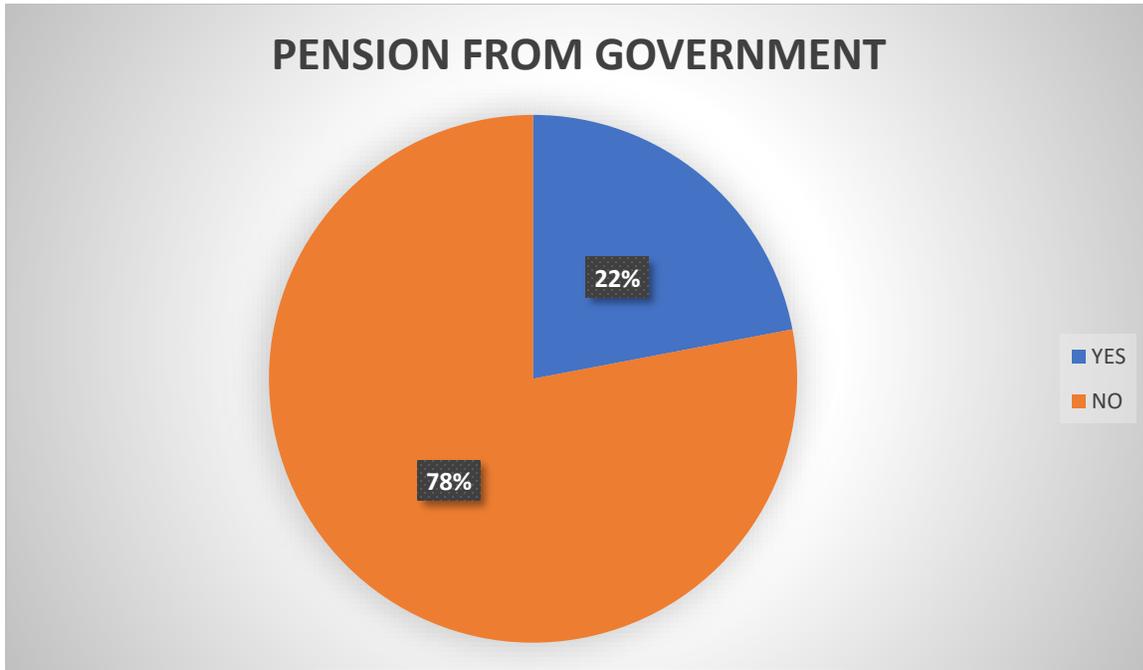
The figure shows the employment bones received by respondents from the government. 94 % of respondents gave a positive response of receiving bones while 6 percent of respondents did not get bones.

The one year of *thozhilurappu* starts in May and the *thozhilurappu* workers have to complete the 100 days of work in March .The respondent will get 1000 rupees as bonus only for the workers who had completed 100 days of work within a year.

94% of respondents have completed 100 days of work within a year and they have received 1000 rupees. However, 6 % does not receive 1000 rupees because of economic circumstance they went for other work along with *thozhilurappu padhathi* .Thus they were unable to complete 100 day of work in *thozhilurappu padhathi*.

FIGURE 4.23

THE FIGURE SHOWING THE PENSION FROM GOVERNMENT



The figure shows how many respondents are receiving the pension from the government. 22% of the respondents implied a positive response of getting pension while the other 78% of them responded of not getting pension from the government. The 22 % depend upon pension and this pension is not provided from *thozhilurappu padhathi* . The pension is mainly the old age pension and Kerala widow pension scheme.

The Kerala government has approved the *thozhilurappu padhathi* scheme to provide pension and other benefits to *thozhilurappu padhathi* workers. The respondent claims that the government just approved it but did not start distributing the pension. Therefore, currently all members of *thozhilurappu padhathi* is not receiving pension of *thozhilurappu padhathi*, but they expect pension of *thozhilurappu padhathi*

TABLE 4.23

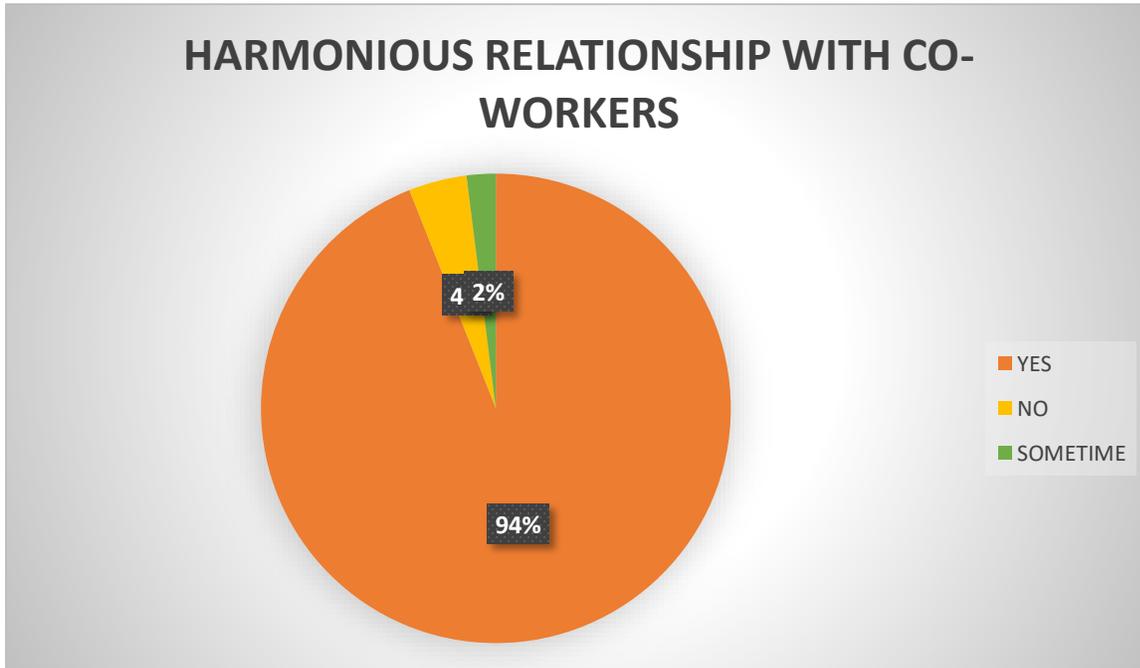
TABLE SHOWING THE SATISFACTION OF RESPONDENTS ON INCOME

<b>SATISFACTION ON INCOME</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>NO</b>	50	100%
<b>YES</b>	0	0
<b>TOTAL</b>	50	100%

All respondents are not satisfied with the per day salary of 291. They expected to increase the salary. Therefore, 100% of respondents are not satisfied. The majority of respondents claim that the consumer expenditure in the society is increasing. They are struggling to meet the daily needs of their family because of the high price level in the market, water bill, electricity bill etc. Therefore, they desire to increase the salary to make economic stability.

FIGURE 4.24

THE FIGURE SHOWING, HOW MANY RESPONDENTS HAVE HARMONIOUS RELATIONSHIP WITH CO-WORKERS



This diagram reveals the harmonious relationship of respondents with co - workers. 94% of the respondents are having a harmonious relationship while 4% of them do not have a harmonious relationship. 2% of the respondents replied that sometimes they have a harmonious relationship and sometimes they do not have a harmonious relationship with co -workers. The Harmonies relationship with co- workers is necessary for better work. The psychological and social well-being of *thozhilurappu* women workers can ensure through harmonies relationship .From this figure it is clear that majority of respondent have harmonies relationship with co workers

TABLE 4.24

TABLE SHOWING THE EXPECTATION OF RESPONDENTS TO INCREASE THE NUMBER OF EMPLOYMENT DAYS

EXPECTATION OF RESPONDENTS TO INCREASE THE NUMBER OF EMPLOYMENT DAYS	NUMBER OF RESPONDENT	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

From the table it is evident that every respondents is expected to increase the employment days at least from 100 to 150 days of work. So 100% of respondents agreed. The respondent desires the authority to increase the number of employment days, which can lead to getting salary for more than 100 days of work. The respondent claims that they can become economically stable through the implementation of more than 100 days of work. Respondents are ready to complete each muster roll of *thozhilurappu padhathi* even if it is increasing.

❖ **To analyze the impact of covid 19 on *thozhilurappu* women workers in the vypin island**

TABLE 4.25

TABLE SHOWING THE NUMBER OF RESPONDENTS RECEIVED COVID 19 VACCINATION

<b>COVID 19 VACCINATION RECEIVED</b>	<b>NUMBER OF RESPONDENT</b>	<b>PERCENTAGE</b>
<b>BOTH FIRST AND SECOND DOSE</b>	50	100%
<b>NOT RECEIVED</b>	0	0
<b>TOTAL</b>	50	100%

From this table it is clear that every respondent received the first and second Covid 19 vaccine. So 100% of the respondents are vaccinated. The Government has provided both COVISHIELD vaccine and COVAXIN vaccine. The *thozhilurappu padhathi* workers get the vaccine and this vaccine is helpful to reduce the probability of contracting COVID 19. Through vaccination, the body becomes prepared to shield off viruses by making your immune system stronger.

TABLE 4.26

TABLE SHOWING THE NUMBER OF RESPONDENTS BECOME COVID 19 POSITIVE (AFFECTED)

<b>RESPONDENT BECOME COVID 19 POSITIVE</b>	<b>NUMBER OF RESPONDENT</b>	<b>PERCENTAGE</b>
<b>YES</b>	15	30%
<b>NO</b>	35	70%
<b>TOTAL</b>	50	100%

The table reveals how many respondents become COVID 19 positive. From the total number of respondents 30% of respondents (fifteen members) had become COVID 19 positive. The COVID 19 virus does not affect 70% of the respondents (thirty-five members).

Coronavirus disease (COVID-19) is an infectious disease caused by SARS - CoV -2 virus. Most people who fall sick with COVID 19 will experience mild to moderate symptoms and recover with or without special treatment. However, some will become seriously ill and require medical attention.

30% of respondents are affected by COVID 19 but they recover from the positive condition by following quarantine measures and medical attention.

TABLE 4.27

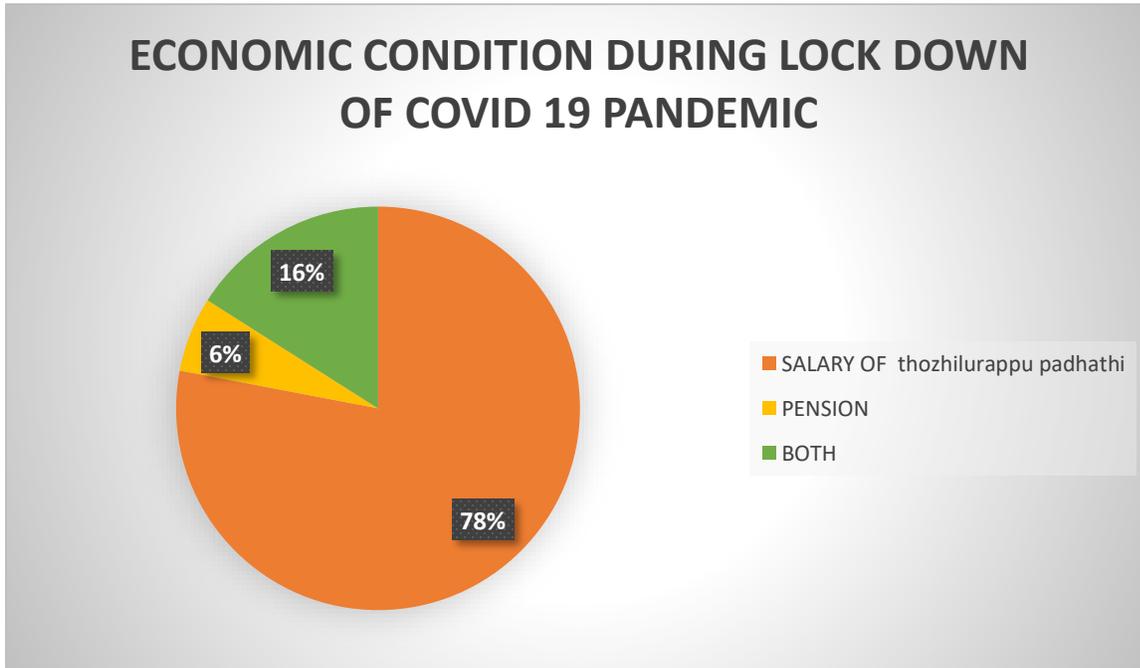
TABLE SHOWING THE POST COVID 19 HEALTH ISSUE AMONG RESPONDENTS

<b>POST COVID 19 HEALTH ISSUE</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENT</b>
<b>TIRED</b>	8	53.3%
<b>SHORTNESS OF BREATH</b>	2	13.3%
<b>BODY PAIN</b>	5	33.3%
<b>OTHER</b>	0	0
<b>TOTAL</b>	15	100%

The table shows the response of the participant regarding Post Covid 19 health issues .This table is based on table 4.26, where 30% of respondents (fifteen members) have become COVID 19 positive and they face the POST COVID 19 health issue. Among 30% of respondents, 53.3% of respondents (eight members) reported being tired while 13.3 % of them (two members) are suffering from shortness of breath. 33.3% of respondents (five members) suffer from body pain.

FIGURE 4.25

THE FIGURE SHOWING THE ECONOMIC CONDITION OF RESPONDENTS DURING LOCK DOWN OF COVID 19 PANDEMIC



The figure reveals during Covid 19 pandemic lock down period 78% of the respondent maintained their livelihood by depending on the salary of *thozhilurappu padhathi*. 16 % of respondent depend upon the pension and 6 % of them depend up on both salary of *thozhilurappu padhathi* and pension.

From this figure, it is clear that the majority of people depend on the salary of *thozhilurappu padhathi*. Even in the Covid 19 lockdown period the *thozhilurappu padhathi* work has continued, in this circumstance the economic condition of the family was managed with the salary of *thozhilurappu padhathi*. The Government free food Kit available from the public distribution system has helped them to live without poverty.

The 16 % of respondents depend upon pension and this pension is not provided from *thozhilurappu padhathi* . The pension is mainly the old age pension and Kerala widow pension scheme.

The Kerala government has approved the *thozhilurappu padhathi* scheme to provide pension and other benefits to *thozhilurappu padhathi* workers. The respondent claims that the government just approved it but did not start distributing the pension . Therefore, currently all members are not receiving pension of *thozhilurappu padhathi*, but they are expecting pension of *thozhilurappu padhathi*.

TABLE 4.28

TABLE SHOWING THE NUMBER OF RESPONDENTS GET GOVERNMENT FREE FOOD KIT

AVAILABILITY OF GOVERNMENT FREE FOOD KIT	NUMBER OF RESPONDENTS	PERCENTAGE
YES	50	100%
NO	0	0
TOTAL	50	100%

From this table it is clear that all respondents are getting the government free food kit and therefore, it is 100%. The government free kit was a huge help from the government during the Covid 19 pandemic period. The free food kit was distribute through the Government public distribution system for both APL and BPL. The Free food kit was started during the period of April – May period of 2020 and ended by September of 2021. The respondent claims that through Government free food kits the people were able to survive the Covid 19 pandemic period without poverty.

TABLE 4.29

TABLE SHOWING THE NUMBER OF RESPONDENTS PRACTICE SOCIAL DISTANCING

SOCIAL DISTANCE	NUMBER OF RESPONDENTS	PERCENTAGE
YES	46	92%
NO	1	2%
SOMETIMES	3	6%
TOTAL	50	100%

The table reveals whether the respondent ensures social distancing while working in the field. From the entire sample, 92 % of respondents ensure social distancing. 2 % of respondents do not ensure social distancing while working in the field. 6 % of respondents claim that they sometimes follow social distancing and some time may not follow social distancing while working in the field.

Social distance is a physical distance of 2 meter or 6 feet from each person and it is intended to prevent the spread of contagious diseases such as Covid 19. In *thozhilurappu padhathi* the number of times people come into contact with each other has reduced through social distancing. From table it is clear that a huge majority of people maintain social distancing in the field as to prevent from Covid 19 pandemic

TABLE 4.30

TABLE SHOWING THE NUMBER OF RESPONDENTS GET COVID 19 PROTECTIVE EQUIPMENT

<b>AVAILABILITY OF COVID 19 PROTECTIVE EQUIPMENT</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>YES</b>	23	46%
<b>NO</b>	27	54%
<b>TOTAL</b>	50	100%

From this table it is evident that 46% of respondents (23 members) are satisfied. 54% respondents (27 members) are not satisfied with Covid 19 protective equipment. Thus, the majority of members claim that they do not get Covid 19 protective equipment regularly.

TABLE 4.31

TABLE SHOWING THE TYPE OF PROTECTIVE EQUIPMENT USED BY RESPONDENTS

NATURE OF PROTECTIVE EQUIPMENT AVAILABLE	NUMBER OF RESPONDENTS	PERCENTAGE
GLOVES	19	82%
MASK	4	18%
SANITIZER	0	0
ALL	0	0
TOTAL	23	100

The table mentions the type of protective equipment that are used by respondents. This table is based on table 4.30, where 23% respondents are satisfied with the protective Equipment provided by the Authority. From 23 respondents , 82% ( 19 members) of the respondents are using gloves while 18 % of the respondents( four members) are using masks which are provided by authority . All respondents of *thozhilurappu padhathi* were wearing masks but 4% of respondents are using the mask, which is provided by authority. The 23 members are using the protective equipment, which is provided in the initial stage of pandemic. Thus, Protective equipment is not regularly provided.

Gloves are necessary for *thozhilurappu padhathi* work thus they are doing physical work in the field. At the same time, gloves prevent from the spread of Covid 19 pandemic.

TABLE 4 .32

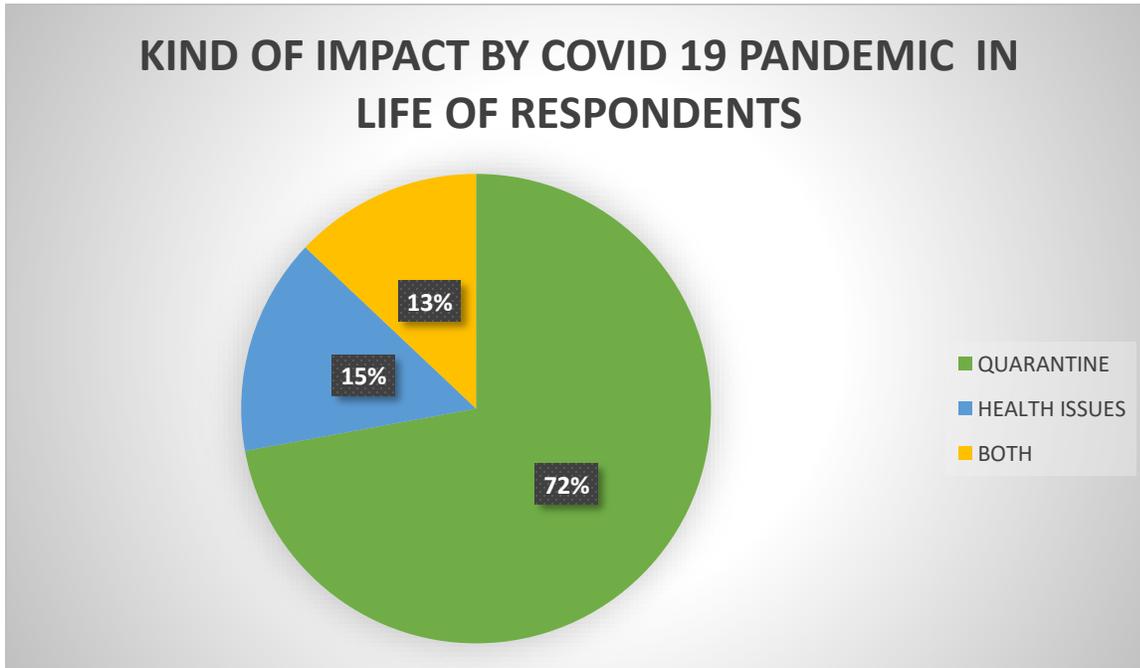
TABLE SHOWING THE NUMBER OF RESPONDENT FACED COVID 19 PANDEMIC IMPACT IN THEIR LIFE

<b>COVID 19 PANDEMIC IMPACT IN THEIR LIFE</b>	<b>NUMBER OF RESPONDENTS</b>	<b>PERCENTAGE</b>
<b>YES</b>	29	58%
<b>NO</b>	21	42%
<b>TOTAL</b>	50	100%

The table highlights the impact of Covid 19 pandemic in the lives of respondents. 58percentage of respondents (twenty-nine members) had affected Covid 19. Covid 19 does not affect 42% of them (twenty-one members). From this table it is possible to analyze that the majority of respondents faced the impact of Covid 19 pandemic and the lockdown.

FIGURE 4.26

THE FIGURE SHOWING NATURE OF IMPACT FROM COVID 19 PANDEMIC

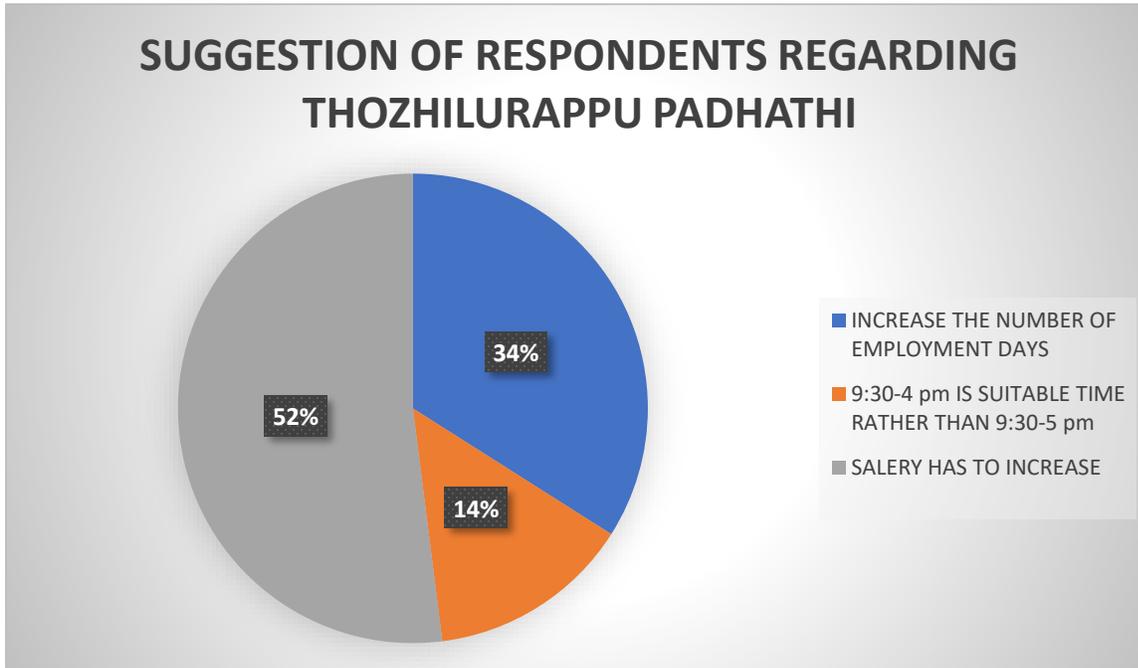


In the survey regarding the number of respondents affected by Covid 19 pandemic is analyzed in this figure. This figure is based on table 4.32, where 29 respondents have claimed that they have been faced with the impact of covid 19 pandemics in their life. From this, 29 respondents 72% of them had quarantined during pandemic. 15% of the respondents suffered from other health issues while 13% of them faced both quarantine and health issues.

The 72% of the respondents has quarantined during Covid 19 pandemic and this quarantine includes both Covid positive patients, quarantine for primary contact people, and quarantine of secondary contacts of a Covid 19 patient. The quarantine had affected the psychological, economic and social condition of people. Still quarantine was a major solution for the spread of deadly virus coronavirus. 15 % of the respondents faced health issues of Covid 19. 13 % of the respondent had faced both quarantine and health issues.

FIGURE 4.27

THE FIGURE SHOWING SUGGESTION OF RESPONDENTS REGARDING THOZHILURAPPU PADHATHI



The suggestions of respondents regarding *thozhilurappu padhathi* are mentioned here. 52% respondents have suggested Salary has to increase. 14% respondents suggest that 9:30am-4pm is a suitable time for working in *thozhilurappu padhathi* rather than 9:30am -5pm. Increasing the number of employment days is another suggestion by the 34% respondents.

The majority of respondents claim that the consumer expenditure in the society is increasing. They are struggling to meet the daily needs of their family because of the high price level in the market, water bill, electricity bill etc. Therefore, they desire to increase the salary to make economic stability.

34% of respondents desire to increase the number of employment days, which can lead to getting a salary for more than 100 days of work.

14% of the respondents desired to change the time schedule from 9:30am to 4 pm rather than the current timing 9:30am to 5 pm. Many of the workers have to travel long distances from home to the working field. The family and social circumstances are forcing them to reach home as soon as possible before 6 pm.

**CHAPTER- V**

**CONCLUSION, FINDINGS AND**

**SUGGESTIONS**

## CHAPTER V

### CONCLUSION, FINDINGS AND SUGGESTIONS

#### MAJOR FINDINGS

The Mahatma Gandhi National Rural Employment Guarantee act is denoted as *thozhilurappu padhathi* in Kerala. This Act ensures a small but accurate income to all members engaged in work, this has been an important link in the economic and social empowerment of India and has since been an important link in the economic and social empowerment of Indian villagers, especially women. The central Government has increased the guaranteed wage by Rs 20 in Kerala, which means 291Rs per day for *thozhilurappu* workers. The increase will benefit to 15.65 lakh workers. 89% of them are women. Kerala is a state with the highest representation of women workers. The Mahatma Gandhi National Rural Employment Guarantee Act has aimed to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work.

The first objective of the study is to evaluate the socio economic conditions of *thozhilurappu* women workers in the Vypin Island. Respondents' age is considered in the first section and it is found that respondents with age 38 to 48 age slot had majority in working at *thozhilurappu padhathi*. People of old age with an age of 58 and above are engaging in *thozhilurappu padhathi* because of the economic instability in the family. The members from age slot of 18 to 28 had less participation in *thozhilurappu padhathi* because these younger age people are working in white-collar jobs. Another finding is that the majority of respondents' educational qualification is below SSLC. Majority of respondents are Hindu and the SC caste category respondent has huge participation.

This study also reveals that every respondent is getting 291 rupees as a per day salary from the gram panchayat. Some respondents claim that there is a chance to increase the salary of a mate (leader) from 291 to 700. Moreover, they also said that this provision would be applicable only to

the mate (leader) who has an SSLC pass. Another finding is that majority of the respondents are living in nuclear family, this is because of the influence of urbanization in rural area family

Second objective of the study is to understand the working condition of *thozhilurappu* women workers in the vying island .The working nature of the respondents are non-seasonal. The financial problems of members is provoking them to do work without considering the climate condition. Every respondent is working both on agricultural and cleaning work. They also increase the depth of the wetland. Through planting indigenous saplings, a sustainable environment can be created by *thozhilurappu* women workers. The Mate (leader) has a prominent role in coordinating the *thozhilurappu* workers. Every respondent is working five and above hours. Their work will start by 9:30 pm and it will end by 5:00pm.

Another finding from the study was 20 % of respondents experience work pressure. 80% of the participants report no pressure during work. Increasing the depth of water bodies like ponds is creating work pressure. The time bound to complete the work of *thozhilurappu padhathi* is also creating pressure on the 20% of the respondent. Every respondent is satisfied with the rest interval. The government is give a proper time interval for having food in *thozhilurappu padhathi*.

Every respondents are vaccinated with TT. TT is meant by tetanus toxoid. It is a toxoid vaccine to prevent disease caused by Clostridium Tetani. Every respondent are getting a doxycycline tablet from gram panchayat. Primary health centers and Asha workers provide it for two weeks. Doxycycline tablets are used to prevent rat fever. The TT vaccine and Doxycycline tablet provided primary health center is preventing diseases.

The study finds that the facility for rest has to improve by fulfilling the basic needs of the members in the fields. The majority of respondents are satisfied with first aid measures in the field but some respondents are not satisfied so there is a need for increasing the quality of the product. The study reveals that the majority of respondents are satisfied with sanitation facilities. But some respondents are not satisfied, so it is necessary to ensure improvement in sanitation facilities. The respondents are expecting more help and facility from Grama panchayat and majority of respondents are satisfied.

Another finding is that about 24% respondents are not satisfied with the salary of *thozhilurappu padhathi* and they are struggling to meet daily needs so they are doing other employment along with *thozhilurappu padhathi* work. Prawn peeling, tailoring, duty of haritha karma sena is the other employment done by the respondent. The majority of *thozhilurappu* women workers are not doing any other employment, thus they are depending on the salary of *thozhilurappu padhathi*. The study find that a large majority of respondents are able to complete *thozhilurappu padhathi* work; a few were unable to complete because of health problems.

Another finding from analysis is that the majority of respondents have lifestyle diseases such as diabetics, cholesterol, and pressure. Among the lifestyle diseases, the majority of the respondents have diabetics, some respondents have cholesterol and few of them have pressure etc. This study analyzes the health problem as a result of *thozhilurappu* work .Among respondents some respondents claim that they are facing health problems such as allergies , back ache , urinary tract infection and leg pain. This study also analyzes how many respondents has faced accidents while working in the field, among the respondent only few had faced accidents such as injuries from equipment, slip and fall accidently.

This study find that *thozhilurappu* women work have a harmonious relationship with plot owners only few respondent have hostility with owners .The *thozhilurappu* work .is group work so majority of respondent does not faced any antisocial behavior and only few has faced antisocial behavior from smokers ,drug addicts , alcoholic people .

The third objective is to analyze the job satisfaction among *thozhilurappu* women workers in the Vypin Island. A majority respondent are joined *thozhilurappu padhathi* because of their financial crises and this problem can be rectify by salary of *thozhilurappu padhathi*. 12% are joined because of their interest .Through the social interaction among respondent can give relief from psychological stress. The majority of respondents are satisfied with the workplace and job. Only a few respondents are dissatisfied with the workplace and job. This study finds that the majority of respondents are getting family support and through this support, a large majority of *thozhilurappu* women workers has capacity to manage both the household and employment activity.

This study found that 94% of respondents have completed 100 days of work within a year and they have received 1000 rupees. But 6 % did not receive 1000 rupees because of economic circumstances they went for other work along with *thozhilurappu padhathi* .Thus they were unable to complete 100 day of work in *thozhilurappu padhathi* .Another finding is that 22 % depend upon pension and this pension is not provided from *thozhilurappu padhathi* . The pension is mainly the old age pension and Kerala widow pension scheme. The Kerala government has approved the *thozhilurappu padhathi* scheme to provide pension and other benefit to *thozhilurappu padhathi* workers. The respondent claims that the government was just approved but did not start distributing the pension . Therefore, currently all members of *thozhilurappu padhathi* are not receiving pension of *thozhilurappu padhathi*, but they expect pension of *thozhilurappu padhathi*.

This study finds that all respondents are not satisfied with the per day salary of 291. They expected to increase the salary. Therefore, 100% of respondents are not satisfied. The majority of *thozhilurappu* women workers claim that the consumer expenditure in the society is increasing. They are struggling to meet the daily needs of their family because of the high price level in the market, water bill, and electricity etc. Therefore, they desire to increase the salary to make economic stability.

The *thozhilurappu* women workers are expecting more than 100 days of work , they can become economically stable through the implementation of more than 100 days of work .Respondent are ready to complete each muster roll of *thozhilurappu padhathi* even though if it is increasing.

The fourth objective of the study is to analyze the impact of Covid 19 on *thozhilurappu* women workers in the Vypin Island. Every respondent received first and second Covid 19 vaccines. So 100% of the respondents are vaccinated. The Government has provided both COVISHIELD vaccine and COVAXIN vaccine. The *thozhilurappu padhathi* workers get the vaccine and this vaccine is helpful to reduce the probability of contracting COVID 19. Through vaccination, the body becomes prepared to shield off viruses by making your immune system stronger. The study find that among respondents the majority of respondents does not become COVID 19 positive. From the total number of respondents 30% of respondent 15 (members) has affected and become COVID 19 positive. 70% of the respondents 35 (members) are not affected by the COVID 19

virus. 30% of respondents are affected by COVID 19 but they recover from the positive condition by following quarantine measures and medical attention.

The study find the post Covid 19 health issues ,among 30 % of respondents some become tired , some experienced shortness of birth, and some respondents feel body pain while working in the field . This study also finds the economic condition of respondents during the lockdown of Covid 19 pandemic. Many of the respondents depended on the salary of *thozhilurappu padhathi* and also depended on pension .This pension is not from *thozhilurappu padhathi* , Thus it is from old age pension and Kerala widow pension scheme. Therefore, currently all members of *thozhilurappu padhathi* are not receiving pension of *thozhilurappu padhathi*, but they expect pension of *thozhilurappu padhathi*.

This study finds that every respondent has received a Government free food kit distributed by public distribution system. The *thozhilurappu* women workers get strength to overcome the lockdown period of Covid 19 through the availability of Government free food kits. Majority of respondents maintained social distance while working in the field. This study found that the majority of member's claim that they are not satisfied with the availability Covid 19 protective equipment .The respondents claim that Gloves and masks are the protective equipment provided by Authority and they also said that these products were distributed only once.

This study has found the majority of respondents had faced Covid 19 pandemic impact in their life, mainly in the form of quarantine and post Covid 19 health issues. The quarantine is experienced by Covid 19 positive member, primary contact members, and secondary contact members. The suggestion of respondent regarding *thozhilurappu padhathi* was that majority of respondent are desiring of increasing of salary, some respondent expect the changing the time schedule from 9: 30 am to 4: 00 pm, and they also expect the increasing the number of employment days for maintain economic stability.

# SUGGESTIONS

- ❖ Many of the *thozhilurappu* women workers have poor economic conditions, so increasing their salary can rectify their problem.
- ❖ Based on respondent's suggestion, 9:30am-4pm is a suitable time for working in *thozhilurappu padhathi* rather than 9:30am -5pm. Many of the workers have to travel long distances from home to the working field. The family and social circumstance is provoking them to reach home as soon as possible before 6 pm
- ❖ The increase in the number of employment days, which can lead to getting a salary for more than 100 days of work.
- ❖ The authority has to make weekly assessments regarding availability of tools and equipment that are needed for *thozhilurappu padhathi* work
- ❖ Free Medical checkup should be provided accordingly.
- ❖ Providing pension from *thozhilurappu padhathi* can create economic indecency among old age people.
- ❖ Providing uniforms to *thozhilurappu* workers can increase social dignity.

# CONCLUSION

The Mahatma Gandhi National Rural Employment Guarantee Scheme has aimed to enhance livelihood security in rural area by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work

The social mobility of women is increased through membership in *thozhilurappu padhathi*. The role of Mate is increasing the leadership quality of women and which will result in to active participation of women in society. This study analyzes that the majority of women are getting support from family, which enables them to manage both *thozhilurappu padhathi* work and household activity. The TT vaccine provided from Grama panchayat is very beneficial for increasing the immunity body, because they are doing physical work in an environment even having reptiles like serpents. The Doxycycline tablet available from the Government public hospital is helpful to prevent malaria, though they are working even in contaminated water while increasing the depth of the water body's like pond etc.

Women empowerment can be achieved through the active participation of *thozhilurappu* women workers. The unity and harmonious relationship between the members are helpful to prevent antisocial behavior while working in the field. The women become economically independent through *thozhilurappu padhathi* salary of 291 per day work. The social dignity of *thozhilurappu padhathi* workers can increase through the implementation of a uniform system.

Coronavirus disease (COVID-19) is an infectious disease caused by SARS - CoV -2 virus. Most people who fall sick with COVID 19 will experience mild to moderate symptoms and recover with or without special treatment. However, some will become seriously ill and require medical attention. 30% of respondents are affected by COVID 19 but they recover from the positive condition Covid 19 by following quarantine measures and medical attention. During the lockdown period, the salary of *thozhilurappu padhathi* was relief as to sustain their life .The Government free food kit also helped *thozhilurappu* women to live without poverty.

The *thozhilurappu* workers' plant sapling in the worksite is creating an environment without degeneration. The *thozhilurappu* workers are doing a prominent role in society by ensuring sustainable development and for a better future.

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# **APPENDIX**

## Questionnaire

A sociological analysis on the problem faced by *thozhilurappu* women workers involved in Mahatma Gandhi National Rural Employment Guarantee Scheme with special reference to the Vypin Island

### **To evaluate the socio economic conditions of *thozhilurappu* women workers**

1) Age:

- a) 18-28                      b) 28-38                      c) 38-48                      d) 48-58                      e) 58and above

2) Educational qualification:

- a) Below SLCC              b) SSLC                      c) HSC                      d) undergraduate              e) other

3) Religion:

- a) Hindu                      b) Christian                      c) Muslim                      d) other

4) Caste category:

- a) OBC                      b) SC                      c) General                      d) other

5) Income (per day)

- a) 291                      b) 700

6) Type of ration card you own

- a) APL                      b) BPL

7) Marital status

- a) Married                      b) unmarried                      c) widow                      d) Divorced                      e) other

8) Number of family members

- a) 1                      b) 2                      c) 3                      d) 4                      e) 5                      f) 5 and above

9) Type of family:

- a) Nuclear family                      b) joint family

10) Number of earning family member

- a) 1                      b) 2                      c) 3                      d) 4                      e) 5and above

11) Income of husband or other family member

- a) 100-1000                      b) 1000-2000                      c) 2000-3000                      d) 3000 and above

12) Type of residence

- a) Own home                      b) rented home                      c) lease

**To understand the working condition of *thozhilurappu* women workers**

13) What is the nature of your work?

- a) Seasonal                                      b) non seasonal                                      other

14) What kind of *thozhilurappu* work are you doing?

- a) Agricultural work                                      b) cleaning                                      c) both                                      d) other

15) How long have you been working in the *thozhilurappu padhathi*?

- a) 1-5 years                                      b) 5-10 year                                      c) 10 years and above

16) Are you working as Mate (leader) in *thozhilurappu padhathi*?

- a) Yes                                      b) No

17) How many hours do you work in a day?

- a) 1 hour                      b) 2 hour                      c) 3 hour                      d) 4 hour                      e) 5 hour                      f) 5 and above

18) Are you experiencing any work pressure?

- a) Yes                                      b) No

19) Are you getting sufficient rest intervals?

- a) Yes                                      b) No

20) Are you getting enough rest facility?

- a) Yes                                      b) No

21) Are you get a proper time interval for having food?

- a) Yes                                      b) No

22) Are you vaccinated for the TT vaccine?

- a) Yes                                      b) No





45) Are you affected by Covid 19 pandemic?

- a) Yes
- b) No

If yes, do you face any post Covid 19 issues that hinder your work?

- a) Tired
- b) Shortness of breath
- c) body pain
- d) other

46) How did you live during Covid 19 pandemic lockdown?

- a) Salary of *thozhilurappu pathathi*
- b) pension
- c) both
- d) Others.....

47) Do you get a Government Free food kit during Covid 19 pandemic?

- a) Yes
- b) NO

48) Are you practicing social distancing while working in the field?

- a) Yes
- b) No
- C) Sometime

49) Do you get the government's Covid 19 protective equipment?

- a) Yes
- b) No

If yes, what kind of protective equipment do you get?

- a) gloves
- b) Mask
- c) sanitizer
- d) all

50) Has the pandemic affected your work?

- a) YES
- b) NO

If yes, How?.....

51. Do you have any suggestions?

# THE ROLE OF KUDUMBASREE IN ECONOMIC EMPOWERMENT OF WOMEN



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MARCH 2022



**THE ROLE OF KUDUMBASREE IN ECONOMIC EMPOWERMENT OF WOMEN WITH  
SPECIAL REFERENCE TO TRIPUNITHURA MUNICIPALITY.**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in fulfillment of the  
requirements for the award of the degree of **Master of Arts in Sociology**

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## CERTIFICATE

I certify that the thesis entitled **“THE ROLE OF KUDUMBASREE IN ECONOMIC EMPOWERMENT OF WOMEN WITH SPECIAL REFERENCE TO TRIPUNITHURA MUNICIPALITY”** is a record of bonafide research work carried out by **ATHIRA VENUGOPAL** under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.



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### DECLARATION

I,ATHIRA VENUGOPAL hereby declare that the thesis entitled "THE ROLE OF KUDUMBASREE IN ECONOMIC EMPOWERMENT OF WOMEN WITH SPECIAL REFERENCE TO TRIPUNITHURA MUNICIPALITY" is a bonafide record of independent research work carried out by me under the supervision and guidance of VYSHNAVI SIVADAS. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



ATHIRA VENUGOPAL

## ACKNOWLEDGEMENT

In this humble endeavour I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Dr. Sr. Vinitha CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, Head of the Department of Sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Smt Vyshnavi Sivadas for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomus). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

March 2022



Athira Venugopal

# CONTENTS

CHAPTER	PAGE
1. INTRODUCTION.....	1-14
2. REVIEW OF LITERATURE.....	15-48
3. METHODOLOGY.....	49-52
4. DATA ANALYSIS AND INTERPRETATION.....	53-72
5. FINDINGS, SUGGESTIONS AND CONCLUSION.....	73-78

**BIBLIOGRAPHY**

**APPENDIX**

## LIST OF TABLES

SL NO	TABLE NO	TITLE	PAGE NO
1	4.1	Age of the respondents	54
2	4.2	Marital status of the respondents	55

## LIST OF FIGURES

SL NO	FIGURE NO	TITLE	PAGE NO
1	4.1	Caste and kudumbasree membership	56
2	4.2	The educational qualification and the years of experience	57
3	4.3	Financial assistance and empowerment	58
4	4.4	Income level and kudumbasree factors	59

5	4.5	Effectiveness of Ashraya and Bhavanasree Programme for the poor people	61
6	4.6	Utilizing financial assistance or loan schemes in improving the position of women in the family and society.	62
7	4.7	Effectiveness of Micro credit and SHG for economic empowerment	63
8	4.8	Kudumbasree features attracts the members to join kudumbasree	64
9	4.9	Problems or issues faced by the kudumbasree units.	65
10	4.10	Support from family to become the influential actors of the society.	66
11	4.11	Decision making in kudumbasree	67
12	4.12	Enhancement of the skills to achieve empowerment.	68

**CHAPTER I**  
**INTRODUCTION**

# **CHAPTER I**

## **INTRODUCTION**

Women empowerment occupies the Centre of discussions of social development and is carried by UNDP (United Nations Development Programme). It continues to be highly debated and contested. Different scholars have defined empowerment in a different ways depending upon the contextual variations. The study seeks to present varied theoretical perspectives on empowerment and reinforce them with current empowerment practices in Indian settings. Based on relevant literature on empowerment, an attempt has been made here to examine the definitions and its cultural and contextual variations. This provides a linkage between theory and practice of empowerment in Indian society. (Amman, 2018)

### **EMPOWERMENT**

Empowerment is related to the beliefs, norms and values of every society; therefore, empowerment can be revealed differently in different societies. The concept of empowerment varies according to different cultural setting. It includes a situation where one can attain control of one's own life socially, economically, politically and culturally. All these types of empowerment have different meaning. Economic empowerment is explained by several scholars where they don't consider the political and social aspect of it. There is no universally accepted definition given to the concept of empowerment. (Batliwala.S, 2007)

### **ECONOMIC EMPOWERMENT**

The movement for empowerment of women began in the nineteenth century in North America and laid the foundation for women's rights movements across the world. In India, several reformers such as Savitribai Phule, Pandita Ramabai and Tarabai Shinde raised issues of discrimination and patriarchy in Indian society in the nineteenth century. These movements subscribed to a more liberal understanding of the rights of an individual, rather than to its constricted form in relation to the society. Over time, as women began securing various social and political rights, the movements began to highlight how the capabilities of women were not

restricted to limited pre-identified set of roles. This led to women participating actively in the economy, taking up roles historically held only by men, though the pervasiveness of patriarchal norms and customs continued to inhibit them from freely participating in economic activities. Even today, all parts of the world are not at par with respect to women's rights. However, the women's rights movement as a whole has now evolved and has taken up complete economic empowerment as its ideal. The movement for WEE has also taken on a new form, distinct from the original movement which was limited to pursuing eradication of political and social barriers. International conventions and global interventions for WEE The Universal Declaration of Human Rights (1948), the International Covenant on Civil & Political Rights (1976), and the International Covenant on Economic Social & Cultural Rights (1966) are the three most internationally accepted and binding instruments which recognise the equal rights of men and women.

The Overseas Development Institute (ODI) similarly defines women's economic empowerment as a process of achieving equal access and opportunity for women to control economic resources, and ensuring they can use them to exert increased control over other areas of their lives. ODI has also put together a comprehensive framework that identifies six core elements that directly affect WEE. These include collective action, unpaid work, education and skill development, quality work, social protection, and access to property, assets and financial services.<sup>36</sup> Additionally, the framework identifies four underlying factors that determine women's individual and collective experiences. These underlying factors are a result of broader structural conditions and include the following primary elements: (i) gender norms and discriminatory social norms; (ii) labour market characteristics; (iii) legal regulatory and policy framework; and (iv) fiscal policy. Of all of the above frameworks, we have chosen to work with the ODI framework that looks at direct and indirect factors that can enable or constrain women's economic empowerment, while identifying clear policy levers that can minimise the said constraints. However, we have adapted the framework by separating financial inclusion from property and assets, to enable a better mapping of schemes and policies. This allows for clear segregation and analysis of different interventions by the government in each of the seven critical domains. But even while doing so, the framework helps highlight that WEE is a complex process that needs to be approached in a holistic manner - the boundaries between direct and indirect factors are relatively fluid, and there are several interdependencies and connections between different variables. The adapted ODI framework

helps in building recognition that no single measure can address the issue completely; any measure will need to work in tandem with several others for it to be truly effective. The acknowledgement of such intersectionality makes the ODI framework relevant for understanding the Indian landscape for WEE. (Rohit Kumar, 2020)

## **WOMEN EMPOWERMENT**

“Women empowerment includes giving equal opportunities in all spheres of life” (Committee, 2011). In reality women are subjected to problems which mainly include domestic violence, sexual harassments, trafficking, rape etc. (sharma.s, 2015)

Women empowerment refers to making women powerful to make them capable of deciding for themselves. Women have suffered a lot through the years at the hands of men. In earlier centuries, they were treated as almost non-existent. As if all the rights belonged to men even something as basic as voting. As the times evolved, women realized their power. There on began the revolution for women empowerment. (Usha Devi & Balakrishnan)

As women were not allowed to make decisions for them, women empowerment came in like a breath of fresh air. It made them aware of their rights and how they must make their own place in society rather than depending on a man. It recognized the fact that things cannot simply work in someone's favour because of their gender. However, we still have a long way to go when we talk about the reasons why we need it. (Combaz, 2014)

## **NEED FOR WOMEN EMPOWERMENT**

Almost every country, no matter how progressive has a history of ill-treating women. In other words, women from all over the world have been rebellious to reach the status they have today. While the western countries are still making progress, third world countries like India still lack behind in Women Empowerment. In India, women empowerment is needed more than ever. India is amongst the countries which are not safe for women. There are various reasons for this. Firstly, women in India are in danger of honor killings. Their family thinks its right to take their lives if they bring shame to the reputation of their legacy. (J.Devika)

Moreover, the education and freedom scenario is very regressive here. Women are not allowed to pursue higher education, they are married off early. The men are still dominating women in some regions like it's the woman's duty to work for him endlessly. They do not let them go out or have freedom of any kind. In addition, domestic violence is a major problem in India. The men beat up their wife and abuse them as they think women are their property. More so, because women are afraid to speak up. Similarly, the women who do actually work get paid less than their male counterparts. It is downright unfair and sexist to pay someone less for the same work because of their gender. Thus, we see how women empowerment is the need of the hour. We need to empower these women to speak up for themselves and never be a victim of injustice. (Dr.K.Venugopalan, 2014)

## **EMPOWERMENT INTO ACTION**

There are various ways in how one can empower women. The individuals and government must both come together to make it happen. Education for girls must be made compulsory so that women can become illiterate to make a life for themselves. Women must be given equal opportunities in every field, irrespective of gender. Moreover, they must also be given equal pay. We can empower women by abolishing child marriage. Various programs must be held where they can be taught skills to fend for themselves in case they face financial crisis. (Chhetri, 2014)

Most importantly, the shame of divorce and abuse must be thrown out of the window. Many women stay in abusive relationships because of the fear of society. Parents must teach their daughters it is okay to come home divorced rather than in a coffin. Women empowerment mainly refers to the practice of making women independent so that they can take their own decisions as well as handle their lives without any familial or societal restrictions. In simple terms, it entitles women to take charge of their own personal development. Since women have always been the oppressed ones in a patriarchal society, the main motive of women empowerment is to help them stand equally with men. It is a foundational step to ensure the prosperous growth of a family as well as the country. Empowering women, the world would definitely witness gender equality and help women from every stratum of society stand on their own and steer their lives as per their own wishes. (E.kuttab, 2010)

Globally renowned for its culture and heritage, India is a country filled with diverse cultures. But the Indian society has always been a patriarchal one which is why women have been continuously denied basic human rights such as education and equality. They have always been suppressed and limited to domesticity and restrained from getting basic education. The notion of gender equality demands parity between males and females but women have been kept oblivious of their rights. For a country like India, women empowerment will be a greater role in its growth and development. (E.kuttab, 2010)

In both biological and moral context, women possess greater abilities to shape the future and development of a family as well as society as a whole. Thus, equal opportunities should be given every women to help them fully grow as an individual and make their own choices. Women empowerment encompasses more than just ensuring that women get their basic rights. In its truest form, women empowerment comprises the aspects of independence, equality as well as freedom of expression. Through this, the real strive lies in ensuring that we bring gender equality. (Women Empowerment : A Strategy. New Delhi : Sonali; Usha Devi & Balakrishnan)

When given the right support, women have shone brilliantly in every field. Even in India, we have seen women handle diverse roles, be it a Prime Minister, Astronaut, Entrepreneur, Banker and much more. Further, women are also considered the backbone of a family. From domestic chores to nurturing children, they handle multiple responsibilities. This is why they are great at multitasking and often many working women efficiently juggle between professional and personal responsibilities. While the urban cities have working women, the rural areas have still restrained them to household chores. How can we aspire to prosper as a nation where every girl does not get the access to education or making their own choices? India is a country where we worship goddesses while we don't bother thinking about gender equality. (Amman, 2018)

Hence, for all our mothers, sisters and daughters we must aim at creating an environment of integrity. We must boost their confidence to make them capable enough to take their decisions in every phase of life and this is how we can strive towards bringing women empowerment. (Education and Women's Empowerment, 1994)

*“Feminism does not aim to make women powerful. Women are already powerful. It is about influencing the way the rest of the world views your strength.”* Women have always had fewer opportunities and possibilities to develop their talents and knowledge since ancient times. Although the world is made up of both men and women. But men were regarded as the family’s most powerful members. They were the family’s decision-maker and were in charge of making a living. Women, on the other hand, were believed to be the responsible person for all home chores and child-rearing, and they were not engaged in making any important family decisions. The roles were assigned depending on gender. If we look at the whole picture, research shows that women’s subjects are either centered on their reproductive role and their body, or on their economic position as workers. However, none of them are aimed at empowering women. Women’s Empowerment is a progressive technique of putting power in the hands of women in order for them to have a happy and respectable existence in society. Women are empowered when they have access to opportunities in a number of sectors, such as the right to an education, gender equality, a professional (equal wage) lifestyle, and others. However, there are no constraints or limitations. It involves training, awareness, increasing their position via education, literacy, and decision-making authority. For the total growth of each country, women’s empowerment is the most essential sector. Previously, the men were the sole breadwinners in the household. Assume the household has one earning person; on the other side, suppose the family has both males and women earning members. Who will have a better way of life? The answer is simple: a household in which both the man and the woman work. As a result, when gender equality is prioritized, a country’s growth rate accelerates. Standing up for equality, women have empowered and spoken up for other women. (Chhetri, 2014)

*Feminism isn’t about making women stronger. Women are already strong, it’s about changing the way the world perceives that strength.”*G.D. Anderson

Women have been facing issues since the day they are born. Fighting for their rights, society stereotypes, and for their freedom. Women Empowerment means encouraging women through education, at a professional level, accepting their opinions, and providing them with the right whatever they desire. Women should not stay behind someone’s shadow not able to express themselves. The main motive of women’s empowerment is to give women a chance to outshine others and get equal rights in society. The first step of women empowerment is literacy. A well-

educated woman is confident, outspoken, and able to make decisions. Especially in a country like India, If women get a chance to study they can be a prime minister like Indira Gandhi, IAS like Kiran Bedi, or become a famous CEO like Indira Nooyi. (Batliwala.S, 2007)

Women are taught to mold themselves based on other's preferences and men are taught to lead because at the end of the day, women have to manage household chores whereas men are the heroes saving their family and providing them financial support. This is the stereotype that has existed for centuries in India and one of the reasons women are denied basic human rights in society. A woman is denied the right to raise her opinions even in her household matters, political or financial viewpoints are far behind. Women are born leaders and if given the opportunity can excel in every field. We live in a male dominant society where a male has every right to do whatever he desires however thought in women's minds is sacred. For centuries, women were not allowed to eat before men or sit in front of other men. Gender equality and women empowerment is a major concern globally. Gender equality starts with providing the same and equal resources of education to both genders. Education of girl child should also be a priority and not just an option. An educated woman will be able to build a better life for herself and the ones surrounding her. Gender equality and women's empowerment are essential for the growth of women in society. Women empowerment ensures that every female gets an opportunity to get an education, seek professional training, and spread awareness. However, gender quality will ensure that access to resources is provided equally to both genders and ensure equal participation. Even at the professional level women faces gender inequality because a male candidate is promoted way before a female candidate. The mindset should be changed and only deserving candidates should be promoted. Gender quality is a key step towards sustainable development and ensures basic human rights for everyone. (C.Nassbaum, 2000)

## **EDUCATION AS A TOOL FOR EMPOWERMENT**

Education is the biggest tool in women's empowerment and also a factor that helps in the overall development of the country. Education can bring a change in women's life. As the first prime minister of India once quoted "If you educate a man you educate an individual, however, if you educate a woman you educate a whole family. Women empowered means mother India

empowered” An educated woman will promote the education of other females around her, mentor them and also a better guide to her children. Education helps women to gain self-confidence, esteem, ability to provide financial support. Education will also help to reduced the infant mortality rate because an educated woman is aware of the health care, laws, and her rights. Educating a woman will benefit her and also in the development of society. With proper education, women can achieve more socially, economically and build their careers. Women are still being denied their right to education in rural parts of India. Education will also reduce the child marriage that is still practiced in some parts of India also help in controlling the overpopulation. The government has launched various schemes over the years to create awareness around women’s education such as Sarva Shiksha Abhiyan, Operation Black-Board, Beti Padhahoo Beti Bachao, and many more. Education helps women to identify the good and bad, change their outlook, way of thinking, and way of handling things. Education helps women to become independent. Indian women have the lowest literacy rate as compared to other countries. Education is a fundamental right of all and no one should be denied the right to education. Education helps to meet the necessities of life, confidence to raise a voice against domestic violence or sexual harassment. Be a part of a change and empower a woman with the help of education. (<http://www.jstor.org/stable/25548253>, 2007)

Women empowerment indicates addressing women’s power to create them proficient in taking decisions for themselves. Women have undergone a lot over the years in this men-dominating world. In more primitive centuries, they were criticized as almost non-existent human beings. As if whole rights belonged to men even the basic right such as voting. As time unfolded, women understood their power. Since then, the revolution for women empowerment started in this world. Nearly every country has a past of ill-treating women. In different words, women from all around the world have been revolutionary to attain the state they have now. While the westward countries are yet making development, countries like India besides lack backward in case of Empowering the women. you can also read women Empowerment Speech. (Johnkutty.P, 2012)

In India, it is necessary to bring the woman empowerment essay 250 Words more than ever. India is amongst the nations where women are still not safe. There are many reasons for giving such a statement. Firstly, in this country, women are at threat of honor killings. Their family

believes it is correct to sacrifice their lives if they bring embarrassment to the status of their legacy. (Johnkutty.P, 2012)

Furthermore, the literacy and democracy situation is very conservative here. Women are not entitled to seek higher education instead they are married off soon. The men are however controlling women in some sectors like it's the duty of a woman to serve him endlessly. In some places, men do not allow their wives to go out or have liberty of any kind. (Gates.M, 2001)

Additionally, domestic violence has become a crucial problem in India. The husbands abuse their wives mentally and sometimes physically considering them as their own property. It happens commonly because women are scared to speak up. In a similar way, the women who work genuinely get paid less than their male equals. It is entirely unfair and sexist to pay someone more insufficient for the same work just because of the different gender. Consequently, we see how women's empowerment is the demand of the time. We require to empower these women to talk for themselves and never be sufferers of injustice. (Gates.M, 2001)

There are several ways to enable rights to women in India. The people and government need to come collectively to make it happen. Schooling for girls must be delivered mandatory so that women can grow literate to build a life for themselves. Women must be provided equal opportunities in every area, irrespective of gender. Besides, they must also be awarded equal compensation for their work. We can also empower women by eliminating child marriages in India, which is commonly conducted in village areas. Many programs must be conducted where they can be given the ability to defend themselves in case they face financial crises. Most necessarily, the humiliation of divorce and abuse must be thrown out of society. Many women tolerate abusive relationships under the pressure of society. Parents must educate their daughters it is wrong to tolerate anyone's abuse, even if they are abused by their own family. They should take action whenever it is necessary (Economist, 2010)

Long celebrated as a 'Model' of alternate development in the South, society in Kerala has often been identified as one which that accords greater worth to women<sup>1</sup>. However, the exclusion of

women from powerful positions in politics has been noted as an unmistakable feature of Kerala's historical record (Jeffrey 2003; Erwer 2003)

Nevertheless, contemporary public life here is marked by the notable presence of women in local government, made possible through the women's quota of 50 per cent<sup>3</sup>, and state-wide network of women's self-help groups (SHGs) under state aegis, the Kudumbasree (henceforth, KS) (literally, 'prosperity of the family'). KS women leaders seem to be able to enter the Panchayath more readily and thus form an important section of lower level leaders of political parties in the state. Nevertheless, many left-leaning and other commentators seem to worry about KS women. For example, in October 2012, large numbers of KS women protested in the capital city of Thiruvananthapuram under the leadership of the Communist Party of India (Marxist)'s (henceforth, CPM) women's front. They changed the CPM women's front's 'respectable' style of agitation by introducing public singing and dancing.<sup>6</sup> Commentators sympathetic to CPM chose to ignore this obvious element of 'trouble', interpreting the agitation as an expression of 'class feminism' and distinguishing between proper and improper feminisms (Biju and Kumar 2013). Others who did not ignore this transgression, however, condemned it as 'spicy' (Jacob 2012). Summarising their common concern, one could ask: what is the KS doing to the Kerala Model Woman? The 'Kerala Model Woman' refers to Robin Jeffrey's (2003) thesis that egalitarian developmentalist public politics and active female domestic agents emancipated from tradition together caused high social development in Kerala. This remains persuasive today in many circles despite strong critiques (Mukhopadhyay, 2007).

In a similar manner, empowerment for a women in a scheduled tribe or caste or women from a poor economic background varies from women of upward class. Hence the conceptualization of empowerment varies. The similar word for the use of women empowerment in Malayalam language is '**Sthree sakhigaranam**, the term got its recognition in the year 2000. It is still not used frequently because of lack of awareness and vacant of the word. It was through Kudumbasree, an organization in Kerala working with the main objective of poverty eradication and women empowerment, the concept came into picture. (B.Natarajan)

Development is that the mantra of economic process and relief. Women have a very important role within the development method. Direction of women and their participation within the

development method has been thought of an important feature of development. It is probable that real development is feasible as long as the women and men add equal terms. Gender equality and direction of is recognized globally as a key component to realize progress all told areas. Nehru counseled —in order to awaken the individuals, it is the women who should be woke up 1st. Once she is on the move, the unit moves, the village moves, the country moves and therefore we have a tendency to build the Republic of India tomorrow. However this position of women in developing and underdeveloped countries isn't thought of smart. Rural womens' area unit thought to be voiceless and defenseless. Raping cases area unit showing within the newspapers a day. Even politicians aren't supporting them. In order that they area unit to be authorized to fight against these evils visaged by them. There had been intensive efforts in nineties to bring the women-folk, particularly those happiness to the weaker sections and poor, who had been economically and socially unfortunate among and outdoors the family, to the forefront and empower them through specific programmes and thereby empower the whole family and community. Making certain justice to women was one in every of the prime objectives of the event agenda of the People's coming up with Campaign initiated in 1997. Women area unit associate degree integral a part of each economy. Overall development and harmonious growth of a nation would be doable only women area unit thought of as equal partners ongoing with men. Direction of women is crucial to harness the ladies labour within the main stream of economic development. (G.Praveen, 2008)

Direction of women may be a holistic idea. It is multi-dimensional in its 2 approach and covers economic, political, social/cultural and private and aspects. Of these aspects of women's' development, economic direction is of utmost significance so as to realize a long-lasting and property development of society. Provision of small finance is a very important means that for attaining women's' direction. Kudumbasree, a South Dravidian coinage, means that prosperity of the family. It is associate degree innovative programme of Kerala introduced for the wipeout of absolute poorness in 10 years through combined community action beneath the leadership of native self governments. (kudumbasree.org)

## STATEMENT OF THE PROBLEM

With a view to improve the living conditions of women in the country, the Government of India has been taking various policy and administrative initiatives since last few decades. Even though certain sectors of the women population had benefitted by the various sponsored initiatives of the state, the lion part of women population who belongs to the weaker and marginalized sectors continue to remain backward. In fact they are unaware of their rights and privileges, thanks to the poor literacy level and the publicity gaps in reaching out the target beneficiaries from the side of the administrators of these initiatives. Moreover, lack of coordination among institutions and agencies supposed to implement the program had destroyed the charm of the whole program resulting in wasted efforts, high delivery costs and scattered resources. Thus, at the grass root level, women were satisfied neither with economic betterment nor with socio-cultural face-lifts. In Kerala, the local self-government set up a mission to facilitate antipoverty initiatives through empowering women at grassroots level. At this juncture it will be logical to investigate and bring out the impact of such initiative on the development of women and to assess the situations if any, that inhibits the successful implementation of the women empowerment programs (kudumbasree.org)

**General Objective:** To study the role of Kudumbasree in bringing economic empowerment in the women population.

**Specific Objectives :**

- 1) To find out the socio demographic profiles of the respondents.
- 2) To identify the major factors influencing the members to join Kudumbasree.
- 3) To analyze the changes in economic aspects of women through the aid of Microfinance and SHGs in kudumbasree.
- 4) To see whether there any changes in gender roles due to participation in kudumbasree.

## **SIGNIFICANCE OF THE STUDY**

The Union as well as the State Governments had set up numerous initiatives for ensuring the constitutional rights of women. Since women offer a big source of manpower towards building up human capital, their potential has to be properly identified, creativity should be explored and productivity should be effectively tapped and utilized for the progress of the nation. Needless to say, these are possible only through empowerment of women. However, women continued to play a secondary role to men in all phases of social life in our country. Part of this syndrome may be attributed to the relative personal inadequacies of women, but a major reason for the present situation is the big scope creep in the government initiatives, especially those relating to the methodology of implementing them. Consequently, there are gaps existing in the women empowerment programs, which negate its vitality and progress. In these circumstances it is significant to analyze the efficacy of the women empowerment programs adopted by the Kudumbashree Mission in improving the status of women in the State. Further, the concentric focus of the Mission about the role of local self-governments in this endeavor and the simultaneous and equitable implementation of the empowerment strategy in every district in the State makes it imperative to study whether Kudumbashree has provided sufficient space for empowering women at the micro level, in the various districts. Viewed from this angle, the impacts of women empowerment program will be better understood by evaluating its progress in an undeveloped district which is commercially and economically most backward and the socio-economic background of women is much apprehensive. Therefore the study of women empowerment through Kudumbashree in Tripunithura of Ernakulam District is most appropriate.

Even after developments taking place throughout the world, women in our country, especially in the urban areas are always denied their due role in socio economic life of the society and still remain victims of neglect and discrimination. Till recently, many of the actions taken in favour of women are mostly welfare oriented ones rather than development oriented, and no constructive steps taken for making women economically independent and socially vibrant. Women need to be provided with opportunity to participate in financial activities and expand their social network to generate income and wealth, to make them self-reliant, economically stable that helps to generate female autonomy and solidarity. The present study is based on

Kudumbasree in Kerala which emphasizes on women empowerment through community based program to eradicate poverty and bring urban women to forefront for their upliftment in economic arena.

Women in general infrequently enjoy the wide spectrum of freedom and rights granted by the constitution and other legal provisions. In a male dominated society, they face a plethora of problems in the form of discrimination, sexual harassment, exploitation, violence and the like in every sphere of life with different intensities. All these drawbacks the process of empowerment. Studying the topic will help us know more about the difficulties and how Kudumbashree plays a role in overcoming it. Apart from contextual variations, the study also includes the existence of structural variations like caste, class and patriarchy on the basis of Kudumbashree experiences.

**CHAPTER II**  
**REVIEW OF LITERATURE**

## **CHAPTER II**

### **REVIEW OF LITERATURE**

This chapter deals with the secondary data that is used by the researcher to study the relevance of Kudumbasree in economic empowerment of women. It includes various articles, books, journals, periodicals, magazines, government reports etc.

An ethnographic study of Kudumbasree, a women organization in Kerala is been carried out where the contextual variations of empowerment is covered. Women empowerment has multiple implications for patriarchal surroundings and has possessed problems in re-engaging with structural inequalities like caste and class identities of women. All these create a plethora of problems to Indian society and empowerment among women helps in solving and eradicating such problems. Hence the study attempts to find out how Kudumbashree negotiates the contextual and structural issues of women empowerment. The problems faced by women tend to increase day by day and studying topics likes these helps in minimizing it thereby providing a better understanding about the concept of women empowerment. The researcher concludes the study by mentioning the contextual and dynamic variations of empowerment. There is no universally accepted definition for empowerment where it varies according to the subjective locations of individuals. For instance; empowerment for a woman in a scheduled caste or lower caste women varies to that of upper caste women.

#### **WOMEN EMPOWERMENT: A CONCEPT**

Empowerment is a process that lodges all sources and structures of power on individual and collective basis. Empowerment has multiple meanings and different agencies have been defining the term in different ways to suit their purpose, so that its definition varies with time and in context. It is a process having personal, economic, social and political dimensions; with personal empowerment being the core of the entire empowerment process. Individually poor women cannot overcome powerlessness. This can be achieved collectively by women by organizing and

contributing equally in decision making, collective control over resources and managing the mechanism for sustaining this gain. Women empowerment is an active multidimensional process which enables women to realize their individuality, status, power and position in all spheres of life. Empowerment offers a greater access to knowledge, information and resources, more independence in decision making, better capability to design lives, greater control over the situations which influence lives, and freedom from rituals, traditional actions, belief and practices. Empowering women insists on moderate and basic alterations in the system of marriage and family, husband and wife relationship and approach towards socialization and remarriage. In short women empowerment is a process that gives women freedom to think, to walk, to react and to make wise decisions. (C.Nassbaum, 2000)

According to United Nations, Women's empowerment definition has five major components

- Women's sense of self-worth;
- Their right to have and to determine choices;
- Their right to have access to opportunities and resources;
- Their right to have the power to control their own lives, both within and outside the home;
- Their ability to influence the direction of social change to create a more just, social and economic order, both nationally and internationally

All the Self-Help Groups and Non-Government organizations enable in the empowerment of women economically. Kudumbasree follows a holistic approach of empowering women socially, economically, culturally and politically. Gaining all these values helps considerably in improving women's status in the society which makes them empowered. Microfinance programmes have increasingly promoted country's positive economic impact and also provided the belief that, they empower women (Dr.K.Venugopalan, 2014)

## **ROLE OF SHG IN THE EMPOWERMENT OF WOMEN**

*“Self Help Group usually refers to small groups of persons with common problems who work together to achieve specific behavioural, attitudinal or cognitive goals”* (Jertson, 1975, pp. 144-

145). They work with the instigation of working women to come up in life. This can play a major role in eradicating poverty in the country. Micro Finance system always engages with Self Help groups to make an economic aid which helps in removing patriarchal obsessions and enjoying freedom. And hence “It has proved they can bring about personal and institutional change in women” (Vattano, 1972, pp. 7-15). In addition to this, all the self-help group majorly involves into to the economic empowerment of women (Srimathi, 2012). Thus, they overcame economic poverty as well as other social and gender issues. It helped in increasing the level of leadership and organizational skills, management of various activities of a business, right from acquiring finance, identifying raw material, market and sustainable diversification and modernization. Self Help Groups of women in India have been accepted as an effective strategy for the empowerment of women in rural areas. It always helps in bringing them up collectively from all spheres of life to fight for their own rights and polices. It has been accepted across world as the best way to tackle poverty and to enable the community in improving their quality of life through social mobilization of poor, especially women, into Self Help Groups. (UNDP India). Self Help Groups like SEWA, Kudumbasree, Navjyoti Indian Foundation etc... are the famous organizations which are working for women empowerment. They make women fit for 7 entrepreneurship, community leadership and social coalitions which benefit her future and well-being (Gates.M, 2001)

Beevi and Devi (2011) conducted a study with an aim to assess the role of Self Help Groups in empowering rural women and to identify the major constraints faced by women in Kollam District of Kerala. The study revealed that micro-enterprises are a practicable pathway for improving the economic status. Some factors like education, income and mass media contact were positively and significantly related to the role of the SHGs. The effectiveness of the SHGs in promoting women empowerment was found to be limited by only factors like hesitation to take up innovative scheme; difficulty in playing dual roles by women; lack of confidence, team spirit, effective leadership, managerial skills, working capital and transportation. These thus were found to be the major constraints faced by SHGs.

Minimol and Makesh (2012) did a study to identify the level of personal, social, economic and financial empowerment achieved by the members through SHGs. The data was collected from a

sample of 200 members of 18 SHGs located within three villages of Cherthala Taluk of Alappuzha, Kerala. Primary data were collected by employing a structured interview schedule, through participant observation, and direct personal discussions with the members of various SHGs. The study concluded that the concept of SHGs for rural women empowerment has not yet run its full course in attaining its objective.

Jaya (2004) evaluated the functioning of SHGs and identified the factors contributing to the successful functioning and sustainability of groups in Kerala. This was achieved through an exploratory study of selected SHGs in the district of Malappuram in Kerala. The findings of the study show that SHG intervention has indeed improved the living standards. Interestingly, it also inculcated saving and loan repayment habits and brought about a positive change in attitudes and social skills of 52% of the respondent women folk thereby leading to empowerment.

The determinants for education and explored how the element of microcredit can impact the demand. The interviews were conducted by the researcher to explore microfinance in depth. The results of the study indicated that microcredit can have an influence on the demand for education (mediated by status effects and wealth effects). It highlights that microloans focus on increasing spending on education and it is critical to consider that increased wealth enhances the family's social status. The results further highlighted that the effect of microcredit on the education's demand tends to come majorly from the increased access to financial resources. Further, the researcher highlighted that microfinance programs can lead to better education for children, as the programs are mainly focused on providing sufficient access of education to children and their family (viswanathan.G, 2018)

conducted a research study to determine the influence of micro credit through utilization of latest data. The data was collected through the use of survey within the four districts of the country. The regression analysis was performed in order to approximate the level of women empowerment after taking part in the microfinance. The results of the study revealed positive influence of microfinance on various chosen indicators for empowerment of women. The researchers concluded that microcredit can be considered a positive element which can help women to achieve the desired goals and contribute to the economy of the country (ghanam, 2017)

Studies relating to two most common types of microfinance models used in India - Grameen-model microfinance institutions (MFIs) and Self-Help groups (SHGs) through the SHG-Bank linkage model in order to determine if there is a general trend indicating that microfinance as a whole has a positive impact on women's economic empowerment. The examination revealed that almost all of the studies conclude that both types of models significantly contribute to an increase in women's income and savings. However, though the Grameen-model of microfinance has been successful at increasing women's income and savings, which are the building blocks for greater economic empowerment, the SHG model was found to be more sustainable and more effective in economically empowering women. The study recommended Grameen-model MFIs adopt the SHG into their own models in order to encourage sustainability and women's continued economic empowerment (Weaver, 2016)

The micro finance helped the women to face the financial crisis with confidence. After participating in micro finance programme they have comparatively greater confidence in meeting the officials. The study also found out that the financial skill of the respondents improved significantly after participating in the micro finance programme. Although the increase in income level was small but the social empowerment provided by these programs were significant. Census data (2011) states, Literacy rate of rural women increased to 58.8% in the year 2011 when compared to 46.1% in the year 2001. Overall 12.7% hike in the literacy level of rural women (Dr. S. Prabhu and Dr. F. Elayaraja, 2015)

Microfinance (the financial services' provision to the poor in a proper manner) attempts to utilize savings, credit and other different products, including micro-insurance to assist families avail advantage of certain activities (income-generating) and to cope with the risk. Particularly, women avail benefit from microfinance as various microfinance institutions (MFIs) focus on targeting female clients. The services of microfinance result in empowerment of women through influencing the decision-making ability of women and improving their socioeconomic status. At the end of the year 2006, services of microfinance had reached around 80 million of the poorest women throughout the world. Microfinance possess the ability to make sufficient contribution to gender equality and enable promotion of enhanced working conditions for women (Banerjee, 2015)

Empowerment of women and poverty alleviation in Kaithal district of Haryana. The study found that there has been considerable increase in the income, savings and economic assets of the beneficiaries after joining the scheme. It has also resulted in increasing their confidence and has helped in social justice and empowerment of women. Also, the researchers advocated that microfinance can be a success story if we adopt healthy practices adopted by Grameen bank of Bangladesh such as five members in SHGs (Goel, 2014)

Micro finance can be considered a medium for improving the economic opportunities for women and possess the ability to enable women empowerment. The analysis conducted by the researcher revealed that there seem to be variation in the microfinance programs across the world. In microfinance system (all inclusive) would assist in strengthening the procedure of financial inclusion within the region of developing countries. It would eventually help in promotion of women's empowerment. The outcomes of the study were revealed to be positive and indicated that increase in the microfinance programs can open door the promote women's empowerment and can also elevate the status of women in the society. It is critical to consider that women empowerment through micro financing can help the family of the individuals. As the businesses of women tend to grow, various women gain increased level of self-confidence and become proud of their business. They gain the capability to make selection for themselves and their relatives (Kuri, 2014)

Collective effort has been recognized as tenets of women empowerment. Through women empowerment leads to sustainable social development. Economic development of women leads to better living status in the family, educational, nutritional, and the health needs of the children were well satisfied. Economic independence through Kudumbasree improved the social participation of its members and the Kudumbasree NHG movement is supporting for social empowerment of poor women flock. (P.C, 2012)

Increasing Microfinance leads to over borrowing, especially the joint liability of women members refrains them from availing the micro credit as the risk of nonpayment is high. This provided the incentive to take successive loans. Microfinance to rural women has given a great opportunity to the rural poor in India to attain reasonable economic, social and cultural

empowerment, leading to better living standard and quality of life for participating households (Lahka, 2012)

Intellectual empowerment is considered more important, or at least equally important to social, economic or financial empowerment. The concept of personal empowerment often fails to encompass intellectual empowerment. The objective intended to be achieved is that the members become more capacitated to think and act better from blunt in thinking to sharp; and from thick in action to fine. According to them the concept of SHGs for rural women empowerment has not yet run its full course in attaining its objective. (G, 2012)

Promoting micro enterprise activities through SHGs in select districts of Bihar and Uttar Pradesh covering 456 respondents, covered under the Priyadarshini Programme, revealed that more than 90 per cent of the respondents were matured SHG members who had undergone Micro Enterprise Development Programmes (MEDP/REDP) training, 3.95 per cent respondents were NGOs who had conducted MEDP/REDP trainings and 5.70 per cent were NABARD and Bank officials. The study highlighted that hardly 15 per cent of the matured SHG members had graduated to microenterprises and that too at a lower level business. Difficulties in getting adequate credit, low level of awareness and lack of skills were the main reasons for this. Even the 15 percent, who had graduated to microenterprises, were still at the nascent stage and their business size was not economically.

The effectiveness of group functioning members of women self-help groups (SHGs) in goat farming, operating under Kudumbashree, in Thrissur district, Kerala. The findings of the study showed that majority of the respondents (76%) perceived the effectiveness of their group functioning as medium. The functioning of the group in terms of official procedures (mean score 1.96) was perceived most effective by the members, followed by that of interpersonal relationships (mean score 1.93) and entrepreneurial activities (mean score 1.76). The study brought to light the need for entrepreneurial training in goatfarming along with provision of resources like good quality breeds, grazing land, feed, market and veterinary care for success of the group's functioning (et.al, 2011)

The poor use micro credit for productive and income generating activities when compared to non-poor micro credit clients. The usage of micro credit also depends on the age of the SHGs. It was been observed that the SHGs with longer period of time have a tendency to utilize credit more towards financing non-income generating activities. The findings also reveal that the members of SHG are also dependent on other financial institutions for their credit requirement. (Gaonkar, 2011)

The enhancement of microfinance qualities among the members of self help groups is a significant step towards social and economic empowerment of women. Status of women has also improved by joining the SHGs. His suggestions for improvement are the development of skill oriented training programmes, encouragement of good leadership in the group and constant guidance and support through the government and nongovernment organizations. (Desai, 2011)

Empowering rural women and to identify the major constraints faced by women in Kollam District of Kerala. The study revealed that micro-enterprises are a practicable pathway for improving the economic status. Some factors like education, income and mass media contact were positively and significantly related to the role of the SHGs. The effectiveness of the SHGs in promoting women empowerment was found to be limited by only factors like hesitation to take up innovative scheme; difficulty in playing dual roles by women; lack of confidence, team spirit, effective leadership, managerial skills, working capital and transportation. These thus were found to be the major constraints faced by SHGs. (Dev, 2011)

There is an essential element in putting efforts for lessening poverty within the developing world. The enrollment in schools tends to be costly and returns to education are revealed to be delayed. In such circumstances, families residing within the underdeveloped countries tend to be trapped in poverty. The impoverished and less educated tend to demand insufficient schooling for the children and hence, the children are not able to have a high standard of living. This study attempted to determine the association between the educational attainment of children and microfinance loans. The findings of the study indicated that the influence of loans (microfinance) over a long period, there seem to be no impact on the educational attainment of children. The researcher concluded that the education of children as a top priority. Without prioritization, there

can be no effect of the microfinance programs on the children education status. (Hytopoulos, 2011)

SHG-bank linkage programme plays an important role in women empowerment. The study undertaken was based on various indicators like women household decision making power, financial autonomy, freedom of movement, political participation acceptance to unequal gender role, exposure to media, access to education and experience to members. (Reddy, 2010)

Leatherman & Dunford (2010) pertinently pointed out that there seem to be around 820 million individuals who do not possess sufficient access to basic education. The core purpose of microfinance organization involves establishing financial services for the individuals. These involve saving and credit services to the poor people with a stress on assisting women and children. PLAN is a microfinance organization which assist children and women by improving their security (economic) and assisting them to achieve reduction in financial risks. PLAN focuses on adapting their services to youth by allowing them to get knowledge from a younger age regarding the importance of saving. Child sponsoring is another critical element of microfinance which can assist the children to get a brighter future. Child sponsoring involves financing a child within a developing country, until that individual becomes self-reliant. The money which is provided by the individual goes to the security, health or education of the child.

Dinesh Raghuwanshi (2010) in his study on —Microfinance: Present Scenario and Emerging Challenges revealed that the Government of India has initiated a number of subsidy-linked rural development programmes and involved formal financial institutions in the implementation of these programmes. After the pioneering efforts of the last ten years, the microfinance scene in India has reached a take-off point.

Sri.V.P.Ragavan (2009), in his article stated that the poor women of the State have become active participants in the planning and implementation process of various ant-poverty programmes. By participating in various incomes generating –cum-developmental activities, the morale and confidence of women became very high. Capacity of the poor women of the State in several areas has gone up considerably. Status of women in families and community has also

improved. Kudumbashree has gained national and international acclaim as an ideal and workable model of participatory development for eradicating poverty. He further stated that women empowerment is the best strategy for poverty eradication.

Sakthivel Murugan and Begum (2008) made an attempt to explain the predominant barriers to women entrepreneurs in a study is based on primary data collected from a sample of 100 entrepreneurs of Chennai City. The study reveals that social and cultural barriers are prominent formidable blocks for the development of women entrepreneurs and concluded that entrepreneurs with ability to plan and run a business can deliver quality products.

According to Ashraf, et al. (2008) there is also an argument over the role of microfinance in empowering women, rather empowerment can be better judged by the female decision making power towards saving product in the family. Here, using a randomized controlled trial, examine whether access to and marketing of an individually-held commitment savings product leads to an increase in female decision-making power within the household with a positive impacts, particularly for women who have below median decision making power in the baseline.

Amarjeet Kaur (2008) in her study on self- help group and rural development found that respondents were not motivated properly for poverty alleviation and rural development through SHGs. The concept of SHGs was also found to be quite successful in many parts of India like Hyderabad, Tamil Nadu etc. where people, government and NGOs have come forward with strong motivation and interest.

Rehman and Khan (2007) presents that microfinance is the provision of collateral free loans to poor people illiterate and don't know how to read or write. The multiple linear regression analysis technique was used to explore the effects of different determinants on women empowerment and role of microfinance in female empowerment.

According to Swain (2006), SHG influences household regarding management, decision making, participation, social and economic empowerment. In his paper, he tries to focus on the link between microfinance movements and third goal of MDG. It empirically validates this

hypothesis by using quasi-experimental household sample data collected for five states in India for 2000 and 2003 consisting of 20 focus group interviews. Each focus group interview comprises of 15-20 SHGs further supported by 1000 household survey.

Research by Gaiha and Nandhi (2005) on the role of SHGs in contributing to women's empowerment states that empowerment was upheld by different sources combined with varying degrees. This study includes better gaining of self-respect, self-confidence, transactional skills and taking firm moves in households. Increasing literacy rate in rural women itself is a symbol of development. Literature on women workers in India by Sonali Das, Sonali Jain-Chandra, Kalpana Kochhar, and Naresh Kumar proves that, the labour force participation in rural areas of India is purely based on the demography, educational accomplishment and women decision. Awareness created by microfinance motivated the rural women groups to the greater accomplishments.

As per Claros and Zahidi (2005), women empowerment from 58 countries has been measured with comparison to men on five parameters such as economic participation, economic opportunity, political empowerment, educational attainment and health and well-being. They analysed the secondary data of World Economic Forum's executive opinion survey. Out of the survey they found that those countries that do not use the full potential of their societies, they are allocated their human resources and other competitive potential in wrong manner. Another common way to measure women empowerment is to assess through economic development. Duflo (2012) refers in his paper that there is a close association between economic development and women empowerment. When economic development happens, women can participate more in the decision making process and can take good care of their children well-being. Both elements reinforce each other though it is not evident that it can bring equality in terms of gender in the society.

Holvoet (2004) in his study aimed to indicate the impact of microfinance specific features on the childhood education. The researcher collected data from the household survey and explored how microfinance influences literacy and schooling, how is credit entered in the household and who generally brings it. The regression analysis was performed to determine the impact. The results

revealed that if there is bank-borrower credit delivery, then there is no importance of whether credit is entered through father or mother. Whereas, there seem to be large differences if the mother is responsible for obtaining credit through specific women's groups. The analysis by the researcher showed that combined social-group and financial intermediation results in a higher educational outputs and inputs, majorly for girls. The researcher pointed out that education of children can be considered one of the potential elements for economic growth of a country and its sustained economic and human development.

Jaya (2004) evaluated the functioning of SHGs and identified the factors contributing to the successful functioning and sustainability of groups in Kerala. This was achieved through an exploratory study of selected SHGs in the district of Malappuram in Kerala. The findings of the study show that SHG intervention has indeed improved the living standards. Interestingly, it also inculcated saving and loan repayment habits and brought about a positive change in attitudes and social skills of 52% of the respondent women folk thereby leading to empowerment.

J. Bhagyalakshmi (2004) , in the article, —Women's Empowerment - Miles to Go , points out that India as a signatory to the UN Convention has taken several measures to ensure full development and advancement of women. The women specific programmes are showing positive results in empowering women, until now, one feels, there are miles to go and promises to keep. All forms of violence against women, physical and mental, whether at familial or communal level shall be dealt with great care. She states that all forms of discrimination against girl child and violation of her rights shall be eliminated by undertaking strong measures both preventive and disciplinary within and outside the family. Though women play a major role in agriculture and allied sectors, their contribution is hardly recognized. Intensive efforts are needed to ensure that benefits of training, extension and various programmes will reach them to make them more effective in their own area of operation.

Meenakshi Malhotra (2004), in her work entitled, —Empowerment of Women, deals with the issues leading to empowerment of women with particular reference to rural women. Volume one deals with issues like gender inequalities in labour market and in entrepreneurship. Volume two focuses on micro finance options for women empowerment. It looks into micro credit schemes

for rural women and micro finance movement in India. Third volume describes the various programmes introduced to empower women and bring them into the orbit of development network .

K.G.Karmakar (2003), in his book —Rural Credit and Self –Help Groups: Micro Finance Needs and Concepts in India, explains, the problems and prospects of rural credit in the context of its ascribed role in rural development; traces the evolution and growth of the rural credit delivery system; analyses the problems associated with credit recycling and overdues; and discusses the recommendations of various committees. The book also, discusses the microfinance needs of various groups including tribals, the rural non-farm sector, rural women and micro finance entrepreneurs. It further, focuses on the concepts and functions of self-help groups with special reference to the BAAC (Bank for Agriculture and Agricultural Co-operatives) System in Thailand and the Grameen Bank in Bangladesh. The concluding section outlines strategies for developing a sustainable rural credit delivery system in developing countries like India.

Malhotra et. al (2002) constructed a list of the most commonly used dimensions of women's empowerment, drawing from the frameworks developed by various authors in different fields of social sciences. Allowing for overlap, these frameworks suggest that women's empowerment needs to occur along multiple dimensions including: economic, socio-cultural, familial/interpersonal, legal, political, and psychological. Since these dimensions cover a broad range of factors, women may be empowered within one of these sub-domains. They give the example of —socio-cultural dimension which covers a range of empowerment sub-domains, from marriage systems to norms regarding women's physical mobility, to non familial social support systems and networks available to women. The World Bank defines empowerment as —the process of increasing the capacity of individuals or groups to make choices and to transform those choices into desired actions and outcomes.

Leach, F. & Sitaram, S. (2002) argues in their research even though micro credit helped in social empowerment of the women in rural areas, foreconomic empowerment it requires knowledge and awareness about the business.

Jaya S. Anand (2002), in her discussion paper titled —Self-Help Groups in Empowering Women: Case Study of Selected SHGs and NHGs, gives a review of progress of Self Help Groups. She has attempted to examine the performance of selected SHGs and NHGs and to assess its impact, especially the impact of micro credit programme on empowering women. It has been clearly established that delivering credit alone may not produce the desired impact. The supporting services and structures through which credit is delivered, ranging from group formation and training to awareness-raising and a wide range of other supporting measures are critical to make the impact of group activity strong and sustainable.

Hunt, J & Kasynathan, N (2002) says that microfinance has a positive Impact on women's mobility and helps in reducing the domestic violence. They observed that women need only a small opportunity to build their own pathway to empowerment. Access to credit and peer support has enabled them to increase their power and decision making capacities in their households.

Sakuntala Narasimhan (2001) focuses specifically on rural Scheduled Caste and Scheduled Tribe women, who are disadvantaged as women, as members of the rural section of the laypeople and because of their low caste status. The book compares the effectiveness of State initiatives with the motivation – and conscientisation strategy advocated by Action for Welfare and Awakening in Rural Environment (AWARE), a non-governmental development organization working in 6000 villages spread over 7 States in India. It also analysed the success of AWARE's work among women through various case studies and concludes that, besides monetary resources, it is the mindset of the policy makers, bureaucrats and particularly the women concerned that must change in order to assist the empowerment of women.

Puhazhendhi and Satyasai (2001) in their study attempted to evaluate the performance of SHGs with special reference to social and economic empowerment. Primary data collected with the help of structured questionnaire from 560 sample households in 223 SHGs functioning in 11 states representing four different regions across the country have formed the basis of the study. The findings of the study reveal that the SHGs as institutional arrangement could positively contribute to the economic and social empowerment of rural poor. The impact on the later is more pronounced than on the former. Though there has been no specific pattern in the

performance of SHGs among different regions, the southern region could edge out other regions. The SHGs programme has been found more popular in the southern region and its progress in other regions is quite low, thus signifying an uneven achievement among the regions. Older groups had relatively more positive features like better performance than younger groups.

Laxmi R. Kulshrestha (2000) in her paper, —Micro Finance: The New Development Paradigm for Poor Rural Women, points out that lack of capital is a serious constraint to the development of rural women. Often, the barriers like legal provisions, loan policies and procedures make credit inaccessible to women. Studies have shown that credit can help women to take up farm-allied activities and the income generated from credit given to women can be expected to be spent for well being of the household. This novel innovative approach of micro finance emphasises financial intermediation with self sustainability of institutions.

Gurumoorthy (2000) reveals that empowering women contributes to social development. He opined that Economic progress in any country whether developed or underdeveloped could be achieved through social development. The self-help group disburses micro-credit to the rural women for the purpose of making them enterprising women and encouraging them to enter into entrepreneurial activities. Credit needs of the rural women are fulfilled totally through the self-help groups. SHGs enhance equality of status of women as social and cultural spheres of life. SHGs also encourage women to take active part in socio-economic progress of our nation.

Kabeer (1999) stresses that women's empowerment is the process to acquire the ability from which those who have been denied the ability to make the strategic life choices. Her emphasis that ability to exercise choice incorporates three interrelated dimensions: Resources, Agency and Achievements.

According to UNIFEM, —to generate choices, gaining the ability and exercise bargaining power, —developing a sense of self-worth, to secure desired changes, belief in one's ability and the right to control one's life are important elements of women empowerment. Women will be empowered when they will have full control over their own life.

Shylendra (1998) assessed performances of eight women SHGs in Vidaj village of Gujarat. The SHGs, it was found, failed to enable members realize their potential benefits. The failure was attributed to wrong approaches followed in the SHG formation, lack of clarity about the SHG goals and concept among the members. The study brought to light the need to constitute SHGs with clear understanding of the concept from the beginning itself.

Mayoux (1997) argues that the impact of microfinance programmes on women is not always positive. Women that have set up enterprises benefit not only from small increases in income at the cost of heavier workloads and repayment pressures. Sometimes their loans are used by men in the family to set up enterprises, or sometimes women end up being employed as unpaid family workers with little benefit. She further points that in some cases women's increased autonomy has been temporary and has led to the withdrawal of male support.

Dixon-Mueller (1993) substantiates employment plays vibrant role in women empowerment. Rural women mainly depend on self-employment and unorganized sector. Employment may empower the women by providing financial freedom, social identity and revelation for power structures free of kin networks. Microfinance created new employment opportunities for rural women in informal sector.(Dixon-Mueller, 1993), SECC survey portrays employment in rural areas progressed to 31.59 per cent to 6.62 crore in the year 2014 when compared to 2005.

J.Devika and Binitha V Thambi mentioned the situation of how the organization enables women in getting all the opportunities and benefits provided to them by the government. It not only provides aid but also helps in acquiring it. As the coin has two sides in it, everything has its own positives and negatives. Women involvement to all such sectors enabled her in developing skills, being knowledgeable and cunning. Women being labeled as "Second Sex" and being treated inferior, many take an advantage of it and consider her for granted. There are cases where women are being trying maximum to come out of such stereotype. Besides this, women are even blamed for many things which she is not aware of. The below explains the interview by a highly success full women leader which is taken from the article "Beyond Feminine Public Altruism: Women Leaders in Kerala's Urban Bodies" by J Devika and Binitha V Thambi.

## **KUDUMBASHREE ON STRUCTURAL INEQUALITIES**

Kudumbashree consist of women form all caste and class. They reside in rural and urban areas of the state. Most of the respondents belong to poor economic strata of the society. Even then the political participation of women was seen high. They didn't feel any sort of rejection from the society. Caste and class was not at all a major concern. A few of the respondents were not interested in politics because of their family situation. It was in them where the whole family depends on and hence time constrains plays a major role. Researcher does felt for a few women staying away from politics because of the family norms and values. It would be unfair to mention that these people are not aware of such participation. The familial and societal role does play a major role here. Statistics among the respondents reveals that majority of them belongs to lower class family. There was a ward councilor among the respondents. The major gossip among the people in the locality claims

“If there is a Kudumbashree women representation, there is no possibility for any other women to win”. This can be due to several reasons. But it was noticed that, the interaction and socialization of the participants was very high and is very much known to the public. They were very much active in interaction in public places like bus stand, canteen, meetings etc... They were known by many. Despite this, during the bus journey to other panchayaths, the researcher was noticed by others because of participant's familiarity and popularity. The article by Sudhakaran in 2015 observing the success of Kudumbashree women in politics stated that: "They are aware of the problems at the grassroots and moreover, they are the ones whom the people contact first whenever there is a local issue. Also, since they are regularly in touch with the local bodies, they are aware of various development and welfare schemes, and once they become the members of the local government, they will be able to do more for the society”(P.Sudhakaran, 2015).

Kudumbashree is a poverty eradication program which is introduced in state of Kerala. A brief view of the studies which are conducted is far is given below.A report on self help groups of women in Kerala State, India: A public health perspective by Mohindra (2003) tells about the

linkages between micro-credit through SHGs and health. The report identifies providing various opportunities to women to for participating in financial activities and in expanding their social network,SHGs also helps in generating autonomy of female which in turn will lead to awareness of their health and also increase their capacity of decision making on family's health Ganeshmurthy VS (2007), in his edited volume book India: Economic Empowerment of Women, had made clear that in India the participation of women rate is very less than the half of total women. Despite efforts which are made towards the women empowerment, most of the active female continues to be remainingnto micro, small-scale enterprises in rural areas and also informal sector.

Jaya S. Anand (2002), in discussion paper which is titled "Self-Help Groups in Empowering Women: Case Study of Selected SHGs and NHGs", gives a review of improvement of Self Help Groups. She also has attempted to analyze the level of performance of SHGs and NHGs which are selected and to analyze its impact, especially on micro credit program which are initiated for empowering women. Sri. V. P. Ragavan (2009), in his article had stated that the women who are below poverty line of the State have become more active member in planning and implementation process of various programs initiated for anti poverty. When women started to participate in various program which are incomes generating and which are developmental in nature, the level of confidence and decision making started to increase

Kenneth Kalyani, Seena P.C (2012) tells that economic development is one of the bases for other development. The empowerment of women leads to social development. The development of women leads in terms of economic condition for better living status in the family, educational, nutritional, and the health needs of the children were well satisfied.Puhazhendhi and Satyasai (2001) in the study had attempted to evaluate the performance of SHGs with reference to empowerment in social and economic life.Primary data are collected with the help of questionnaire from 560 samples in 223 SHGs which functions in 11 states. The findings of the study reveal that the SHGs, which act as arrangement, could contribute in a positive manner for the economic and social empowerment. The effect of this is more pronounced on the latter than on the former. Though there is no specific pattern in the performance of SGGs among different regions in the state, the south regional area could edge out other regions. The SHGs program had

become more popular in the southern region. Older groups were able to perform better than younger.

Sakuntala Narasimhan (2001) focuses specially on rural Scheduled Caste and Scheduled Tribe women, who are being disadvantaged as women, as people of the rural section of the populace and also due to their low caste status. The book evaluates the effectiveness of State initiatives with the motivation.

Manoshi Baruah Deka, Manju Dutta Das, Sangeeta Borah Saikia and Rekhamoni Saikia (2008) organised a study in five accepted villages of AICRP on Home Science. Ten self-help groups and fifty members of SHG and fifty non members were selected as respondents for conducting the study. The findings of the study pointed out that majority SHGs were of medium size and linked with banks. Also found that the two major motivating factors for joining SHG were economic surveillance and inculcating savings thrift. The study revealed that joining in SHGs helps the members to generate income, facilitate sufficient loans, to increase social contacts, opening up training opportunities consequently leading to intensify the socio-economic capacity of rural women.

Nideesh (2008) in his article mentioned that the Kudumbashree programme is the best strategy for poverty eradication and empowering women in rural areas. The study concluded that the aim of this novel scheme is to improve the standard of living of poor women in rural areas by setting up micro credit facilities from banks and to undertake productive micro enterprises for providing gainful employment to the people below poverty line as it boosts economic growth as well as increases the desirable outcomes.

Manjusha (2010) in her study attempted to assess the level of empowerment achieved by the women community of Ulladan Tribe through Kudumbashree units of the North Paravur Taluk in Ernakulam District of Kerala. The findings of the study show that a significant change has come about in the socio-economic life of the women groups in the Taluk. The administrative avenues as well as the general skills of the respondents were also realized to be changed after joining the

Kudumbashree units. The study recommended that for upcoming development, training and awareness programmes should be conducted for empowering the poor women in the area.

Beevi and Devi (2011) made a study with an intention to evaluate the role of Self Help Groups in empowering rural women and to identify the major constraints faced by women in Kollam District of Kerala. Income, social status and education were the factors seemed to be positively and significantly related to the role of the SHGs. From the survey it was found that the major constraints faced by SHGs were lack of confidence, poor team spirit, ineffective leadership, unfair working capital and transportation, unwillingness to take up innovative schemes, strain and difficulty in playing dual roles by women. The study also revealed that micro-enterprises played a feasible pathway for improving the economic status of rural women.

Kenneth Kalyani and Seena P.C. (2012) in their study discovered the impact of various programmes that were introduced in order to raise the women from below poverty line in Puthanvelikkara Grama Panchayat of Ernakulum, Kerala. Collective attempt has been recognized as fundamental idea of women empowerment and women empowerment leads to sustainable social development. The results of the study indicated that economic development is the base for all other development and it leads women to have better living status in the family, the health and educational requirements of the children were well satisfied and economic independence through Kudumbashree improved the social participation of its members.

Minimol M. C and Makesh K. G (2012) in their study identified the level of personal, social, economic and financial empowerment achieved by the members through SHGs. A structured interview schedule was administered among 200 members of 18 SHGs located within three villages of Cherthala Taluk of Alappuzha, Kerala and also made participant observation, and direct personal discussions with the members of various SHGs. The study concluded that intellectual empowerment is considered more important or at least equally.

Venugopalan K. (2014) conducted a survey to examine the influence of Kudumbashree programme on empowering women. The findings of the study stated that after joining Kudumbashree there was considerable improvement in self-confidence, decision making power,

personal skills and awareness about need for nutrition, dangers of using pesticides, and abuse of liquor among the members. The study further disclosed that the women empowerment parameters like decision making power, personal skills, self-confidence, knowledge and awareness etc. have achieved only limited progress.

Mrs. S. Gayathiri, (2014) in her article stated that SHG Programme obviously plays a significant role in the lives of the poor women. It is evident from the study that the programme has increased the household income of the poor and seems to be successful in reaching individual poor clients of the region. The findings of the study indicated that the programme participant's standard of living has increased and the food security is far better than before. She concluded that the Self Help Groups have proved the way for economic independence of rural women and contribute substantially to push up the conditions of female population and through this eliminate poverty in the society.

### **KUDUMBASREE MISSION**

Kudumbasree is an initiative by the Kerala State Government that works with the objective of Poverty Eradication and Women Empowerment. The mission aims to eradicate absolute poverty within the framework of 10 years. The name Kudumbashree in the Malayalam language means "Prosperity of Family". The program focuses upon the strong platform of the "Sthree" of the family, i.e.; the women. It was officially inaugurated by the Prime Minister Atal Bihari Vajpayee in 1988. The mission follows a process approach rather than a project approach by involving women to all the sectors which helps in their upliftment. The mission has adopted different methodology in addressing the poor through community-based organizations. (kudumbasree.org)

In 1998, the Government of Kerala introduced Kudumbasree to completely wipe out poverty from the state through collective community participation under the guidance and supervision of local self government. Kudumbasree was formally registered as the State Poverty Eradication Mission (SPEM), under the Travancore -Kochi Literary Scientific Charitable Societies Act 1955, and it has a governing body led by the state minister for local self government. Kudumbasree is a

female-oriented, community-based, poverty eradication mission of the Government of Kerala, the state lying in the south-west part of the Indian subcontinent, where many development experiments are being tested, refined and implemented (Pragabhal, 2017). It has been built around three crucial components namely, micro credit, entrepreneurship and overall empowerment. Being a joint programme of the government of Kerala and NABARD, Kudumbasree Project was considered as a poverty reduction program implemented through Community Development Societies (CDS), consisting of poor women, serving as the community wing of local governments. (Economist, 2010)

The bottom layer of the Kudumbasree programme is formed by the Neighborhood Group (NHGs) comprising of 20-40 women members selected from poor families. Area Development Society (ADS) is formed at the level of ward of local government by federating 8-10 NHGs. The ADS sends its representatives to the Community Development Societies (CDS) which completes the unique three-tier structure of Kudumbashree. These Community Development Society (CDS) formed at the village panchayath level or at the municipality or corporation is a federation of ADSs. The CDS are also very active in government programmes and plays vital roles in development activities extending from socio-economic reviews and enterprise development to community participation, management and social audit. The women have organized themselves into collectives under a three-tier community based organization in the Kudumbashree programme. These collective groups through their thrift and credit activities promote saving habits among the poor women and help them access loans for both consumption and investment purposes. These thrift and credit societies play an important role in directing and channelizing rural savings to the Kudumbashree poverty eradication programme. (Economist, 2010)

Eradication of absolute poverty from Kerala is the prime purpose of Kudumbasree programme; this slogan of the mission is coming to families through women and to the community through families. Women empowerment initiatives, micro credit facilities, promoting micro enterprise and convergent community action and resources form the core activities of Kudumbasree. Also Kudumbashree conducts training modules and skill development programmes for the benefit of women groups and foster the economic status of women as a means to alleviate poverty. The individual initiatives and the income generating activities of Kudumbasree project were

promoted profoundly as they immensely meet the livelihoods of the poor women (Manoj P. K., 2014).

## **ECONOMIC EMPOWERMENT THROUGH KUDUMBASREE**

Kudumbasree is that the poorness wipeout mission of the state of Kerala. Kudumbasree project was started in Kerala in 1998. The programme has thirty seven lakhs members and covers over five hundredth of the households in Kerala. It is engineered around 3 very important parts, small credit, entrepreneurship and direction. Women's direction is one in every of the vital objectives of Kudumbasree alongside poorness wipeout. The aim of the Kudumbasree theme is to boost the quality of living of poor women in rural areas by putting in micro-credit and productive enterprises. It is a community based mostly self facilitate initiative involving poor women. Kudumbasree was planned as a joint programme of the govt. of Kerala and NABARD enforced through Community Development Societies (CDSs) of Poor women, serving because the community wing of native Governments.

The aim of the Kudumbasree theme is to empower women as a method for poorness wipeout. Direction of girls, ladies and poor women driving their development may be a powerful strategy to alleviate poorness. The Kudumbasree Community based mostly organizations area unit acting as social safety nets, increasing access to entitlements and providing avenues for political participation.

According to the census of 2011, Kerala is the only state in India where women outnumber men in terms of population. Thrissur is considered as the place where female populations are high when compared to male. The literacy rate is high too. But the problems faced by women still exist (Khader, 2017, pp. 85-92).

As a result the government started implementing programs for their welfare. The evolvement of projects like Kudumbhashree helps in improving the situation of women in society. Kudumbhashree is a successful program launched by the government of Kerala for poverty eradication and women empowerment. as per the status of Kudumbasree, Studies conducted in the place are also very few. Conducting a study here would benefit the researcher in getting suitable samples which is appropriate for the research study.

## THE RISE OF THE KUDUMBASREE WOMAN

Kerala state in the 1950s was formed at a moment in which pre-modern patriarchies had faded, and patriarchal formations which naturalised gender in and through the various social/community reform movements were triumphant. The decline of the pre-modern caste-order meant that women of most social groups experienced individuation to some degree. Nevertheless hegemonic modern domestic ideologies in social/community reformisms and the state worked as powerful countervailing factors (Devika 2007). The individuating effects of the massive expansion of women's access to higher education in the mid-twentieth century were counterbalanced by sacrificial domestic ideologies<sup>10</sup>. Largely-lower-caste women workers moved from less-gendered working lives into highly gendered domestic lives (Lindberg 2001); domestic ideologies and restrictive notions of feminine respectability now thrived among the literate poor women (den Uyl 1995). Women were largely excluded from political power even when they formed majorities in trade union membership and participated actively in militant working class action (Lindberg 2001; Devika and Thampi 2012). These developments ran parallel to decreasing fertility, popularity of the two-child norm, and declining joint family, which changed the nature of domestic labour of childcare (Devika 2008). The gradual decay of agriculture and traditional industries in this period affected women workers the worst (Arun 1999; Lindberg 2001); women's land ownership declined and even the vestiges of matriliney ended (Arun 1999). High dowry demands came to characterize marriage negotiations of an increasing number of communities (Kodoth and Eapen 2005). Nevertheless, this unfolded in a period in which state investment in health and education was substantial and access was secured for the poor through militant public action (Jeffrey 2003).

Late-twentieth century politico-economic conditions were considerably altered but idea that women need 'balance' between individuation and domestic orientation stayed hegemonic. Research on Kerala's 'remittance economy' (Planning Commission 2008; Raman 2010) shows that skilled labour has been, since late-twentieth century, Kerala's major 'export'. The making of globally-marketable human-power requires closer disciplining of the 'raw material', the child, and the female caregiver's affective labour of managing emotions (Weeks 2007) is necessary for this. Added to this, the general fall in public service provisioning in health and education in the

post-liberalisation years (Oommen 2010), the rise in the number of female-headed households (Lini 2013, 9), and the dismal prospects of employment and income for women in Kerala (Christabell 2012, 92-3; 96), indicate that material aspects of women's domestic burdens have also risen in comparison to the pre-migration, pre-liberalisation period. It is also possible that rising costs of education and job search for men indirectly pushed up dowry rates even in poor communities (Devika 2013).

Decline of state welfare was accompanied by responsibilised welfare targeting women, cutting for them a path through which they could move between domestic and market spheres. Women's domestic duty seemed to have been extended to include the larger measure of household provisioning in and through programmes such as the Urban Basic Services Programme (UBSP), and later, in the KS. Women were now regarded as economic agents and had access to credit, but KS emphasized income-generation, not wage labour, and did not violate dominant norms of gender segregation. But a new, higher, level of balance between individuation and domesticity seemed now possible, and no wonder that studies of KS women revealed that they were upbeat despite poor economic returns (Eapen and Thomas 2005). These developments signalled the emergence of a new 'regime of empowerment', that displaced the older one, central to Kerala's many social development achievements. The latter understood 'empowerment' as: claiming of welfare entitlements as 'people's rights', militant mass mobilisation, and constant challenge to bureaucratic power. Its major instrumental form was the national-developmental state; its institutional forms, the political parties and trade unions in formal politics. In contrast, the new regime of empowerment of the 1990s interpreted 'empowerment' as flexibility within the existing social hierarchy and self-help; its instrumental form was local government, viewed as representing local community-interests, and its institutional form is the self-help group. Civil society, understood as descriptive, non-critical, and state-centric, and feminised, was taken to be at its core. Most importantly, this 'regime of empowerment' consecrated the Below-Poverty-Line Woman as its principal subject. (Chhetri, 2014)

Women in this regime could access 'invited spaces' of governmentalised welfare (including KS) where they could, potentially, learn the ropes of local government. The risk, obviously, was that these women would be trapped at the lowest level of the highly gender-iniquitous development bureaucracy as underpaid voluntary workers. But given that familiarity with the bureaucratic

procedures and norms were by now inevitable for elected members in the local government and that the women's quota (of thirty-three per cent initially, and now, fifty per cent) had to be fulfilled, KS women leaders found themselves in great demand, actively wooed and organised by political parties, especially the CPM, through women's wings (CDS 2008).

Certainly, the KS woman was not automatically open to feminist mobilisation. Worse, given women's century-long exclusion from power in public politics, KS women leaders were at risk of being captured individually by local party structures, and collectively by political parties, none of which showed sustained interest in gender equality (Erwer 2003; Devika and Thampi 2012).

### **ENTER THE SUBJECT OF *AANUKOOLYAM***

The first spell of fieldwork<sup>11</sup>, in 2006-8 with village panchayat-level KS leaders seemed to confirm the above fears. If working class women were 'effeminised' in the mid-twentieth century, it appeared now that the lower middle-class woman<sup>12</sup> who carried out domestic and affective labour at home was being interpellated into socially-oriented hyper-femininity.

Three kinds of political authorities were competing to utilise the services of KS leaders – political parties, the panchayat, and the KS Mission itself. It was apparent that most of our interviewees were closely affiliated to particular political parties – out of commitment or necessity – and that even when they were impartial in welfare distribution they used their connection with the poor to build ground support in and for their respective parties. They felt that it was risky to antagonise local political leaders and the panchayat; but crucially, they believed that the KS was 'under' the panchayat and hence had to take orders from elected representatives. This perception has an interesting history.<sup>13</sup> The second authority, the panchayat, seemed to be reproducing exploitative domestic power relations in community-space, and even denying women's political citizenship. Interviewees' perception of the Women's Component Plan (WCP), a mandatory component of the panchayat's plan in Kerala was that it was a *dole*, and not their collective *right* as citizens. Besides, KS women were often caught between different bureaucracies, some sympathetic, some not. A feared figure was the 'Charge Officer', a local-level official assigned to assist the Chairperson of village-level federation of KS groups, the Community Development Society (henceforth, CDS CP) in accounts-keeping, report-writing and

other such routine tasks. Most CDS CPs we interviewed had no clear idea of this officer's responsibilities and he/she was treated as higher authority. The KS Mission district-level office was widely perceived to be far more friendly, flexible, and gender-sensitive. Most district coordinators interviewed were critical of the panchayats' and local politicians' use of KS women and the domestic patriarchy that prevented them from accessing training and other microenterprise opportunities. But this more 'humanised' bureaucracy (as perceived by our interviewees) could not always resist the temptation to deploy KS women tasks that could potentially disempower them in the community, such as data collection bordering on surveillance. Nor could their disdain of KS leaders' political ambitions be missed. As for anti-patriarchal politics, most CDS CPs interviewed felt that it was necessary to intervene only in cases in which the patriarchal moral economy was violated. It was also striking that they seemed to perceive themselves primary as members of the lower tiers of the development bureaucracy and not local leaders. So their most frequently voiced complaint was about honoraria and the denial of bureaucratic status to their authority. (Chowbey, 2011)

However, there were already signs of 'unintended consequences', in the rank-and-file of the KS. KS leaders were critical of who they called *aanukoolyam*-seekers – the seekers of the welfare-handout. The *aanukoolyam*-seekers observed market discipline in repayments, which was relatively easy given the low interest-rate, but apparently dodged 'governance labour' – the many subsidiary tasks that SHG members are expected to perform, such as dissemination of information, attendance at government functions and labour related to preparing the venue etc., health-related work, destitute care and other social service promoted by the panchayat, and keeping records and accounts. This was either unpaid or very poorly paid but panchayats often claimed that the rank-and-file were obliged to perform it, being welfare beneficiaries. Despite the best efforts of KS leaders, they resisted such labour and demanded more benefits in lieu of participation. KS leaders felt that they were dealing with people who resembled 10 ungovernable consumers, who contrasted with the older-generation party supporters, unfailingly loyal to the party even when it could not meet their demands immediately. The rank-and-file apparently indulged in 'unhealthy' financial practices, migrating between credit networks. Clearly, these women, felt their leaders, were not moving from domesticity to income-generation along the disciplined path of responsabilised welfare. Certainly, they did not seem to meekly accept the semi-pedagogic, semi-bureaucratic authority of the CDS CP. Indeed, it appeared that sheer

proximity to the leaders within the space of the panchayat made it possible for these women to threaten them to exile back in individual domesticity through gossip and slander. The KS leaders' grip on their constituencies seemed, thus, a very shaky one.

However, these welfare-seekers cannot to be dismissed as a greedy horde as they may appear in the view from above. Indeed, they seemed to indicate a new mode of gaining vital consumption resources from the state by the poor in a context in which responsabilised welfare was being thrust on them. The rank-and-file of the KS, originally planned as a state-centric civil society, seems to function now as a 'civil-political society', overwhelmingly of women. The new welfarism of the 1990s did not usher the poor into civil society; neither did it foster the political society-formation that Partha Chatterjee (2008) points to. Rather, a hybrid, the 'civil-political society', seems to be taking shape. The 'civil-political society' also gathers in the space in which the legal and bureaucratic apparatus of development interacts with populations, like in Chatterjee's description of political society. But if the groups that manoeuvre in political society are often illegal entities that advance demands through projecting on to population groups the moral attributes of a community, the 'civil-political society' is composed of legal entities with which the state can negotiate with directly. SHGs operate within a framework of clearly-laid-down rules; they are formally shaped and controlled by government agencies. But it was clear from our interviews that the CDS CPs were forced by the rank-and-file to engage in paralegal negotiations quite similar to negotiators of Chatterjean political society. Nevertheless, this hybrid grouping was hardly amenable to collective action because it was difficult to project the moral attributes of a community on the SHG women who resembled more a group of individual rational agents. This is no coincidence because the liberal logic of SHGs treats collective interest as the sum of individual preferences. Hence its reliability as a political constituency is decidedly low.<sup>14</sup> And the poorest were often left out, as in Chatterjean political society (John and Deshpande 2008; Williams et al 2011).

In short, the 2006-8 fieldwork produced a mixed picture. KS woman leaders seemed to confirm feminist critiques of self-help-centred 'women's empowerment' (Batliwala and Dhanraj 2004). However, there were undeniable 'unintended consequences'. Even critiques preceding demands for women's full citizenship<sup>15</sup> were absent. Nevertheless, by 2008, the KS itself seemed to be entering a new phase with the adoption of a new by-law that clarified several key aspects of the KS-Panchayat relation, as well as the relation between the three tiers at the village level.

# **THEORETICAL FRAMEWORK**

## **THEORETICAL FRAMEWORK**

In many discussions and studies it is found that women have been treated as second class citizens of all across the globe. It is a fact that almost common everywhere, irrespective of the development index of a country, women have always been subjected to denied rights and support systems for their adequate functional growth. This situation is caused due to loss of women's self-dignity as human beings over time under such conditions. Women are not independent entities. Especially in Kerala, they are found to be fully associated and dependent on men particularly in addition to other aspects in the context of intellectual and professional capabilities. One of the remedies then, is to improve the women status in society which has consequently become the goal of various Women empowerment schemes. Empowerment has been considered an effective tool to bring about changes in the socio-economic conditions of women. A nation, society as well as the individual himself or herself, cannot progress adequately until the status of women in the region is improved, in the very least. Mahatma Gandhi written about the role of women in society that "to call woman the weaker sex is a libel; it is man's injustice to woman. If by strength is meant brute strength, then, indeed, is woman less brute than man. If by strength is meant moral power, then woman is immeasurably man's superior.

Feminist theorist mentioned that in any social analysis women should be treated as a separate class. Women's position in the society has been determined by the father or their husband's occupation. It has become almost a common place to say that classes are gendered and that gender relations are class-specific.

Our identity is how we understand ourselves and differentiate ourselves from other people but theorists maintain that the identity we own is largely constructed for us by society. This is particularly relevant when it comes to gender roles.

### The Social Construction of Gender

Ann Oakley's contributions include lots of academic works; most of them touch upon women's place in life. There are also lots of novels; one of the most popular is *The Men's Room*. She has also written her own biography, however it is not full for now.

Main spheres of her interest are numerous. They are childbirth and motherhood, family, feminism, housework, imagining the future, men, relationships between men and women, sex and gender and social science.

In a wide range of books Anne Oakley has proved that the understanding of person's gender role comes not from biological matter, but from a social one. A person perceives his or her place with communication and interaction with others. The same is with the children. They are given their gender basis from childhood.

It is important to understand the difference between gender and sex. Sex is biologically determined by one reproductive organs. Gender, however, is socially constructed. It is the way in which one acts in relation to the societal expectations of their sex. Our gender identity is the name given to the way in which a person acts in relation to their sex and societies expectations. The main influences on gender identity are the many different agents of socialisation. Socialisation is the process in which we learn the norms and values of the society we live in. Agents of socialisation are people or groups that assist individuals in the socialisation; these are groups such as the family, the media, religion and the workplace. The purpose of this essay is to examine how great an influence on our gender identity the family is and to assess whether it is the most important influence on our gender identity.

There are many reasons for believe that the family is the most important agent of socialisation. The family is a primary agent of socialisation, it is responsible for the basic skill that are learnt to be a functional member society e.g. communication, mobility, right from wrong. One could argue that at a young age the family is the most dominant agent of socialisation and thus has a direct influence on ones gender Identity.

Talcott Parsons suggests that the family is the most important agent of socialisation as he argued that the norms and values are learnt first and foremost from the family.

Ann Oakley argues that children are socialised into their gender roles and hence in their gender identities by the family in four ways. The first of these ways is Manipulation. This consists of parents (or other family members) encouraging behaviour that is seen as the norm for the child's gender and discouraging behaviour that is not considered the norm e.g. congratulating a boy for completing an obstacle course but discouraging a girl from attempting the obstacle course. The second method described by Oakley is Canalisation. This

comprises of parents channelling the child's interests into activities that are considered the norm for their gender e.g. encouraging girls to do ballet and encouraging boys to play football. The third of Oakley's methods was Verbal Appellations. This involves giving children nicknames or pet names that are appropriate for their gender e.g. little angel for girls and little monster for boys.

So, socialisation is a key factor to identifying oneself as a male or female person. Furthermore, roots of this process go back to our childhood. Gender programmes of Kudumbasree aims to create awareness about the rights, status and justice of women by themselves through the discussions of their experiences, identify their role in the local development process, and equip women to recognize about their rights, inequalities and violence against them. It has been creating an understanding of violation of human rights of women for nearly a decade. The program attempted to create awareness among the women as well as sensitized the society around. Through Gender Self Learning Programme, Kudumbasree seeks to generate public discourse and political debate regarding the important relationship between sexuality, gender, and human rights. In particular, we will work to raise the visibility of these issues—as well as amplify the voices of women. Gender team will expand our programmes in the coming years, especially those related to violence prevention and intervention. Kudumbasree had undertaken many small steps to come closer to our aim of creating a gender just society through Gender Corner, Crime mapping and related activities and through Snehitha interventions. Also a process of identify the vulnerability in the neighbourhood area. Address poverty in multiple dimensions and also prevent atrocities against women and children through convergence, Action group formation and by availing Government services to the community.

Women play a vital role in the development and sustenance of society at large. On account of the traditional patriarchy followed since time immemorial, often their contribution is not accounted and valued. With the changing times, the status of women both in the oriental world as well as in the occidental world has changed. Along with equality, and empowerment, today's woman has also to tackle new challenges and shoulder responsibilities manifold specifically in the context of developing nations. Unlike other poverty's alleviation programmes, Kudumbasree has a multi-pronged design and strategies that empower women in socially, economically and politically. Further, the three-tier federated community structure adds to its authenticity, accountability and commitment towards the poor and marginalized. Kudumbasree recognizes that capacitating women to understand and exercise

their rights is a basic requirement for the success and sustainability of any poverty eradication programme. Kudumbasree has attempted to bring every poor woman in the state to federations of NHGs and capacitate them to address the issues of women by enhancing or improving female work participation, health and nutritional status, participation in decision making, local governance and their role in planning in addition to make them as local entrepreneurs for finding their livelihoods.

Kudumbasree is further play an active role in bringing women in to local governance. The participation of Kudumbasree members in Gram Sabhas and development works of GPs providing them the space for involving in local governance. This participation is giving opportunity for them to involve as a community interface for local economic development lead by GPs in the areas of social infrastructure development, welfare programmes based on rights and entitlements, employment generation, from food security, health insurance, housing, enterprise development, MGNREGS and Jagratha Samiti for enduring the safety and protection of women. Convergence with Panchayat Raj Institutions (PRIs) has been one of the central themes within the Kudumbasree idea. Convergence means seamless working together of the Kudumbasree and the PRIs; it includes institutional and programmatic convergence as well as sharing of resources.

According to Oakley's gender socialisation theory, gender is a concept determined by environment and culture via verbal and nonverbal signifiers (such as interpersonal relationships, media use), social value and belief, and stereotypes. Kudumbasree act as a tool for providing better environment for women, to think that the differences between men and women are biologically based and these are socially and culturally constructed and reproduced.

What truly sets Kudumbasree apart is the focus on social inclusion for women across all strata. For long now, women had to struggle for having their identity validated in the eyes of the society dictated by norms of the oppressor. The scheme stands true to the spirit of democracy and good governance by protecting the right to choice and extending support to its citizens without discriminations to freely exercise the choice. It is far from ideal and there is a long road to walk ahead in terms of diminishing the line of segregation and celebrating diversity amongst women. However, under the current circumstances, this is a measure to promote equity in terms of access and rights.

**CHAPTER III**  
**METHODOLOGY**

## **CHAPTER III**

### **METHODOLOGY**

This chapter deals with the methodology being used by the researcher to study the role of Kudumbasree in economic empowerment of women. This chapter includes the research design, research setting and the tools used for data collection.

#### **OPERATIONAL DEFINITION**

Economic empowerment – economic empowerment means providing the people especially the women groups with education, skills, training programmes, financial assistance through kudumbasree to earn an income and become self sufficient to look after themselves and their families and to become economically independent.

#### **RESEARCH QUESTION**

- How the women in Tripunithura Municipality were economically empowered through Kudumbasree mission?
- How a woman is empowered after her involvement to Kudumbasree. Does it have an impact on her entire life circle?

#### **RESEARCH DESIGN**

This researcher chooses Quantitative approach for this study and the research design used in this study is descriptive in nature, Descriptive research is defined as a research method that describes the characteristics of a population or the phenomenon that is being studied. The descriptive research design helps to understand more about, which are the factors that contribute to the economic empowerment of women, how these factors help the women to become self dependent and self sufficient and why the economic empowerment of women is important for the overall development of our country.

## **RESEARCH SETTING**

The research is done in Tripunithura Municipality in Ernakulam district, Kudumbasree is a successful program launched by the government of Kerala for poverty eradication and women empowerment. Ernakulam is considered a place where much development is seen when compared to other districts like Thrissur, Thiruvananthapuram, Kottayam, etc. as per the status of Kudumbasree, the Studies conducted in the place are also very few. Conducting a study here would benefit the researcher in getting suitable samples which is appropriate for analyzing the role of kudumbasree in economic empowerment for the research study.

## **UNIVERSE AND THE SAMPLING METHOD**

The universe of the study comprised the Kudumbasree NHGs and its members in Ernakulam District, the population of the study is Kudumbasree having completed the tenure of minimum five years and the women having atleast three years experience as kudumbasree members and are still in the group, in Tripunithura Municipality of Ernakulam District, Kerala.

Multi stage and simple random sampling method is used for the selection of samples required for the present study. In the first stage from the 49 wards, 9 wards were selected randomly. In the second stage from each selected wards 18 NHG (2 NHG from each ward) were selected by simple random sampling method.

In the third stage from the 18 NHGs, 10 kudumbasree units were selected randomly and in the fourth and final stage, from each selected kudumbasree units 5 members were selected at randomly constituting 50 members.

Thus the sample for the present study consists of 10 kudumbasree and 50 members.

## **SOURCES OF DATA COLLECTION**

The primary and secondary data have been used for analysis. The primary data will be collected using pre- structured questionnaire, specially designed for eliciting information for

the study. The over all aspects of kudumbasree unit is being assessed with the help of secondary data which are collected from published sources like annual reports and records of state poverty eradication mission, periodicals, newspapers, journals, articles etc

### **TOOLS FOR DATA COLLECTION.**

The researcher uses pre structured questionnaire to collect data from the respondents and statistical tools like SPSS will also be used for the analysis.

### **LIMITATIONS OF THE STUDY**

Every researched study suffers from errors and limitations. Some of these are inherent in the research design while some others become part of the study during various stages of operation. The present study is subjected to the following limitations:

- The reluctance of the respondents to answer some of the questions was one major limitation.
- The researcher faced problem in explaining questions because most of them were not proficient in English languagr.
- The study is based on a sample of 50 respondents. Demerits of the sampling techniques have affected the study.
- The time taken to complete this study was very limited.

**CHAPTER IV**  
**DATA ANALYSIS AND**  
**INTERPRETATION**

## CHAPTER IV

### DATA ANALYSIS AND INTERPRETATION

This chapter deals with the Data analysis and interpretation. The study is aimed at measuring role of Kudumbashree in economic empowerment of women. The measurement of role of Kudumbashree is presented in different dimensions like on reasons to join Kudumbashree, awareness on various banking procedures, service providers, financial products and services and their usage, benefits derived from Kudumbashree, satisfaction and decision making.

**Table 4.1 Age of the respondents**

Sl no	Age slot	No of respondents	Percentage of respondents
1	25 to 35	12	24
2	35 to 45	18	36
3	45 to 55	11	22
4	Above 55	9	18
	Total	50	100

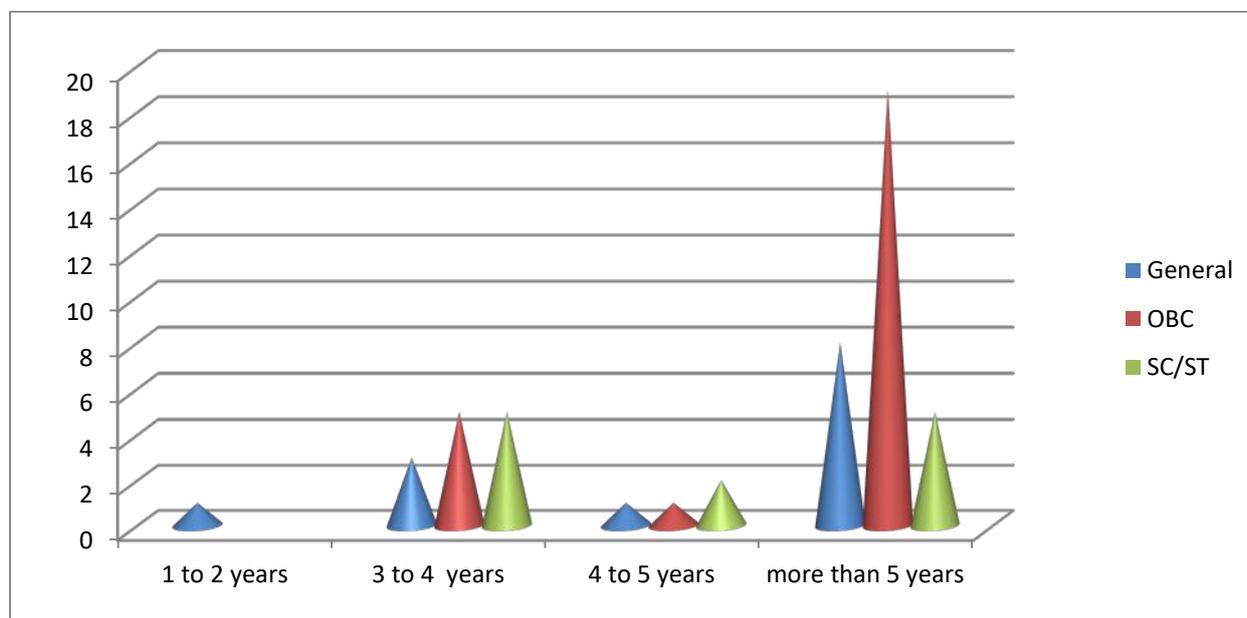
The table highlights that most of the members fell within the 35 to 45 ageslot(36percentage). The second the highest no of respondents fell within 25 to 35 age slot (24percentage) and the third age slot is 45 to 55 (22 percentage) and 18 percentage of the total 50 respondents came under the age group of above 55.

**Table 4.2 Marital status of the respondents**

Sl no	Marital status	No of respondents	Percentage
1	Married	45	95
2	Un married	0	0
3	Divorced	0	0
4	Widow	5	5
	Total	50	100

The table highlights that most of the members ie 95% fell within the category of Married. Then the remaining 5% comes under the category of widow. There no is no one among the respondents who is unmarried and divorced.

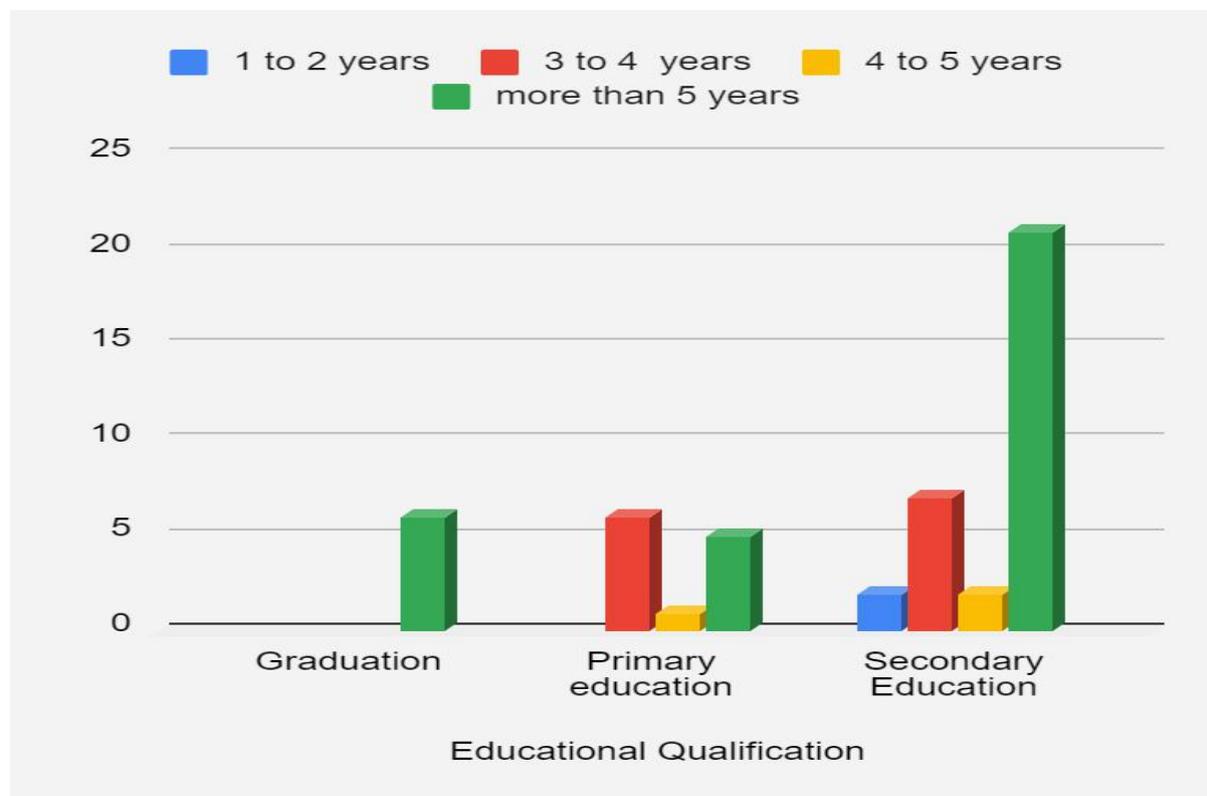
**Chart 4.1 Caste and membership preference in kudumbasree**



From this figure it is observed that 2% of General category have 1 to 2 years membership in kudumbasree. The next category is 3 to 4 years of membership, this group includes 6% general, 10% OBC and 10% SC/ST category. The next is 4 to 5 years of membership, it consists of 2% of general category, 2% of OBC and 4% of SC/ST category. The last category is more than 5 years of membership. In this category 16% belongs to general category, 38% belongs to OBC and 10% belongs to SC/ST category.

From this figure it is very well clear that OBC category is the majority (50%) and in this category 38% has more than 5 years of membership in kudumbasree. SC/ST category is the lower majority ie 24%, in this category only ten percentage of the total respondents has more than five years membership.

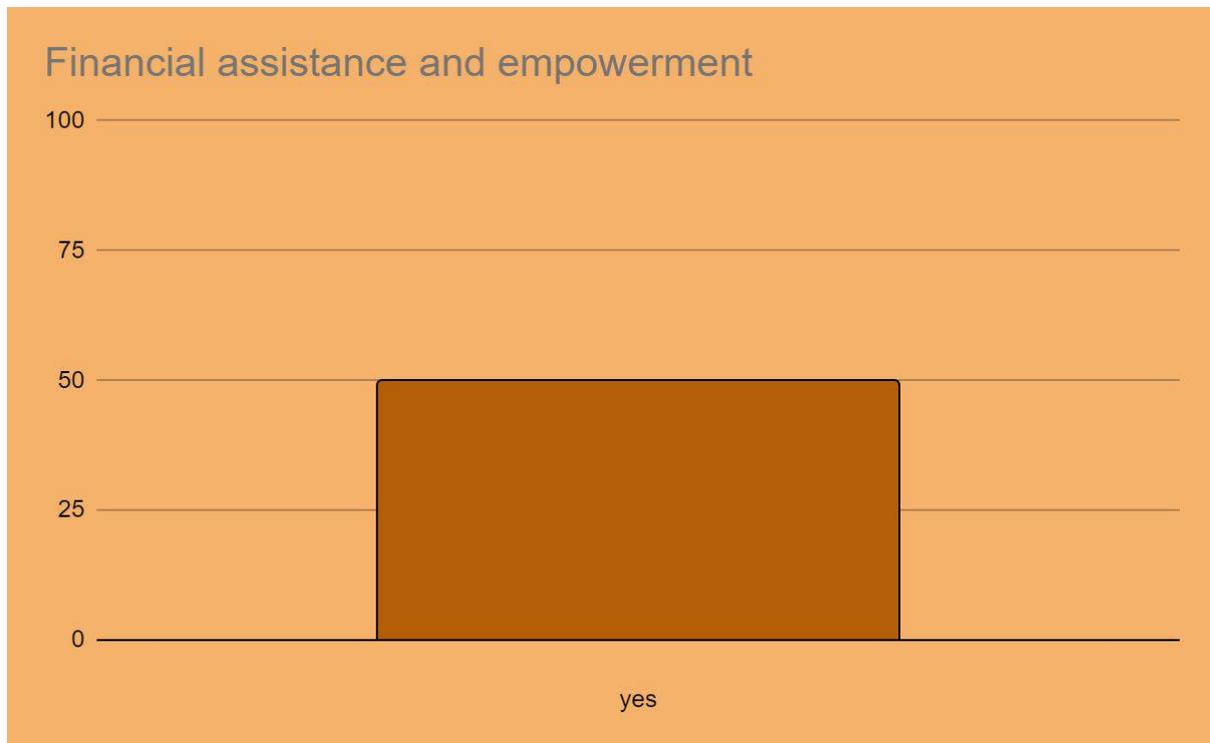
**Chart 4.2 The educational qualification of the members and the years of experience in kudumbasree**



In the study it was founded that, there is no women who is illiterate in the Kudumbasree with reference to these kudumbasree units. From this figure it is clear that 12% of graduates have more than 5 years of membership in kudumbasree. The next category is primary education, in this group 12% have 3 to 4 years of membership in kudumbasree, 2% have 4 to 5 years of membership and 12% have more than 5 years of membership in kudumbasree. The next is secondary education, in this group 4% have 1 to 2 years of membership, 14% have 3 to 4 years of membership, 4% have 4 to 5 years of membership and 42% have more than 5 years of membership in kudumbasree.

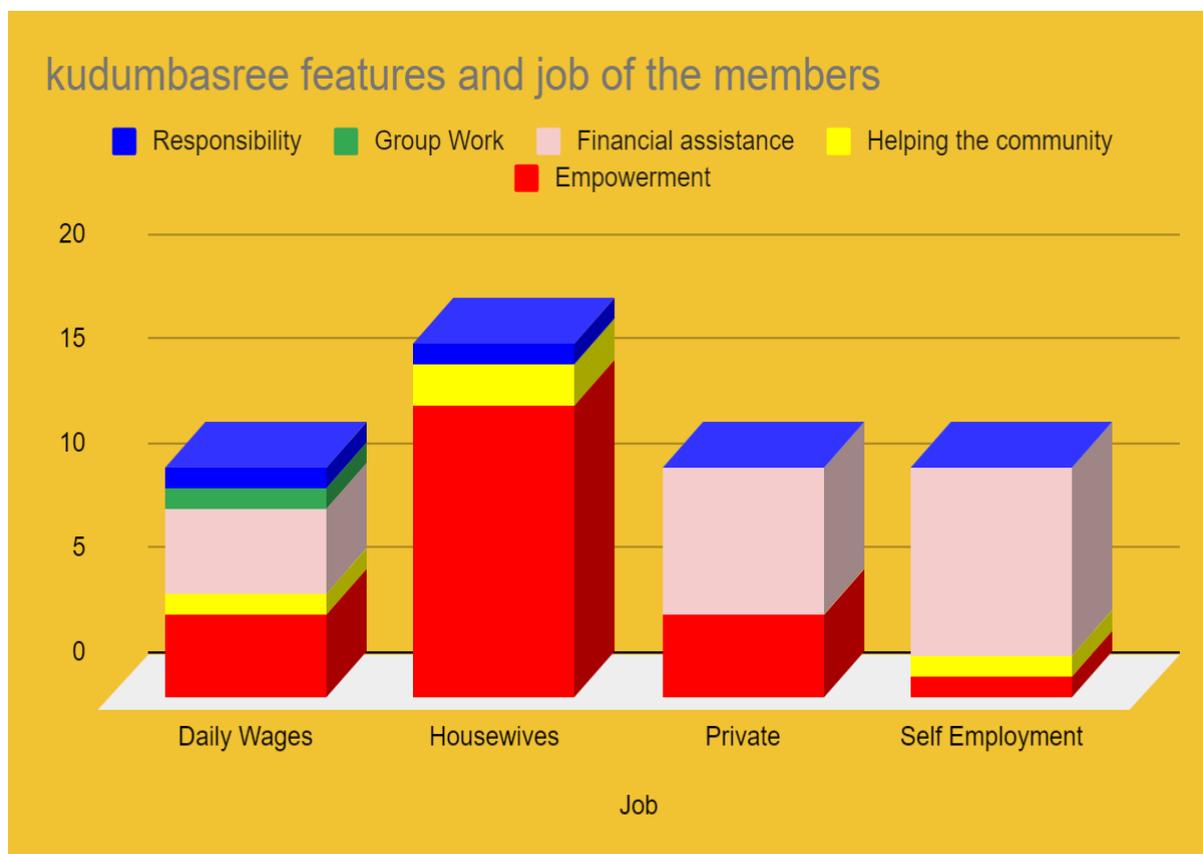
Most of the women in these units are qualified and majority of them have completed their secondary education (64%). In this sixty four percentage, 42% of them have more than 5 years of experience. The least majority is graduates only 12% of the respondents.

**Chart 4.3 Financial assistance and empowerment**



From this figure it was clearly founded that kudumbasree gave 100 percentage financial assistance or support in terms of loans, savings, thrift, micro credits etc. And they said that this sort of financial assistance improves the position of women in the society and helps them to come into the frontline of the society. None of the respondents selected the No option, ie kudumbasree provides financial assistance to the kudumbasree members and this enables the members to become self reliant and empowered.

**Chart 4.4 Income level and factors motivated to join in kudumbasree**



In the present study the comparison between the income level and responses of the members which motivated them to join the Kudumbasree Programme are analyzed. There are many reasons to be motivated to join kudumbasree. That is classified into financial assistance, empowerment, Group work, helping the community, taking responsibilities etc.

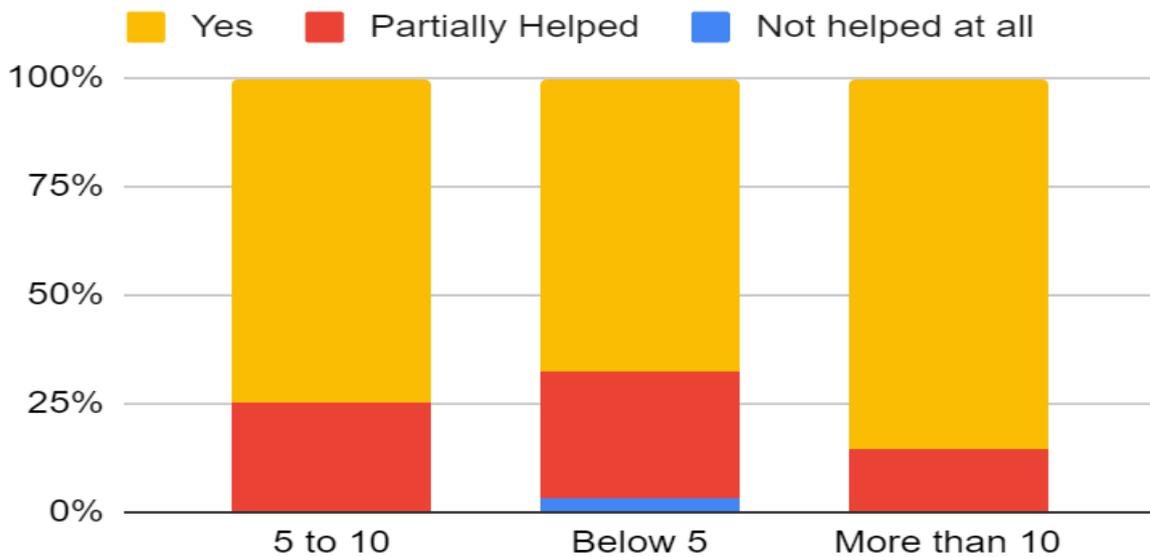
In this figure, the first category is Daily wages job (22%), among these 8% of them were opted for empowerment feature of kudumbasree, 2% opted for Helping the community, 8% opted for financial assistance, 2% opted for Group work and 2% opted for Taking responsibility.

The second category is Housewives (34%), out of these 28% selected the option of empowerment, 4% selected the option of helping the community, and 2% selected the option of responsibility taking.

The third category is Private job (22%) among these, 8% were motivated to the kudumbasree feature empowerment, 14% for financial assistance. The last category is self-employed (22%), in this 2% opted for empowerment, 2% opted for helping the community and 18% opted for financial assistance.

From this it is clear that majority (46%) attracted to join in kudumbasree for empowerment. Among these 28% of them are Housewives. The second majority is focused on the factor of financial assistance (40%) like bank linkage loans, micro credits, savings etc. and remaining 15% were favored for group work, helping the community and taking responsibilities.

**Chart 4.5 Effectiveness of Ashraya and Bhavanasree Programme for the poor people**



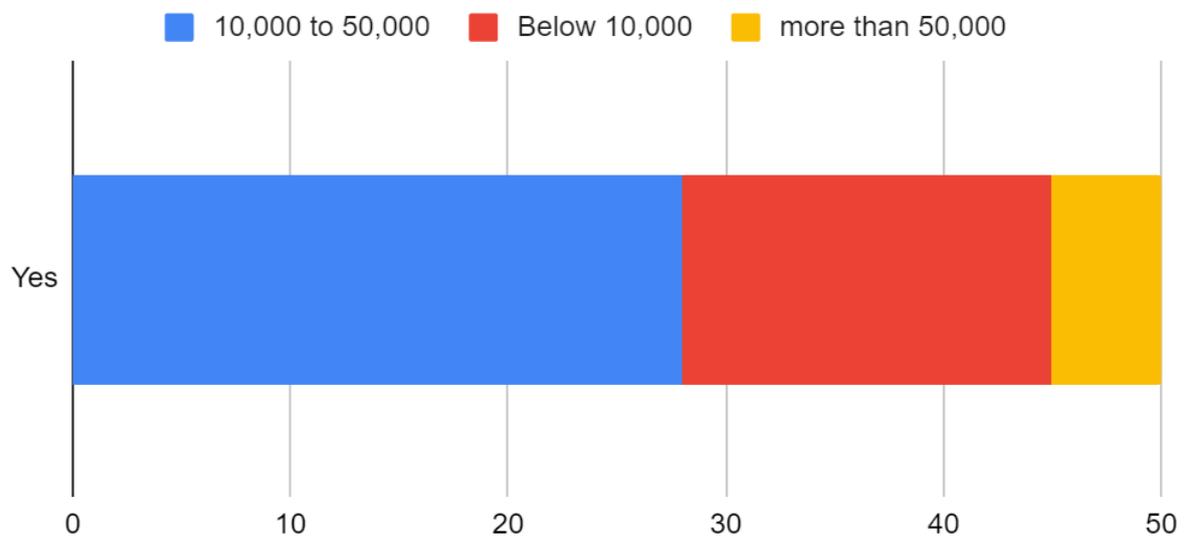
In this figure, the first category is 5 to 10 ( 24%) people received support from the government for rehabilitation, among these 26% of respondents said that this project partially helped the needy and 18% of them said that it is a very effective programme for the rehabilitation of the houseless poor.

The next category is Below 5 (62%) were identified as needy and 2% said that ii is not helped the houseless and 18% said that it is partially helped them and 42% said that it is very effectively implemented.

The last category is More than 10 houseless poor were identified (14%) among these 2% said that it is partially helped and 72% said that it rehabilitate houseless poor in more appropriate manner

From this data it is clear that majority of the respondents 72% of the respondents say that through kudumbasree meetings 5 to 10 houseless and poor people were identified and 98 percent said that these activities helped a lot to rehabilitate them. They also mentioned that Ashraya is an integrated project aimed at identification and rehabilitation of destitute families and also makes the women household capable of supporting her family. . It is an initiative to identify houseless poor and support them.

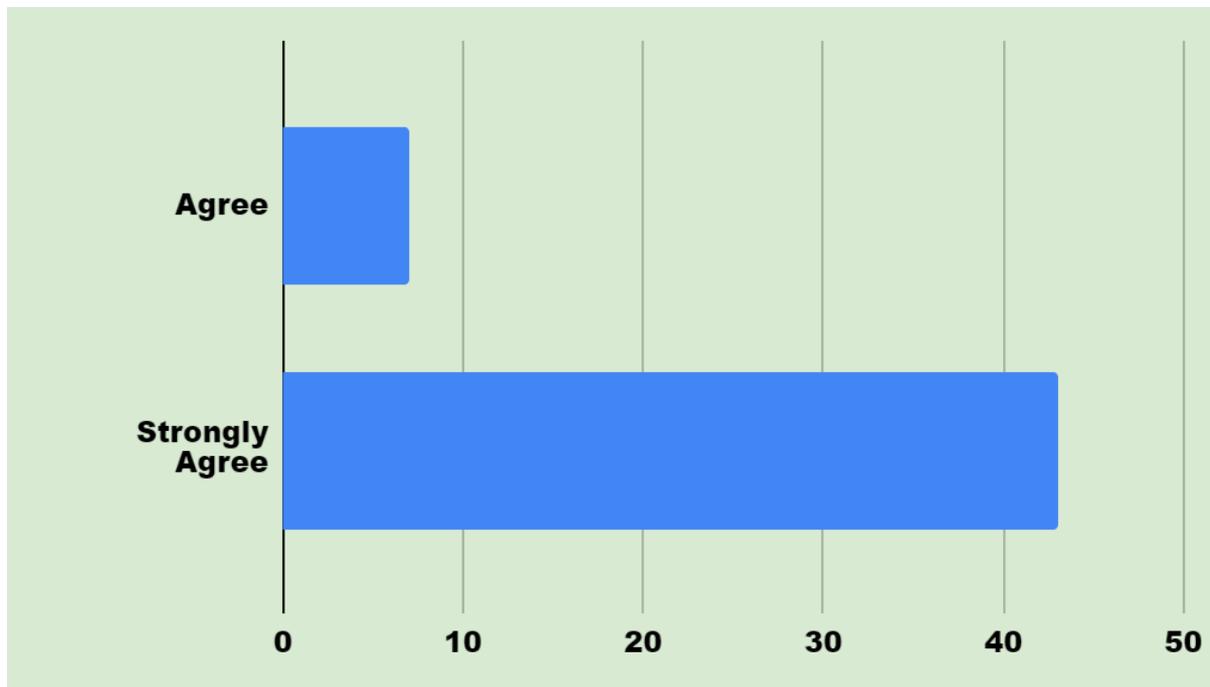
**Chart 4.6 Utilizing financial assistance or loan schemes in improving the position of women in the family and society.**



In this study 100 percent of the respondents were utilized the financial assistance schemes and majority of the proportion ie 56 % were borrowed ten thousand to fifty thousand rupees, 34% were borrowed below ten thousand rupees and only 10% were borrowed more than fifty thousand rupees. Kudumbasree can issue small loans from the group's savings to its members as per requirement.

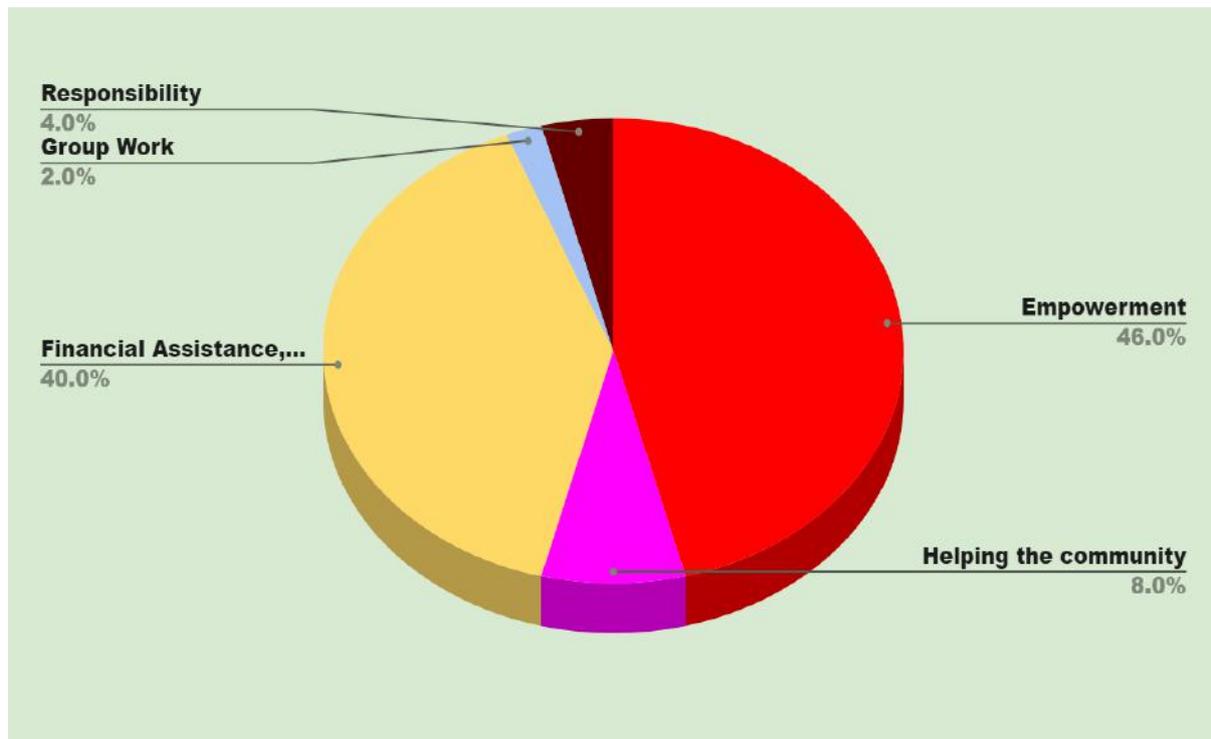
All decisions are to be taken by consensus or through majority support from the members for satisfying their basic and urgent needs. So there is no need to depend on others for financial assistance. The interest rate is also very low. So this helps women a lot to support their family.

**Chart 4.7 Effectiveness of Micro credit and SHG for economic empowerment of women**



In this figure of economic independence by SHGs and micro credits noted that 100 percent were appreciated the role of microcredits and SHG, among them 86% strongly agreed that these features of kudumbasree aids the women for achieving the economic independence and 14% were agreed to this statement. No one opted the options of Disagree, Strongly disagree and neutral. From this it is clear that Economic independence is the base for empowerment and this is very effectively done by the kudumbasree through its various schemes.

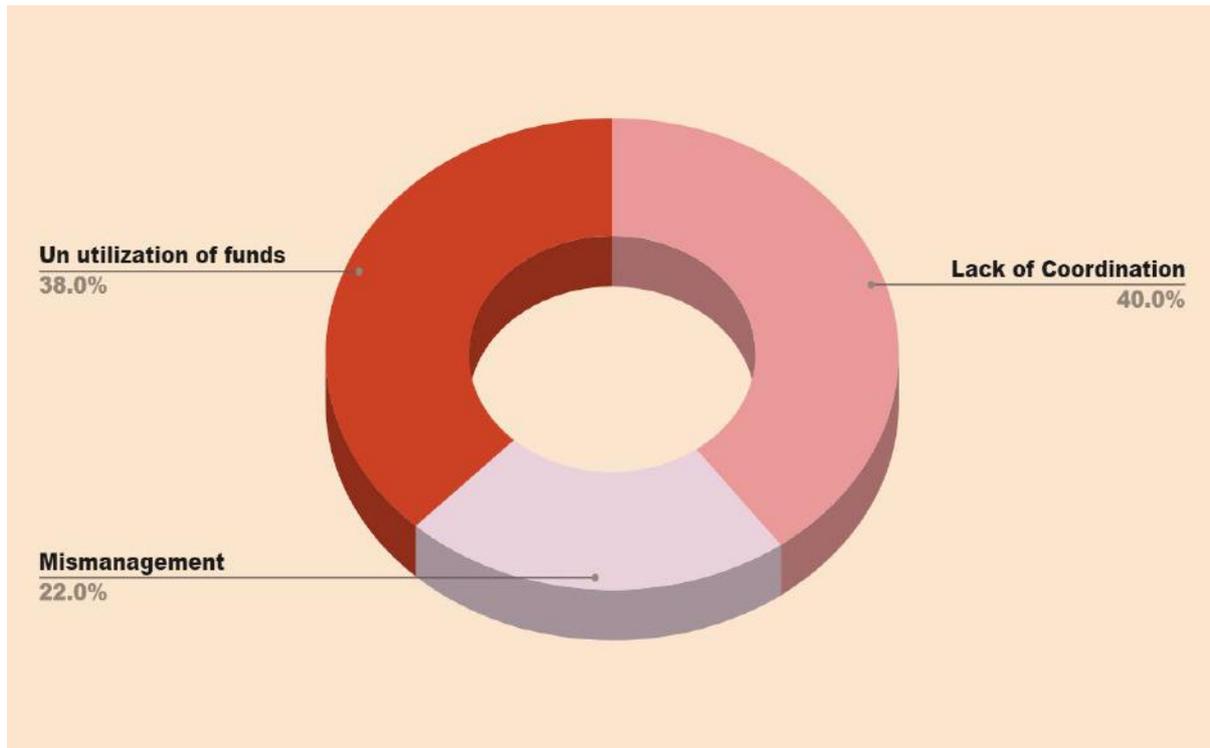
**Chart 4.8 Kudumbasree features attracts the members to join kudumbasree**



The figure shows that the most influencing factor that attracts the women for joining Kudumbasree. 46% of the respondents joined in kudumbasree for empowerment, 40% were attracted towards the financial assistance schemes provided to the kudumbasree members and 8% on helping the community, 4% were interested in taking responsibility and 2% were focused on Group work activities.

The ranks obtained for the factors that influenced to join Kudumbasree are stated above. The lower the ranks were given for helping the community and group work and the higher ranks were given for empowerment and financial assistance.

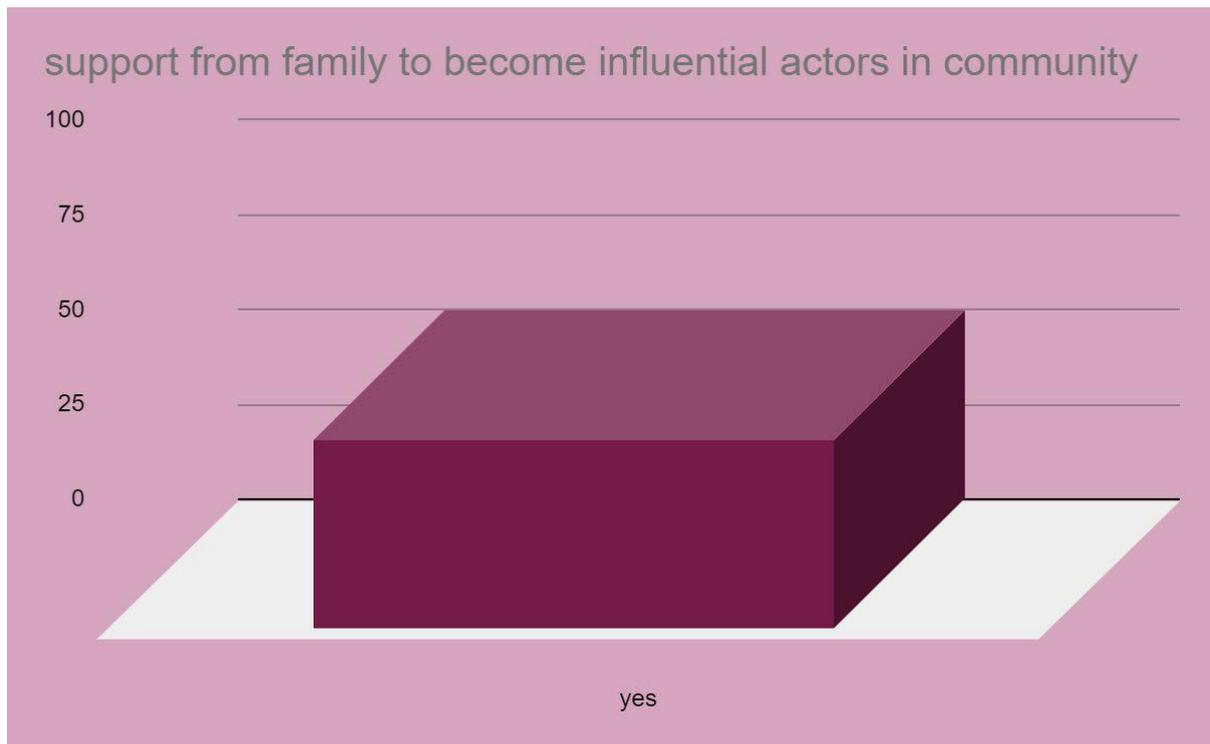
**Chart 4.9 Problems or issues faced by the kudumbasree units .**



From this figure it is clearly identified that majority of the respondents (40%) were said that lack of coordination is the major problem faced by the kudumbasree units followed by Un utilization of funds (38%) and mismanagement (22%).

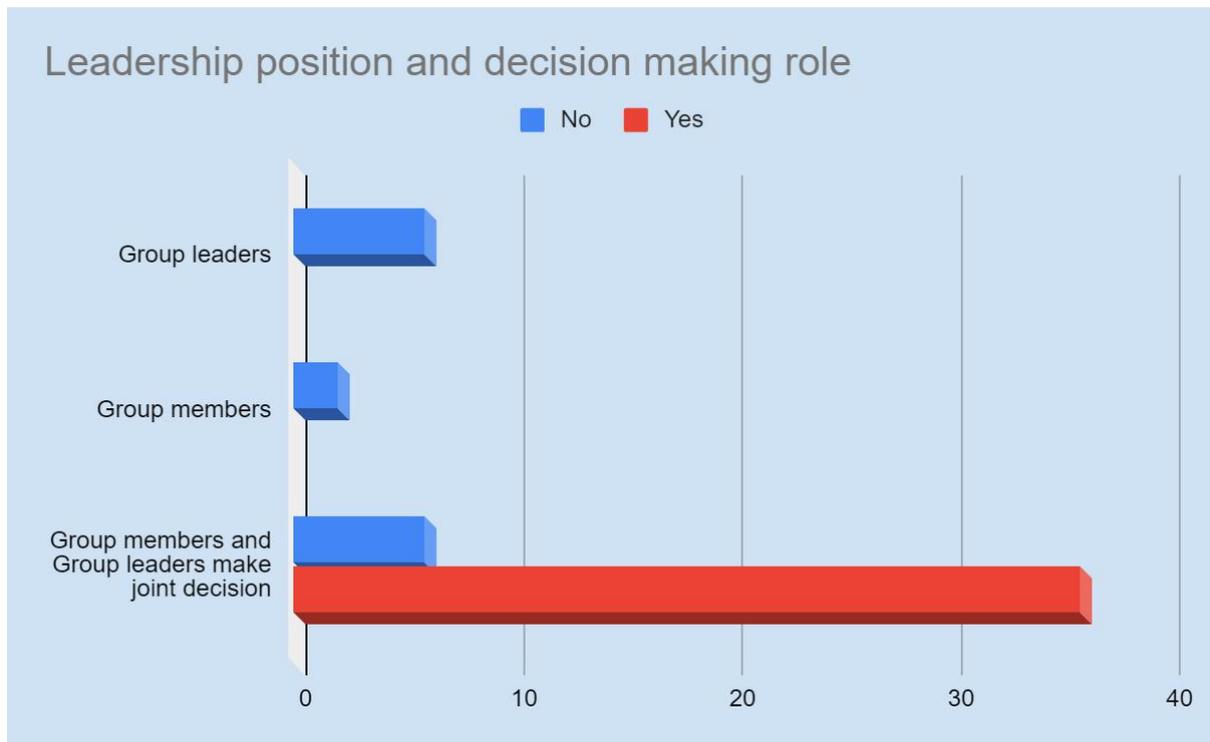
A lack of coordination can decrease productivity, hesitance to taking up responsibilities and complicate processes and delay the completion of tasks. In order to coordinate the efforts of an entire unit, the organisation requires systematic integration of a process that creates accountability within the organization. The efficient fund utilization enables the kudumbasree members for improving savings and bettering its value.

**Chart 4.10 Support from family to become the influential actors of the society.**



From this study it was found that 100% of the respondents agreed that they received support from the family matters and they got opportunity to become the influential actors of the society. Women made their way to the forefront of accomplishment or power primarily through their own efforts. They act as the key for development of a community and a country.

**Chart 4.11 Decision making in kudumbasree**



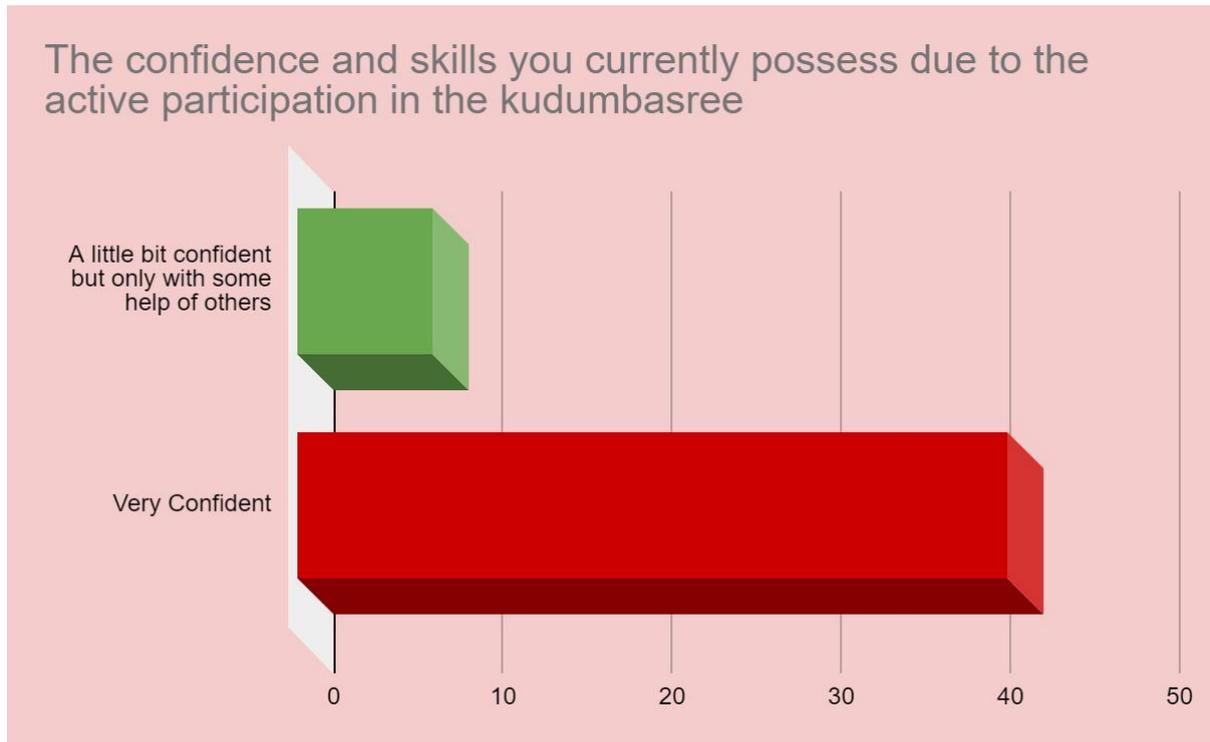
From this study it is clearly understood that majority of the respondents ie 72% were agreed that joint decisions were taken in kudumbasree during the weekly meetings especially on Sundays, in any of the matters regarding the kudumbasree.

Among the respondents 12% said that Group leaders will take the decisions and 4% of them said that Group members also have the power to take the decisions, and the last category 28% agreed that group members and group leaders will take the joint decisions.

The group leaders and all the group members were involved in it. Only 16% said that the group members were not involved in the decision making process, and group leaders took all the decision without the consent of the members.

From this it is noted that in kudumbasree all the decisions are the output of joint decisions and it is like a team effort and group work and all are involved in it.

**Chart 4.12 Enhancement of the skills to achieve empowerment.**



From table it can be observed that 84% that of the respondents who participated in kudumbasree Programme developed their level of confidence to take up responsibilities after joining the initiative. 16% of the respondents said that they are little bit confident, but improved their level of confidence after participating in these programmes. No one opted for the No option. So from this it is very well clear that kudumbasree enhances the skills of women and molded them as a better person to fit in the society.

## DISCUSSION

### **To find out the socio-demographic profiles of the respondents.**

- Kudumbasree is a women centered, state poverty eradication programme in rural and urban areas of the state of Kerala. It aims at eradicating absolute poverty, making the women empowered and it also envisages the prosperity of the economically backward families of the state.
- But the main problem behind the lukewarm response of the poor and backward caste people towards kudumbasree has clearly been the lack of awareness, devoid of active participation in community programmes like gramasabha meetings, notion of being marginalized from the community and due to lack of interest in coming to the forefront of the society. Increased income in the hands of women is invested in health, education and housing of their families and make them self-dependent and empowered.
- It has been observed that in India, women are discriminated against and marginalized at every level of the society whether it is social participation, political participation, economic participation, access to education, and also reproductive health care. Women are found to be economically very poor all over India. A few women are engaged in services and other activities. So, they need economic power to stand on their own leys on part with men.
- It has been observed that 24% of members of the units were under the age groups of 25 to 35 and 36% under the age group of 36 to 45 and 22% of them are between the age group 46 to 55. There were 24% respondents under the age group of above 56 years.
- Monthly income of the respondents varies from daily wages to monthly salary. However, all such contribution is the combined effort of both the husband and the wife. Regarding the ownership of land by the families of the respondents, it was seen that only a few per cent do not own land.
- In this study most of the members ie 95% fell within the category of Married. Then the remaining 5% comes under the category of widow. There no is no one among the respondents who is unmarried and divorced.

- Women among the respondents under this study are having graduation or degree. Still we see they are entering into Kudumbasree might be due to their family concerns or to develop certain skills and to become economically empowered.

**To identify the major factors influencing the members to join Kudumbasree.**

- Kudumbasree chooses a family based approach; it reaches the family through women and the community through these families.
- Thrift and credit schemes encourage the poor to save some money from what they use for their regular expenses, and help them to avail small loans from their savings. Every member brings a pre-decided amount (this amount is decided by the group) to the weekly group meetings. The money collected is deposited in a bank in an account jointly operated by the president and secretary of the group. As months pass, these savings progressively increase to relatively large amounts, this makes them economically empowered.
- It was found out from the study that a major reason for women joining in self-help groups is to add additional family income. SHGs could be helpful in inducing positive self -image, self-reliance, self-confidence and economic independence in women members.
- “Ashraya” in local language (depending) aims at uplifting the poorest of the poor from their destitution. The houseless women were identified in kudumbasree meetings and provide them with financial assistance to set up a house and also to meet their basic needs, this is given for the poorest of the poor families, which lack adequate food, drinking water, shelter, educational facilities for children, sanitation facilities, employment opportunities and land for shelter and worst sufferers of illness and chronic diseases are identified and rehabilitated under various schemes. So from this figure we can conclude that this is a milestone for the grass root development of the poorest.
- The housing need of poor families are identified and addressed by the Kudumbasree led them to an innovative housing programme Micro housing. Under this programme, financial support is provided to poor families through loans from banks.

**To analyze the changes in economic aspects of women through the aid of Microfinance and SHGs in kudumbasree.**

- There is a bidirectional relationship between economic development and women's empowerment, improving the ability of women to access the constituents of development such as health, education, earning opportunities, rights, and political participation. In other words these features of kudumbasree plays a major role in driving down inequality between men and women.
- The participants are actively involved in NHG activities. In the last six years both the units had many activities with maximum participation. It was observed that, most important factor that motivated the participants in joining the program was the availability of loan with less interest which aids in living independently and also the political participation which benefits in bringing their voice in front of the society. The availability of the loan also enables the members to save money for their children's education. This is followed by other forms of empowerment which include social empowerment, personality and skill development, political development etc.
- In this study cent percent of the respondents were utilized the financial assistance schemes and majority of the proportion were borrowed ten thousand to fifty thousand rupees, some of them were borrowed below ten thousand rupees and only few were borrowed more than fifty thousand rupees. Kudumbasree can issue small loans from the group's savings to its members as per requirement.
- Kudumbasree's Thrift and Credit system have been an enabler for women across the state. In the weekly meetings, the members submit a pre-fixed amount (also called the thrift) with the Secretary. The amount thus accumulated over time is used to provide a loan (or credits) to the poor who haven't been able to access banks which require a basic capital that is much higher. The repayment of a loan is done in the weekly meetings and the interest contributes to enhancing the amount available with the NHG.
- The success of the thrift and credit systems have been such that they are known as informal banks for poor women at their doorstep which can now provide loans for purposes beyond covering basic needs, such as income-generating activities. The success led to NABARD coming up with a set of criteria on which individual NHGs

would be assessed. The NHGs which meet all the criteria will be enrolled in the Linkage Banking Scheme under various banks and the members will be eligible to receive finance without any individual collateral security.

**To see whether there any changes in gender roles due to participation in kudumbasree.**

- Ayalkkottam (NHGs) tend to involve more in activities which provides awareness about women empowerment. All the participants tend to have a proper idea about their rights and duties. They started living independently with the power to take a decision by themselves. Women started involving themselves into many activities which enable in removing the stereotype prevailing in the society. They do face familial and societal barriers where they started breaking it for their own sake. Leadership opportunities being provided on the basis of equality, all women tend to get an opportunity which enables in taking up responsibilities.
- The awareness class that has been provided helps them in updating themselves with current issues and reality. They started differentiating right and wrong. Classes on gender help in their empowerment resulting in major changes in their decision-making capability. It helps them in knowing about the schemes and policies which would provide them aid and beneficiaries. Many of the participants was able to avail BPL (Below Poverty Line) card because of the organization. It also helps them in realizing the importance and usage of the internet and all related social media. At the initial stage, all the participants were against the usage of all the social media and scolded their children for its usage, but now they have their own whatsapp group for passing important information and details about the NHG meetings.. In a similar manner, they also encouraged in providing their daughters higher education than making them get married. All the participants were fortunate about their involvement in the kudumbasree.
- All decisions in kudumbasree are taken by the consensus from each and every member or through majority support from the members for satisfying their basic and urgent needs. So there is no need to depend on others for financial assistance. The interest rate is also very low. So this helps women a lot to support their family

**CHAPTER V**  
**FINDINGS, SUGGESTIONS AND**  
**CONCLUSION**

## MAJOR FINDINGS OF THE STUDY

- It was also observed that there was active participation of members in NHG meetings and 90% of women from the meetings are regular. Other 10% misses the meeting due to emergencies or health issues. The priority in the discussion during the Ayakkottam meetings observed was the distribution of loans at the starting which is followed by social issues in their areas and personal issues of the members. The respondents also involved in cultural activities if time permits.
- All of them belong to any among the three religious groups which include Hindus, Christians and Muslims. Thus the study ensures representation for all categories of people in the study area.
- Many of the respondents are engaged in micro enterprises and are more matured in the decision-making process in the areas related to the microenterprise and important breadwinner in the family.
- Everyone reported that they gain confidence to take up responsibilities. So from this it is very well clear that kudumbasree enhances the skills of women and molded them as a better person to fit in the society.
- It was found out from the study that a major reason for women joining in self-help groups is that kudumbasree is serving the purpose of an added additional income to their family. SHGs could be helpful in inducing positive self -image, self-reliance, self-confidence and economic independence in women members.
- SC/ST category borrowed the least loan amounts, compared to other castes, this may be due to the financial instability or due to the issues they are facing while repaying the loan amount.
- At a first glance, it might just look like financial empowerment, but in the process of understanding thrift and credit, the women undergo an application-based education which is critical to empowerment.
- The serious problem which was observed during the study was, in one among the unit there were lack people who were interested in taking up the role of president and secretary. They denied because of the following reasons which include their educational status and not being comfortable in dealing with the accounts and were scared of taking responsibilities and improper settling of loan amounts, with all these difficulties and problems kudumbasree is running successfully.

## SUGGESTIONS

- There is some personal problem for respondents like lack of proper guidance, proper and timely guidance must be provided to them according to their needs. Officials related to kudumbasree should conduct awareness programmes about the Banking procedures, service providers ,Financial products and services ,Usage of financial products and services
- Education plays a prominent role in the empowerment of women. As majority of the respondents and their spouses are having an educational qualification of higher secondary, sufficient opportunities must be provided to them in the form of seminars, conferences etc., to impart additional knowledge on various issues related to them.
- Eradication of illiteracy is the first step towards empowerment of women. Still there are kudumbasree members who do not have even primary education. Efforts must be made by the authorities to give them primary education.
- More supportive and planning attitude on the part of the Government, NABARD, NGO's and Banks are highly essential to the members to develop their entrepreneurial abilities and skills. Separate departments have to be formed in these institutions for the development of microfinance and micro enterprises in State.
- Small responsible jobs regaining collective effort may be entrusted to SHGs thus helping the members to their additional income.
- Attractive saving schemes and insurance schemes, if introduced to SHG members, will enhance their thrift habit.
- It is good to formulate a common policy for the formation of SHGs and frame directives related to membership, meetings, registers, accounts and audit etc.
- Recent technological knowhow has to be provided to SHGs to increase the quantity and quality of their products.
- Socio economic effectiveness can be promoted through innovative activities and technology. The other suggestions that can be implemented are education, training Programmes, non –harassment and non – violence, bank linkage

- Members of the Kudumbasree units should be encouraged to take up income generating activities. Entrepreneur development programme may be conducted and proper training may be provided in this regard.
- All members of the group are to be insisted to open bank accounts, so as to increase their banking habits and enhance the skills in doing banking operations independently.
- Proper orientation should be provided to all the Kudumbasree members about the scope, aims and the members must volunteer to ensure their involvement in different activities initiated by the groups including politics.

## CONCLUSION

This study was conducted statistically of 50 members. The opinion and findings revealed that socio economic effectiveness and overall empowerment is achieved through Kudumbasree. In this study, it can be concluded that the working system of Neighbourhood Groups are satisfactory, but some initiatives can be taken to improve the performance of the unit. The problem which was observed during the study was, people were not much interested in taking up the role of president and secretary. They denied may be because of the their educational status or were scared of taking responsibilities.

It was also admitted that the socio economic status of women has improved compared to their earlier economic status when they are not an active member of kudumbasree. In order to improve the socio economic status of women there were a lot of training programmes, promotional activities, awareness programmes can be imparted. Participation in social programmes, meetings can be improved.

The study conducted by several authors across the state mentioned the similar perspectives pointed out by the researcher. But most of the studies include a quantitative study and interview schedule where the responses from the respondents are taken into consideration.

The study of Hunt, J & Kasynathan, N (2002) says that microfinance has a positive Impact on women's mobility and helps in reducing the domestic violence. They observed that women need only a small opportunity to build their own pathway to empowerment. Access to credit and peer support has enabled them to increase their power and decision making capacities in their households. The findings are same when the researcher done this project to find out the role of kudumbasree in enhancing economic empowerment.

Economic development is the base for other development. Collective effort has been recognized as tenets of women empowerment. Through women empowerment leads to sustainable social development. Economic development of women leads to better living status in the family, educational, nutritional, and the health needs of the children were well satisfied. Economic independence through kudumbasree improved the social participation of its members and the Kudumbasree NHG movement is supporting for social empowerment of poor women flock.

Kudumbasree has proved that women are the agents of change towards development. They have all the rights to get equal treatment and opportunity. Kudumbasree has changed the life of many women and hence the organization is viewed differently by different people. It is a relief for many people, for some, it is a place where they express all their feelings, for some, it's a financial aid, for some its happiness. It is viewed differently by many people. It is a helping hand for many people. It helps in making women empowered politically, socially, economically and culturally. All these forms of empowerment together make a woman fully empowered and Kudumbasree helps in doing that.

### **SCOPE FOR THE FUTURE RESEARCH**

A more detailed study is needed to explore the factors behind the lower participation of SC/ST categories in Kudumbasree projects. A family's financial situation plays a role in whether or not they are able to afford to send a child to school. This is a major contributor to low participation rates since SC/ST have considerably lower incomes than those in upper castes, and therefore have a hard time paying for education and they shows an inhibition towards active involvement in such projects.

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# **APPENDIX**

## QUESTIONNAIRE

Introductory statement to be read out before interview commences:

"We are independent researchers carrying out this survey to help us understand important pieces of information about the kudumbasree units in this community. The information we collect will be kept confidential." "Please be aware that no special support will come to your household as a result of your responses to the questions. This is for research purposes only. As such, please do your best to be as open and honest as possible." "Are you willing for us to spend approximately 1 hour with you carrying out an interview?" Tick the box below if respondent provides consent.

### **I To find out the socio demographic profiles of the respondents.**

1) Respondent's name

2) marital status

3) Age

4) Residential address

5) Respondent's Religion

Hindu  Muslim  Christian

6) Respondent's caste:

Others/General  OBC  T

7) Respondent's membership in kudumbasree (number of years) :

8) Educational qualification of the respondent?

Primary education  Secondary education

Graduation  Post Graduation  Other

**To identify the major factors influencing the members to join Kudumbasree.**

9) Did Kudumbasree give any sort of Financial assistance

Yes  No

10) Does kudumbasree schemes help in improving the position of women in the family?/public life

Yes  No  Do not know

11) What is the principal job of the head of your household :

Daily wages  Private  Govt  Self employment   
Nil

12) What is your own principal job :

Daily wages  Private  Govt  Self employment   
Nil

13) which of the kudumbasree features you like the most

Financial assistance  Group work  Helping the community   
Responsibility  Empowerment  \_\_\_\_\_

14) Are there specific health activities in your Panchayat/Municipality under kudumbasree programme during the last three years?

Yes  No  not known

15) If yes, who are the beneficiaries?

General public  Women  children

Aged  Others ( specify) \_\_\_\_\_

16) As a part of the Ashraya programme, how many destitute are identified in your locality?

Below 5  5 to 10  more than 10

17) How many projects are implemented or being implemented for destitute in your panchayat/ward? (Numbers) :

0 to 1  1 to 3  3 to 5

18) Mention the purpose of the projects for the destitute in your panchayat/ward.

Providing food  Health improvement  Pension

Education for children  Housing  others

19) How many beneficiaries did receive assistance in your Panchayat/Municipality as a part of Bhavana sree programme during the last three years? (Numbers)

20) Have these activities helped the houseless people?

Yes  partially helped  Not helped at all

21) Are there activities for youth in your Panchayat/Municipality under kudumbasree programme during the last three years?

Yes  No  Not Known

22) Please rate the impact of these activities on youth?

Very Good  Good  Average

Poor  Not Known

**III To analyze the changes in economic aspects of women through the aid of Microfinance and SHGs in kudumbasree.**

**23)** Whether to borrow money from the kudumbasree unit as a loan , if yes how much money did you borrow

Below 10,000  10,000 to 50000  more than 50000   
a) Specify the reason \_\_\_\_\_

**24)** Do kudumbasree schemes help in improving the position of women in the family?/public life

Yes  No  Do not know

**25)** What are your suggestions to make women economically empowered in your area , with the help of Kudumbasree

\_\_\_\_\_

**26)** Micro credits and SHGs held in your kudumbasree are very helpful

Strongly disagree  Disagree  Agree  Strongly agree

**27)** How do you rate the activities/performance of Thrift and Bank linkage loans?

Very Good  Good  Average

Poor

No comments

28) Are there instances of the following in your units?

Mismanagement  un-utilization of funds

Lack of coordination  corruption  Others, if any \_\_\_\_\_

**IV To see whether there any changes in gender roles due to participation in kudumbasree.**

29) Are you receiving support from family members?

Yes  No

30) Imagine that you did not agree with a decision made by other senior members ,To what extent do you think you can change their decision?

Not at all  To some extent  a large extent

To what extent do you agree with the following statements

1 = Strongly disagree 2 = Disagree 3 = Agree 4 = Strongly agree

31) Micro credits and SHGs held in your kudumbasree are very helpful– is it difficult for a woman like you to stand up and voice any concerns.

32) A man's job is to earn money; a woman's job is to look after the home and family.

33) Nowadays, women's opinions are valued in your community and are used to create more just policies.

34) Men can make better decisions in community meetings than women.

35) If you wanted to participate in a group in the community, you would not have to seek permission from anyone.

36) Once a husband has paid his dowry, the woman should oblige and take care of all the household chores.

37) You would be able to rely on others in the community for advice or support if you needed it.

38) Do you hold any leadership position in this group?

Yes  No

39) In this women group, who normally makes decisions about [decision area]?

Group not engaged in such activity

Group leaders (chairperson, treasurer, secretary)

Group members

Group members and group leaders make joint decision

Someone outside of the group

40) Compared to a few years back, there are now more opportunities for women in your position to become influential actors in how your community is governed.

Strongly disagree  disagree  Agree  Strongly agree

41) How confident do you feel about the skills you currently possess to carry out such an activity effectively as a member of this kudumbasree unit?

Not confident at all

A little bit confident but only with some help of others

Very confident

I can do this on my own

42)As a part of the Kudumbasree mission did you feel any power or self esteem in making decisions in family matters

Yes

No

43) To what extent kudumbasree schemes are successful in reducing poverty and improving the income of the family? Explain -----

-----  
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**ELDERLY AS A SOCIAL CAPITAL IN FAMILIES:  
WITH SPECIAL REFERENCE TO COVID-19  
PANDEMIC**



By  
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MARCH 2022**



**ELDERLY AS A SOCIAL CAPITAL IN FAMILIES: WITH  
SPECIAL REFERENCE TO COVID-19 PANDEMIC**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in fulfillment of the  
requirements for the award of the degree of **Master of Arts in Sociology**

By

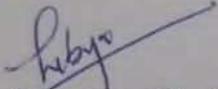
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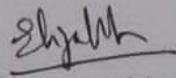
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*Dr. Lebia Gladis N.P.*

  
Name and Signature of the Head of Department

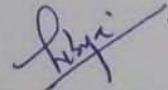
*Elizabeth Abraham*

**MARCH 2022**



## CERTIFICATE

I certify that the thesis entitled "**ELDERLY AS A SOCIAL CAPITAL IN FAMILIES: WITH SPECIAL REFERENCE TO COVID-19 PANDEMIC**" is a record of bonafide research work carried out by **DEVIKRISHNA**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology



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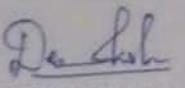
March 2022

## DECLARATION

I, **Devikrishna** hereby declare that the thesis entitled "**ELDERLY AS A SOCIAL CAPITAL IN FAMILIES: WITH SPECIAL REFERENCE TO COVID-19 PANDEMIC**" is a bonafide record of independent research work carried out by me under the supervision and guidance of **Dr. Lebia Gladis N.P.** further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022

  
DEVIKRISHNA

## ACKNOWLEDGEMENT

In this humble endeavor, I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom, and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Dr. Lebia Gladis N.P. for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends, and my family for their love and support.

Ernakulam

March 2022

# CONTENTS

<b>CHAPTER</b>	<b>PAGE</b>
1. INTRODUCTION.....	1-9
2. REVIEW OF LITERATURE.....	10-26
3. METHODOLOGY.....	27-30
4. DATA ANALYSIS AND INTERPRETATION.....	31-61
5. FINDINGS AND CONCLUSION.....	62-64

BIBLIOGRAPHY

APPENDIX

## List of tables

<b>Figure no.</b>		<b>Page no.</b>
<b>4.1</b>	<b>Graphical representation of age of the respondents</b>	<b>32</b>
<b>4.2</b>	<b>Graphical representation of gender of the respondents</b>	<b>33</b>
<b>4.3</b>	<b>Graphical representation of educational qualification of the respondents</b>	<b>34</b>
<b>4.4</b>	<b>Graphical representation of type of family of the respondents</b>	<b>35</b>
<b>4.5</b>	<b>Graphical representation of the locality of the respondents</b>	<b>36</b>
<b>4.6</b>	<b>Graphical representation of occupational status of the respondents</b>	<b>37</b>
<b>4.7</b>	<b>Graphical representation of income of the respondents</b>	<b>38</b>
<b>4.8</b>	<b>Graphical representation of data about which the respondents live with</b>	<b>39</b>
<b>4.9</b>	<b>Graphical representation of data about the respondents lives with their children or not</b>	<b>40</b>

<b>4.10</b>	<b>Graphical representation of data of the respondents those who live with their children who has close connection</b>	<b>41</b>
<b>4.11</b>	<b>Graphical representation of data depicts the level of connection with the respondent's children</b>	<b>42</b>
<b>4.12</b>	<b>Graphical representation of data of respondents communicate via phone</b>	<b>43</b>
<b>4.13</b>	<b>Graphical representation of data depicts the number of times their children call the respondents</b>	<b>44</b>
<b>4.14</b>	<b>Graphical representation of data of the respondents who has grandchildren</b>	<b>45</b>
<b>4.15</b>	<b>Graphical representation of data represents the number of grandchildren the respondents have</b>	<b>46</b>
<b>4.16</b>	<b>Graphical representation of data about whether grandparents have a good relation with grandchildren</b>	<b>47</b>
<b>4.17</b>	<b>Graphical representation of data about how they rate their extend of good relationship with their grandchildren</b>	<b>48</b>
<b>4.18</b>	<b>Graphical representation of data represents the care given by other member of the family towards the respondents</b>	<b>49</b>

<b>4.19</b>	<b>Graphical representation of the data shows the level of care given by other members of the family</b>	<b>50</b>
<b>4.20</b>	<b>Graphical representation of data shows whether the respondents get any free time</b>	<b>51</b>
<b>4.21</b>	<b>Graphical representation of data shows whether the grandparents do any household works in the family</b>	<b>52</b>
<b>4.22</b>	<b>Graphical representation of data shows the works respondents do in the family</b>	<b>53</b>
<b>4.23</b>	<b>Graphical representation of data shows the role of taking care of the grandchildren by the respondents</b>	<b>54</b>
<b>4.24</b>	<b>Graphical representation of the data represents the respondent's role in helping family financially</b>	<b>55</b>
<b>4.25</b>	<b>Graphical representation of data shows whether the respondents hold the financial power in their family</b>	<b>56</b>
<b>4.26</b>	<b>Graphical representation of the data shows whether if the respondents have not affected with covid-19</b>	<b>57</b>
<b>4.27</b>	<b>Graphical representation of the data shows whether the respondent's family face any problems during covid-19 pandemic</b>	<b>58</b>
<b>4.28</b>	<b>Graphical representation of data shows the problems faced by the respondents during covid-19 pandemic</b>	<b>59</b>

<b>4.29</b>	<b>Graphical representation of data shows whether other members of the respondent's family have time to talk to them</b>	<b>60</b>
<b>4.30</b>	<b>Graphical representation of data shows whether the respondent's grandchildren annoy them</b>	<b>61</b>

# **CHAPTER 1**

## INTRODUCTION

Ageing is a biological process, experienced by mankind at all times. Ageing is a continued process and 'the aged' is a category. The word ageing has been defined by several researchers in various ways. According to Tyagi, "ageing means the effect of age, i.e., the deterioration in physiological capabilities". Becker defines ageing in a broader sense as "those changes occurring in an individual, as a result of passage of time". According to Stieglitz, "Ageing is a part of living. It begins with conception and terminates with death" (Srivastava, 2010). An individual ages biologically as a continuing process, socially as perceived by the members of the society, economically when retired from the workforce; and throughout some chronological criterion is attached to this ageing process.

The aging of humans is a diverse process in all spheres of life, including the biological, psychical and social. Biological aging is defined as the natural occurrence of irreversible, increasing with age changes in metabolism and the physicochemical properties of cells, leading to impaired self-regulation and regeneration, and structural and functional changes in tissues and organs. Physiological changes occurring during aging run unevenly in the various organs and systems of the body, and may also take place at different rates in individuals. Psychosocial aging is treated as a phenomenon secondary to biological aging. Changes that occur with age in the functioning of individual organs affect the mood, attitude to the environment, physical condition and social activity, and designate the place of the elderly in the family and society. Psychosocial aging, however, to a great extent depends on how a person is prepared for old age, and takes effect over time. (Dziechciaż& Filip, 2014)

Social aging refers to how a person perceives the aging process and how it relates to the society in which they live. Everyone enters old age with an individual vision of what it means, although this period in life is formed by many aspects, for example, watching old people closely, existing stereotypes of old age, and their own expectations arising from past experience. The vision of old age created by humans is a kind of guide, according to which behavior towards the aging process is shaped. Depending on which old age image is dominant – positive or negative, those who are aging develop a real dimension of their age. The subjective way of perceiving the aging process

influences the aging functioning, life activity, and all actions and contact with other people. (Dziechciaż& Filip, 2014)

People who perceive their friends and family members as supportive during times of need have a stronger sense of meaning in their lives; that is, they live their lives with a broader purpose, adhering to a value system that fits within the larger social world (Krause, 2007). In addition, people with strong social networks report greater emotional well-being in day-to-day life and also when they experience stressful life events. In old age, social spheres may also influence cognitive functioning. A growing number of studies have found that older adults embedded in strong social networks and high levels of social activity are less likely than their more socially disengaged peers to experience declines in cognitive functioning. (Charles & Carstensen, 2014)

Ageing in India is exponentially increasing due to the impressive gains that society has made in terms of increased life expectancy. By 2025, the geriatric population is expected to be 840 million in the developing countries. As old age sets in, people above the age of 60 are considered elders. The elderly population in India has steadily increased and has almost doubled in the past 20 years. It is projected that the proportion of Indians aged 60 and older will rise from 7.5% in 2010 to 11.1% in 2025. (Mane, 2016) India has thus acquired the label of “an ageing nation” with 7.7% of its population being more than 60 years old. The demographic transition is attributed to the decreasing fertility and mortality rates due to the availability of better health care services. (Ingle & Nath, 2008) Increased life expectancy, rapid urbanization and lifestyle changes have led to an emergence of varied problems for the elderly in India. An aging population puts an increased burden on the resources of a country and has raised concerns at many levels for the government in India. The aging population is both medical and sociological problem. The elderly population suffers high rates of morbidity and mortality due to infectious diseases.

The elderly in India faces multiple social, political, economic and cultural challenges including suboptimal financial security, decline of traditional extended family systems due to rural-urban migration of young people, and increasing costs of health care. In India, as is the case in many developing countries, the health systems are inadequate to promote, support and protect health and social well-being of the elderly due in part to lack of human and financial resources. The elderly finds themselves exposed to harsh realities of globalization; changes in cultural values and beliefs, high disease burden from chronic noncommunicable diseases, and weak family and social welfare system. To address the health and welfare needs of this vulnerable section of society, the

Government of India in 1999 developed and adopted the National Policy for Older Persons. A National Council for Older Persons and an Inter-Ministerial Committee was set up to implement the policy directions. To date, Government of India with its partners, have introduced various schemes and initiatives to promote and protect the welfare of the elderly. These initiatives include financial assistance for the construction of and maintenance of old peoples' homes and non-institutional services to the elderly, as well as the provision of nutritious food and appropriate medical services. The Government of India, through the National Rural Health Mission has embarked on efforts to strengthen provision of primary health services and to reorient health care professionals from curative to preventive services at various levels. However, challenges remain for the health system, social welfare and health financing as the elderly population continue to rise. (Krishnaswamy, et al., 2008)

The demographic transition in India shows unevenness and complexities within different states. This has been attributed to the different levels of socio-economic development, cultural norms, and political contexts. (Mane, 2016) Disparities exist if we compare the growth rate of elderly population of different states of India. The rate of growth of elderly population is highest in southern states such as Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu. Amongst the southern states Kerala has the largest growing rate of elder's population. (Mudgal & Wardhan, 2020)

India, which has the second-largest population in the world, is suffering severely from COVID-19 disease. The COVID-19, which was declared as an epidemic by the World Health Organization (WHO) on March 11, 2020, caused great concern all over the world; it spread rapidly, affecting more than 223 countries and regions. Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness (WHO).

The disease had an unprecedented effect all over the world, especially in older individuals. Although all age groups are at risk of contracting COVID-19, older people face significant risk of developing severe illness if they contract the disease due to physiological changes that come with ageing and potential underlying health conditions (WHO). Older people and those with underlying

medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.

There are many additional issues for the older adults related to the changing social and medical support levels during COVID-19. Like any other disaster situations, the services are stretched and are available to a proportion rather than the whole population. Another concern is the isolation and their effects on the elderly. The issues are more acute for those who are dependent on others for their basic needs, those who are living alone and residents of care homes. Although many countries could set up support systems and many voluntary organizations stepped in to help in most parts of the world, older adults continue to experience difficulties. As health care systems are stretched, it is quite possible that the support for the older adults with chronic non-communicable diseases is compromised to a variable extent. While the attention at the moment is understandably focused to contain the spread of the virus, provide treatment and arrange economic support for the general public; there is a specific need to address the issues of the older adults as well. Older adults are known to have increased vulnerability during disastrous situations; and it is a reality that their needs are often neglected. (Kar, 2020)

The risk of developing a serious and often deadly disease has led to numerous restrictions in many countries that can have a detrimental effect on the psychological functioning of the elderly. However, with these restrictions, limited contact with other people can lead to the loss of social support, which is especially important for older people. Also, social isolation may result in loneliness, which is a factor significantly associated with depression in the elderly. Recent cross-sectional studies have reported higher levels of loneliness during the COVID-19 pandemic. Loneliness is a strong risk factor for the development of a number of health conditions, such as coronary heart disease and stroke<sup>19</sup>, and is associated with a 26% -50% increased risk in mortality. These situations have been shown to predict worse disease outcomes and quality of life in older populations. (Kasar&Karaman, 2021)

During the COVID-19 pandemic, it has become essential that elderly is isolated and social distancing is enforced to keep them safe and protected. Besides the threat of contracting coronavirus infection, social isolation itself could be a source of anxiety and other psychological problems. Most nations have resorted to quarantine, lockdown and curfew to contain the community transmission of infection. All these techniques warrant people in the community to stay at home and maintain social distancing. (Girdhar, Srivastava, & Sethi, 2020)

COVID-19 not only killed people through virus incursion but also due to economic and mental collapse, where developing countries suffered from unemployment and hunger. To combat the disease, the Government of India imposed a lockdown in most districts of the 22 States and Union Territories where confirmed cases were reported from March 24, 2020 onwards. India enforced 68 days of four-phased-lockdown starting from 24th March-31st May to deal with COVID-19. Due to the growing number of infestations from COVID-19, on 14th April, Indian government declared an extended 2nd phase lockdown till 3rd May which was further lengthened till 17th May and later imposed till 31st May. To make the lockdown and social distancing effective, India also levied the quarantine law under the Epidemic Disease Act, 1897. (Ghosh, Nundy, & Mallick, 2020)

“Lockdown” is an emergency protocol that prevents public from moving from one area to the other. Complete lockdown further means that persons should stay where they are currently and no entry/exit movements would be allowed further. It can be both a preventive and an emergency strategy in order to save the lives of the vulnerable or at-risk persons. In this scenario, all educational institutions, shopping arcades, factories, offices, local markets, transport vehicles, airports, railways, metros, and buses are completely shut down except hospitals, police stations, emergency services like fire station, petrol pumps, etc., and groceries. While lockdown can be a significant and effective strategy of social distancing to tackle the increasing spread of the highly infectious COVID-19 virus, at the same time, it can have some degree of psychological impact on the public. It is well known that quarantine/isolation for any cause and in the context of a pandemic (Severe Acute Respiratory Distress Syndrome, 2003) has been associated with significant mental health problems ranging from anxiety, fear, depressive symptoms, sense of loneliness, sleep disturbances, anger, etc., in the immediate few days of isolation, and later with symptoms of posttraumatic stress disorder and depression after discharge from the hospital. However, the psychological impact of lockdown on the general public has not been studied yet. Man being a social animal, such restrictions on free movements can lead to anger, frustration, loneliness and depressive symptoms. There can be fear/apprehension among the public related to supply of basic amenities like groceries and milk supplies, medicines, care of previously sick persons in the family due to other medical causes, elderly persons staying alone, restriction of free movements, having a prevailing sense of being imprisoned in one’s own house or “being in house arrest,” etc. (Grover, et al., 2020)

Lockdown can have different effects on different age groups. As schools remain shutting, children are in a prolonged state of physical isolation from their peers, teachers and society. The loneliness due to lockdown could lead to high rates of depression and anxiety in children and adolescents. Lockdown may cause behavioral changes in children. The parents may struggle to cope with their children's behavioral problems. The closure of the schools has affected the academic and personal development of the children. Adolescents seek independence and have a need to establish their identities. They lost their opportunities to indulge this urge. Online learning also creates challenges. The technical issues, distractions, continuous use of electronic devices, lack of proper interactions in the class etc. all makes the learning process stressful. The young people are also affected by the lack of job opportunities during lockdown, delay in completing their studies, family pressure and isolation from friends. The young women face more problems including reproductive and mental health challenges. Lockdown was a challenging time for all age categories. Among all, the elderly is more likely to get seriously affected by the disease and lockdown restrictions.

The COVID-19 pandemic has adversely impacted the elderly population worldwide in various ways. Due to the vulnerability of elderly for COVID-19 infections, others would avoid to meet the elderly, which can be a major source of distress, both for the elderly and their family members. As is the case with most infectious diseases, older adults are the most vulnerable group. In this scenario, they are expected to adhere to these restrictions for extended periods, to minimize the risk of contracting the infection. However, these safety measures pose a risk of social isolation. Visiting community meetings, parks, neighborhood, places of worship and day centers are possibly the only socialization channels for most of the elderly. With lockdown or quarantine these are now not possible. Elderly who lives with their families are better placed in this respect; but some of them may still expect to maintain social distancing within their house considering their own existing ailments or COVID symptoms of family members. As younger generation may be busy with various chores, it is quite possible that the elderly may get neglected even when they are with their families. This leads to social and psychological isolation, which may be a contributing factor for poor mental health. Most preventive measures during infectious disease epidemics focus on prevention of the spread of infection and looking after the physical health of infected person. In this state of crisis, a wide range of psychological problems often accompany the outbreak. Social isolation and loneliness are particularly problematic in old age due to various reasons such as: decreasing functional limitations, economic and social resources, the death of spouse and relatives,

changes in family structures and mobility. Lockdown adds more reasons to this list including: inactivity, repeated exposure to disturbing news related to the pandemic, reminiscences of previous traumatic events (and anxiety associated with those), the interactional problem within family members, and the lack of opportunities to share their worries. Confinement, loss of usual routine, and reduced social and physical contact with others are frequently shown to cause boredom, frustration, and a sense of isolation from the rest of the world, leading to distress (Girdhar, Srivastava, & Sethi, 2020).

In this scenario, Kerala needs a special attention. Kerala stands out in the Indian context due to its large elderly population. Kerala's population is ageing at a rate faster than the rest of the country. Kerala has witnessed a dramatic demographic transition in comparison with the other states in the country (Government of Kerala 2017). Out of the total elderly population, 11 per cent are old-old, which is the fastest growing group in the old category that includes those above 80 years. In the elderly category, women outnumber men, and among them majorities are widows. The old age dependency ratio of Kerala at 19.6 per cent is higher than the rest of the country at 14.2 percent. (Rajan, Shajan, & Sunitha, 2020)

According to 2011 Census, there are 7.4 million people who are above 60 years of age in Kerala. Of these, 3.3 million are males and 4.1 million are females. The proportion of population aged 60 years and above is slightly higher in rural areas than in urban areas. Around 12.6 per cent of the population is above 60 years of age which is the highest in the country. It grew from 10.5 per cent in 2001 at a rate of over 2 per cent per annum. (BKPAI, 2011)

Kerala reported the first three cases of coronavirus in India in late January 2020. The critical situation is that Kerala is a small state (38,863 Sq.KM), but it homes for 35 million people makes it 819 people per square kilometer, eight most densely state in India. Other than people living in closely Kerala has 25 lakh migrants, who frequently travel to their native land. In addition to that, international travelling is a part of Kerala culture, which is connected to the rest of the world through four airports serve around 17 million passengers annually. Finally, Kerala has 2.5 million migrant laborers from other states. Simply Population density, affluent non-resident Keralites and thriving tourism all raise the risk for an outbreak in Kerala. On March 23, Kerala announced complete lockdown before the announcement of national lockdown. (T., A.P., K., &Sulaiman, 2020)

People aged above 65 were strictly advised to stay at home during the lockdown period. Volunteer forces looked after the needs of those confined to their homes, but social distancing created a challenging situation for the mental health of the elderly. A major cause of loneliness was reverse quarantine, wherein the elderly remained separate from the rest of their household to avoid contracting the infection from them. (Gulia& Kumar, 2020) The department had warned that people over the age of 60 and those with other serious illnesses should stay in quarantine at home (reverse quarantine). Under reverse quarantine, people having underlying medical conditions, especially those above 60 years and persons who are immune-compromised are segregated from other family members (Mint, 2020). The death audit report of august 2020 published by the department of health and family welfare says that “Failure of reverse quarantine was observed in 61 (24%) of the COVID deaths. Mortality may be prevented by vigilant observation of reverse quarantine.”

Lockdown has adversely affected the health care and non-COVID medical services of the elderly. Fear of COVID infection and the presence of possible COVID infection symptoms were associated with psychological distress and anxiety. (Balasundaram, Libu, George, & Chandy, 2020)

## **CHAPTER 2**

## REVIEW OF LITERATURE

This chapter deals with the secondary data which is used by the researcher to study the role of grandparents in families. The secondary data used in this chapter includes articles, books, journals and newspaper.

There are many factors which affect the type of interactions that occur between grandparents and grandchildren. These factors include culture, ethnicity, gender, family structure and traditions.

“It is common knowledge that various cultures seem to have different types of family systems. In the United States and Canada and the countries of northern Europe, the nuclear family, father, mother and the children, appears to predominate. In almost all of the rest of the world, extended families, the grandparents, father, mother, children, but also aunts, uncles, cousins, and other kin are considered to be “family” (Georgas, 2003).

In Japanese culture for example, the first son takes care of the elderly parents. The parents core side with his family. As a result, this close proximity allows for grandparents to develop strong relationships with their grandchildren, passing on cultural traditions (Mitchell, 2009).

**Raju, Asirvatham, & Madani**, (2021) points out that due to repeated lockdown in India, people suffered with massive mental health crisis because of unemployment, alcohol abuse, economic hardship, domestic violence and indebtedness. It will affect most of the population where poor people are the most vulnerable and marginalized groups.

**Saikarthik, Saraswathi, & Siva**, (2020) says that though quarantine and lockdown help containing the spread of infection, it is also accompanied by potential psychological distress in the population. Isolation, fear of contracting the disease, confusion created by rumors, financial strain, apprehension regarding job security, boredom, frustrations, lack of freedom and space due to restrictions, alcohol withdrawal, and concerns for the family members that occur during lockdown period could affect the mental health of the population to varying degrees.

**Shweta Singh**, (2020) studies shows that lockdown can have different effects on different age groups. In children and adolescents, the pandemic and lockdown have a greater impact on emotional and social development compared to that in the grown-ups. The pre-lockdown learning of children and adolescents predominantly involved one-to-one interaction with their mentors and peer groups. Unfortunately, the nationwide closures of schools and colleges have negatively impacted over 91% of the world's student population. The home confinement of children and adolescents is associated with uncertainty and anxiety which is attributable to disruption in their education, physical activities and opportunities for socialization. Many children and young people have experienced loneliness during lockdown and in particular, been affected by lack of physical contact with their friends, families and peers, and the boredom and frustration associated with a loss of all the activities they have been used to taking part in. Moreover, many children and young people have experienced worries and distress about their education and returning to school.

The psychological wellbeing of working adults was also influenced by the lockdown due to COVID-19 pandemic. The mental status of women was affected more than the men. Additionally, gender, age, monthly income, history of quarantine, tested positive for Corona Virus had strong association with Psychological wellbeing. (**Raju, Asirvatham, &Madani**, 2021)

During the third phase of the lock down, less than one fifth of the adult Indian population suffered from depression, one fourth suffered from anxiety and more than one fifth suffered from stress. Females were more likely to suffer from depression and anxiety when compared to males. Employment in the government sector and higher educational status were protective against anxiety. Age above 25 years, smaller household size and single status were associated with decrease levels of stress. Parents with lesser number of kids or none were less likely to suffer from depression when compared to parents with more than 2 kids. (**Saikarthik, Saraswathi, & Siva**, 2020)

Individuals aged over 60 years and those with underlying conditions such as hypertension, diabetes, cardiovascular disease, chronic respiratory disease and cancer are at highest risk of affecting the disease. Fear of getting infected is significant in persons aged 60 years and above.

This is probably because co morbidities are more common in old age and advancing age is also a risk factor for COVID-19. (**Miglani, 2020**)

Although all age groups are at risk of contracting COVID-19, older people face significant risk of developing severe illness if they contract the disease due to physiological changes that come with ageing and potential underlying health conditions (**WHO**).

According to the survey conducted by Agewell foundation, elderly are the worst affected among all during current lock down situation due to the global Covid-19 pandemic. According to the survey findings, 70 per cent elderly were either already facing health complications or fearing to develop some medical complications due to current COVID-19 lockdown restrictions. During the survey, while interacting with older persons, volunteers observed that majority of older persons were depressed due to this new phenomenon. They expressed sense of apprehension, resentment, anxiety and even anger while talking over the phone. (**Agewell foundation, 2020**)

Lower immunity levels and co-morbidities put the geriatric population at a higher risk for corona virus disease (COVID-19). There was an increase in the anxiety levels among the elderly as they are unable to get advice from doctors on time due to the lockdown. Many were unable to go and get medicines from government hospitals, while some were unable to check their sugar levels and creatinine levels as many laboratories were closed. Some are also facing psychological issues. There is fear of death, and loneliness due to restriction in movement. They could also slip into depression. (**The Hindu, 06 May 2020**)

**Shin Yin Chee** (2020) has conducted a phenomenological study to explore the lived experiences of older adults in an aged care home during the COVID-19 pandemic. The study focuses on their perspective on how the pandemic has impacted their daily routine, relationships and overall well-being. This qualitative research is driven by an interpretivist paradigm. The author selected two aged care homes with comparable care service qualities, daily living activities, demographic distribution, building typology and environmental features. Semi-structured, in-depth, one-on-one interviews with 10 participants were conducted with open-ended questions. Through this study the researcher found that, even though COVID-19 resulted in significant social changes, it has not changed the way the older adults' perceptions of spending the rest of their lives in an aged care

home. Some developed a fear of death when they were made aware of COVID-19 and had very little faith that they could overcome the COVID-19 pandemic. Participants expressed feeling trapped, confined and vulnerable; all of which are depicted with negative feelings because of the measures being enacted to protect them from COVID-19. The experience described indicates that older adults may view this COVID-19 pandemic as potentially ‘the end’. The results clearly show the need to promote the development of information programs for helping older adults stay up to date with pandemic.

According to a study conducted to determine the effect of COVID-19 lockdown on the health care and psychosocial aspects of the elderly in Kerala, hypertension was the most common lifestyle disease in the elderly, followed by diabetes. Those who used to do regular blood tests missed the same during the lockdown period. Some of them missed regular exercise during lockdown. The effect of lockdown on the mobility of the elderly population was even more evident among those who missed regular medical follow-ups and consultations. Scarcity of public transport shut down of outpatient departments in many private hospitals, and the conversion of many government hospitals into COVID hospitals would have been the reasons for this scenario. Frequent hand washing was one of the essential practices promoted in the state as a part of “break the chain” movement in Kerala against COVID. It was well received among the elderly population as only few respondents reported as not having done it. This was a fair indicator of the acceptance and practice of preventive measures by the elderly during the lockdown period. According to the study, Lockdown has adversely affected the health care and non-COVID medical services of the elderly. Fear of COVID infection was associated with psychological distress and anxiety. Proper psychosocial interventions are necessary to mitigate the effects of lockdown on health care and psychosocial aspects of the elderly. **(Balasundaram, Libu, George, & Chandy, 2020)**

Social distancing because of the COVID-19 pandemic could lead to negative consequences for the physical health of older adults. This is caused by the decrease of physical activity levels due to the total or partial restriction of social participation in community groups and family activities during the pandemic. Social participation has several positive effects on physical health in elderly people. Studies have reported that older adults who were enrolled into social activities presented better dynamic balance and muscle strength, healthy lung function and lower disabilities and chronic

inflammation compared to those without social participation. For this reason, attending social activities is an important component for successful aging. The relationship between social interaction and physical health may operate through different pathways. A possible explanation for these findings is that participating in meetings or social activities stimulates the musculoskeletal, cardiovascular, respiratory and nervous systems through physical activity and social interaction. Physical activity generates benefits for the physical health of older adults, stimulating muscle contraction, energy expenditure, decreasing systemic inflammation and oxidative stress, reducing prevalence of chronic diseases, and geriatric syndromes such as sarcopenia, osteosarcopenia and frailty. As expected, decreasing or total restriction of social interaction could generate negative consequences for the health of elderly people, especially in those with chronic diseases, disabilities and geriatric syndromes. Evidence has demonstrated a relationship between social isolation and loneliness with disability, chronic diseases, risk of mortality and physical inactivity in elderly population. However, the effect of increased sedentary behavior and decreased physical activity on elderly people during the COVID-19 pandemic is unclear. Isolated older people have less physical activity and more sedentary behavior than those non-isolated the quarantine implied a radical change in the lifestyle of elderly people, reducing the social interaction, participation in exercise group, religious or spiritual group which have negatively affected the mental and physical health in this population. (Loyola, et al., 2020)

In India, the older are more afflicted with chronic rather than acute illnesses – aside from locomotors difficulties – such as high blood-pressure, hypertension and diabetes, which require long-term medication. They are also more at risk of cancer, renal diseases and musculoskeletal disorders, particularly arthritis. Reduced mobility during this time prevents them from seeking regular medical attention, and leaves them dependent on others. To top it all off, 83% of their health expenses are out-of-pocket, leaving them financially vulnerable as well. Since older people are partially or entirely financially dependent on others. Their social security is quite fragile, especially in the context of the ongoing pandemic. (Chaudhary & Suresh, 2020)

Covid-19 has disrupted the lives and livelihood of people, especially in rural India. The lockdown has reduced income and threatens the food security of the rural population. One-quarter of India's

population is below the poverty line and approximately half a billion people are working in the informal sector, living on daily wages. The lockdown has affected millions of lives, leaving them hungry and penniless, and with no money and means to earn, these people depend on others for food and help, while there are many more who are simply starving. The elderly not only feared for their lives but also the stigma attached to the infection. The lockdown fanned their fears further, as they faced isolation, uncertainty, and income loss. The biggest challenge for the elders during the pandemic has been accessing healthcare, buying medicines, groceries, and banking. (**HelpAge India**, 2020)

Weakness is one of the most important issues faced by elders that are related to movement restriction, malnutrition and poor immunity. Weakness leads to loneliness and isolation with poor nutrition. Sensory problems that having difficulties in vision, hearing etc... can prevent them from taking sufficient precautions. Poor cognitive abilities like memory power, processing speed, thinking capacity and communication can prevent them from understanding and follow the prevention measures. People with dementia might have behavioral issues and wandering nature that can be a great challenge of keeping they isolated. Social distancing alone might not always be possible because, multiple people of various specialties mixed up in their care. It is necessary that elderly should be aware and updated with genuine information about the infection and the spread through a variety of modes. (**B & T**, 2020)

The outbreak of the COVID-19 pandemic has resulted in the disruption of food supply and unavailable or in short supply of adequate necessary materials. This leads to the vulnerable of the older adults to malnutrition and consuming non-healthy foods. The overconsumption of diets high in sugars, refined carbohydrates and saturated fats at the globe contribute to the prevalence of type 2 diabetes and obesity, and could place the elderly, at an increased risk for infected with the COVID-19 and then death in the sever case. The overconsumption of non-healthy foods impairs immunity and activates the innate immune system, leading to chronic inflammation and impaired host defense against viruses. Due to these risks, access to healthy foods should be taken into consideration and the older adults should be mindful of healthy eating habits to minimize long-term complications from COVID-19. (**Radwan, Radwan, & Radwan**, 2021)

An online survey conducted under the aegis of the Indian Psychiatry Society evaluated the psychological impact of lockdown due to COVID-19 pandemic on the general public. The objective of the study was to assess the prevalence of depression, anxiety, perceived stress, well-being, and other psychological issues. The survey suggests that more than two-fifth of the people is experiencing anxiety and depression, due to lockdown and the prevailing COVID-19 pandemic.

The mental and physical health in older people is negatively affected during the social distancing for COVID-19. The main mental and physical outcomes reported were anxiety, depression, poor sleep quality and physical inactivity during the isolation period. (**Loyola, et al., 2020**)

In the context of prolonged lockdown and social distancing, loneliness can become a core component of a variety of psychiatric disorders through a subtly or grossly declared clinical picture. It may lead to hopelessness and discouragement, which can progress to depressive disorders and potentially self-destructive acts. It may aggravate fears and precipitate one or several types of anxiety disorders, including a variety of phobic syndromes. Also, it may generate painful memories that, later, can make the experience of social isolation a prelude of a potentially invalidating posttraumatic stress disorder. Finally, it may exacerbate behavioral styles and symptoms of conditions such as obsessive-compulsive disorder (e.g., washing hands repeatedly, sanitizing the household articles). Studies have revealed loneliness is associated with depressive symptoms in older age groups. Sleep quality continues to be affected by feelings of loneliness in this age group. Sleep duration tends not to differ between lonely and non-lonely older adults, but the same amount of sleep is less restful and results in greater daytime fatigue and dysfunction. (**Girdhar, Srivastava, & Sethi, 2020**)

The COVID-19 pandemic had an enormous impact on older adults aged 65 years or older. The risk of social isolation and loneliness due to governmental regulations raises concerns about the mental health and cognitive functioning of the elderly population. An online survey with self-report measures, studied the impact of the COVID-19 period on wellbeing, level of activity, quality of sleep and cognitive functioning of a general population of older adults aged 65 years or older. According to the study, changes in wellbeing, activity level, sleep quality and cognitive functioning were especially related to depression. The findings suggest that depression might be a

vulnerability factor that influenced the impact of the COVID-19 period on older adults. As the COVID-19 pandemic led to a decrease of older adults' social network and contacts, this emotional buffer might have disappeared, which in turn could have paved the way for depression. Next to depression, other variables such as living in a care facility or not and gender were related to changes in one specific domain of wellbeing and sleep quality, respectively. Susceptibility to cognitive failures was related to changes in cognitive functioning during the COVID-19 period. This study exposed that when we are faced with extreme stressors, such as COVID-19, in the future, prevention and intervention strategies are needed to aid older adults to prepare for and cope with them, especially for those at risk of depression. **(Pue, et al., 2021)**

There have been reports of more than 300 people dying by suicide during the lockdown period; some 80 of them have been attributed to the fear of being infected by the virus and the consequent isolation and loneliness. Loneliness is a serious concern among the elderly, and could be a result of lower economic resources, death of contemporaries or spouse, lack of an active social life and dissatisfaction with familial and social relationships. There is also the self-perceived stigma of ageing and loss of purpose. **(Chaudhary & Suresh, 2020)**

A study estimates that 6% of elderly citizens live alone in India. Further, 10%–20% of them are enduring from mental desolation and loneliness. Usha Rana has conducted a study on “Elderly suicides in India: an emerging concern during COVID-19 pandemic”. According to this study, elderly those are living alone find themselves unprotected due to the lack of social support in the lockdown scenario. Elderly, who are already suffering from mental disorders, are more vulnerable to COVID-19 pandemic, and the social consequences of COVID-19 have invigorated them to end their lives. The excessive information about consequences of COVID-19 for the elderly proclaimed by the news channels and social media led to the development of initial anxiety. The suicide cases of the elderly can be observed more where they experience loneliness because of social ignorance. **(Rana, 2020)**

Although it is natural for older adults to experience death anxiety (DA), the COVID-19 pandemic has exacerbated feelings of death anxiety in older adults, leading to catastrophic consequences on older adults' body functions and immunity. Religious coping can help protect individuals from

death anxiety. With social distancing being one of the effective ways of limiting the spread of COVID-19, religious practices in Mosques and Churches were suspended. Consequently, the religious coping and spiritual well-being of older adults have been dramatically and negatively impacted, and it is expected that their levels of death anxiety have increased. A study conducted among elderly found older adults' levels of religious coping, spiritual well-being, and death anxiety to vary significantly based on the selected socio demographic characteristics. Further, the results indicated significant associations between death anxiety and certain socio demographic characteristics, religious coping levels, and spiritual well-being levels in older adults. It is essential to consider the spiritual well-being of older adults during a stressful and life-threatening situation such as the COVID-19 pandemic. (**Rababa, Hayajneh, & Bani-Iss, 2021**)

Since social networks can act as a buffer against negative events, it might be beneficial to devote more attention to the importance of maintaining strong social relationships during major stressors, such as the COVID-19 pandemic. Social media usage and telephone contact could increase social interactions among the older adult population. Media actions might help in stressing the importance of maintaining such interactions for older adults. In addition, improving social skills could aid in preventing loneliness and decreased wellbeing. (**Pue, et al., 2021**)

The elderly population has been hit with some of the worst effects of the pandemic, with harsher lockdown measures, and increased risks of mental and physical health problems, and the digital divide has seen that the effects of these measures have not been minimized. The population most affected by the lockdown is also the population least helped by the digital tools aiming to mitigate the negative effects. The uneven access and proficiency in technology is contributing to increased negative outcomes within elderly population. While technology may have gone a long way to mitigate negative effects of the crisis in the general population, the situation is more complicated in the elderly population. Access to, and ability to proficiently use technology is much lower in older populations than in younger adults. This uneven distribution of technological access and skill is known as the digital divide, or the gray digital divide there is a need to ensure that digital solutions to lockdown problems are also accessible to older populations. As of 2015, about 8.5% of the world population was aged 65 or older, and this number is growing every year. This is not a small group of people, and during the COVID-19 pandemic it is essential that society remains

aware of the challenges they are facing and takes measures to mitigate them. Encouraging the use of digital solutions in elderly groups is necessary, and governments and care homes should take measures to ensure the elderly population is aware of the resources available online during this pandemic. Raising awareness of the resources which can be accessed and making them available to less technologically savvy older individuals could have large benefits. Online socializing events catering to older individuals would allow for social contact, without any risks of COVID-19 infection. The introduction of online exercise programs geared toward homebound older individuals could offer simple workout routines to reduce the physical risks of decreased exercise. While short-term measures are unlikely to reach all older individuals, especially those with minimal material access to technology, they could help maximize the usefulness of digital tools in older individuals without current knowledge of their availability. (Jaarsveld, 2021)

Due to various reasons such as lack of familiarity, cognitive or sensory deficits, and difficulties in adapting to a new practice, many senior citizens might not be proficient enough to stay in touch with their loved ones through social networking (WhatsApp, Facebook, etc.) and video-conferencing methods, which are recommended worldwide during the COVID-19 crisis for social connectedness. Especially the older adults residing alone might not have the required assistance when they want to connect virtually with their families. This can add to the frustration and helplessness. Even though digital connection appears to be a rational substitute, it has been shown in earlier studies that the elderly prefers personal communication and care, rather than virtual interactions. During the current pandemic situation, staying physically “segregated” adds to their loneliness and social isolation. (Banerjee, D’Cruz, & Rao, **Coronavirus disease 2019 and the elderly: Focus on psychosocial well-being, ageism, and abuse prevention – An advocacy review**, 2020)

The COVID-19 outbreak and the resulting economic shock are having a strong impact on the personal and financial lives of all. This impact can be greater on seniors as a recent survey by the OECD International Network on Financial Education (INFE) 1 shows that seniors in most economies were already displaying lower levels of financial well-being prior to the COVID-19 pandemic. Elderly people are most likely to fall ill and to suffer serious complications from the

disease. They are also likely to endure stricter lockdown measures in the present time and in the near future, limiting their possibility to live their (financial) lives as they did previously and requiring a profound adjustment. The pandemic and its socio-economic consequences are exacerbating factors that contribute to the increased vulnerability of elderly people, together with low financial and digital literacy, and possibly declining cognitive abilities. Lockdown measures and social distancing imposed in particular on the older population can put them at risk of financial exclusion. On the one hand, elderly people might prefer cash and not be familiar with digital or online payments, on the other, elderly people might not be able to access financial institutions, post offices or financial advisers. **(OECD/INFE, 2020)**

The compulsory measures taken to protect people against COVID-19 pandemic have severely impacted economic activity globally. As a result of this, many people have lost their jobs, 38 some face losses in business and share investments, 39 and others have had difficulty in receiving pensions. For those who don't get a pension, the problem is even worse. With the extended lockdown, they have spent most of their savings on daily necessities like groceries and medicines. In lack of a steady source of income and insufficiency of savings, many faces financial crises. In India, elderly constitute about 9 percent of the population and 50 percent of them are very poor. This current pandemic is likely to push them into financial crisis. **(Pant &Subedi, 2020)**

Most of the elderly in India work to make ends meet as there is no universal social security system. Most of them are in the unskilled, casual workers, who earn a meager daily wage to survive. These people were hard hit by the lockdown. Many of them did not have enough savings to sail them through and most of them were not credit worthy. The lockdown, consequent slow economic growth and broken production cycles, are likely to impact the elderly in more ways than one. They are expected to lose the opportunity for employment for three reasons: fear of going out and contracting infection, increased pressure on job market and loss of employment of the main breadwinner of the family. Such economic hardships are likely to impact the fulfillment of their basic needs of food, clothing, shelter and medical expenses.

To know how COVID 19 impacted the lives of older persons in India, a survey was undertaken by HelpAge India in June 2020. The survey covered 17 states and 4 Union Territories. According to the findings, 65% respondents stated, that COVID 19 impacted their livelihood. 60% of those who

stated impact of COVID 19 on their livelihoods were from rural areas while 40% were from urban areas. 56% were males, as compared to 44% females in this category. 67% were in the age segment of young old 60-69, 28% in the old-old category and 5% in the oldest old age group. (**HelpAge India, 2020**)

Ahead World Elder Abuse Awareness Day on June 15, a survey with focus on the impact of Covid-19 pandemic found 71% elderly respondents are of the opinion that cases of abuse against them increased during lockdown period and after. A majority 56.1% of the respondents said they were suffering abuse in their families or by society. The forms of abuse include a wide range from disrespect and verbal abuse, ignoring their daily needs, denying proper food, denying medical support, cheating financially, physical and emotional violence and forcing the elderly to work. (**Times of India, 15 June 2020**)

Besides being prone to isolation, loneliness, stress, grief, depression, and anxiety during the lockdown, the seniors are also victims of stigma, prejudice, and abuse, stemming from ageism. Substance abuse-related complications and cognitive disorders are added concerns. Elder abuse in every form has particularly been concerning during the present pandemic. Especially those staying alone, those with sensory or cognitive impairment, and those institutionalized are at a greater risk (**Banerjee, D’Cruz, & Rao, Coronavirus disease 2019 and the elderly: Focus on psychosocial well-being, ageism, and abuse prevention – An advocacy review, 2020**)

Implemented preventive measures to contain the COVID19 outbreak mean that the older adults will spend more times in their homes. The home, however, is not always a safe place for older adults who are experiencing or are at risk of abuse. Reports reveal that violence can increase during and in the aftermath of the outbreak of diseases including the COVID-19 pandemic. Violence against older adults (e.g., psychological, physical, and sexual violence, neglect, and financial abuse) can have damaging consequences and can even lead to death. More recently, it was reported that violence against older adults has risen sharply during the COVID-19 pandemic and imposition of lockdown procedures. During the COVID-19 crisis, older adults facing violence in their homes, long-term care homes, and online with a surge in scams. The preventive measures imposed during the COVID-19 pandemic exacerbate the factors which put older adults at risk of violence. Discrimination towards people due to their age has increased the risk factor for violence against

older adults during the COVID-19 crisis. For older women, prolonged exposure to their abusers as well as gender inequalities has worsened the risks of gender-based violence against them. In many countries influenced by the COVID-19 pandemic, records indicate an increase in the cases of domestic violence, in particular older women maltreatment. Although reports on violence during the COVID19 crisis are very scarce, established evidence on family violence against older adults reveals that various risk factors are likely to be exacerbated during the time of the COVID-19 pandemic. (**Radwan, Radwan, & Radwan, 2021**)

Ahead of World Elder Abuse Awareness Day on June 15, a survey with focus on the impact of Covid-19 pandemic found 71% elderly respondents are of the opinion that cases of abuse against them increased during the lockdown period. A majority 56.1% of the respondents said they were suffering abuse in their families or by society. The forms of abuse include a wide range from disrespect and verbal abuse, silent treatment (not talking to them), ignoring their daily needs, denying proper food, denying medical support, cheating financially, physical and emotional violence and forcing the elderly to work. (**Pandit, 2020**)

The World Health Organization encourages the public to support older adults through networks of family/friends and health professionals, especially those already affected by cognitive deficits including dementia who may feel more withdrawn during quarantine. The Inter-Agency Standing Committee (IASC) has summarized mental health and psychosocial support (MHPSS) considerations during this outbreak of COVID-19. Specifically, for older adults, it is important to provide continuous emotional support, as well as simple facts and information related to the outbreak, such as how to reduce transmission. In a world already filled with isolation and loneliness, the Health in Aging offers practical advice to share with elders. The first one includes consuming news in moderation, as the news is constantly being updated and can be emotionally overwhelming. The second piece of advice is to encourage outdoor activities while being mindful of maintaining 6 ft away from others. Next is to stay connected to family and friends via smartphones and computers. For those without internet access or the inability to utilize a smartphone, making daily phone calls and even writing letters is helpful. The last piece of advice is to ensure prescriptions are being refilled and medications are being taken daily. Maintaining any spiritual/religious affiliation via virtual events has been adopted in many locations as well. Free

classes online, live streaming of prayer services and community gatherings on Zoom have become popular. (Roy, Jain, Golamari, Vunnam, & Sahu, 2020)

Families and care givers need to be holistically involved in the care of the elderly, with increased sensitivity to their mental health. The seniors might be frail due to age, but they are definitely not weak. Their resilience can be noteworthy, if adequately cared for. It is high time that the pandemic-related policies and legislation in various countries are made more senior-friendly. The WHO and Centre for Disease Control and Prevention (CDC) have updated data related to geriatric-care during the pandemic. Besides their physical health burden, their psycho-social needs are also vital to be protected for their well-being and healthy survival. This is just the starting phase of the crisis. It is expected that in the post-pandemic months, there will be a surge in various mental-health issues, and a significant proportion of them might be the elderly. Preparedness to deal with this is necessary. Integrating them into this struggle against the unprecedented outbreak, can help us learn from their hope and wisdom for a better post-pandemic aftermath. (Banerjee, 2020)

Women elders in India have always found their own ways of social connections and engagement. Meeting their grandchildren, children and peer groups provide them with a sense of identity, security and support. The pandemic and its consequent precautions have restricted these day-to-day sources of joy. Moreover, limiting the movements and activities of our aged parents and grandparents with the best intentions of protecting them, has been often done without providing alternatives. The norms that dictated and restricted them all their lives as women got a renewed impetus during COVID-19. Those in care-homes have also faced an increased risk of loneliness, known to be an independent predictor of depression in the elderly. Cultural influences on older women are also of paramount importance. In the Indian socio-cultural milieu, wives who are often younger than their spouses serve as their main caregivers in the older age. The pandemic has grossly restricted domestic help and paid caregivers due to safety concerns, which made the elder women the sole carers of their elderly husbands. Their own safety and psychological concerns might not have been catered to. For some, it all just became a habit over time, with indifference forming the mainstay of coping. (Chandra & Banerjee, 2021)

Older women may be at heightened risk of domestic violence, by partners, adult children, or other family with whom they live, or from caregivers. The World Health Organization regards violence

against older people, including older women, as physical, psychological, and sexual violence, financial abuse, and neglect. This violence can occur in but is not limited to homes, long-term care facilities, and the internet. Covid-19 lockdown orders, which in some places lasted longer or were exclusively targeted for older people, may exacerbate the risk of violence and can increase social isolation and loneliness, financial dependency on family members or other caregivers, and alcohol and substance use in caregivers. **(Human Rights Watch, 2021)**

Kerala's population is ageing at a rate faster than the rest of the country. Kerala has witnessed a dramatic demographic transition in comparison with the other states in the country (Government of Kerala 2017). Kerala has achieved remarkable milestones in terms of demographic indicators in comparison to rest of the states in India. Various factors contributed to this, including reduction in fertility and mortality, higher age at marriage and high female literacy. The concept of elderly care is embedded in a three-tier system: the household, institutional and society levels. At the household level, caregivers would be spouses, children, siblings and other relatives. Second, at the institutional level, hospitals, local self-governments and care homes would take care of the elderly. Finally, at the societal level, neighbors, friends and other non-relatives would be the caregivers. **(Rajan, Shajan, & Sunitha, 2020)**

According to a study conducted among elderly in Kerala, female and the 'old-old' category elderly are the most vulnerable to chronic diseases. Most of the female elderly had a low level of life satisfaction. Among elderly men, most of the 'young-old' had good accommodation, while most of the 'middle-old' and 'old-old' were not satisfied with their accommodation. This was partly due to the built environment not being conducive for 'middle-old' and 'old-old' persons. The findings say that depression was high among the 'middle-old' and 'old-old', irrespective of gender. Among the female elderly, 'young-old' and 'middle-old' resided in urban areas, while among males, most 'young-old' resided in rural areas. It is quite natural since as age increases, the prevalence of disabilities also increases. These disabilities were normally related to vision, hearing, walking and dental problems. The 'old-old' need maximum assistance. Most of the 'middle-old' and 'old-old' are single (unmarried or separated or widowed or divorced), and most in this category are also disabled. The 'old-old', irrespective of their gender, have severe cognitive impairment. It is the 'middle-old'. And 'old-old' categories of the elderly that need special care for both males and

females. The ‘old-old’ among the female elderly needed the most care as the percentage of women in this category is more. (**Rajan, Shajan, & Sunitha, 2020**)

A Study on the Health Care and Psychosocial Aspects of Elderly in Kerala State reveals that Lockdown has adversely affected the health care and non-COVID medical services of the elderly. Fear of COVID infection was associated with psychological distress and anxiety. (**Balasundaram, Libu, George, & Chandy, 2020**)

A few measures are also taken by the administration to ensure social connectedness for the elderly. One of the world’s largest women empowerments in Kerala, named Kudumbashree (means ‘prosperity of the family’), launched an outreach programme for the elderly during the COVID-19 lockdown with confidence-building measures through IEC (Information, Education and Communication) with the focused objective of extra precautions by the elderly. To help the elderly during the lockdown period, the Kerala Police Department introduced a scheme Prasanthi (means ‘highest peace’) which was executed by its special branch called Janamaitri (means ‘people friendly’) police. They provided their services to the elderly in need of essential medicines, food, other provisions and treatment. Counseling services were also available under the scheme. Specially trained women police officers worked 24x7 at their call centers. (**Gulia& Kumar, 2020**)

With the Covid-19 safety protocols constantly redefining the new normal, Kerala is one place that may initially struggle but soon comes to terms with strange paradoxes. Because, with those above 65 years of age forced to remain out of sight, Kerala is feeling the pinch more than any other state in India, as its demographic profile, along with many other human development indices, is more in line with the developed world, especially the Scandinavian countries. According to figures mentioned by IrudayaRajan, about 10-14 lakh elders with established sources of disposable income also happen to be in the 65 plus age group in Kerala. And by suddenly asking them to withdraw from all kinds of public appearances, Kerala now runs the risk of opening up cases of mental stress (**The Print, 2020**)

From the literature we can understand that the pandemic and the lockdown have affected people of different age categories in different ways. The elderly is most vulnerable among all. The older people are likely to feel more stressed, lonely, which may also adversely affect their health.

## **CHAPTER 3**

# METHODOLOGY

This chapter deals with the methodology which is used by the researcher to study the role of grandparents in the family during covid-19 pandemic.

## **Statement of the problem**

This study is focused on the role of grandparents in families during covid-19 pandemic. This study is trying to find out the socio-economic profile of the grandparents.

## **General Objective**

A study on the role of grandparents in the family

## **Objectives**

- To find out the socio-economic profile of the respondents.
- To analyze the relationship between grandparents and other members of the family.
- To study the nature of the role of grandparents in the families during covid-19 pandemic.
- To find out the problems faced by the grandparents in the families during covid-19 pandemic.

## **Clarification of Concepts**

Theoretical Definitions

- Elderly: According to Collins Dictionary, elderly means, past middle age, or approaching old age
- Social capital: According to Britannica, social capital is, ‘the concept in social science that involves the potential of individuals to secure benefits and invent solutions to problems through membership in social networks.

- Families: According to Merriam Webster Dictionary, family is ‘the basic unit in society traditionally consisting of two parents rearing their children’.
- Covid-19: According to WHO, covid-19 is “the disease caused by a new coronavirus called SARA-CoV-2. WHO first learned of this new virus on 31 December 2019, following a report of a cluster of cases of ‘viral pneumonia’ in Wuhan, People’s Republic of China.”

#### Operational definition

- Elderly: In this study, the term elderly that is being referred to the grandparents in the family.
- Social capital: In this study, the social capital that is being referred to describe how members are able to band together in society to live harmoniously.
- Covid-19: In this study, covid-19 is being referred because of the present situation which affected a lot number of people in the world.

#### Variables

##### **Independent variables:**

- Age
- Gender
- Educational qualification
- Type of family
- Locality
- Occupational status
- Income

##### **Dependent variables:**

- Role played by grandparents in the family.

#### Pilot Study

In order to find out the feasibility of the present study, the researcher visited the village officer of Kalavoor panchayth. He agreed to cooperate with the study and expressed the willingness to give the required assistance for conducting the data collection.

### **Research design**

The research design used in this study is Descriptive research design since this study requires an in-depth and detailed study. The research is designed to study the role of grandparents in families during covid-19 pandemic.

### **Universe**

The universe of the study is the grandparents from Kalavoor panchyath in Alappuzha district.

### **Sample size**

The sample size for this study is 50 samples.

### **Sampling methods**

The sampling method intended to use in this study is Simple random sampling.

### **Tools for Data Collection**

In this study, interview is used as a tool for data collection. The questionnaire was prepared and the researcher goes directly and collected the responses from the elder people.

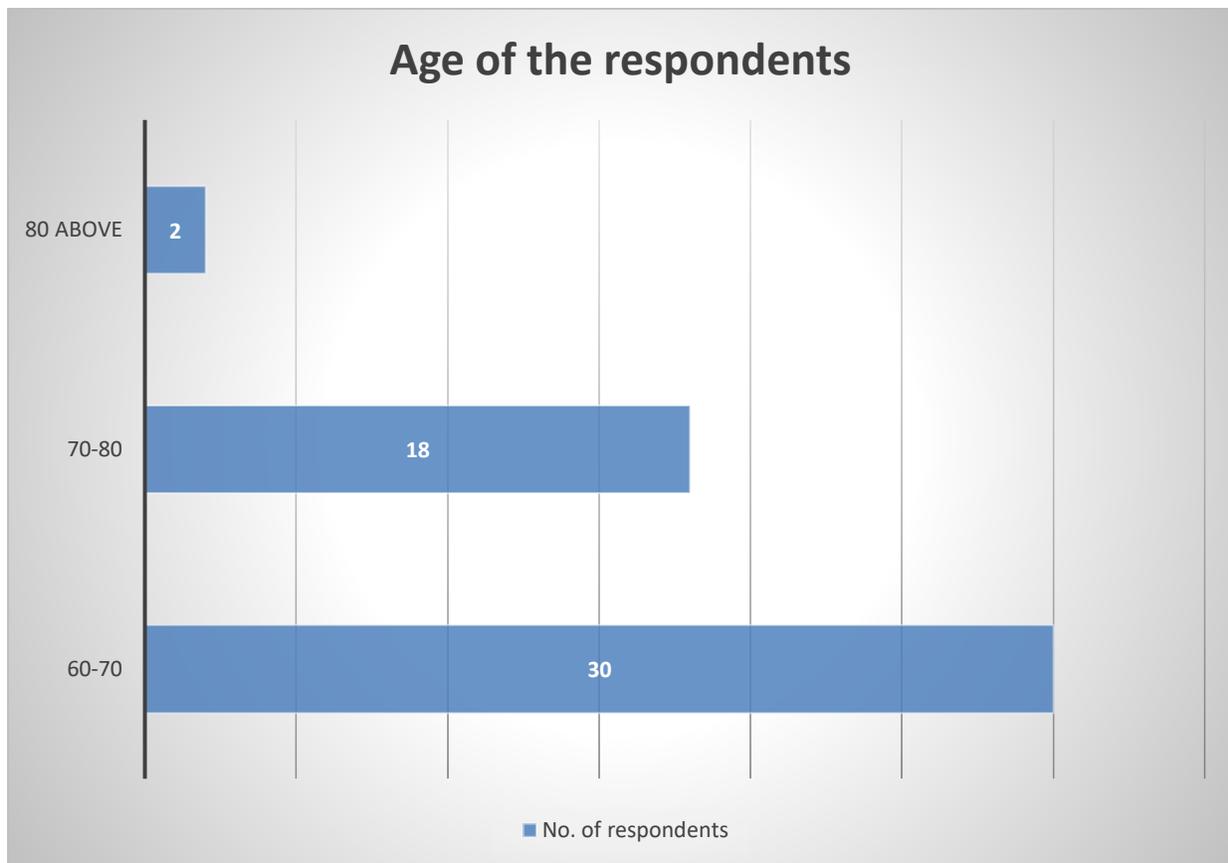
## **CHAPTER 4**

## ANALYSIS AND INTERPRETATION

This chapter deals with the analysis and interpretation of data, collected through interview. The data collected in this study was analyzed in a systematic manner in order to determine the study's objective.

**Figure 4.1**

### Age of the respondents



The figure 4.1 shows the graphical representation of the age of respondents. Majority of the respondents come under the age group of 60-70. 30 respondents are under the age group of 60-70. About 18 of the respondents come under the age group of 70-80. And least number of respondents is 80 above. Only 2 respondents come under 80 above.

**Figure 4.2**

**Gender of the respondents**

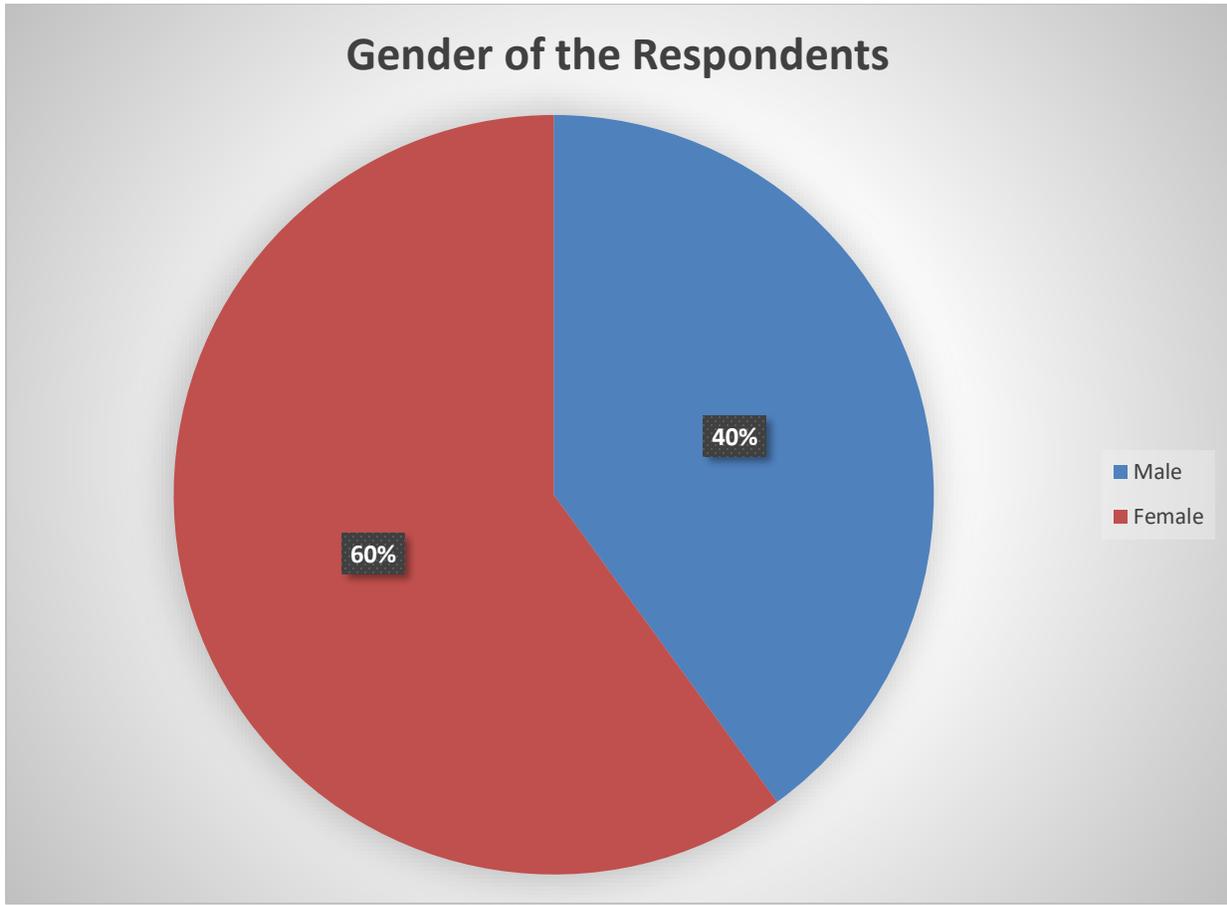
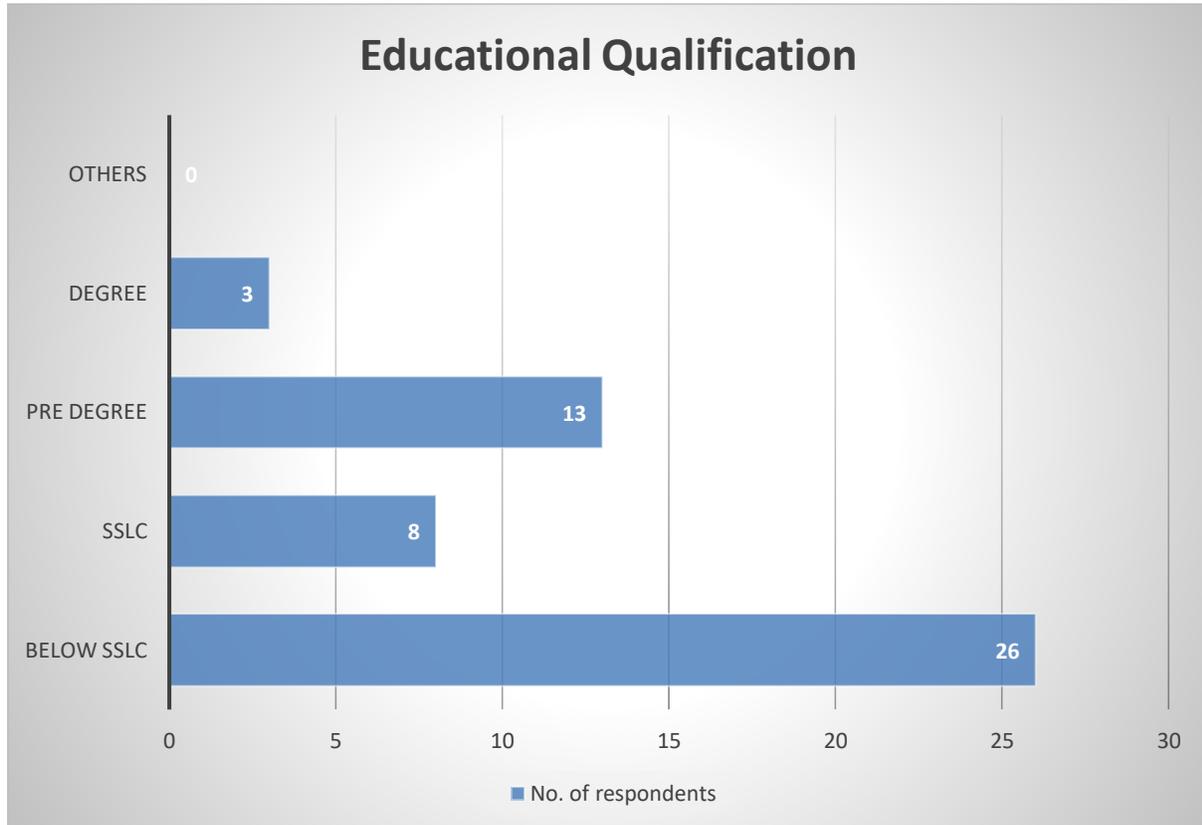


Figure 4.2 represents the graphical representation of the gender of respondents. About 60% of the respondents are female. And 40% of the respondents are male. And we can see majority of the respondents are Female.

**Figure 4.3**

**Educational qualification of the respondents**



In the figure 4.3 the educational qualification of the respondents is graphically represented. Majority of the respondents are below SSLC. About 26 of the respondents have educational qualification below SSLC. 13 numbers of respondents have completed pre degree. About 8 respondents attained SSLC. And only 3 respondents have degree level qualification.

**Figure 4.4**

**Type of family of the respondents**

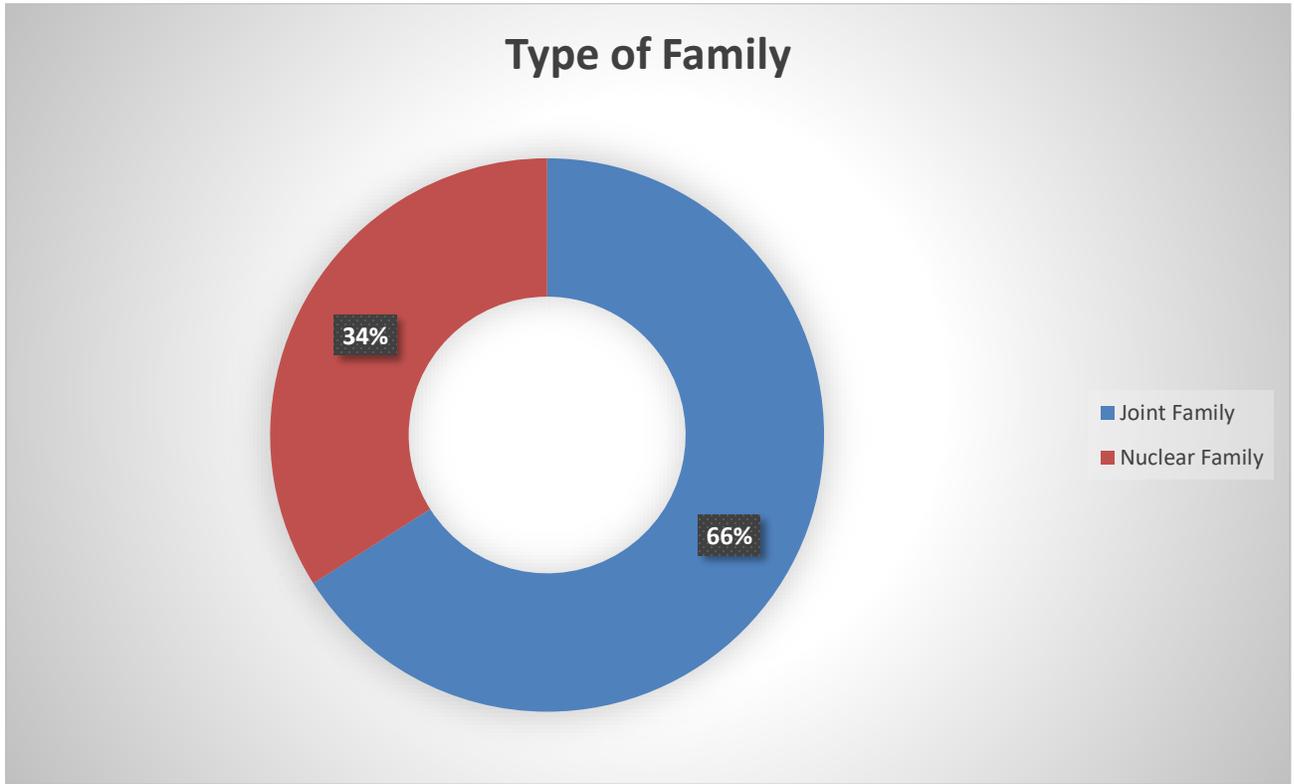


Figure 4.4 shows the graphical representation of the type of family of the respondents. 66% of the respondents are from joint family and 34% of the respondents are from nuclear family type.

**Figure 4.5**

**Locality of the respondents**

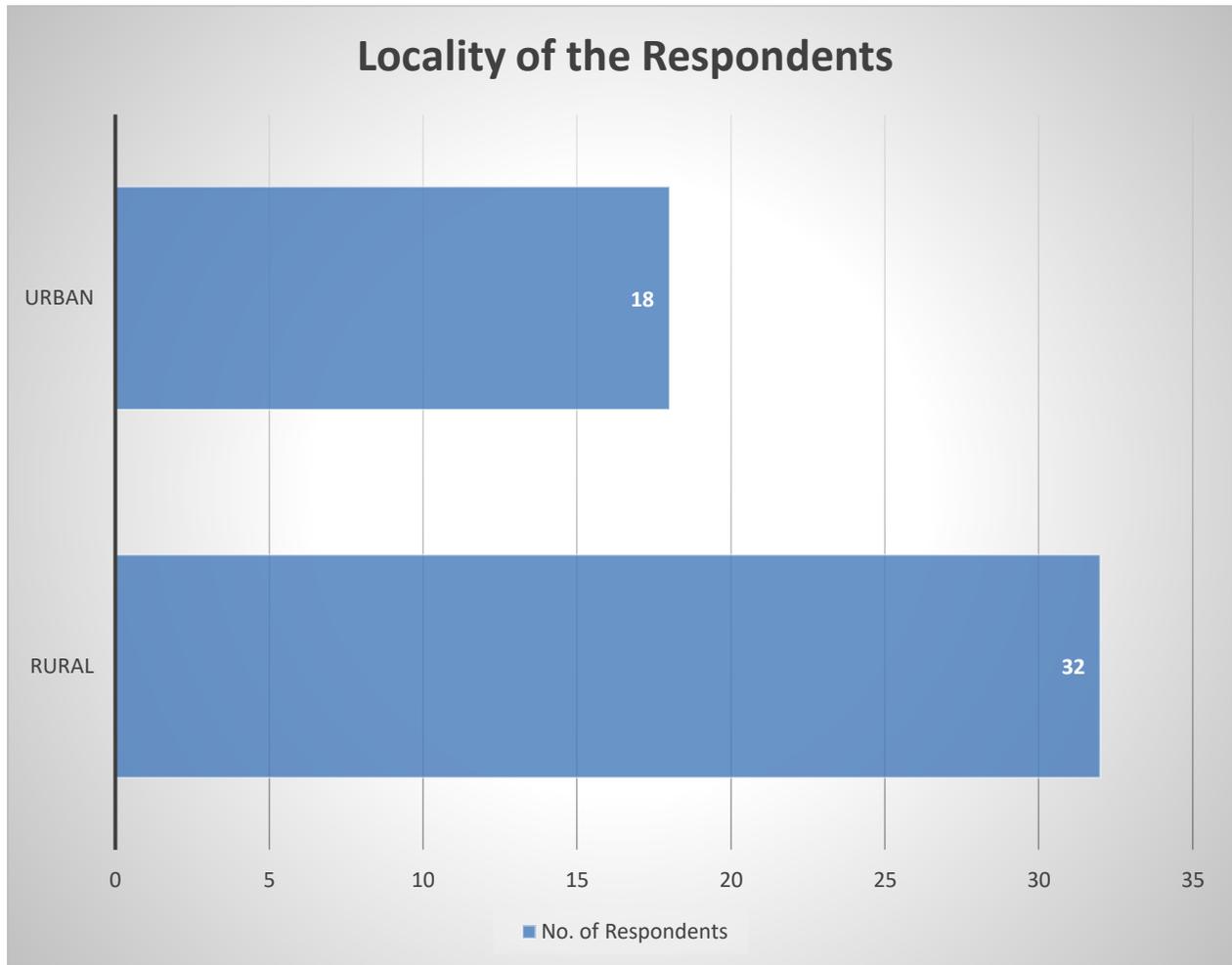
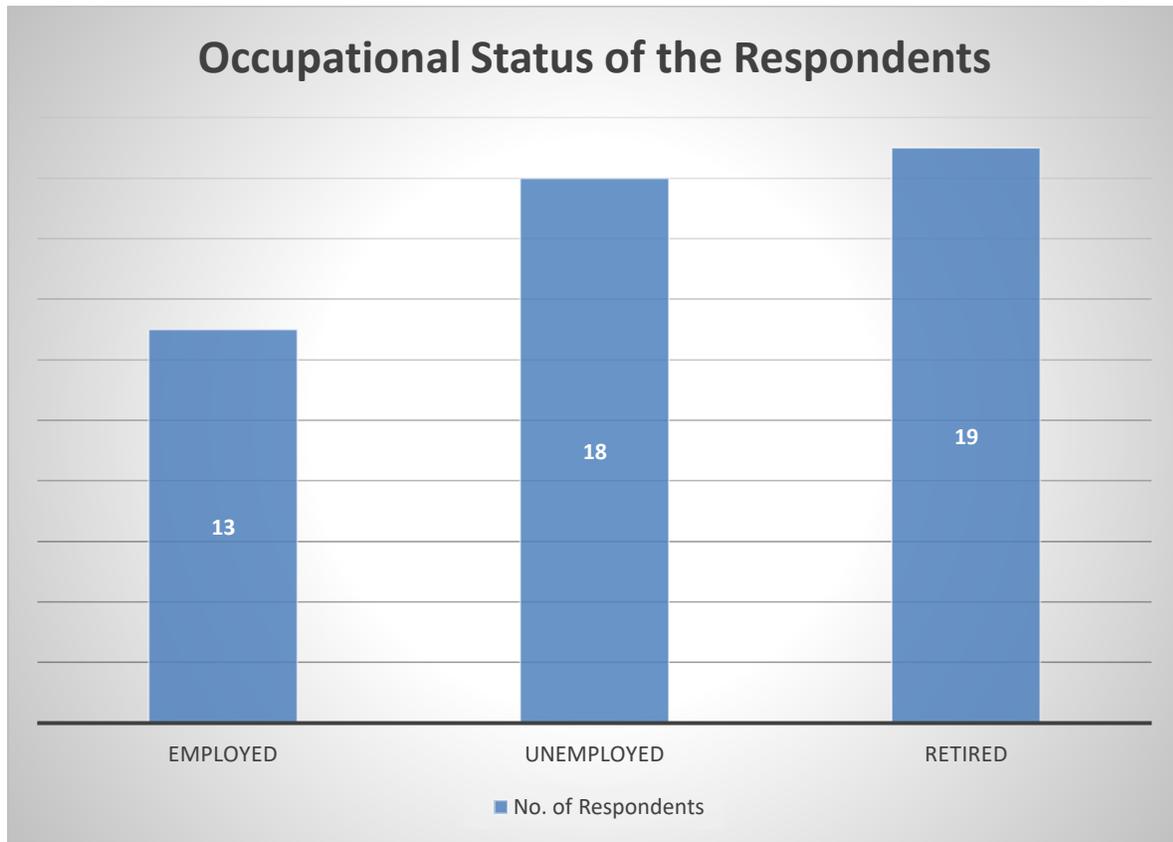


Figure 4.5 represents the graphical representation of the respondent's locality. About 32 of the respondents come from rural area and 18 respondents are from urban area. Majority of the respondents are from rural area.

**Figure 4.6**

**Occupational status of the respondents**



The figure 4.6 shows the graphical representation of the occupational status of the respondents. About 19 numbers of respondents are retired. 18 of the respondents are unemployed. And about 13 respondents are employed. Majority of the respondents are retired.

**Figure 4.7**

**Income of the respondents**

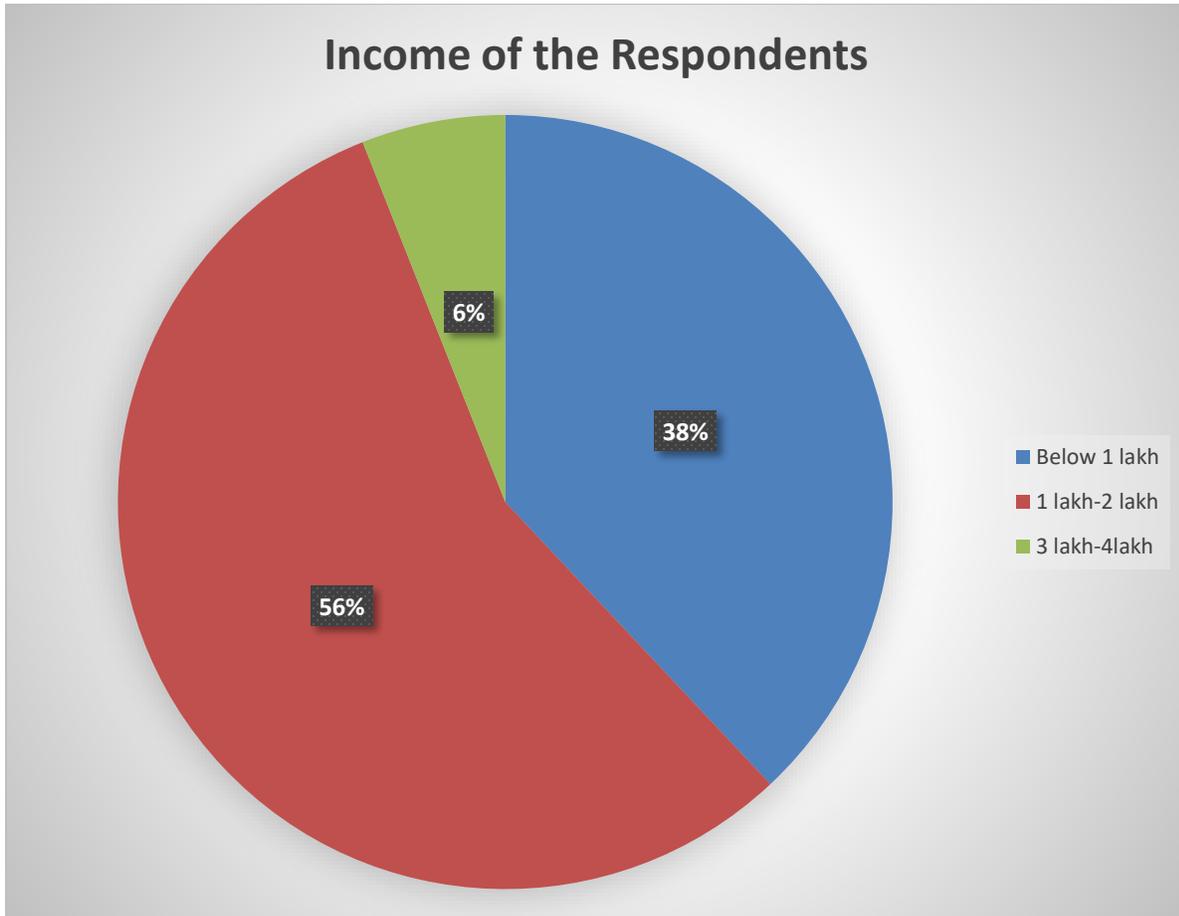
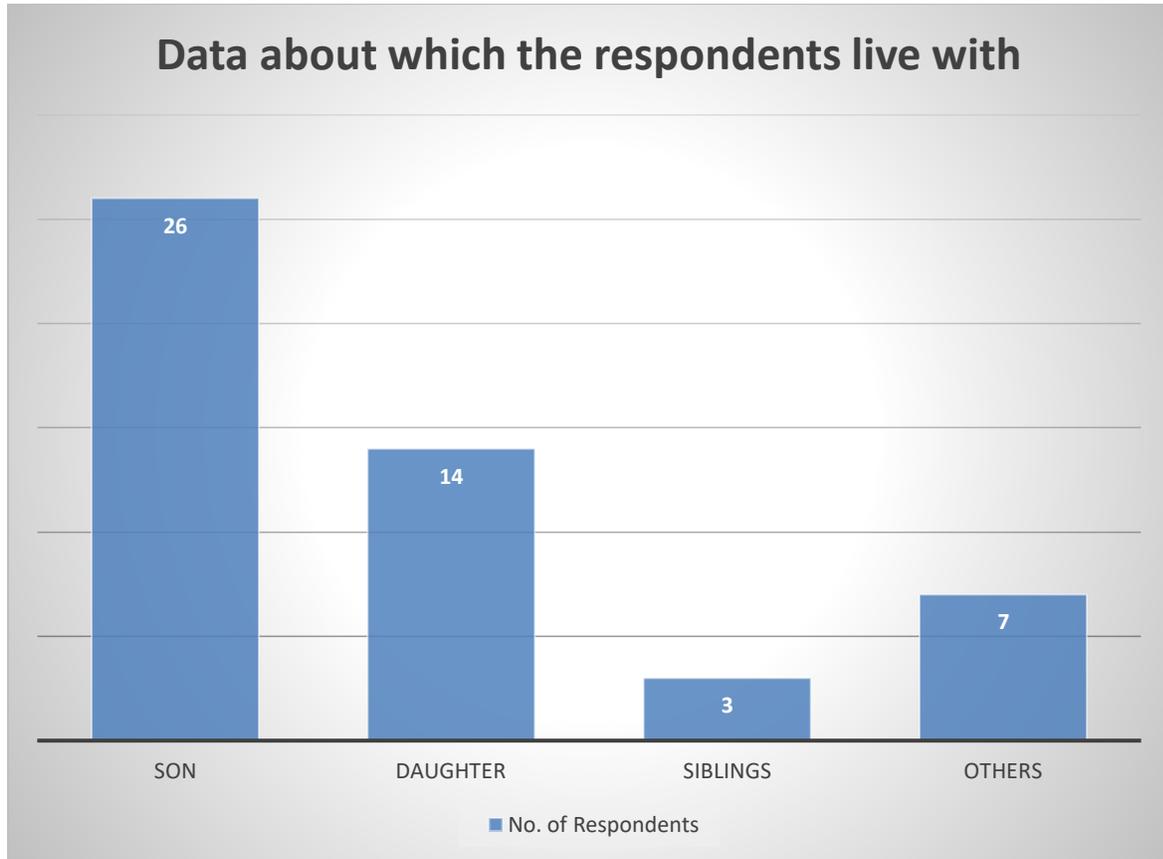


Figure 4.7 represents the graphical representation of the income of the respondents. 56% of the respondents have income level from 1 lakh to 3 lakhs. About 38% of the respondents have income below 1 lakh. And 6% of the respondents have income from 3 lakh to 4 lakh.

**Figure 4.8**

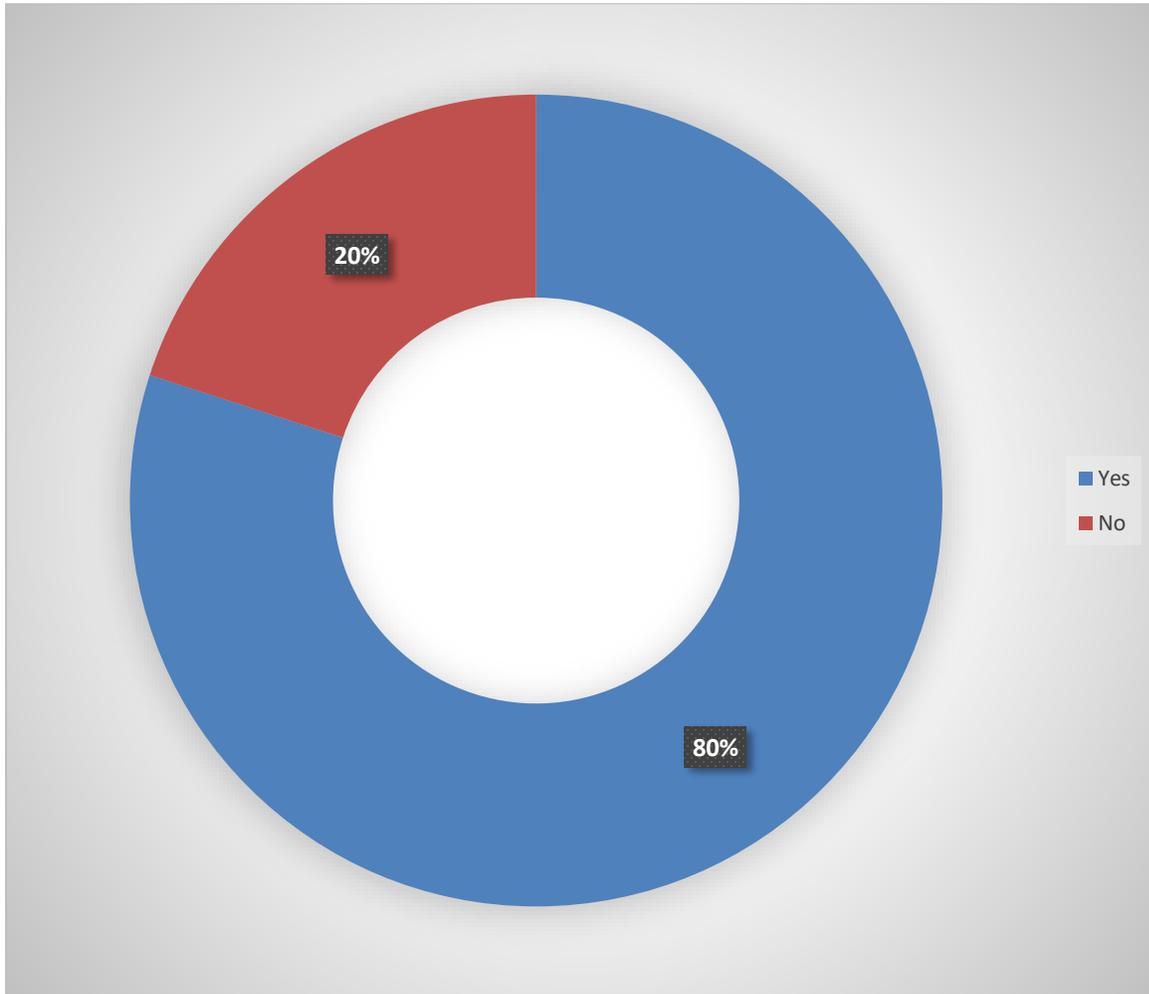
**Data about which the respondents live with**



The figure 4.8 depicts the graphical representation of the respondents whom they live with. About 26 respondents live with their son. 14 numbers of respondents live with their daughter. Only 3 of the respondents live with their siblings. Here majority of the respondents lives with their son. 7 numbers of respondents lives alone.

**Figure 4.9**

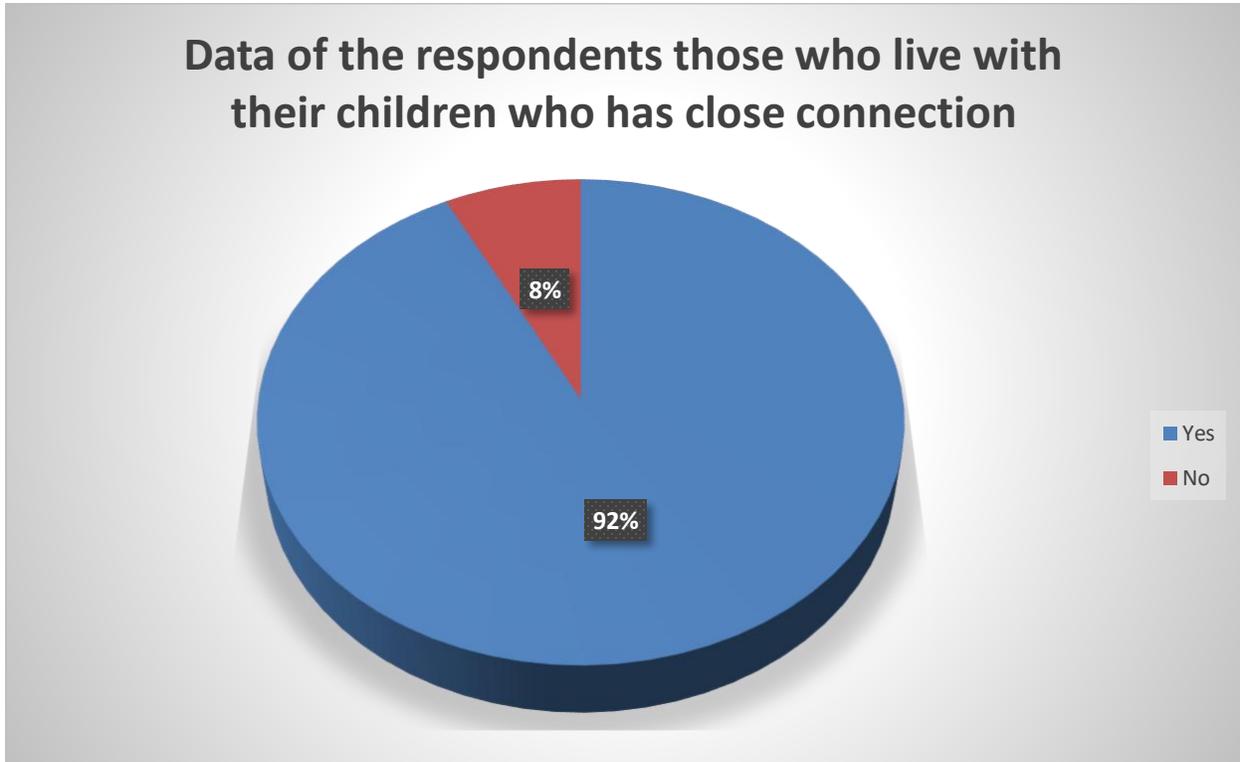
**Data about the respondents lives with their children or not**



The figure 4.9 shows the graphical representation of the respondents those who live with their children. 80% of the respondents live with their children and 20% of the respondents didn't live with their children.

**Figure 4.10**

**Data of the respondents those who live with their children who has close connection**



The figure 4.10 represents the graphical representation of the respondents those who live with their children who has close connection with them. About 92% of the respondents have close connection with their children and 8% of the respondents who do not have a close connection.

**Figure 4.11**

**Data depicts the level of connection with the respondent's children**

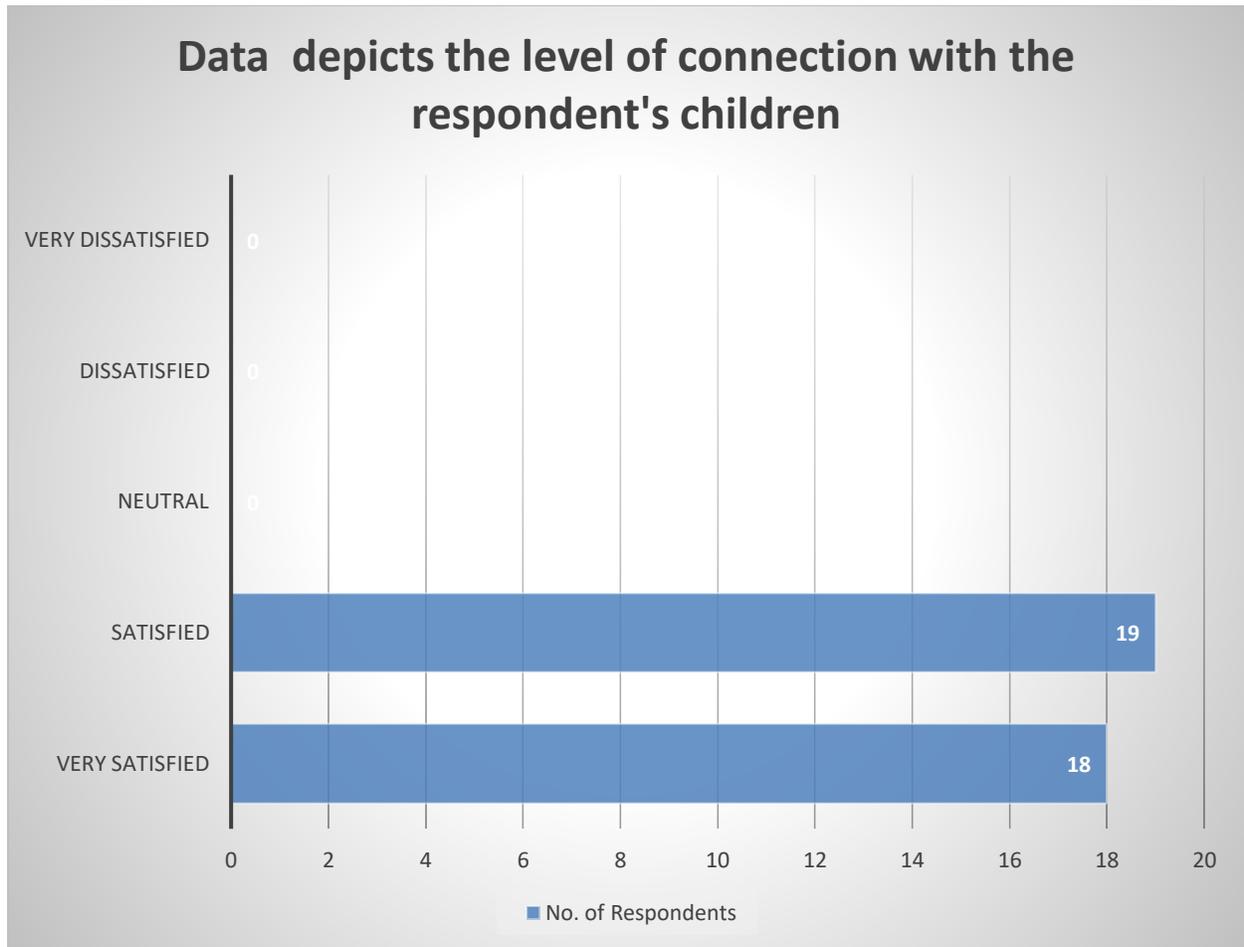


Figure 4.11 depicts the level of connection the respondents have with their children. About 19 of the respondents are satisfied and 18 respondents are very satisfied with the connection between the children and them.

**Figure 4.12**

**Data of respondents communicate via phone**

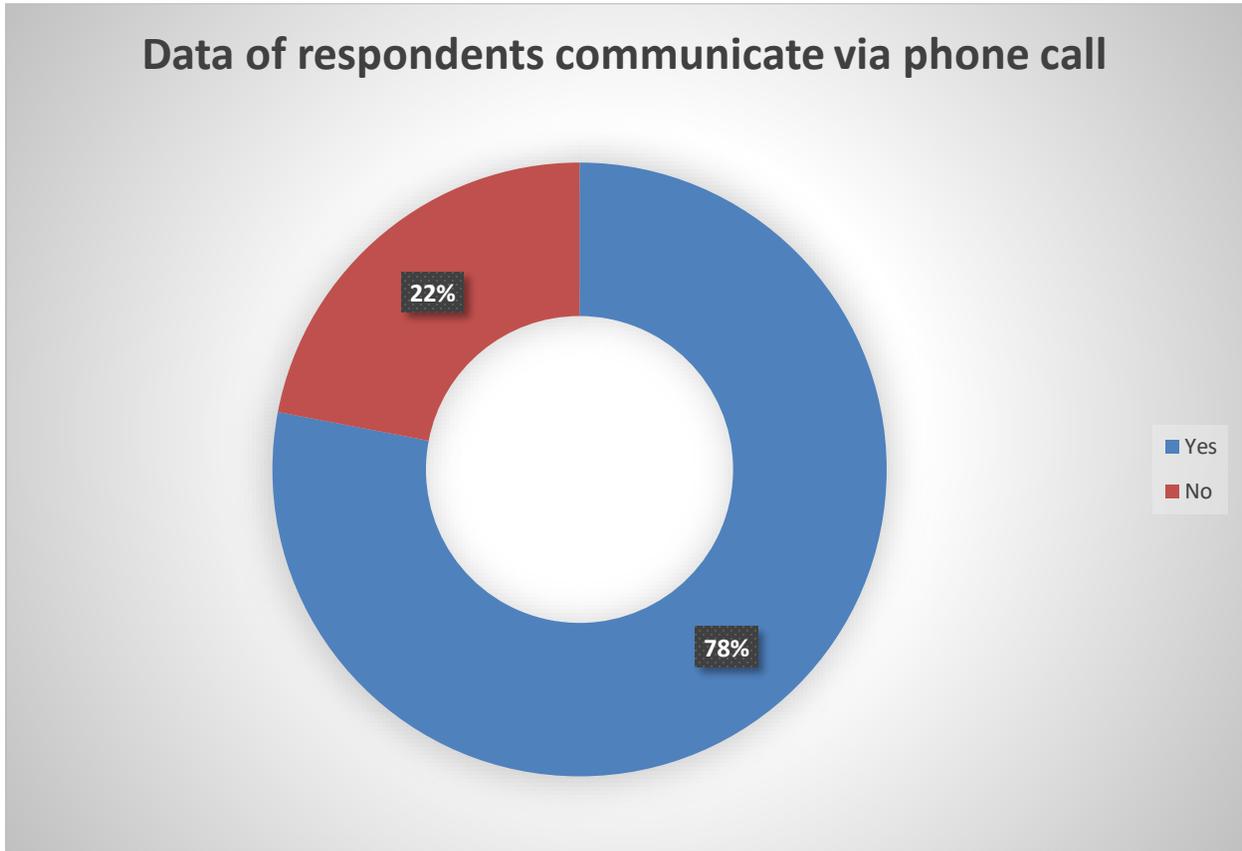
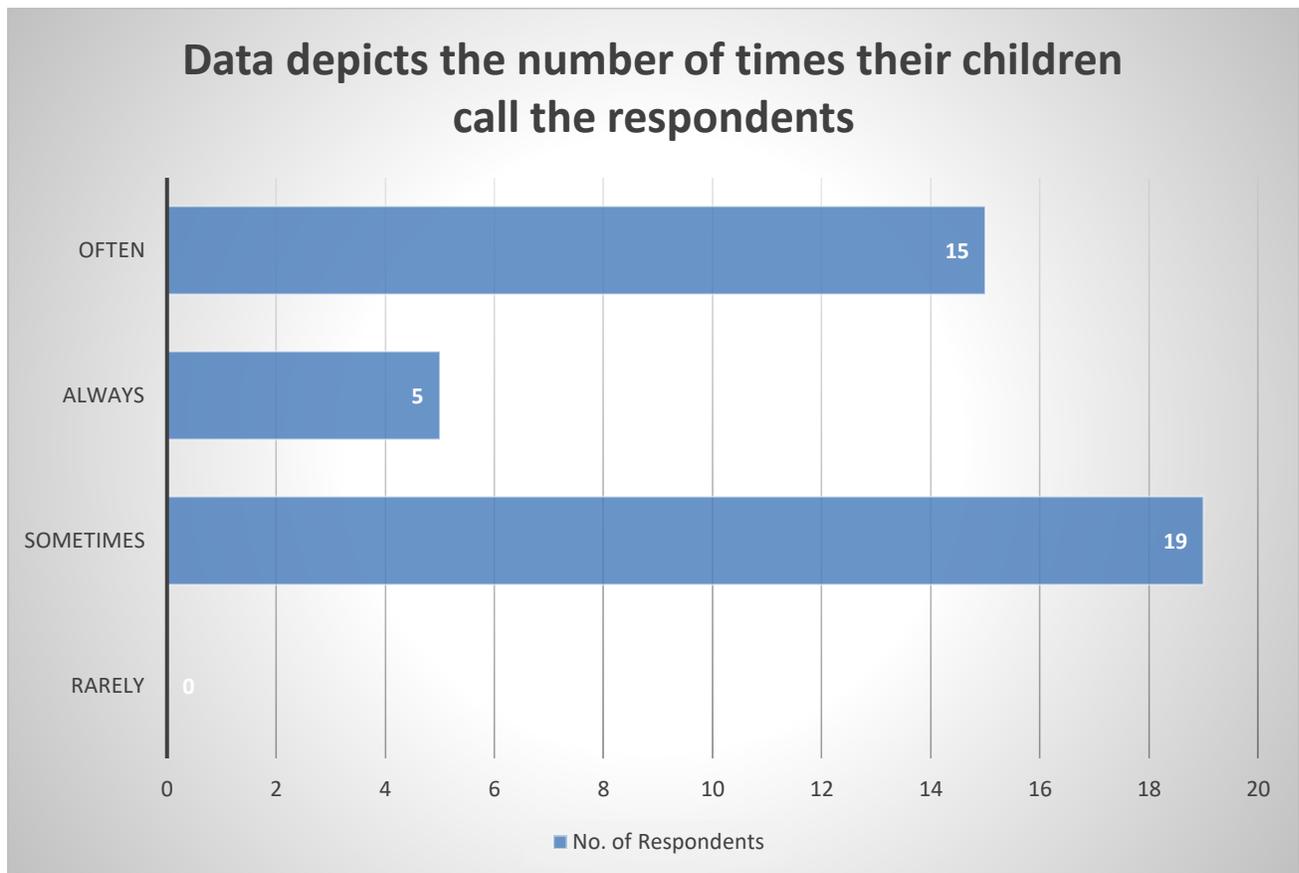


Figure 4.12 shows the graphical representation of the respondents those who communicate via phone call. About 78% of the respondents communicate through phone calls. And 22% of the respondents did not communicate often.

**Figure 4.13**

**Data depicts the number of times their children call the respondents**



The figure 4.13 represents the graphical representation of the number of times their children call the respondents. About 19 number of respondent's children call them sometimes. 15 of the respondent's children call them often and only 5 respondent's children always call.

**Figure 4.14**

**Data of the respondents who has grandchildren**

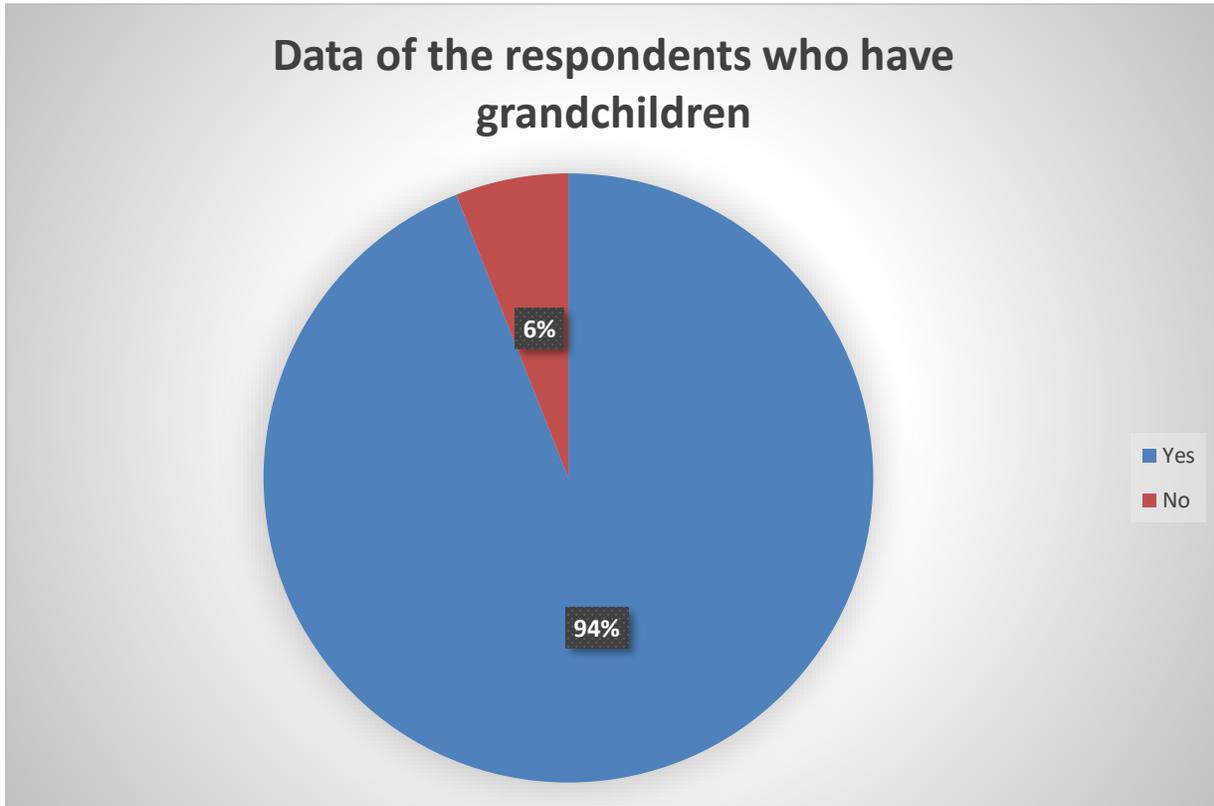
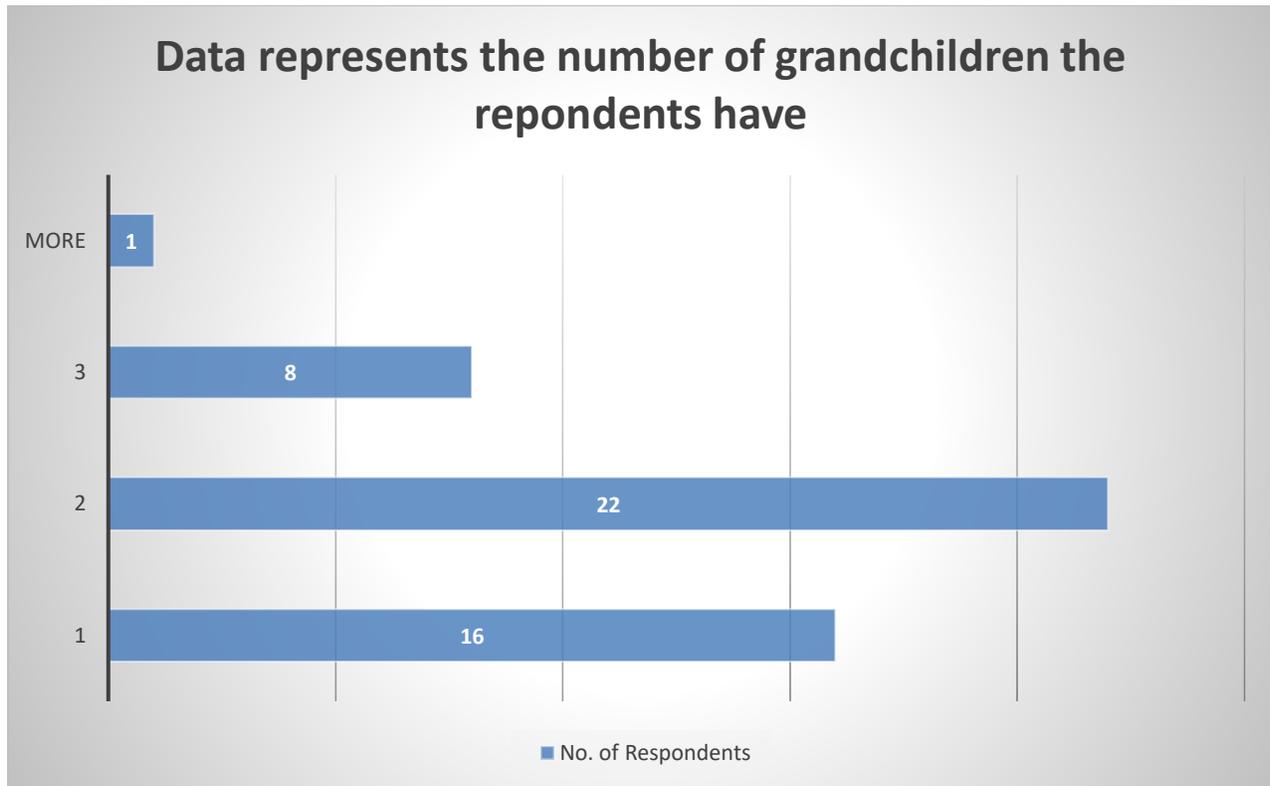


Figure 4.14 depicts the graphical representation of the respondents who has grandchildren. About 94% of the respondents have grandchildren and 6% of the respondents do not having grandchildren. Majority of the respondents are having grandchildren.

**Figure 4.15**

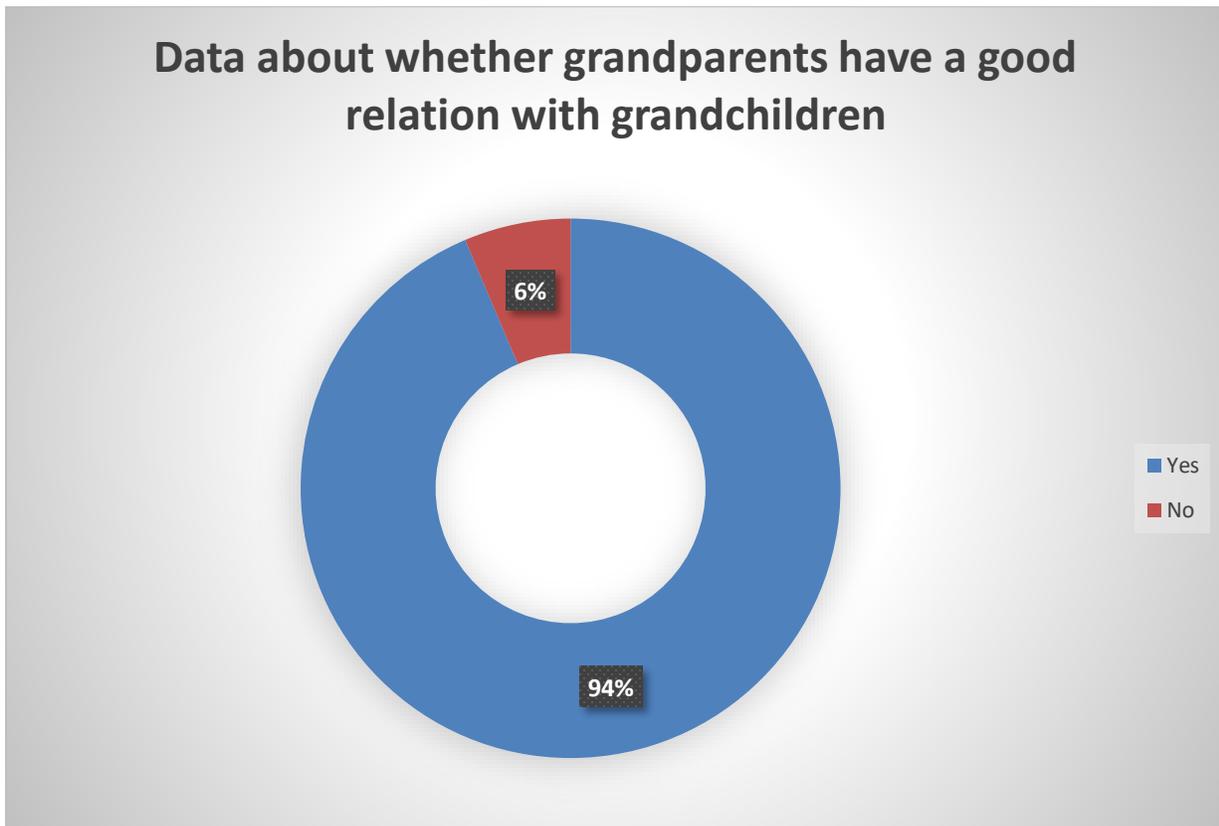
**Data represents the number of grandchildren the respondents have**



In figure 4.15, shows the graphical representation of the number of grandchildren the respondents have. About 22 of the respondents have two grandchildren, 16 numbers of respondents are having one grandchild, and 8 respondents have 3 grandchildren. And only 1 of the respondents is having more than 3 grandchildren.

**Figure 4.16**

**Data about whether grandparents have a good relation with grandchildren**



The figure 4.16 represents the graphical representation of the data about whether the grandparents have a good relation with grandchildren. About 94% of the grandchildren have a friendly relationship with their grandparents. And 6% of the grandchildren do not have a friendly relationship with their grandparents.

**Figure 4.17**

**Data about how they rate their extend of good relationship with their grandchildren**

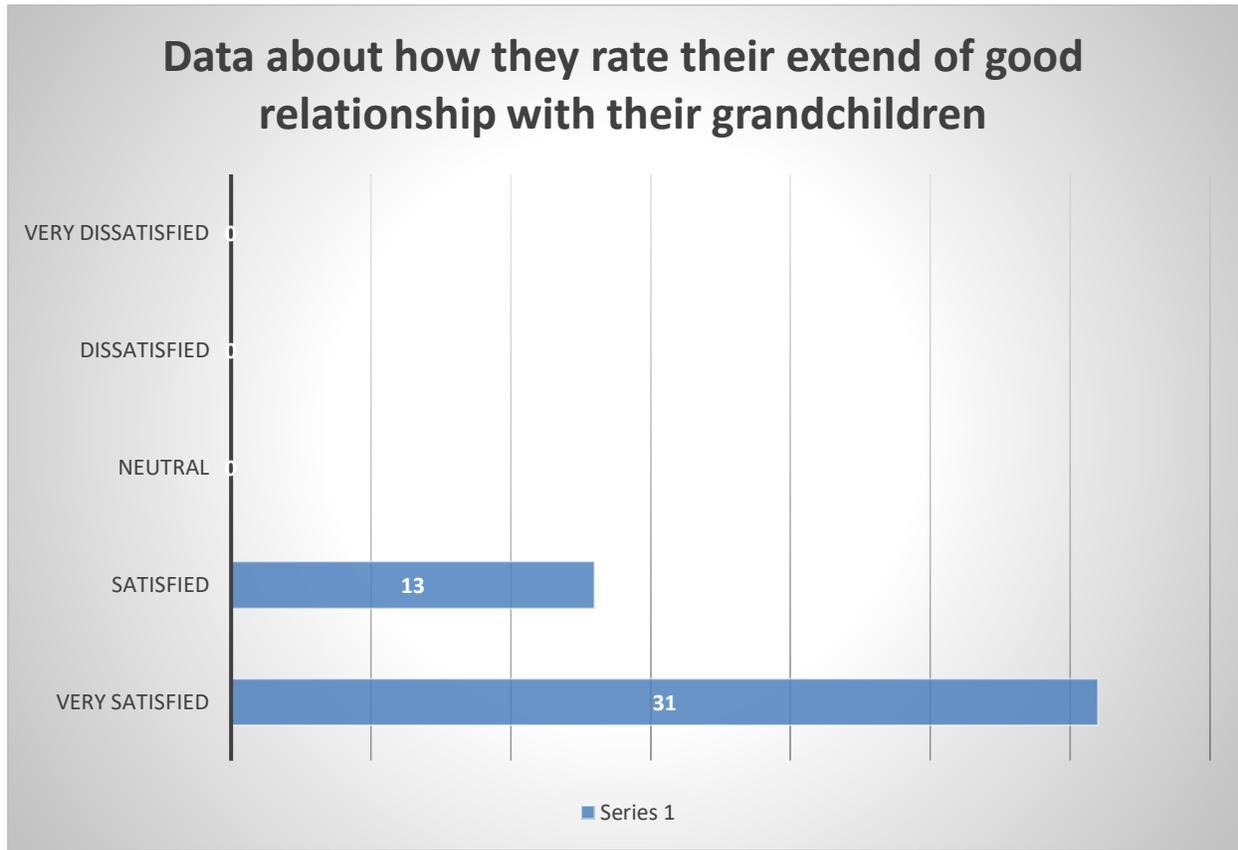


Figure 4.17 shows how the respondents rate their extend of good relationship with their grandchildren. 31 numbers of respondents are very satisfied with the relationship with their grandchildren. 13 of the respondents are satisfied with the relationship with their grandchildren. Majority of the respondents are very satisfied and have a good relationship with their grandchildren.

**Figure 4.18**

**Data represents the care given by other member of the family towards the respondents**

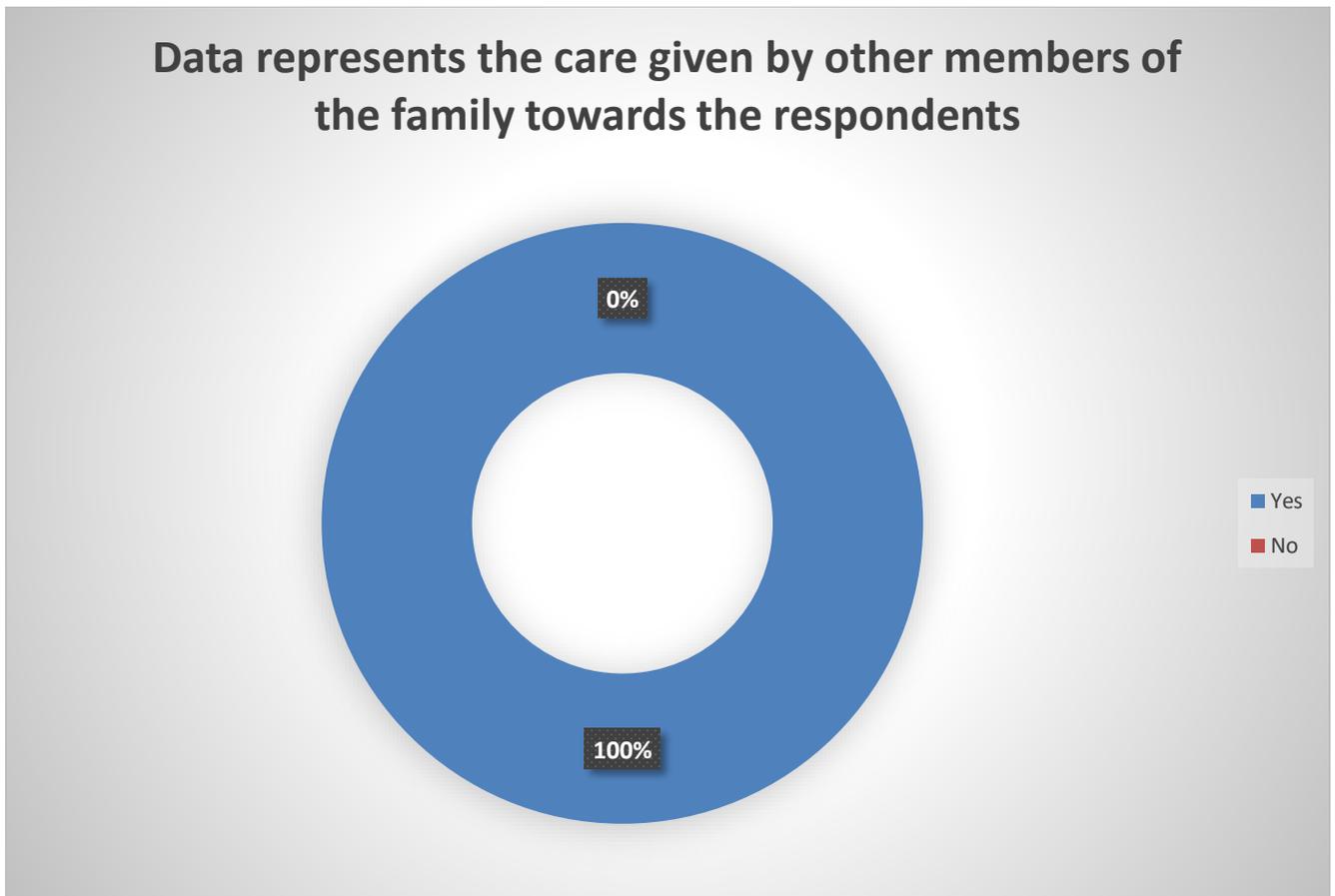
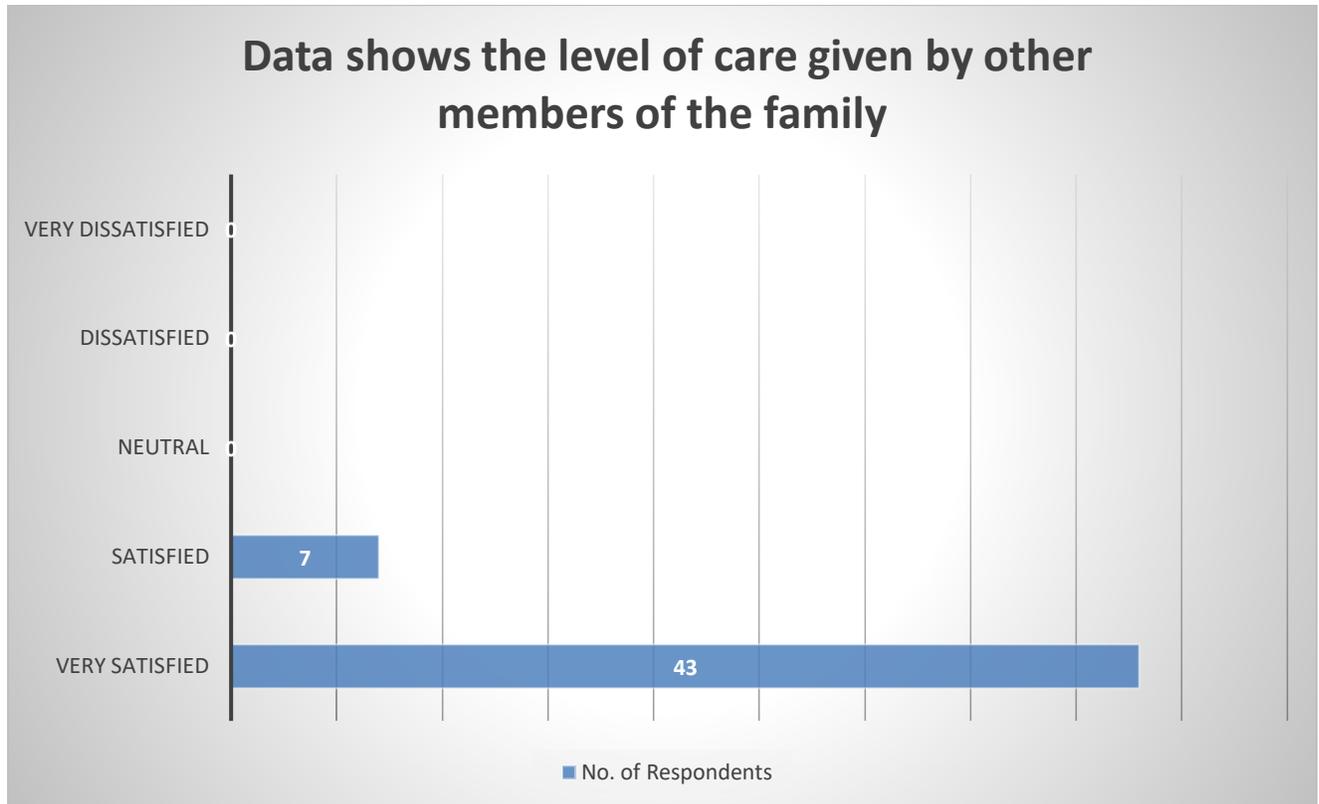


Figure 4.18 depicts the graphical representation of the care given by other members of the family towards the respondents. 100% of the respondents are take care by the other family members.

**Figure 4.19**

**Data shows the level of care given by other members of the family**



The figure 4.19 depicts the graphical representation of the level of care given by other members of the family. About 43 respondents are very satisfied with the level of care given by other members of the family. 7 respondents are satisfied with the level of care given by other members of the family.

**Figure 4.20**

**Data shows whether the respondents get any free time**

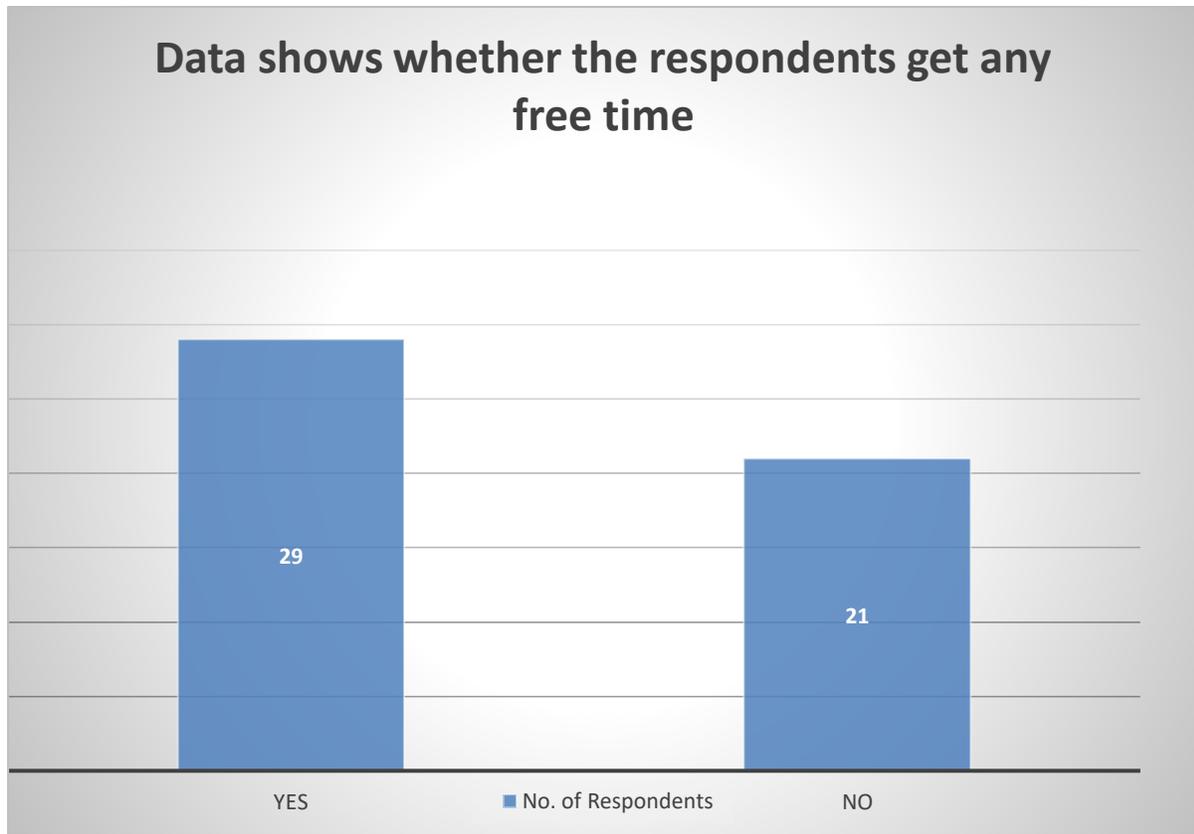


Figure 4.20 depicts the graphical representation of the respondents who get any free time. About 29 numbers of respondents get free time and 21 of the respondents didn't get any free time.

**Figure 4.21**

**Data shows whether the grandparents do any household works in the family**

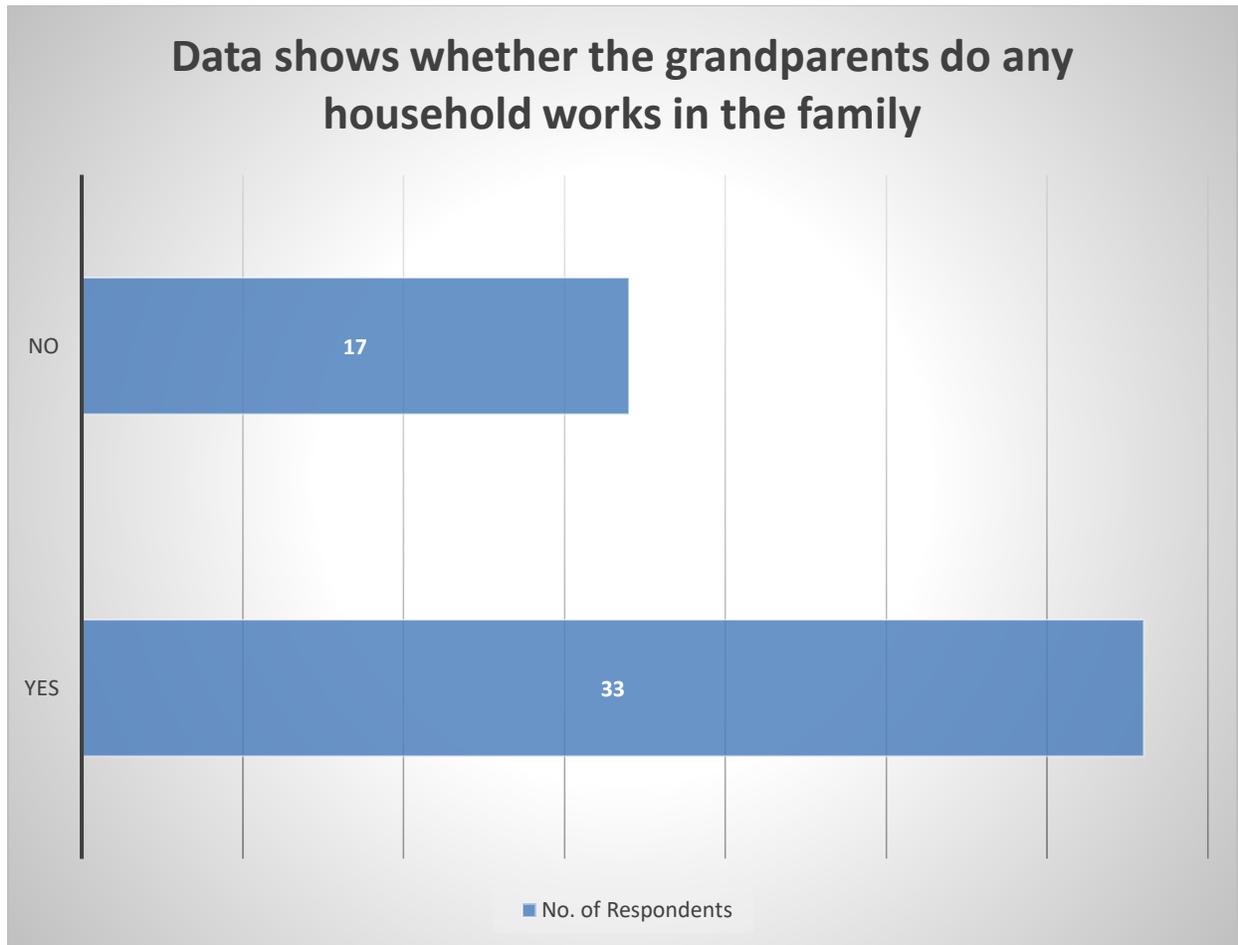


Figure 4.21 represents the graphical representation of the grandparents those who do any household works in the family. And about 33 respondents do the household works in the family and 17 numbers of respondents do not do any household works. Majority of the respondents does the household works in the family.

**Figure 4.22**

**Data shows the works respondents do in the family**

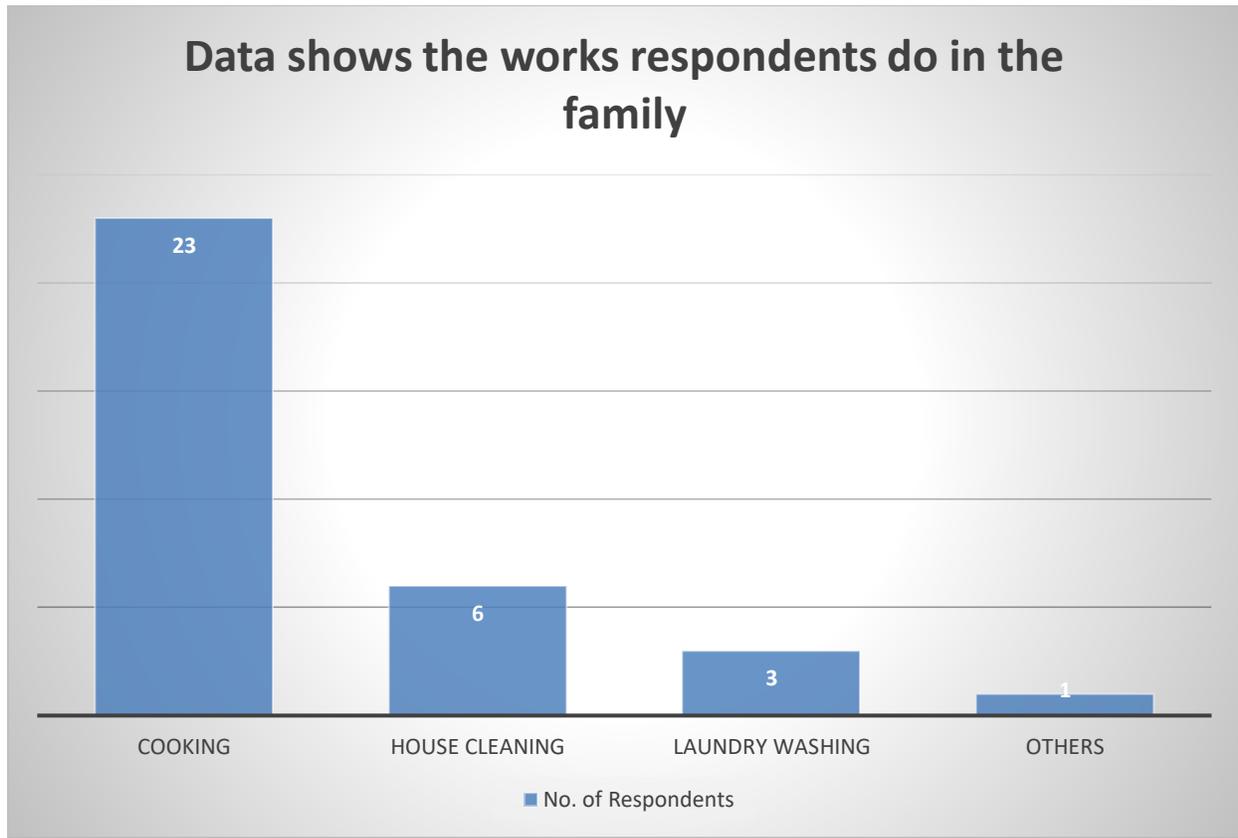


Figure 4.22 shows the graphical representation of the works the respondents does in the family. About 23 numbers of respondents do cooking, 6 of the respondents does the house cleaning, 3 respondents do laundry washing and one of the respondents does the terrace farming. Here, majority of the respondents does cook.

**Figure 4.23**

**Data show the role of taking care of the grandchildren by the respondents**

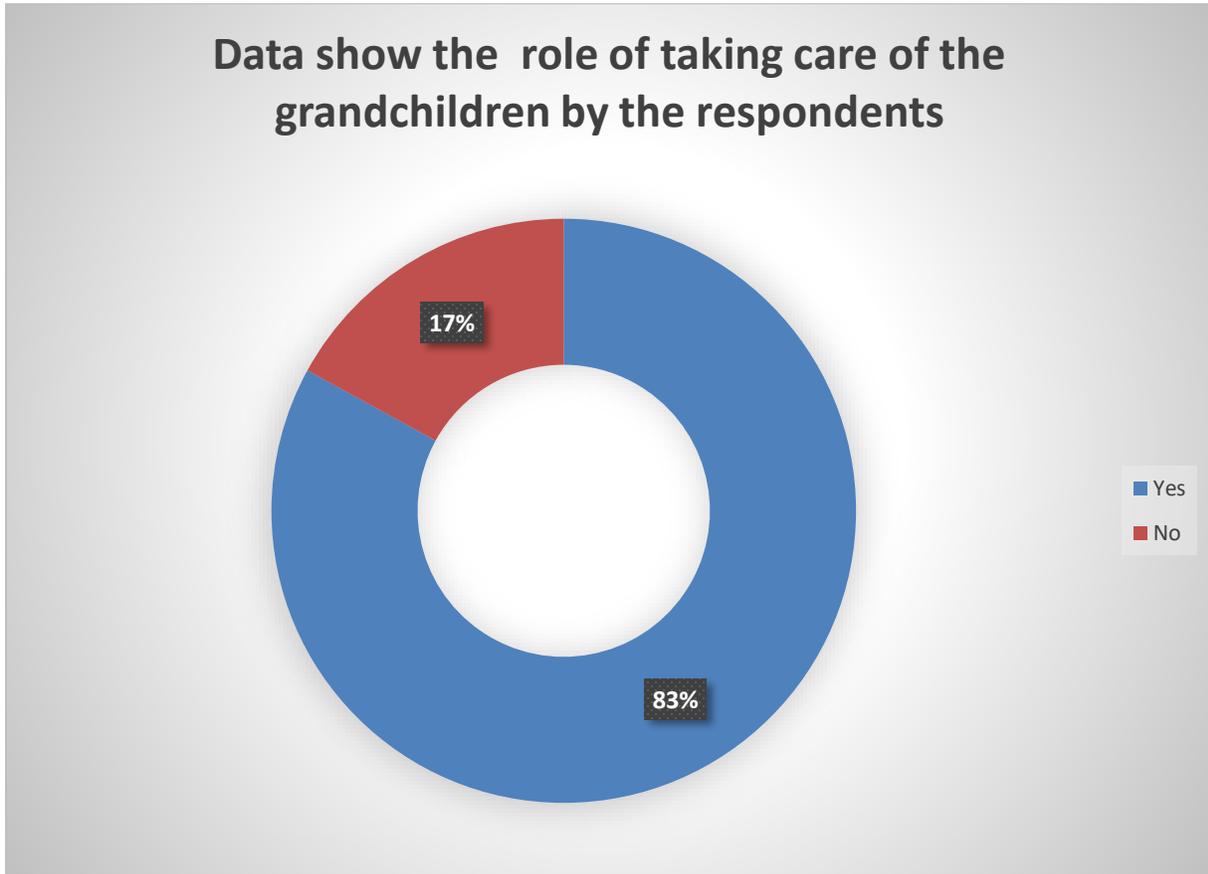


Figure 4.23 shows the graphical representation of the role of taking care of the grandchildren by the respondents. Here about 83% of the respondents play a major role in taking care of their grandchildren, and 17% of the respondents did not play the role of taking care of their grandchildren.

**Figure 4.24**

**Data represents the respondent's role in helping family financially**

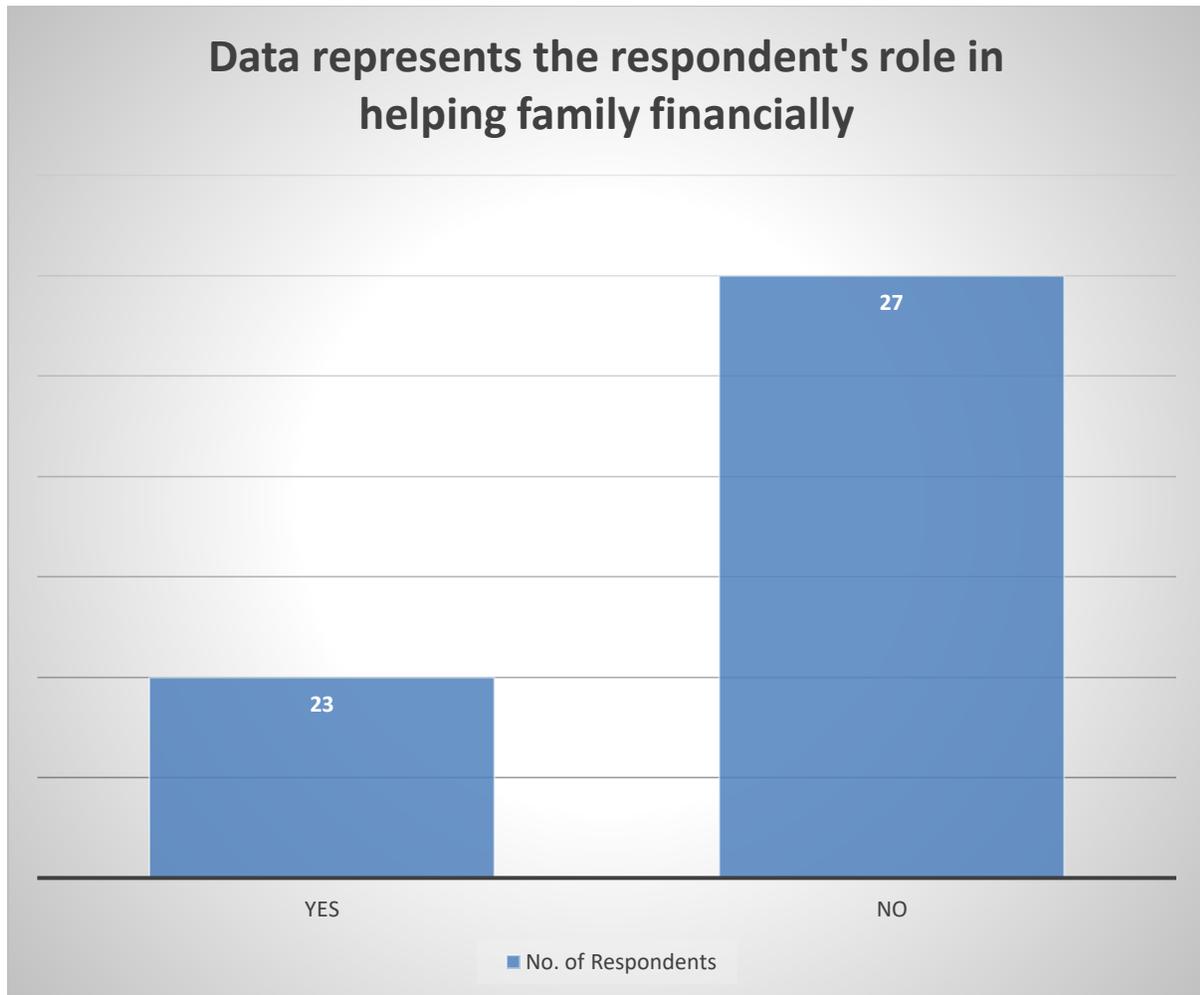


Figure 4.24 depicts the graphical representation of the respondent's role in helping the family financially. About 27 of the respondents do not help the family financially. Whereas 23 numbers of the respondents do help their family financially. Here, majority of the respondents does not help or involve in the financial aspects of the family.

**Figure 4.25**

**Data shows whether the respondents hold the financial power in their family**

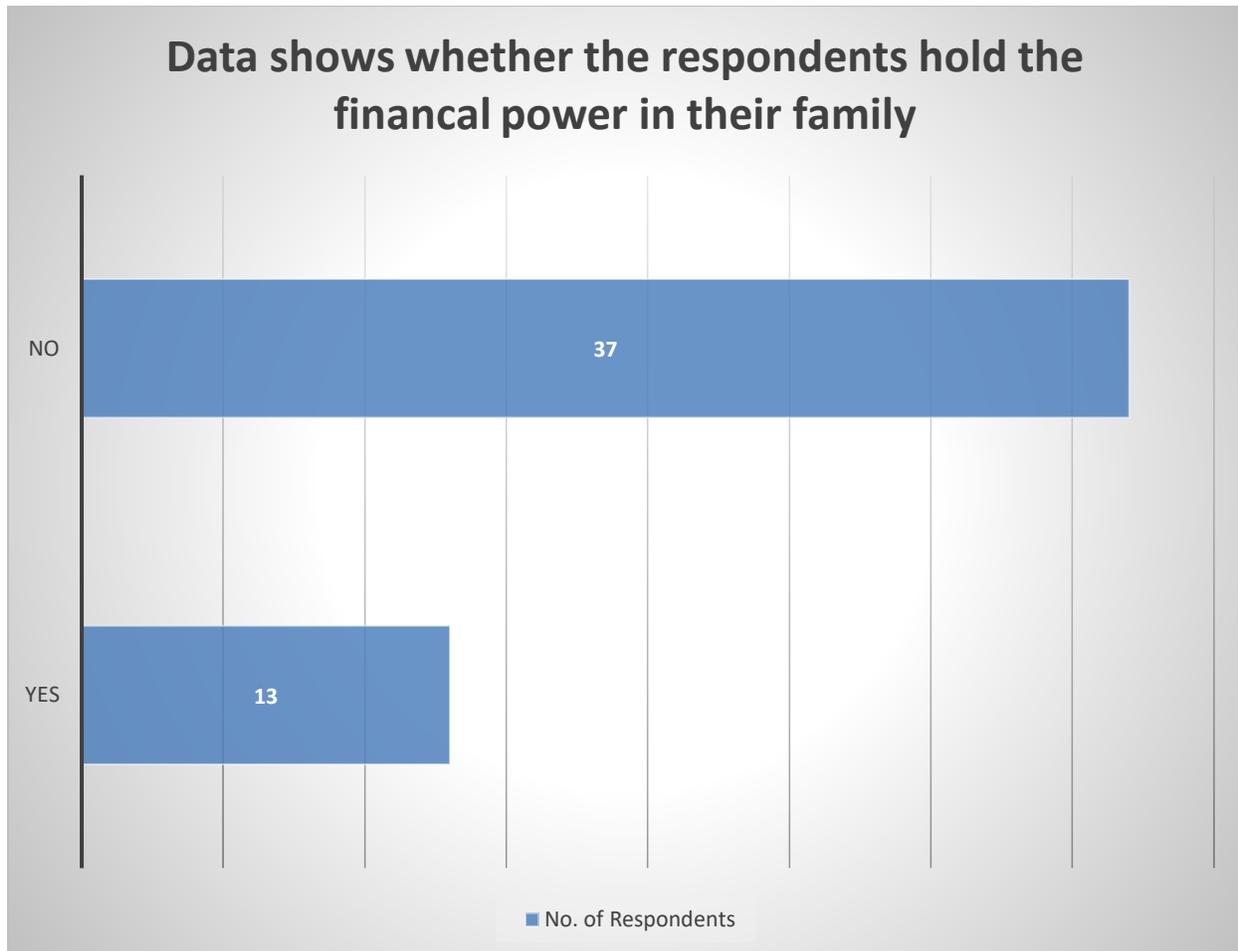


Figure 4.25 shows the graphical representation of the data were the respondents hold the financial power in their family. And, 37 respondents do not hold the financial power of the family. 13 of the respondents do handle the financial power of the family.

**Figure 4.26**

**Data shows whether if the respondents have or have not affected with covid-19**

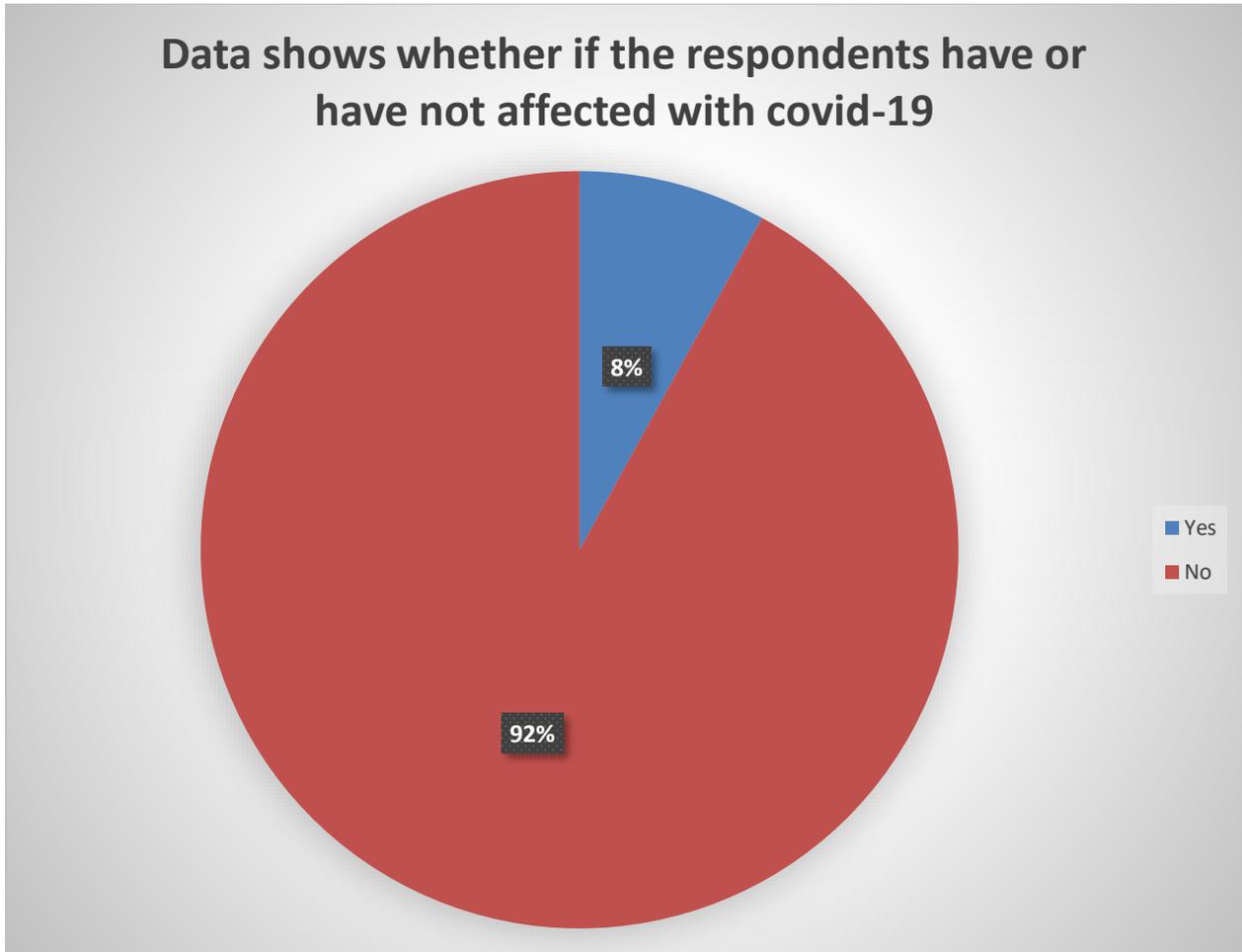


Figure 4.26 depicts the graphical representation of the respondents those who were affected with covid-19 or not. About 92% of the respondents have not been affected with covid-19 and 8% of the respondents have been affected with covid-19.

**Figure 4.27**

## Data shows whether the respondent's family faces any problems during covid-19 pandemic

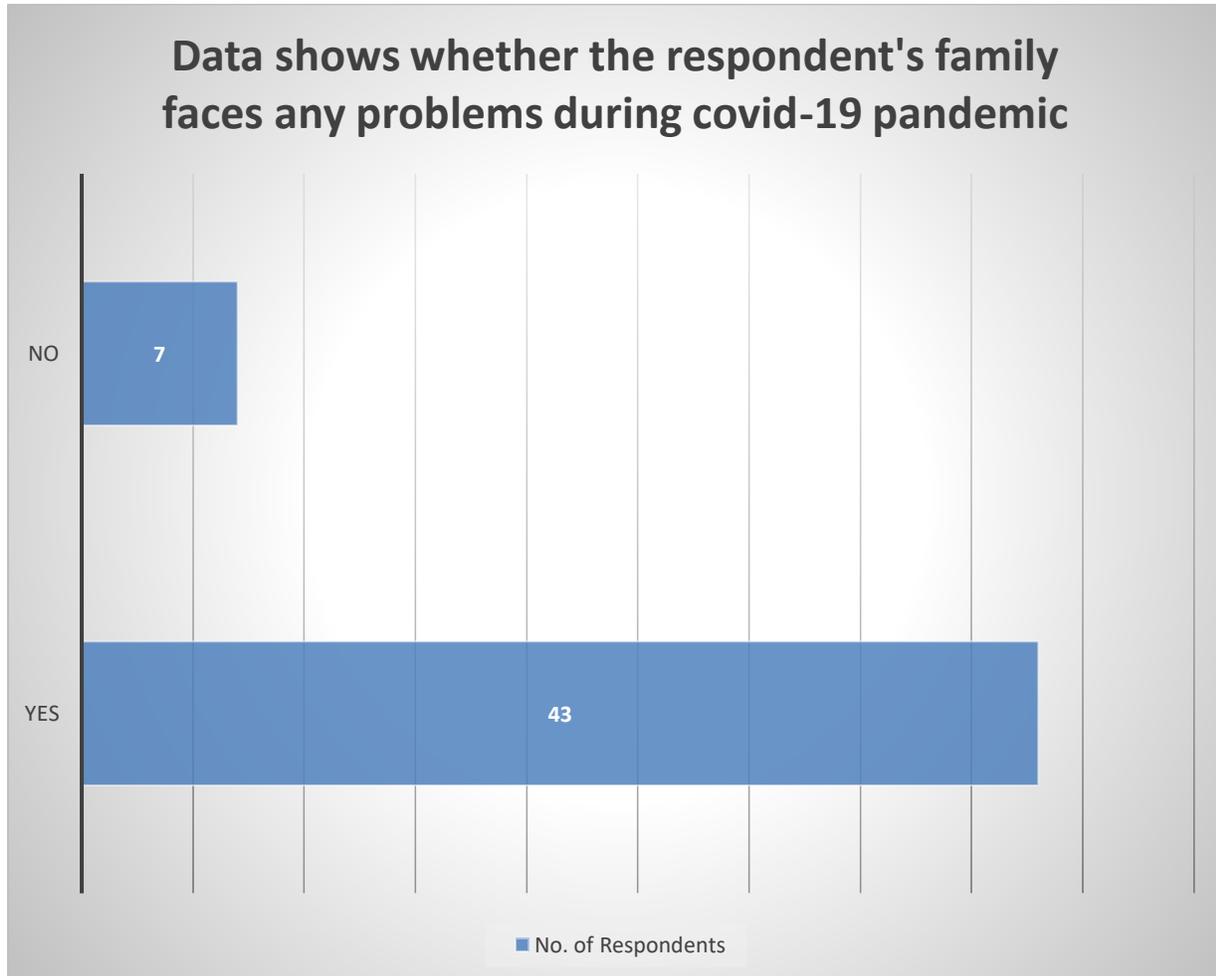


Figure 4.27 represents the graphical representation of the data which shows whether the respondent's family faces any problems during covid-19 pandemic. About 43 numbers of the respondent's family face problems during covid-19 pandemic and, 7 number of respondent's family did not face any problems.

**Figure 4.28**

**Data shows the problems faced by the respondents during covid-19 pandemic**

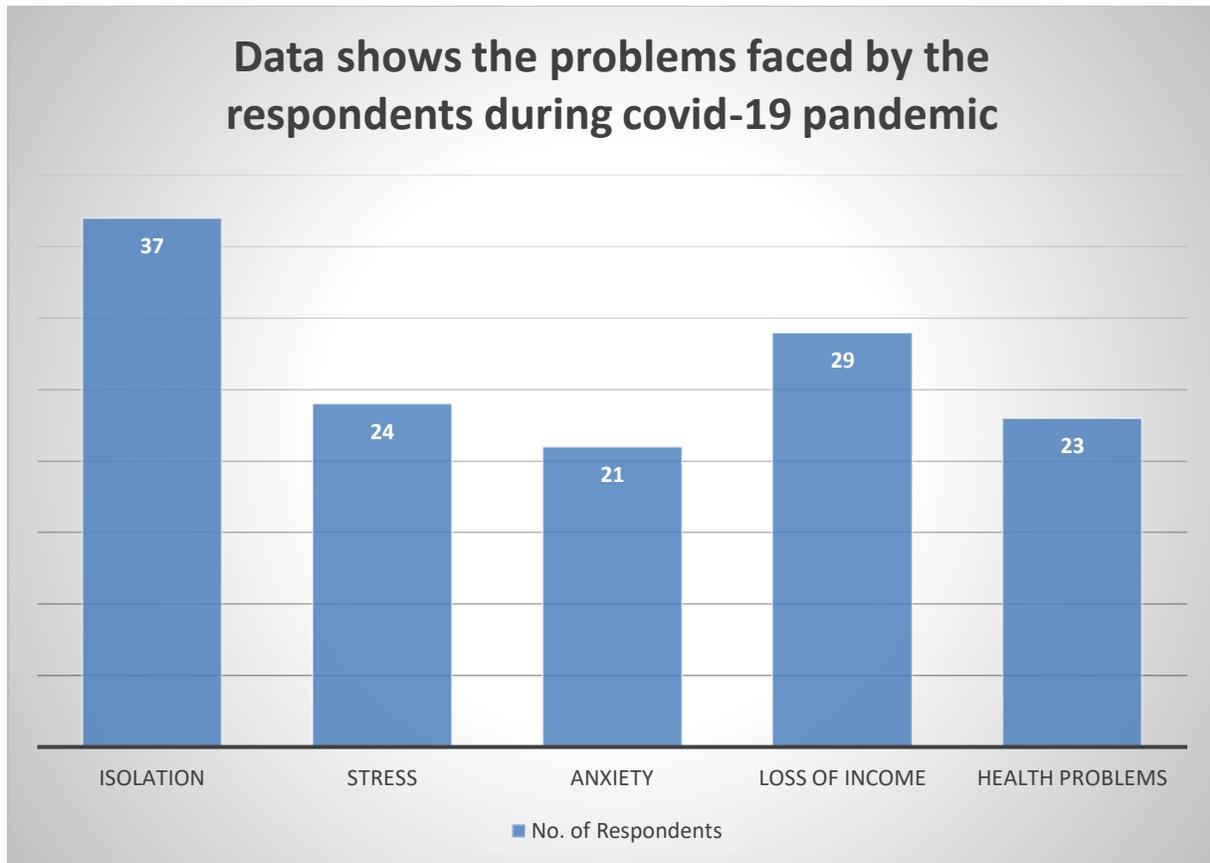
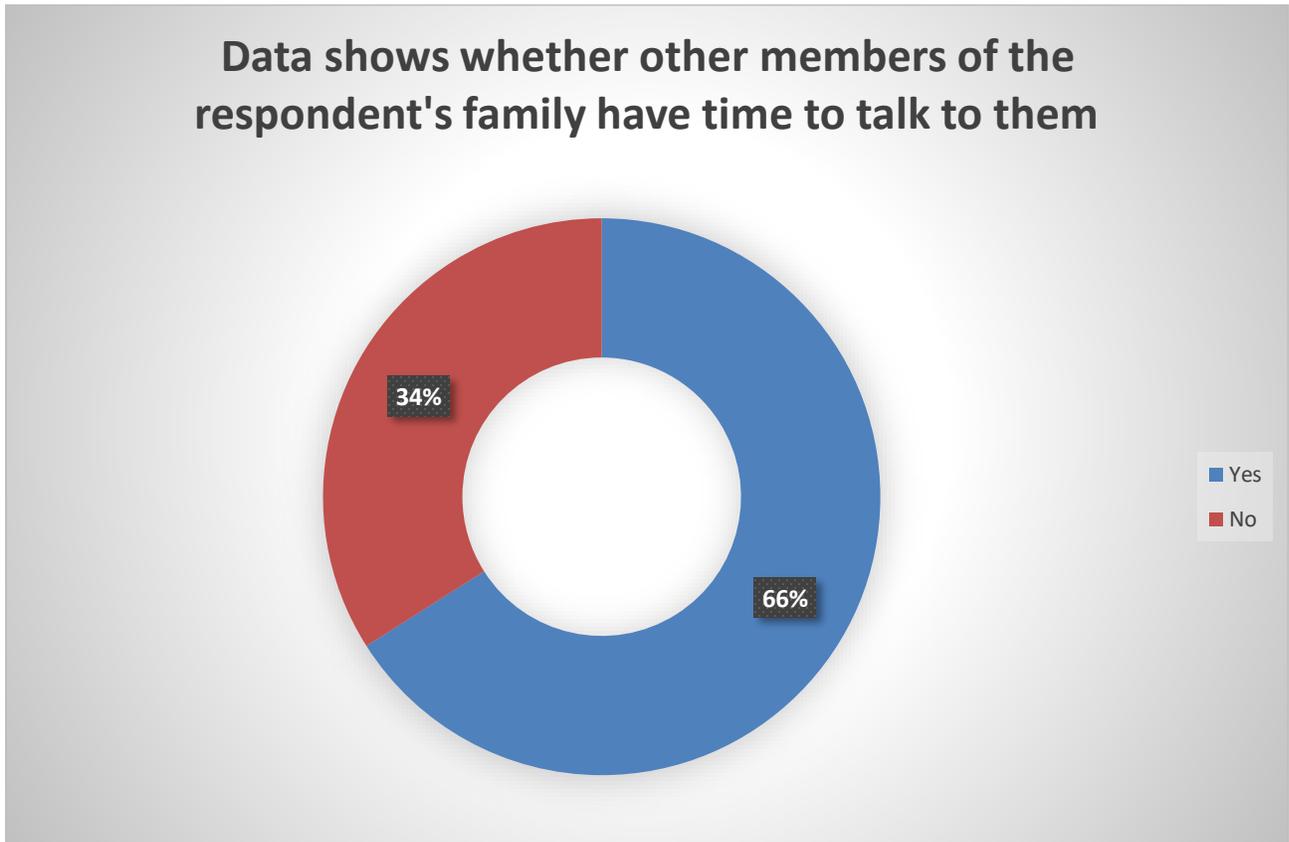


Figure 4.28 depicts the graphical representation of the problems faced by the respondents during covid-19 pandemic. 37 of the respondents are feeling isolated from the social network, which may create stress for them. About 29 respondents' loss their income. 24 of the respondents are feeling stress, 23 numbers of respondents have health related problems and 21 of the respondents are going through anxiety.

**Figure 4.29**

**Data shows whether other members of the respondent's family have time to talk to them**



In figure 4.29 shows the graphical representation of the data whether other members of the respondent's family have time to talk to them. About 66% of the respondent's family has time to talk for. But 34% of the respondent's family didn't get any free time to talk to the respondents.

**Figure 4.30**

**Data shows whether the respondent's grandchildren annoy them**

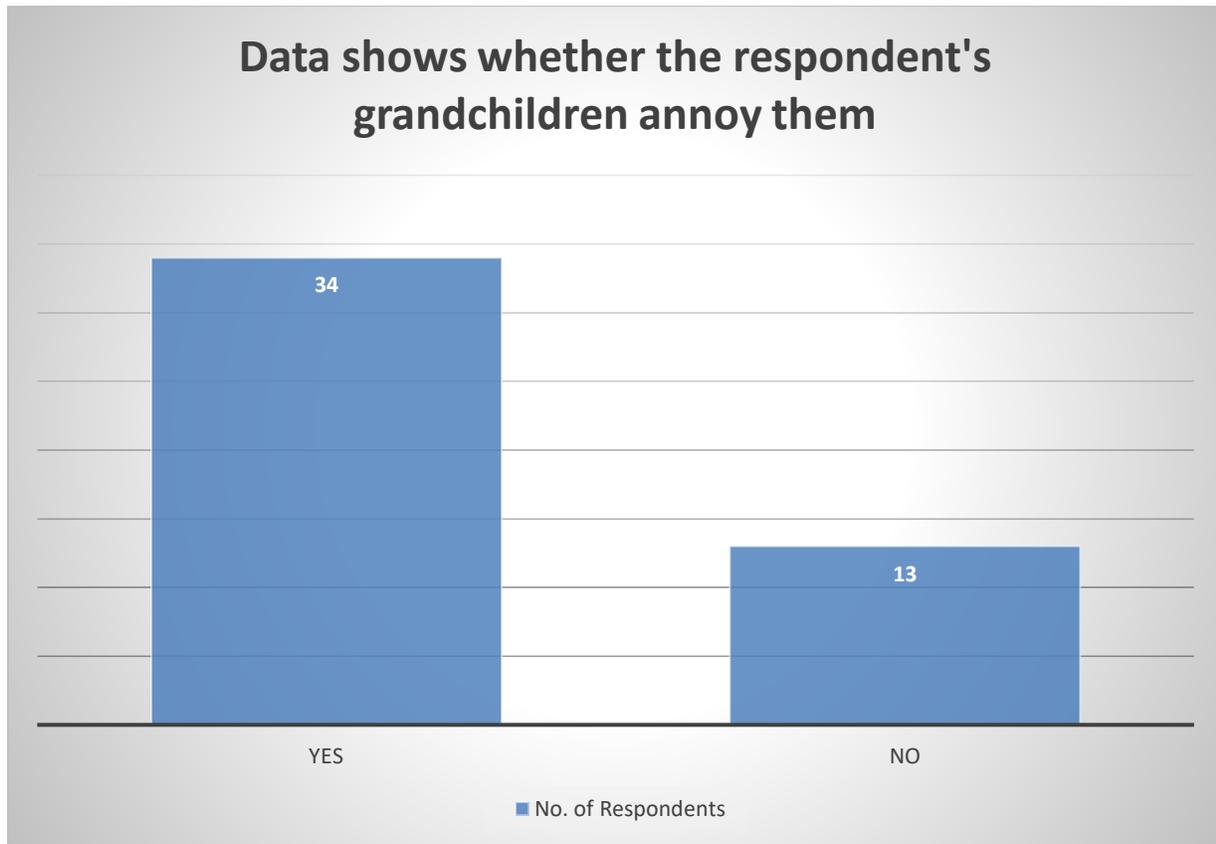


Figure 4.30 shows the graphical representation of the data whether the respondent's grandchildren annoy them. About 34 of the respondents say that their grandchildren annoy them. And, 13 respondents say their grandchildren did not annoy them.

## **CHAPTER 4**

## FINDINGS AND CONCLUSION

The first objective was to find out the socio economic profile of the grandparents. From the 50 sample, majority of the respondents belong to the age group of 60-70 (60%). And about 36% of the respondents belong to the age group of 70-80. Only 4% of the respondents are 80 above. Majority of the respondents are female (60%) while 40% of the respondents are male. Majority of the respondents (52%) are below SSLC, 26% of the respondents have education level up to pre degree, and 16% does up to SSLC and only 6% of the respondents have degree level qualification. About 66% of the respondents are from joint family while 34% of the respondents are from nuclear family. Majority of the respondents (64%) come from rural area, while 36% of the respondents are from urban area. Majority of the respondents (38%) are retired from the job while 36% of the respondents are unemployed and 26% of the respondents are employed. About 56% of the respondents have income level from 1 lakh to 3 lakh. And 38% of the respondents have income level below 1 lakh. While 6% of the respondents have income level from 3 lakh to 4 lakh.

The second objective was to analyze the relationship between grandparents and other members of the family. Majority of the respondents (52%) live with their son. 28% of the respondents said that they live with their daughter, while 6% of the respondents lives with their siblings. And about 14% of the respondents live alone. In this study 80% of the respondents' lives with their children and about 20% of the respondents did not live with their children. Majority of the respondents said that they have a close connection with their children (92%). While 8% of the respondents said that they do not have a close connection with their children. In this study, 38% of the respondents said that they are satisfied with the level of connection with their children. Whereas, 36% of the respondents said that they are very satisfied with the connection between the children and them. Majority of the respondents (78%) communicate through phone calls with their loved ones, while 22% of the respondents did not communicate often. And about 38% of the respondent's children call them sometimes and 38% of the respondent's children call them often. While 10% of the respondent's children always calls. In this study, about 94% of the respondents have grandchildren and 6% of the respondents do not have grandchildren. Majority of the respondents (44%) have 2 grandchildren, while 32% of the respondents have 1 grandchild. About 16% of the respondents have 3 grandchildren. And only 2% of the respondents have more than 3 grandchildren. In this study, majority of the respondents (94%) have a good relationship with their grandchildren. Whereas, 6% of the respondents did not have a good relation with their grandchildren. In this study, 62% of the respondents are very satisfied with the relationship with their grandchildren, and 26% of the respondents are satisfied with the relationship they have with their grandchildren. In this study 100% of the respondents said that, other members in the family take care of them. 86% of the respondents are very satisfied with the level of care given by other

family members and 14% of the respondents are satisfied with the level of care given by other members of the family.

The third objective is to study the nature of the role of grandparents in the families during covid-19 pandemic. Majority of the respondents (58%) get free time, whereas 42% of the respondents did not get any free time. In this study, about 66% of the respondents do the household works in the family and 34% of the respondents do not do any household work. In this study, it has also been found that majority of the respondents (46%) do cooking, whereas, 12% of the respondents do the house cleaning. About 6% of the respondents said that they do the laundry washing and 2% of the respondent does the terrace farming. In this study, about 83% of the respondents play a major role in the taking care of their grandchildren, whereas, 17% of the respondents did not play the role of taking care of their grandchildren. Majority of the respondents (54%) said that they do not help the family financially. Whereas, 46% of the respondents said that do help their family financially. And, 74% of the respondents said that they do not hold the financial power of the family. And 26% of the respondents do handle the financial power of the family.

The last and fourth objective was to find out the problems faced by the grandparents in the families during covid-19 pandemic. In this study, about 92% of the respondents have not been affected the covid-19, whereas, 8% of the respondents have been affected with covid-19. In this study, majority of the respondent's (86%) family faces problem during covid-19 pandemic and 14% of the respondent's family did not face any problems. In this study, 74% of the respondents are feeling isolated from the social network, which may create stress for them. 58% of the respondents said that they loss their income. About 48% of the respondents said that they are having heavy stress due to their pandemic situation. And about 46% of the respondents are facing health related problems. And 42% of the respondents are going through anxiety. In this study, about 66% of the respondents said that their family has time to talk to them, whereas, 34% of the respondent's family did not get any free time to talk to the respondents. In this study, about 68% of the respondents say that their grandchildren annoy them and about 26% of the respondent's says that their grandchildren did not annoy them.

## **Suggestions**

- Awareness should be spread about the importance of mental health of elderly.
- Digital literacy of elderly should be encouraged more.
- Visit the elderly regularly.
- Include grandparents in outings.
- Keep them mentally busy.

## CONCLUSION

After the detailed study about the role of grandparents in the family it is very well understood that, the grandparents have a major role in the family. 50 respondents from Kalavoor panchayath were selected. The pandemic and the lockdown have brought many challenges to the older adults. It had a direct impact on their lives and wellbeing. The support from the family helped them to cope with such a difficult situation. The children helped them in buying daily essentials and ensuring medical care. They gave financial support for their parents who lost their job during lockdown. Above all, the time spent with them and the mental support given to them are invaluable. This helped them to cope with the situation.

The activity theory of ageing proposed by Robert J. Havighurst says that successful aging occurs when older adults stay active and maintain social interactions. In a situation like lockdown, elderly loses their spaces for social interaction. The loneliness and anxiety developed in them resulted in loss of interest to engage in activities.

During situations like lockdown, they are connecting virtually to the outside world with the help of their children and grandchildren. Their mental health is as much important as their physical health. The relationship with family and friends always helps elderly in overcoming the difficulties and challenges of their life.

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## **APPENDIX**

### **ELDERLY AS A SOCIAL CAPITAL IN FAMILIES: WITH SPECIAL REFERENCE TO COVID-19 PANDEMIC**

1. Age
  - 60-70
  - 70-80
  - 80 above
2. Gender
  - Male
  - Female
3. Educational qualification
  - Below SSLC
  - Higher Secondary
  - Degree
  - Others
4. Type of family
  - Joint family
  - Nuclear family
  - Other
5. Locality
  - Rural
  - Urban
6. Occupational status
  - Employed
  - Unemployed
  - Retired
7. Income
  - Below 1 lakh

- 1 lakh - 3 lakh
  - 3 lakh – 4 lakh
8. Whom do you live with?
- Son
  - Daughter
  - Siblings
  - Others
9. Do you live with your children?
- YES
  - NO
10. If yes, do you have a close connection with them?
- YES
  - NO
11. If yes how far?
- VERY SATISFIED
  - SATISFIED
  - NEUTRAL
  - DISSATISFIED
  - VERY DISSATISFIED
12. Do they call you often?
- YES
  - NO
13. If yes, how often?
- RARELY
  - SOMETIMES
  - ALWAYS
  - OFTEN
14. Do you have grandchildren?
- YES
  - NO
15. If yes, how many?
- 1
  - 2
  - 3
  - MORE

16. Do you have a friendly relationship with them?

- YES
- NO

17. If yes, how far?

- VERY SATISFIED
- SATISFIED
- NEUTRAL
- DISSATISFIED
- VERY DISSATISFIED

18. Do other members of the family take care of you?

- YES
- NO

19. If yes, how far?

- VERY SATISFIED
- SATISFIED
- NEUTRAL
- DISSATISFIED
- VERY DISSATISFIED

20. Do you get any free time?

- YES
- NO

21. Did you do any household works in the family?

- YES
- NO

22. If yes, what all are the works you do?

- Cooking
- House cleaning
- Laundry washing
- Others

23. Do you play the role of taking care of your grandchildren?

- YES
- NO

24. Did you help the family financially?

- YES

- NO

25. Do you handle the financial power of the family?

- YES
- NO

26. Were you affected with covid 19?

- YES
- NO

27. Do you face any problem in the family during covid 19 pandemic?

- YES
- NO

28. If yes, what all are the problems do you face?

29. Do other members of the family have time to talk to you?

- YES
- NO

30. Do your grandchildren annoy you?

- YES
- NO



**A SOCIOLOGICAL STUDY ON THE IMPACT OF  
SURVEILLANCE CAPITALISM ON COLLEGE  
STUDENTS THROUGH INSTAGRAM WITH SPECIAL  
REFERENCE TO KOCHI**



By

Hesha Anjum Yousaf

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DEPARTMENT OF SOCIOLOGY AND CENTRE FOR RESEARCH

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAXU LAM

**MARCH 2022**



**A SOCIOLOGICAL STUDY ON THE IMPACT OF SURVEILLANCE CAPITALISM  
ON COLLEGE STUDENTS THROUGH INSTAGRAM WITH SPECIAL REFERENCE  
TO KOCHI**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the require  
ments for the award of the degree of **Master of Arts in Sociology***

By  
**Hesha Anjum Yousaf**

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Head of the Department

MARCH 2022





## CERTIFICATE

I certify that the thesis entitled "A Sociological Study on the Impact of Surveillance Capitalism on College Students through Instagram with special reference to Kochi" is a record of bonafide research work carried out by Hesha Anjum Yousaf, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.



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March 2022

## DECLARATION

I, Hesha Anjum Yousaf. hereby declare that the thesis entitled "A Sociological Study on the Impact of Surveillance Capitalism on College Students through Instagram with special reference to Kochi" is a Bonafede record of independent research work carried out by me under the supervision and guidance of Smt. Dora Dominic. I further declare that this thesis has not been previously submitted for the award of any degree, diploma associateship or other similar title.

Ernakulam  
March 2022



Hesha Anjum Yousaf

## ACKNOWLEDGEMENT

As an aspiring social scientist this project has been my first research paper and in this humble attempt, I have received a great deal of emotional and academic support from different quarters I shall never forget. As is obvious, I firstly thank God Almighty for bestowing upon me abundance of grace for making this study possible.

I am extremely thankful to the Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt. Elizabeth Abraham, Head of the Department of Sociology and Centre for Research and to all the faculty members of the department for their encouragement and guidance in accomplishing the work.

I am grateful to Smt. Dora Dominic, Assistant Professor, Department of Sociology and Centre for Research, St. Teresa's (Autonomous) College, Ernakulam, for her constant support and faith in me as she guided me through this arduous project, whose completion would have been impossible without her.

I also take this opportunity to thank my family members, friends, classmates and respondents for their support and cooperation.



Ernakulam

Hesha Anjum Yousaf

March 2021

## **CONTENTS**

<b>CHAPTER</b>	<b>PAGE</b>
<b>1. INTRODUCTION</b>	<b>1</b>
<b>2. REVIEW OF LITERATURE</b>	<b>7</b>
<b>3. METHODOLOGY</b>	<b>16</b>
<b>4. ANALYSIS AND INTERPRETATION</b>	<b>21</b>
<b>5. FINDINGS AND CONCLUSION</b>	<b>38</b>

**BIBLIOGRAPHY**

**APPENDIX**

## LIST OF FIGURES

Sl. No	Title	Page No.
4.1	GENDER OF RESPONDENTS	24
4.2	RELIGION OF RESPONDENTS	25
4.3	ANNUAL INCOME OF RESPONDENTS	27
4.4	RESPONDENTS APP USAGE AND DEPENDENCY SINCE INCEPTION	28
4.5	PURPOSE OF INSTAGRAM OF RESPONDENTS	29
4.6	RESPONDENTS TAKE ON ADDICTION TO INSTAGRAM	30
4.7	IMPACT OF PANDEMIC ON TIME SPENT ON INSTAGRAM	30
4.8	NUMBER OF RESPONDENTS THAT READ PRIVACY POLICY ON INSTAGRAM	31
4.9	RESPONDENTS OPINION ON USING LAYMEN LANGUAGE IN PRIVACY POLICY	32
4.10	RESPONDENTS TAKE ON SURVEILLANCE ON INSTAGRAM	33

4.11	RESPONDENTS' OPINION ON KEEPING THEIR PRIVATE DATA	33
4.12	RESPONDENTS FAMILIARITY WITH THE TERM SURVEILLANCE CAPITALISM	34
4.13	RESPONDENTS UNDERSTANDING OF SURVEILLANCE CAPITALISM	34
4.14	RESPONDENTS TAKE ON WHETHER TARGETTED NEWS IMPACT THEIR WORLD VIEWS	35
4.15	RESPONDENTS' POLITICAL ACTIVISM AFTER USING INSTAGRAM	36
4.16	RESPONDENTS ATTITUDINAL CHANGE ON FRIENDSHIPS OUTSIDE IDEOLOGICAL ACCEPTANCE	36
4.17	RESPONDENTS TAKE ON INSTAGRAM AND FREE SPEECH	37

## LIST OF TABLES

<b>Sl.no</b>	<b>TABLE</b>	<b>Page.no</b>
4.1	AGE OF RESPONDENTS	23
4.2	ANNUAL INCOME OF RESPONDENTS	26
4.3	RESPONDENTS APP USAGE SINCE INCEPTION	27

**CHAPTER – 1**  
**INTRODUCTION**

# **CHAPTER -1**

## **INTRODUCTION**

*Whenever you increase surveillance of individuals, you must simultaneously increase surveillance of government and corporations.*

- Yuval Noah Harari

The most characteristic feature that distinguishes our times may be dedicated towards technological innovation and it's increasing saturation in society and every-day life. If one were to observe the course of human history, it would be undeniable that technology was never an end to itself. It was and always will be a mean to ideological and economic imperatives. So, even though technology is neutral by nature and helps weave the fabric of society with opportunities once unimaginable, it poses threats. Veiled threats. These threats are especially to be addressed in world that pushes itself to technological digitalization in the name of development and progress.

In an attempt to contribute to the narratives that overhaul people's rightful use of the internet and their digital footprint, this paper endeavors the impact surveillance capitalism holds on young adults in Kochi.

### **1. WHAT IS SURVEILLANCE CAPITALISM**

The neology of the term 'Surveillance Capitalism' dates only back to 2014, when Shoshanna Zuboff, American author, Harvard professor, social psychologist, philosopher, and scholar, first delved into this new economic order in her essay, "A Digital Declaration" published in the Frankfurter Allgemeine Zeitung.

A complete critique of her grounded theory and its consequences for twenty-first century technology and society has been thoroughly elucidated in her work *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*, 2019.

Surveillance Capitalism has been attributed eight definitions as follows:

1. A new economic order that claims human experience as free raw material for hidden commercial practices of extraction, prediction, and sales; 2. A parasitic economic logic in which the production of goods and services is subordinated to a new global architecture of behavioral modification; 3. A rogue mutation of capitalism marked by concentration of wealth, knowledge

and power unprecedented in human history; 4. The foundational framework of a surveillance economy; 5. As significant a threat to human nature in the 21st century as industrial capitalism was to the natural world in the nineteenth and twentieth; 6. The origin of a new instrumentarian power that asserts dominance over society and presents startling challenges to market democracy; 7. A movement that aims to impose a new collective order based on total certainty; 8. An expropriation of critical human rights that is best understood as a coup from above : an overthrow of the people's sovereignty. (Zuboff, 2019)

By these definitions it is congruent to call surveillance capitalism as an unprecedented and unique form of economic order that unilaterally claims human experiences as free raw material for translation into behavioural data. The data collected are not just used for service improvement but the rest of the data or behavioural surplus are fed into advanced manufacturing processes known as machine intelligence that fabricate prediction products. These prediction products anticipate your actions thereby creating a marketplace that trades on future behaviour. The 20th century saw the rise of Industrial Capitalism whose 'original sin' was the accumulation of capital from labour. At its core it revives Marx's old image of capitalism but instead of feeding on labour, it feeds on every aspect of human experience. Thus, Surveillance Capitalism characterizes a rather post Marxist critique.

Technological development and ever competitive market dynamics have driven surveillance capitalists to acquire ever more predictive sources of behavioural surplus with respect to things as personal as emotions, feelings, or personalities. This is concerning as competitive pressures have led automated machine processes to nudge, coax and herd behaviour purely towards profitable outcomes.

## **1.2 THE ORIGIN OF SURVEILLANCE CAPITALISM**

The grounded theory of Surveillance Capitalism as described in *The Age of Surveillance Capitalism* traces the roots to this phenomenon back to the warehouses of user data stored (rather uselessly) in Google during the early 2000s. As the company tried to boost its ad relevance by relying and repurposing its growing cache of behavioral data, this digital data became one of the most priced commodities – a tipping point where Google's revenue increased by about 4000%. Surveillance capitalism originates in this act of digital dispossession, operationalized in the rendition of human experience as behavioral data. Thus, as articulated by Zuboff, Google launched an unprecedented market operation into unmapped spaces on the internet akin to an invasive species in a new landscape.

Zuboff (2019) found that the second modernity's individualism and neoliberalism was the key moment in history triggering a socio-political turmoil which allowed surveillance capitalists to exploit the vulnerabilities of the modern citizens. It did so by establishing close ties with the government of the US, lobbying congress and creating relationships with US presidents to protect it's ways from the federal regulations of the state.

However, it is concerning to note that surveillance capitalism has become the default business model for most internet-based businesses. Seeping from big companies like Google, Meta or Amazon, it now extends to finance, retail, insurance, etc and other offline spaces like a conversation with family members.

### **1.3 THE WORKINGS OF SURVEILLANCE CAPITALISM**

The conceptual roots of the modification of behaviour as seen in surveillance capitalism takes root from the 70s, when science helped manipulate behaviour during the Cold War as ideological anxieties of communism spurred from the East. However, by 1971, public concerns were raised which allowed the Constitutional Rights Subcommittee to address public concerns to protect privacy and independent thought.

The surveillance economy that we all reside in began with an extraction architecture. Here, the user's behavioural data was collected systematically and unethically by corporations as they saturated into the lives of people through their internet services, smart phones, facial recognition technologies, etc. Advanced technology, better understanding of biology, psychology, etc. led to the accumulation of more data than ever before to a point where machine intelligence was able to identify complex things like human emotions before people recognized this themselves. It then, moved towards an execution architecture or 'economy of action' which directly aimed at individual autonomy by systematically replacing self-determining action with hidden operations designed to shape behaviours of people. This directly impacted people's choices and intervened people's life. This way, by shaping the behavior of people, it guaranteed outcomes allowing profit-oriented corporations to make the future for the sake of predicting it. In this second imperative So, corporations now didn't work towards improving their performance but instead tried to guarantee its outcomes or people's behavior. In other words, like industrial capitalism which focused on the intensification of means of production, surveillance capitalists are locked in the cycle of continuous intensification of means of behavioural modification.

Zuboff (2019) also introduces the concept of "uncontract" which is a contractual mode of agreement that relies purely on automation and not human relationship spearheaded by Google's

Chief Economist Hal Varian as surveillance capitalism seeps into private lives through ubiquitous computing, acts of rendition and behavioural modification. She emphasises “economies of Depth” while focusing on the concept of rendition where everyday objects like ovens, toothbrush, or lightbulbs on the pretext of being “smart” exert power by turning in their profitable data from these. She claims that the supposedly anonymous metadata will be cross- references with public information like zip code or birthdays and thereby de-anonymise it. These economies of depth also follow personalisation which on the forefront appear as a boon but they only secure streams of behavioural data surplus.

These economies of action that nudge and coax building off of ubiquitous computing first begins by tuning. They occur through messages or websites that are specifically designed to elicit patterns of behaviour. Tuning is followed by herding through controlling the environment and finally through conditioning where a stimulus initiates desired behaviour.

#### **1.4 SOCIAL REPURCUSSIONS OF SURVEILLANCE CAPITALISM**

Zuboff ( 2019) arrogates that the colonisation of the 18<sup>th</sup> and 19<sup>th</sup> century and the expansion of Surveillance Capitalism have similar conquest patterns to our lives and personal data i.e. the invention of legal rationale to justify an invasion of territory, declarations of claims to said territory, and the founding of a new town to legitimate the invasion and conquest.

These declarations of conquest that claims lived experience as raw materials free to be taken, translating then to behavioural data, owning this data, unilaterally deciding it’s interpretation, and how to use the knowledge gained from this interpretation and finally the taking the steps required to maintain it’s survival all create unbalanced concentration of knowledge and power in society. This is by far the most alarming consequence as only certain individuals know bodies of information, authorise its access and determines who knows what. And so, it is congruent to say that the 21<sup>st</sup> century is faced with an unprecedented and unimaginable division of power and knowledge which society at present has no laws or means to stop.

## **1.5. UNDERSTANDING THE INSTRUMENTARIAN POWER OF SURVEILLANCE CAPITALISM**

The historical forces of totalitarianism and radical behaviourism has contributed to the construction of surveillance capitalism whose ideological power has enforced a certain kind of instrumentarianism. This is a form of control slightly different from totalitarianism. Here, the mode of control is behavioural modification unlike that of violence or coercion used by totalitarianism.

Instrumentarianism relies on the “Big Other” to monitors and datifies every individual’s behaviour, where Big Other used B.F Skinner’s analogy of radical behaviourism. Its control is masked and not recognised readily as control is subtle, omnipresent and not violent on the surface.

It is characteristic of surveillance capitalism to feign the mask of progress and lead it’s ulterior motifs without being questioned unlike new laws and regulations that come to being which people can readily critique with time. Another difference to be noted here is also that unlike laws, policies or regulations that are put into effect after its announcement, surveillance capitalism always passes it’s action first and then feigns it’s mask of progress.

**CHAPTER – 2**  
**REVIEW OF LITERATURE**

## **CHAPTER – 2**

### **REVIEW OF LITERATURE**

#### **INTRODUCTION**

A literature review is a “critical analysis of a segment of a published body of knowledge through summary, classification, and comparison of prior research studies, reviews of literature, and theoretical articles” (University of Wisconsin Writing Centre, 2020). By doing a literature review, the researcher gets more ideas about various aspects of their study.

The canonical text on surveillance capitalism was released very recently in 2019 by Prof. Shoshanna Zuboff titled “The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power.” The work details the development of digital companies and proves how their business models represent a new form of capitalism that trades in human futures. It is a qualitative work paying close attention to interviews, speeches, conferences, company programs and policies etc. to understand the new capitalist orders’ infrastructure. The book is detailed in three parts comprehending the foundations, advances, and the instrumentarian power of surveillance capitalism.

Cinnamon, Jonathan (2017) in their paper “Social Injustice in Surveillance Capitalism” shows how the practises of surveillance capitalism threatens social justice and social participation in the parity of social life, based on Nancy Frazer’s theory of ‘abnormal justice’ to show how accumulation of personal data of people by corporations is a form of economic injustice of maldistribution. The paper addresses the socio-cultural misrecognition, political misrepresentation, etc caused by algorithmically processed data subjected to categorization. It continues by pointing out the need for conceptual development of the threats of dataveillance as well as empirical research that exposes further examples of unjust data practices occurring within the broader assemblage of state and corporate surveillance. The paper also calls for research that would seek to ascertain the conditions necessary to recast personal data as a force for advancing social equality rather than injustice.

Graham, Stephen; Wood, David (2003) in their paper “Digitizing Surveillance: Categorization, Space, Inequality critiques surveillance and society and its Social Implications” through the emerging surveillance practices surrounding surround digital techniques and

technologies. It comprehensively explores the nature of digital surveillance, political economies of cities and urban societies and digitisation within the context of privatization, liberalization and social polarization, and the policy and research implications due to the spread of digital surveillance.

Nurik, Chloe Lynn (2022) in their paper “Facebook and the Surveillance Assemblage: Policing Black Lives Matter Activists & Suppressing Dissent” uses empirical data address the role of third parties and provide insights into the opaque of surveillance on social media by intertwining private policing, surveillance studies, and social movements literature. It outlines the “social media surveillance assemblage”(Trottier 2011:63) on Facebook, including its deployment against social activists.

Kim, Mun-Cho (2004) in their work “Surveillance Technology, Privacy and Social Control” explains how through South Korea’s digital National Identification Card has led to threaten the increasing dependence on sophisticated, more unobtrusive, and thus less illegal surveillance technologies which ultimately chart the classical perspectives from the shift of control from overt and abusive to covert and pseudo self-controlling. It thus, describes how technologies alter the social order.

Andrew, J., Baker, M. (2021) “The General Data Protection Regulation in the Age of Surveillance Capitalism” in their book studies the social costs that accompany the collection of Big Data as it records and analyses clicks, comments, transactions, and physical movements. This study tries to delineate the issues that come with and surveillance by presenting them as in tension with one another. By considering the European Union’s General Data Protection Regulation (GDPR) it postulates that controlling Big Data could create more trade-off of risks than an overall improvement in data protection. Showing that the GDPR is a new ‘gold standard’ of cyber-laws the work advocates anonymization and pseudonymization, while representing effective counter measures to privacy concerns, also incentivize the use, collection, and trade of behavioral and other forms of de-identified data. It inturn considers the legal status of ownerless forms of data which show data protection techniques anonymization and pseudonymization raising concerns over who owns behavioral data, and its usage in the large-scale modification choices made both on and offline by people.

Linder, Thomas (2019) work titled “Surveillance Capitalism and Platform Policing: The Surveillant Assemblage-as-a-Service” is based on empirical research on training webinars, interviews, and promotional material from Vigilant Solutions. The work investigates the

surveillance regime enabled by platform policing such as the implementation of cloud-based platforms which are designed and run by private corporations providing mass surveillance-driven simulations for a range of police operations like predictive policing, targeted surveillance, and tactical and strategic governance, etc. It builds on Amoore's (2016) work on "cloud geographies," to argue that the platform model embodied by Vigilant Solutions involves multivalent processes of de- and reterritorialization where new technological and datalogical spaces are formed and these erode older societal boundaries of private, public, and state. It is very specific that the Vigilant Solutions leverages its multi-sided platform business model through the deterritorializing, cloud-based concatenations of surveillant technologies. The paper moves on to argue that the resultant reterritorialized cloud space, which is accessible through its Vigilant Investigative Centre (VIC) platform incidentally fuses mass surveillance data from diverse private, public, and state sources in a simulated geography. Moving on, the VIC furnishes to law enforcement an array of data analytics which will exploits this cloud geography to enable a boundary-crossing surveillance regime of association analysis and proximal suspicion.

Sangiovanni, Andrea (2019) in their work "Democratic Control of Information in the Age of Surveillance Capitalism" uses Carol Gould's article and accesses three claims she makes namely (1) democratic control is required by the all-affected principle; (2) democratic control is a means of ensuring that surveillance corporations and governments track public, rather than merely private, interests; and (3) democratic control is constitutive of freedom as self-development and self-transformation. The article is an argument against the insufficiency of informed consent in surveillance capitalism

Nikhil Venkatesh; (2021) paper "Surveillance Capitalism: a Marx-inspired account Philosophy" analyses the relations between industrial capitalists and workers who are closely analogous to the relations between surveillance capitalists and users. By describing the three problematic aspects of industrial capitalism in Marxist philosophy that is – alienation, exploitation and accumulation, the paper shows its newform incarnation in surveillance capitalism drawing from Zuboff's work to make these parallels but only differs over the nature of the exchange between users and surveillance capitalists. Zuboff akin surveillance capitalism to robbery or the gathering of raw materials which on the Marx-inspired account may qualify as a voluntary sale. By picking up this difference the paper shows the important implications for the question on how to resist surveillance capitalism.

Gidaris, Constantine (2019) paper "Surveillance Capitalism, Datafication, and Unwaged Labour: The Rise of Wearable Fitness Devices and Interactive Life Insurance" explores the

relationship that interactive life insurance companies and their policyholders share with each other. It understands how wearable fitness devices are deployed by these companies as data-generating surveillance technologies and their agenda isn't necessarily the personal health of their clients. The work expands on the framework of "surveillance capitalism" (Zuboff 2015) and argues that while the notion of self-care generally associated with wearable fitness devices is underpinned by neoliberal constructs its incentivization of interactive life insurance programs works to stop the immense value placed on information capital. This paper also pays heed to the legal loopholes that enables the harvesting of sensitive health and fitness from these devices. It suggests that the push toward fitness trackers has little to do with any real concerns for the health and fitness of consumers and policyholders. The paper ends with the consideration of different forms of unwaged labour in the relationship between policyholders and interactive life insurance programs contending that policyholders do not recognise the free and immaterial labour that goes into sustaining the data-based business model which interactive life insurance companies and social media platforms use and rely on for profit. The work also shows that by doing so they relinquish power and control over the data they work to produce only so the collected data is used against the clients.

Turner, Fred (2018) work "The arts at Facebook: An aesthetic infrastructure for Surveillance Capitalism" discusses how Facebook has maintained two internal organizations to commission and create artworks for Facebook offices around the globe from the last decade. The paper maps these enterprises, organizational practices, as well as the aesthetics promoted by them. It then builds on recent work in the critical sociology of capitalism to argue two cases such that: one, the ways Facebook works with the arts marks a radical departure from traditional, industrial-era corporate collecting practices; and two, that Facebook's arts initiatives mirror and help legitimate profit-seeking techniques particular to social media. In conclusion, these features give a glimpse of the ways in which surveillance-based for-profit media such as Facebook are create new relationships between the arts, the corporation, and the people.

Paul-Olivier Dehaye;Joel Reardon; (2020) in their work " Proximity Tracing in an Ecosystem of Surveillance Capitalism " traces the apps that propose as an aid to help deal the COVID-19 crisis when in actuality some of those apps leverage attenuation of Bluetooth beacons from mobile devices in order to build a record of proximate encounters between a pair of device owners. These underlying protocols suffer from false positive and re-identification attacks. The paper evidences that attacker's difficulty in mounting such attacks are overestimated and that an attacker leveraging a moderately successful app or SDK with Bluetooth can access, eavesdrop and

interfere with these proximity tracing systems at no hardware cost while performing these attacks against users who do not have this app or SDK installed. It cites concrete examples of actors who would be in a good position to execute such attacks and presents a novel attack called biosurveillance attack, where the attacker monitors the exposure risk of a smartphone user who installs their app or SDK but does not use any contact tracing system and may falsely believe they have opted out of the system. With the help of traffic auditing by using an instrumented testbed the paper characterises precisely the behaviour of one such SDK that we found in a handful of apps—but installed on more than one hundred million mobile devices. These behaviours on the surface seem indistinguishable from a re-identification or biosurveillance attack but are capable of executing a false positive attack with minimal effort. The discussions continue on how easily an attacker could acquire a position conducive to such attacks, by leveraging the lax logic for granting permissions to apps in the Android framework that is any app with some geolocation permission could acquire the necessary Bluetooth permission through an upgrade, without any additional user prompt. The paper concludes by understanding the motifs behind these attacks.

Holloway, Donell (2019) in their work “Surveillance capitalism and children’s data: the Internet of toys and things for children” discusses the positioning of children both as objects of economic activity as and subjects of market relations under the new order of surveillance capitalism. It briebs at the history of children’s engagement with the market economy through their engagement in the labour force during industrial revolution times and their disappearance from direct economic activity during the Romantic Movement. It then traces their emergence as both data sources and data consumers within the new big data economy. The case argued here since the late 19th and early 20th centuries due to labour law reforms children weren’t part of the force but now their activities are of significant economic value with the emergence of Internet-connected toys and as theysignificantly amplify children’s position as data sources under surveillance capitalism.

## **THEORETICAL FRAMEWORK**

The present research draws on the conceptual framework of theories such as Weber's 'Economic Orientation', Knowledge and Power by Foucault, Network Society by Castells and Post-Marxism.

### **ECONOMIC ORIENTATION**

Zuboff (2019) has clearly distinguished between technology and Surveillance Capitalism in an effort to erase the latter. She demarks the confusion it has held onto commoners and the guise put forth by Surveillance Capitalists in order to shield and proliferate the impudent new economic order. Her work shows how this new economic order only imbues technology and commands it into action, and that surveillance capitalism is only a logic in action.

This finding is established by the bearings of Weber's "economic orientation". Weber claims that economic ends are always intrinsic to both the deployment as well as the development of technology. This means that technology is not an end in itself but always a reflection of the objectives held forth by social and economic detriments. He notes how the modern society is so largely oriented economically to profit-making that is it one of the most fundamental facet in the history of technology itself.

A classic example stated in the text about the so called inevitabilism that bewilders the public by conflating commercial imperatives to technological necessity was when Eric Schmidt, CEO of Google in 2009 defended how the search engine maintained the user's search engine history arguing it was a technological clause and not an end in itself, thereby camouflaging the practises of Surveillance Capitalism in the name of technology.

### **KNOWLEDGE AND POWER**

Foucault was an epistemological constructivist and historicist who argued that power and knowledge are inextricably linked to the point where it doesn't make sense to speak of one without the other. As knowledge takes place within a vast system of power relations, Foucault was critical of the idea if people could attain "absolute" knowledge about the world as he realised absolute knowledge was historically contingent. Thus, power bases itself on knowledge by making use of it and reproducing it by shaping it in accordance with its intentions. Thereby allowing power to recreate its own fields of exercise through knowledge.

The modern world uses Big-data in its information civilisation as means to generate knowledge and power making information processed and capitalised by global corporations transforming it to economic power. Surveillance capitalists have succeeded to amass world-historic concentration of power and knowledge. They achieve dominance through the axial principle of social order in an information civilisation that is the division of learning in society. This concerning as it is an unprecedented process that we are yet to know about it's yielding dangers.

### **NETWORK SOCIETY**

Network society understands the social ramifications caused by the interlinking of globalisation and the role of electronic communications and technology in society. Manuel Castells (2004), the concept's leading theorist, defines a network society as "a society whose social structure is made up of networks powered by micro-electronics-based information and communication technologies." His work demonstrates how social networks have always existed; however, the network culture is distinguished by the use of ICTs to help build and maintain far-flung networks in which new kinds of social relations will emerge. This enables to form economic, social, and political relationships which aren't constrained by time - or, in other words, by our spatial position. Varied social relations, traditions, and community exist in separate spaces now adhere to the most influential standards where people can connect people without having the personal interaction and by the use of global net of mass media, internet and computers in a globalizing society. Here, they are becoming less and less connected by a common history and mutual face-to-face relationships. 'Contact' is determines by this shift in the social meaning of place is interpreted.

It is important to understanding how ICTs are used for growth. Comprehending the difference between passive and empowering communication allows what opponents of globalisation see as an intrusive force for cultural homogenization which fosters standardization of powerful technological, commercial, and cultural forces emanating from centres of power and control determining what information and knowledge is and how it is communicated. These centres sometimes have an unprecedented degree of predominance where communication is a two-way process: inflowing information is not just taken in uncritically; it is subject to local interpretation and creative applications. These two concepts are not mutually exclusive: it is not a choice between them. The tension between the efforts of some networks to enforce their ideals and priorities and the efforts of others to resist their dominance is one of the most powerful forces for

change and growth in the network society. Being social media app users youngsters use Information and Communication Technology (ICT) so paramount to a point where it can consider as the central pillar of their life.

### **POST-MARXISM**

Zuboff uses Marx's foundation to give a framework to her critiques of surveillance capitalism as she develops her post-marxist views. The conceptual framing of Utopia, historical materialism and even behavioural modification all encompass post Marxist themes.

Surveillance capitalism allows primitive accumulation akin to the original sin of capitalism. Reviving Marx's old image of capitalism as a vampire that feeds on labour it audaciously lays claim to private experience for translation into fungible commodities instead of claiming land, wealth, etc. as in the industrial capitalism and its market dynamic.

By superimposing means of production with the means of behavioural modification those who control it are the new hegemony with power in society. The new hegemonic class also decides every other sphere of society spanning from what may be deemed valuable, appropriate or even things like leisure and personal relationships – only in means now unimaginable with wider division of knowledge and power.

She views surveillance capitalism as a regression or a break from Marxist philosophy and the linear thought of historical materialism. This stance is held by exploring the impact of neoliberal policies accompanied by surveillance capitalism, hampering the attainment of Utopia as described by Marx.

**CHAPTER – 3**  
**METHODOLOGY**

## **CHAPTER – 3**

### **METHODOLOGY**

#### **INTRODUCTION**

Creswell (2003) portrays methodology as a coherent group of methods that harmonize one another and that have the capability to fit to deliver data and findings that will reflect the research question and suits the researcher's purpose. Methodology defines "a contextual structure" for the study as a coherent and logical scheme based on attitudes, opinions, and values that directs researchers' decisions and is regarded as a critical component because it can be used not only to show its relevance, but also to propose better ideas on the same subject to the same researcher and other scholars in the future. The methodology section thus assists in the upgrading and updating of the subject at hand. It should be carried out in an analytical and systemic manner. This chapter contains information regarding the statement of the problem, general and specific objectives, concepts and their theoretical and operational definition, Independent and dependent variables, the universe, sampling method, sample size, research design, tools for data collection.

#### **STATEMENT OF THE PROBLEM**

Surveillance capitalism is the new economic order which severely impacts all spheres of life unseen before. Although first guised as a technological boon, it predicts, commodifies, controls and manipulates human behaviour for profit. It directly impacts autonomy, free will and democracy. This study attempts to understand the impact it can have on college students through the social media app, Instagram.

#### **OBJECTIVES**

The purpose of this study was to accomplish the following objectives:

## **GENERAL OBJECTIVE**

To study the impact of surveillance capitalism on college students through Instagram

## **SPECIFIC OBJECTIVE**

1. To understand the socio - economic profile of the respondents.
2. To study the impact of surveillance capitalism's privacy on respondents.
3. To study the extent of the level of awareness about surveillance capitalism
4. To study the impact of surveillance capitalism on Behavioral Modification with respect to political views
5. To study the impact of surveillance capitalism on free speech.

## **THEORETICAL DEFINITION**

- **Surveillance Capitalism**

It is the new pervasive mode of capitalism of the present society where human behavioral data is commodified instead of capital from labour in new markets that trade in human futures. It thereby severely impacts society accompanied by huge disparities of knowledge and power.

- **Instagram**

It is a social media app of parent company Meta used to share photos or videos both publicly and privately. This app, also enables news channels, artists, or businesses to advertise or show their services.

## **OPERATIONAL DEFINITION**

- **College students**

Here, college students refer to students of the age 18-29, studying in a UGC recognized institution.

## **IDENTIFICATION OF VARIABLES**

A variable is defined as an attribute of an object of study

### **INDEPENDENT VARIABLE**

The independent variable is the variable that when the researcher manipulates or changes, it is assumed to have a direct effect on the dependent variable. The following are the independent variables of the present study;

- Age
- Gender
- Religion
- Annual family income

### **DEPENDENT VARIABLE**

The dependent variable is the variable being tested and measured in an experiment and is 'dependent' on the independent variable. In this study the dependent variable is;

‘The impact of surveillance capitalism’.

## **RESEARCH DESIGN**

According to Suchman, “Research design is not a highly specific plan to be followed without deviation, but rather series of guidepost to keep one headed in right direction”. In the present study, the descriptive research design is used to provide an understanding of the impact of surveillance capitalism on college students in Kochi.

## **UNIVERSE**

The term "universe" (population) in statistics refers to a sum of all items for which data is sought. In this study the universe includes, the college students between the age group 18 to 29 who are using the social media app Instagram in Kochi.

## **SAMPLE SIZE AND METHOD OF SAMPLING**

The number of participants used in a study is referred to as sample size. Here, a sample size of hundred respondents were selected using simple random sampling method.

## **TOOLS FOR DATA COLLECTION**

For data collection and analysis, a number of methodologies may be used. The majority of them are designed around a collection of fundamental resources. Interviews, focus group discussions, evaluation, photography, questionnaires, and case studies are some of the approaches used.

So, the present study uses Questionnaire method by using ‘Google forms’ is used as a tool for data collection, process of collection of data was conducted during the month of February; hence the results are easy and accurate to find the result from the researcher’s point of view.

**CHAPTER – 4**  
**ANALYSIS AND INTERPRETATION**

## **CHAPTER 4**

### **ANALYSIS AND INTERPRETATION**

Data analysis and interpretation is one of the most important aspects of research. This chapter explains how the collected data are used to accomplish the objectives. Data analysis is essential to the development of any research project. The information was gathered from hundred college students residing in Kochi from the age 18-29. The following chapter provides a systematic and thorough study of respondent data on different parameters.

The subparts include:

- To understand the socio - economic profile of the respondents.
- To study the impact of surveillance capitalism's privacy on respondents.
- To study the extent of the level of awareness about surveillance capitalism
- To study the impact of surveillance capitalism on Behavioral Modification with respect to political views
- To study the impact of surveillance capitalism on free speech.

## **SOCIO ECONOMIC PARAMETERS**

The first part brings the socioeconomic data of the respondents. Income, employment, education, age, and other social supports, among many other things, can have a significant impact on how well we live.

These variables play an important role in sociological surveys because they influence our ability to make life decisions, interact with others, and so on.

### **4.1 TABLE SHOWING THE AGE OF RESPONDENTS OUT OF 100 OBSERVATIONS**

<b>AGE RANGE</b>	<b>MALE</b>	<b>FEMALE</b>	<b>NON-BINARY</b>	<b>PERCENTAGE</b>
<b>18-20</b>	<b>6</b>	<b>23</b>	<b>1</b>	<b>30%</b>
<b>21-23</b>	<b>13</b>	<b>51</b>	<b>1</b>	<b>65%</b>
<b>24-26</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>3%</b>
<b>27-29</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2%</b>
<b>Total</b>	<b>22</b>	<b>76</b>	<b>2</b>	<b>100</b>

Table 4.1 reveals the majority of the respondents fall in the age range of 21-23 and then 18-20. As compared to these two class intervals, 24-26 and 27-29 age groups have fewer respondents. Out of the total respondents, 65% of the respondents fall under the age group of 18-20 years and only 2 percent fall under the age group of 27-29 years. 75% of the respondents fall under the 18-23 age group and only 5 percent lie in the 24-29 age group.

From the entire sample it was found that the maximum number of participants belonged to the age group of 21-23 years.

#### 4.1 FIGURE SHOWING THE GENDER OF RESPONDENTS OUT OF 100 OBSERVATIONS

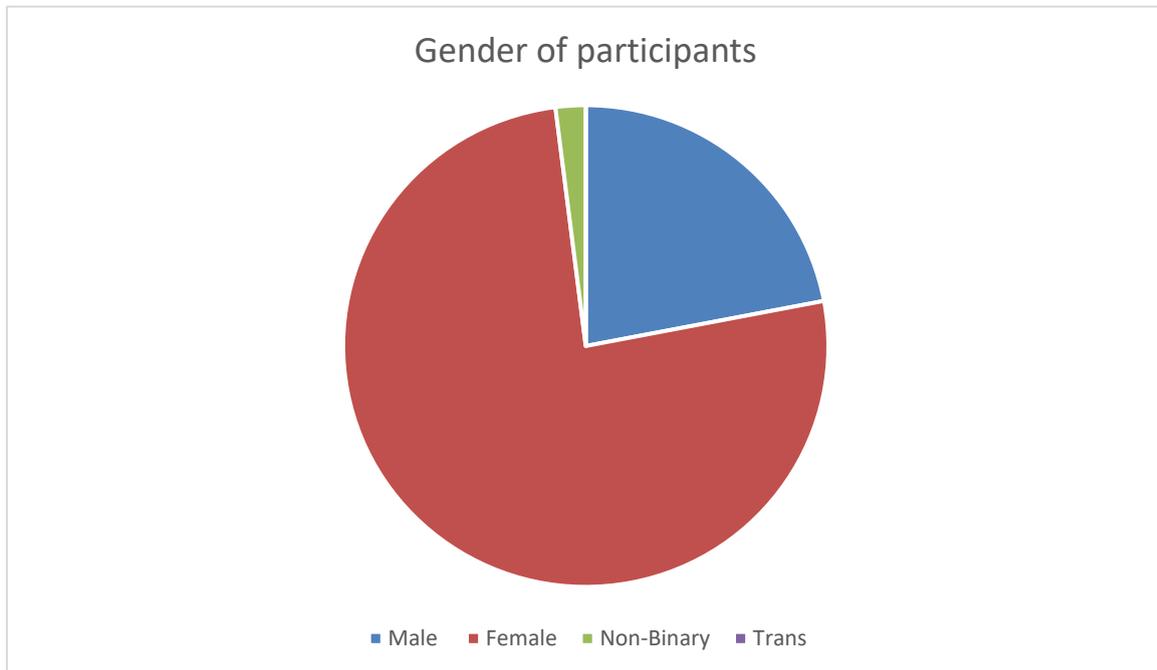
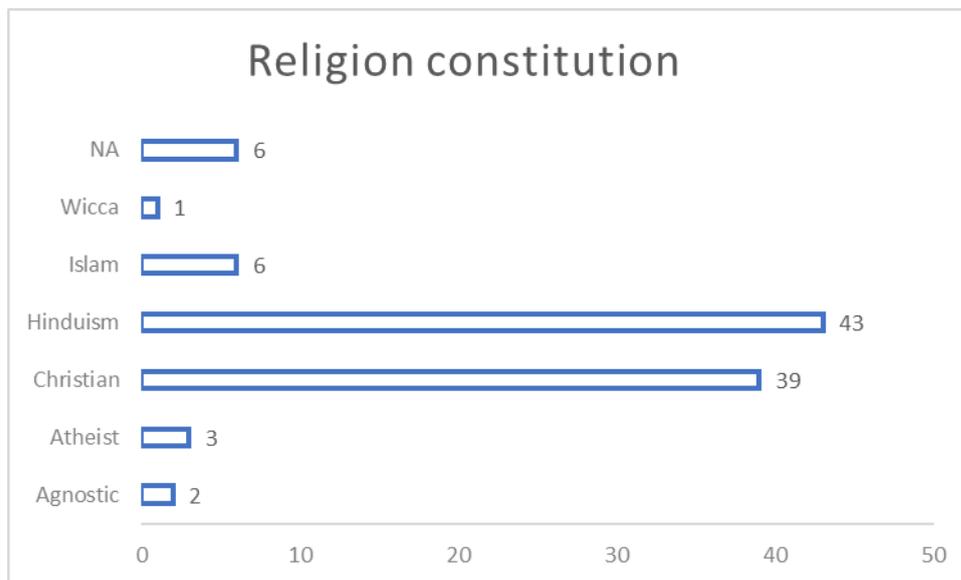


Figure 4.1 reveals that majority of the participants were female with about 76% participation. It is only then that the male population covers the survey with about 22% participation. Although no trans- persons have participated in the survey, about 2% of the population is followed by Non-Binary persons.

## 4.2 GRAPHICAL REPRESENTATION OF RESPONDANTS RELIGION



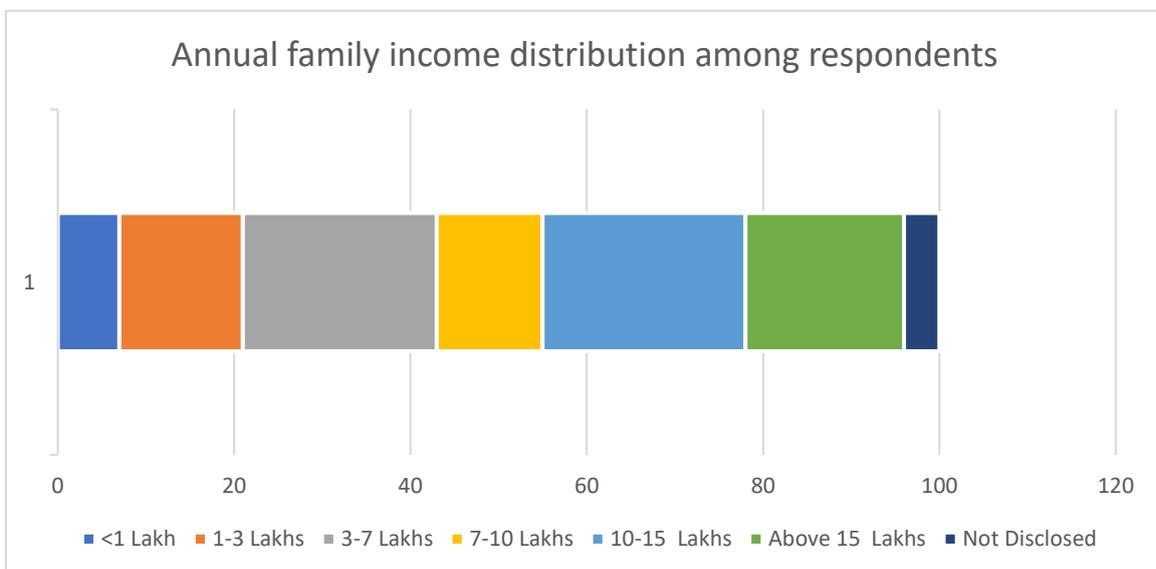
Religion is a major demographic factor and is important for future population growth trends, as well as other social indicators. The figure reveals the majority of the respondents follow Hinduism as Religion, closely followed by Christianity. It can be observed that 82 percent of the respondents follow Hinduism and Christianity. The data shows us that there are few Atheists, Agnostics and Wicca making up under 10 percent of the sample size. Islam forms a small minority of the sample population making up about 6 percent of the size. A small fraction of the respondents has chosen not to disclose their religious preferences and form about 6 percent of the sample size.

#### 4.2 TABLE REPRESENTING THE ANNUAL INCOME OF RESPONDANTS

INCOME	No: of Observations	PERCENTAGE
<1 Lakh	7	7%
1-3 Lakhs	14	14%
3-7 Lakhs	22	22%
7-10 Lakhs	12	12%
10-15 Lakhs	23	23%
Above 15 Lakhs	18	18%
Not Disclosed	4	4%
Total	100	100%

The table shows that 23% of the respondents have 10-15 lakhs as their annual income, followed by 22% of the respondents who have 3-7 lacks as their annual income. About 18% of the respondents have more than 15 lacks as their annual, and about 14% of the respondents have 1-3 lakhs as their annual income. 7% of the participants have below one lack as their annual income and the remaining 4% chose not to disclose their annual income. The data collected shows that most participants except those that disclosed their income belong to the Indian middle class

#### 4.3 GRAPHICAL REPRESENTATION OF ANNUAL INCOME OF RESPONDENTS

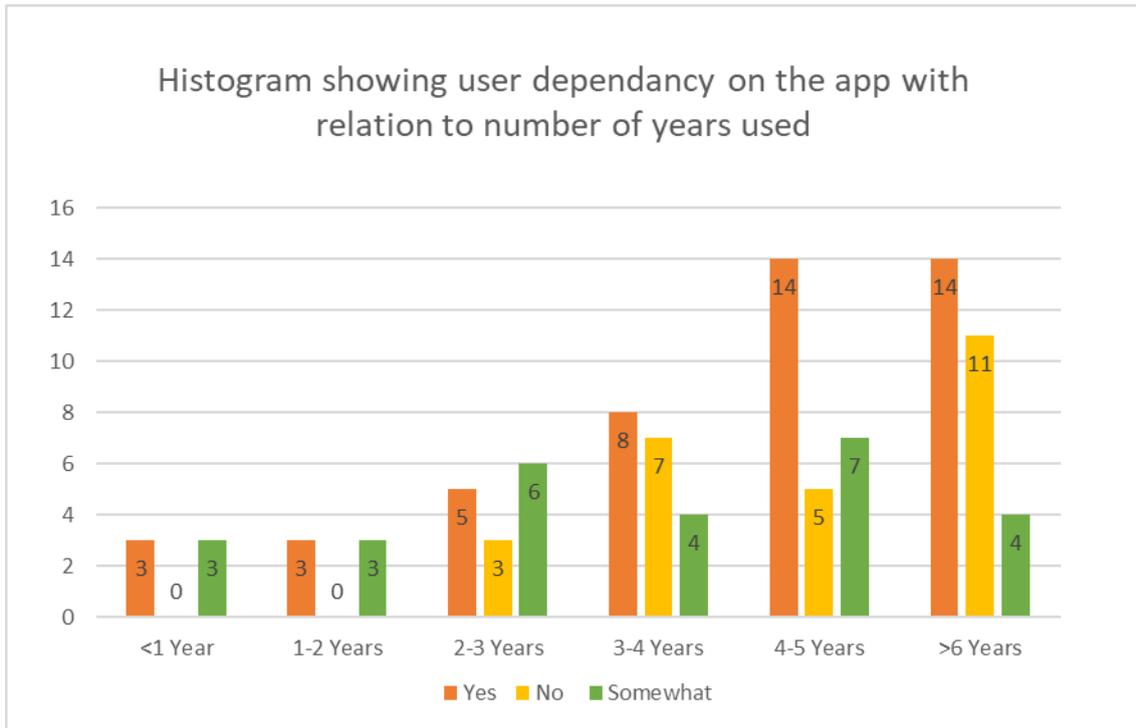


### 4.3 TABULAR REPRESENTATION OF RESPONDANTS APP USAGE SINCE INCEPTION

<b>YEAR RANGE</b>	<b>PERCENTAGE</b>
< 1 YEAR	6%
1-2 YEARS	6%
2-3 YEARS	14%
3-4 YEARS	19%
4-5 YEARS	26%
>5 YEARS	29%
<b>TOTAL</b>	100%

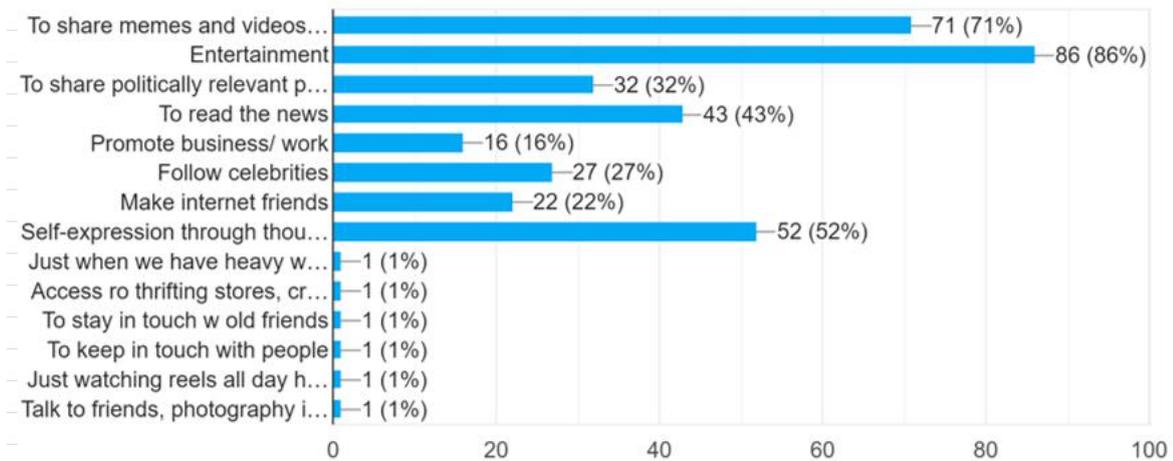
The figure shows that most participants have been using Instagram from the last five years. This data reminds us how Gen Z was a generation born into the age of surveillance capitalism. The next majority of 26% of participants have been using Instagram for the past four to five years, about 19 percent of them have been using Instagram for less than four years, 14% shows less than three years and over 12% of the participants have only been using Instagram since the pandemic.

#### 4.4 GRAPHICAL REPRESENTATION OF RESPONDANTS APP USAGE SINCE INCEPTION AND THEIR DEPENDENCY ON THE APP



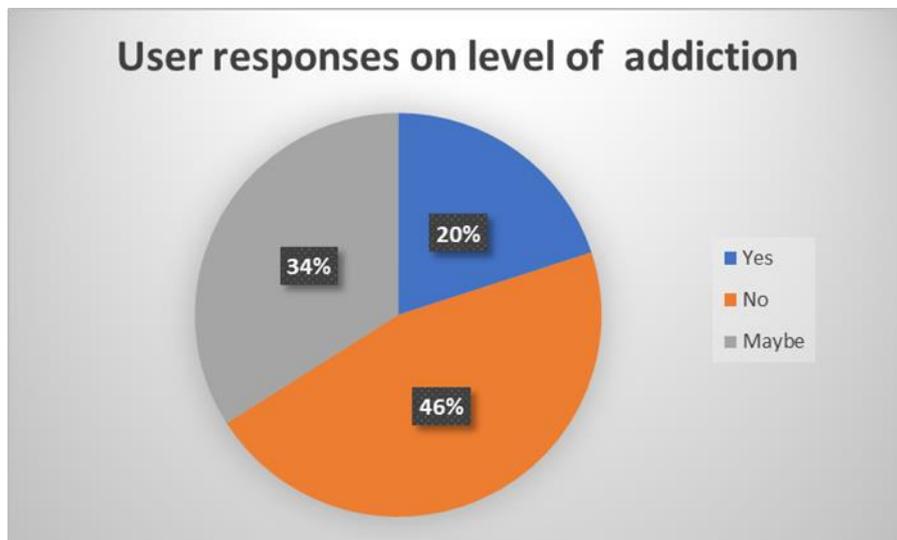
Reading the histogram shows that more the number of years a respondent has spent on the app, greater has been their dependency on it. Out of 59% of the respondents who have spent more than four years on the app more than 28% of them believe that they are dependent on the app. On the contrary, of the 12% of respondents who have spent less than two years on the app, feel that they are only somewhat dependent on the app.

#### 4.5 GRAPHICAL REPRESENTATION OF APP USAGE PURPOSE OF RESPONDENTS



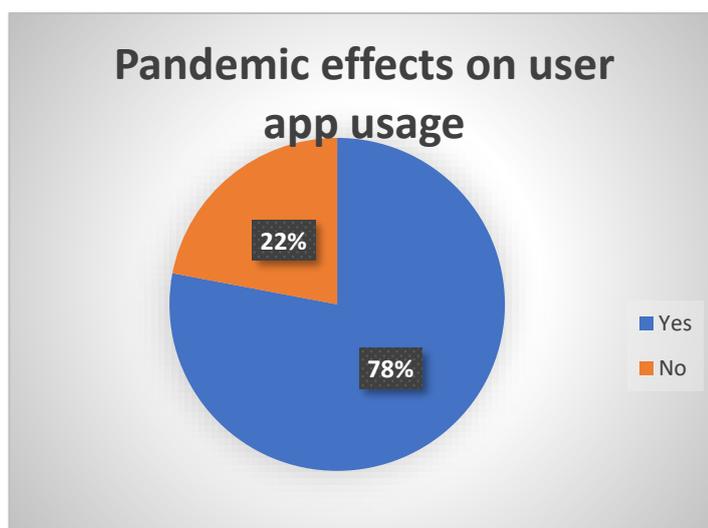
Majority of the participants in the survey use Instagram for entertainment by 86%. However, 71% alone use the app to share memes and videos and 52% use the social media app as a way of self-expression. 32% of the participants share politically relevant posts, and about 43% agree to consume news from the app. About 22% of participants agree to have made internet friends on Instagram, and only 16% use Instagram to promote their work and business. Only 1% of the respondents use Instagram to keep in touch with old friends, shop thrift, etc.

#### 4.6 GRAPHICAL REPRESENTATION OF RESPONDENT'S TAKE OF THEIR ADDICTION TO INSTAGRAM



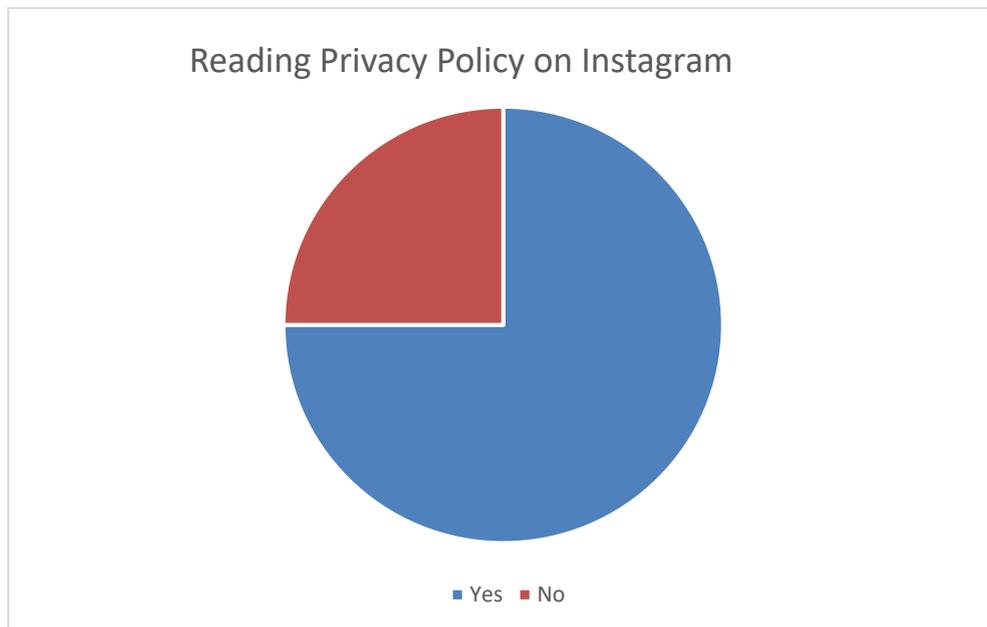
About 46% of the respondents believe that they are not addicted to Instagram. However, 20% acknowledge their addiction to the app and 34% are unsure if they may be addicted or not.

#### 4.7 GRAPHICAL REPRESENTATION OF IMPACT OF INCREASED USAGE OF INSTAGRAM DURING THE PANDEMIC



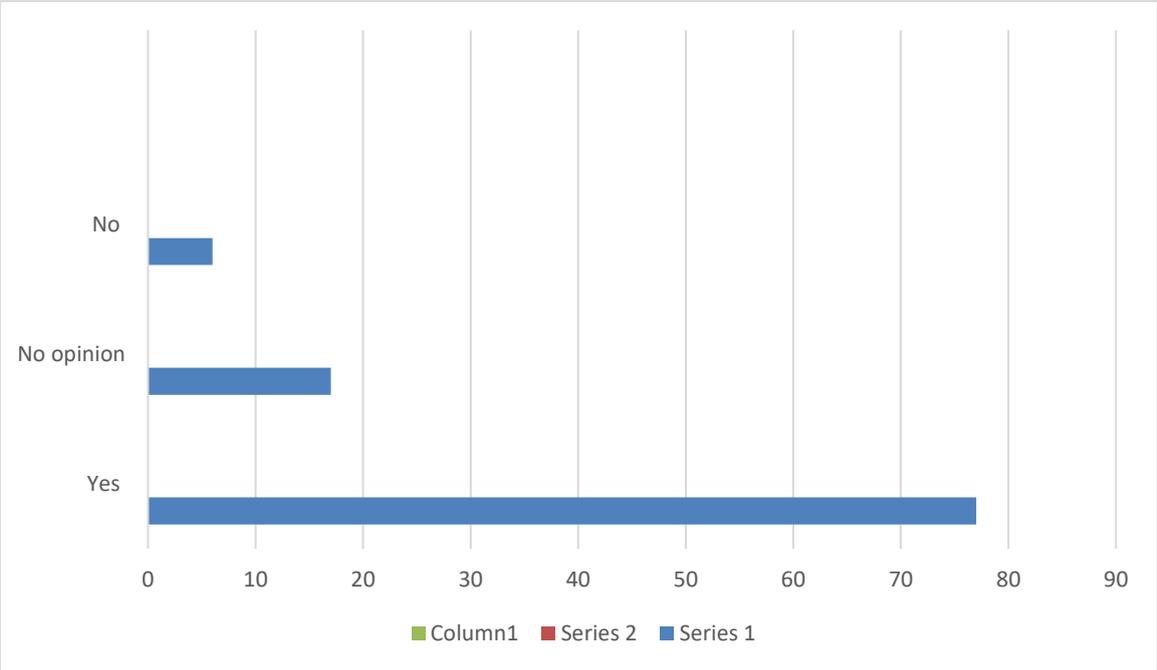
About 78% of respondents agree that they've spent more time on Instagram during the pandemic than 22% of the respondents who claim that their usage has remained the same.

#### 4.8 GRAPHICAL REPRESENTATION OF RESPONDENTS WHO READ THE PRIVACY POLICY OF INSTAGRAM



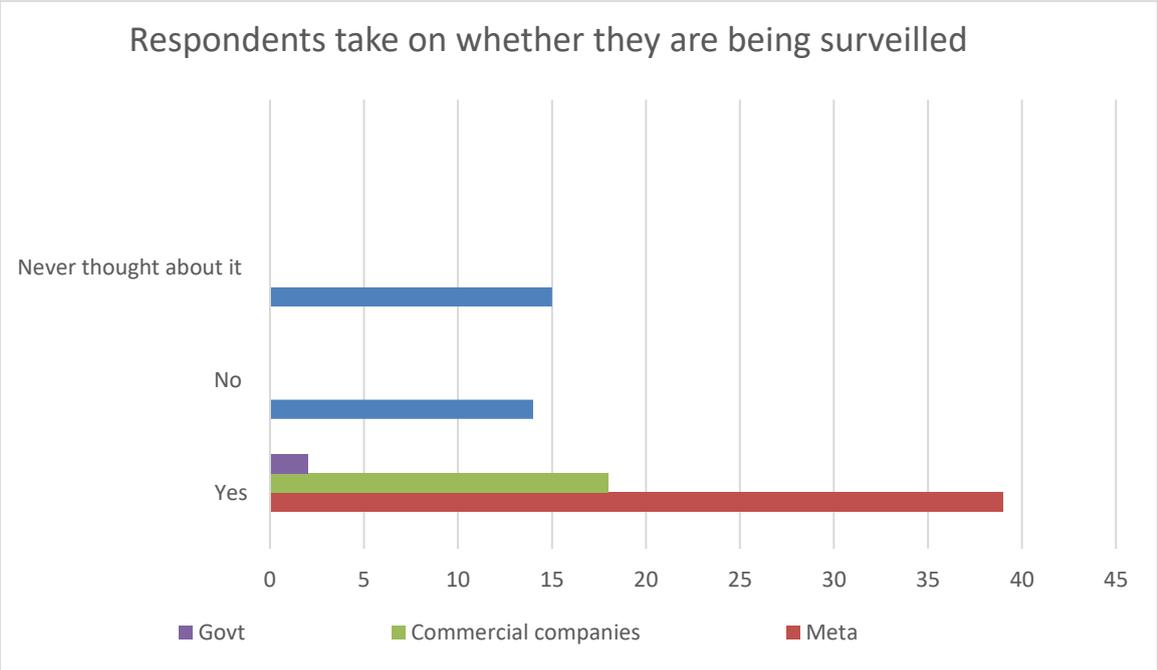
The Pie chart shows that 75% of the respondents do in fact try to read the privacy policy of the social media app before complying to the terms and conditions in order to use the app, however the other 25% are oblivious to it.

**4. 9 RESPONDENT’S OPINION ON INSTAGRAM USING LAYMEN LANGUAGE IN THEIR PRIVACY POLICY**



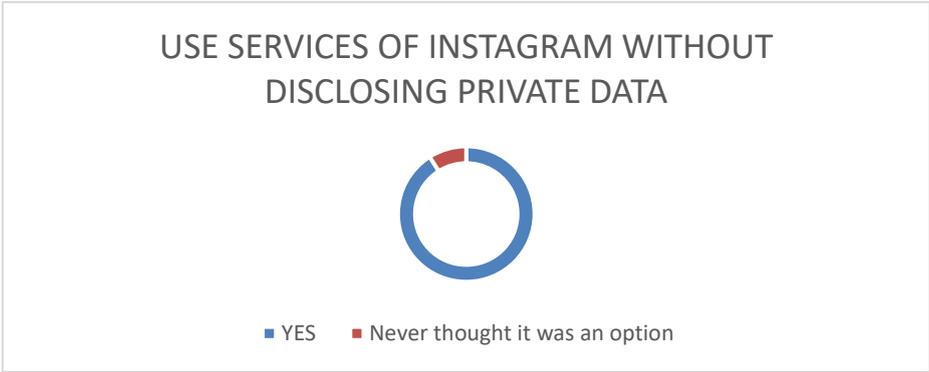
It is noted that 77% of the respondents wished that Instagram would have their privacy policy written with brevity and clarity in laymen language instead of the cumbersome lengthy read that the app currently provides. 17% of the respondents had no opinion on the following and 6% of the respondents were okay with Instagram’s current way of presenting their privacy policy.

**4.10 GRAPHICAL REPRESENTATION ON RESPONDENTS TAKE ON IF AND WHO SURVEILES THEM ON INSTAGRAM**



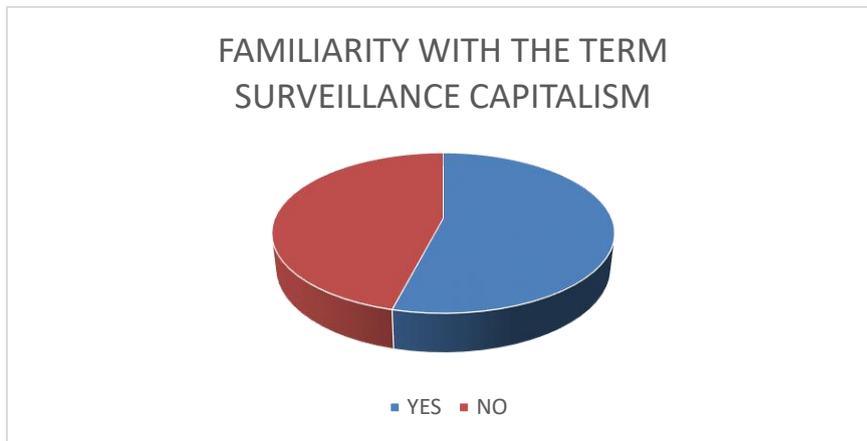
The histogram shows that 71% of the respondents do feel watched over while using Instagram, about 15% never thought about it and the remaining 14% do not in fact feel watched while using Instagram. Of the 71% respondents who feel watched 2% of them feel watched by the Govt, 18% feel watched over by commercial companies and 39% of them feel watched over by Instagram’s parent company Meta.

**4. 11 GRAPHICAL REPRESENTATION OF RESPONDENTS WISHING TO USE INSTAGRAM BY KEEPING THEIR DATA PRIVATE**

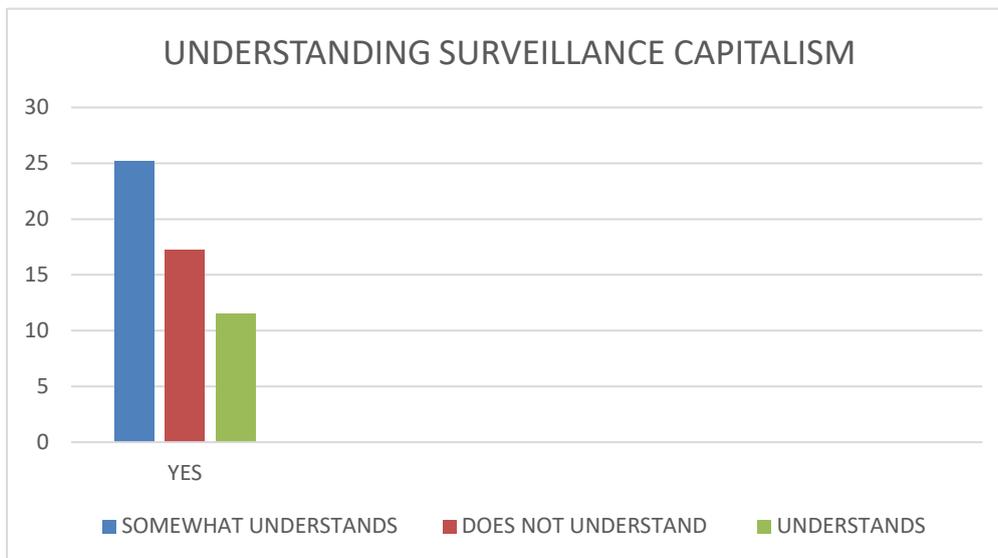


About 91% of the respondents wished that they could use the services of Instagram without compromising their privacy and private data whereas, the other 9% did not know that there was an inherent choice to actually keep their data to themselves yet enjoy the means of a social media app like Instagram.

#### 4.12 GRAPHICAL REPRESENTATION SHOWING NUMBER OF RESPONDENTS FAMILIAR WITH THE TERM SURVEILLANCE CAPITALISM

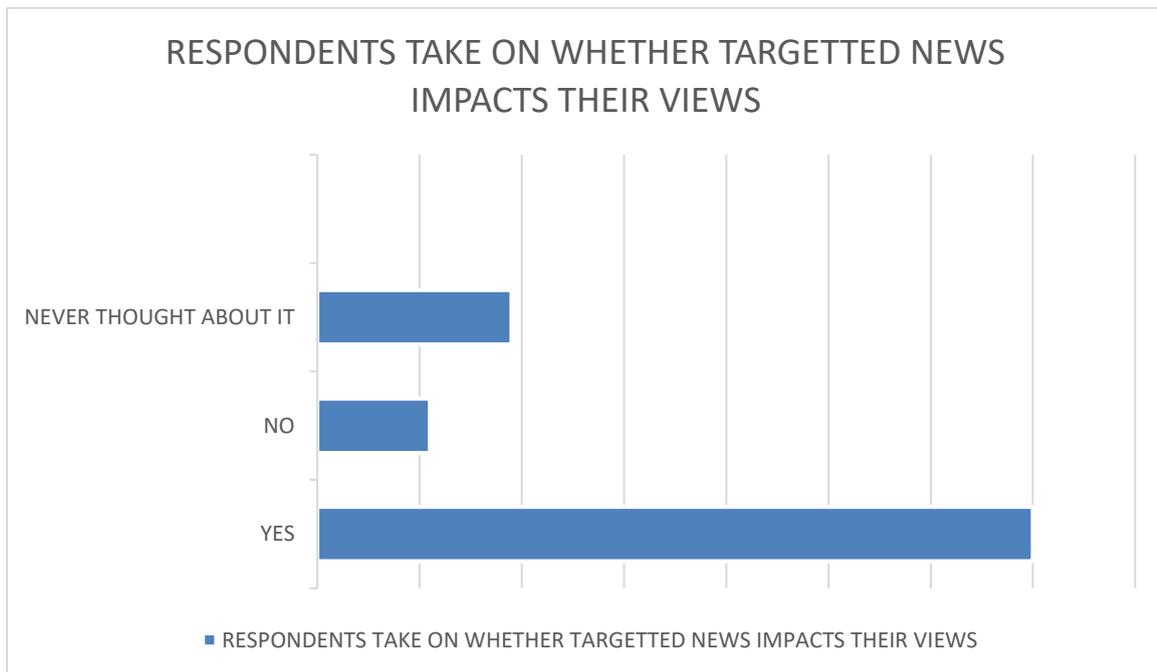


#### 4.13 GRAPHICAL REPRESENTATION RESPONDENTS UNDERSTANDING OF SURVEILLANCE CAPITALISM



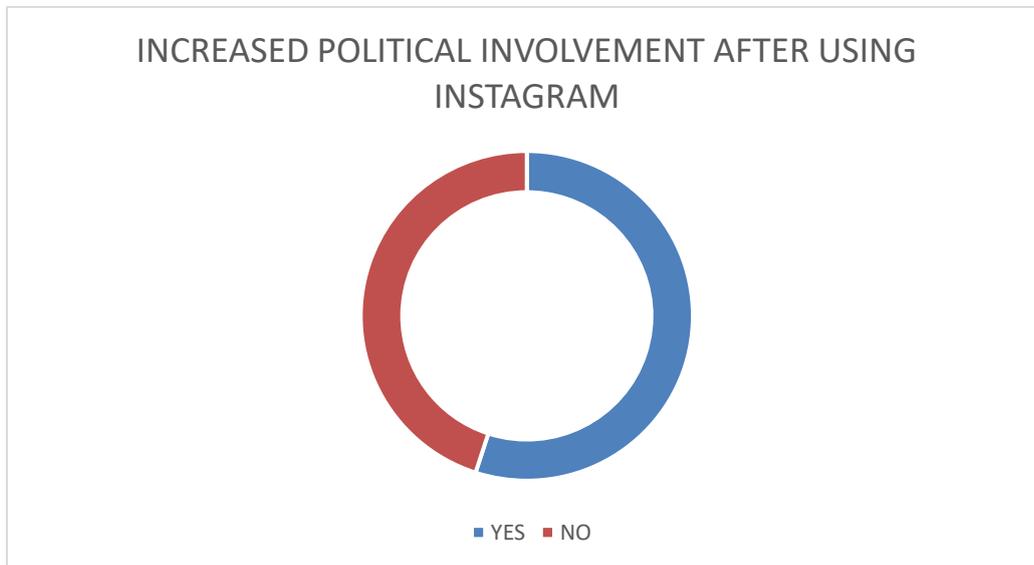
The following figures show that about 54% of the respondents do not in fact know about the new economic order of surveillance capitalism that they are subjected to. On the contrary, 46% of the respondents have at least come across the term. Of the 46%, 25% of respondents only somewhat understand it, 17% have no clue and only 11% understand the phenomenon. This means that only one/tenth of the respondents are even aware of surveillance capitalism.

#### 4.14 RESPONDENTS TAKE ON WHETHER TARGETTED NEWS IMPACT THEIR WORLD VIEWS



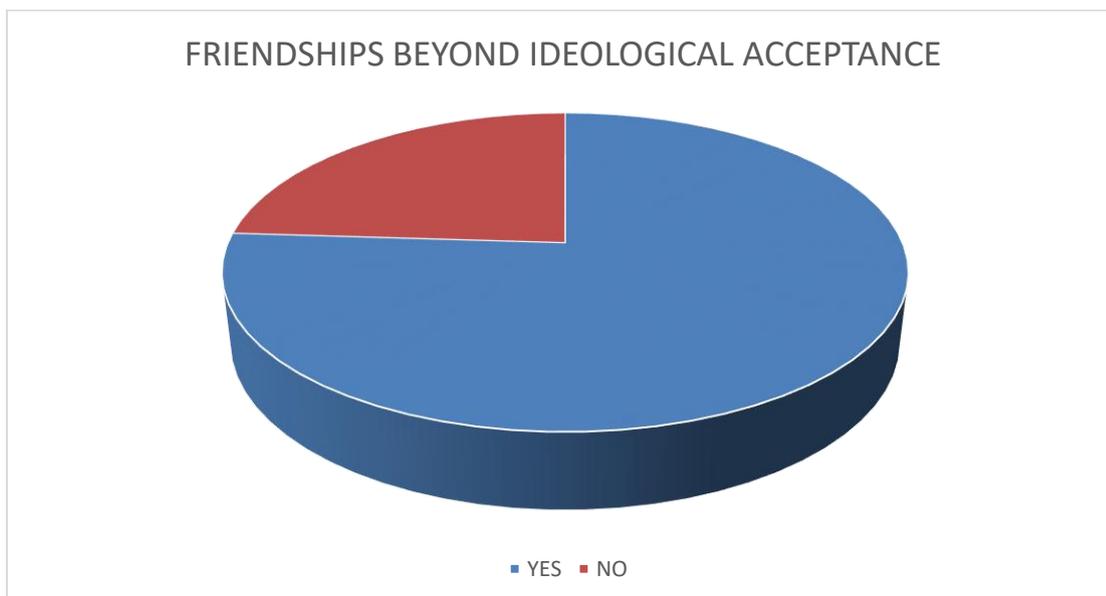
From the graph, it is clear that most respondents are aware about the fact that targeted news do impact the perspectives they hold on current affairs. In the survey conducted, 86% of the respondents admitted to consuming news from Instagram. Out of which, 70% admit that targeted news impact their world views, 19% never thought about targeted news impacting their world view and 11% are confident that targeted news do not impact them or have a role in forming their perspectives on current affairs.

#### 4.15 GRAPHICAL REPRESENTATION ON RESPONDENTS' POLITICAL ACTIVISM AFTER USING INSTAGRAM



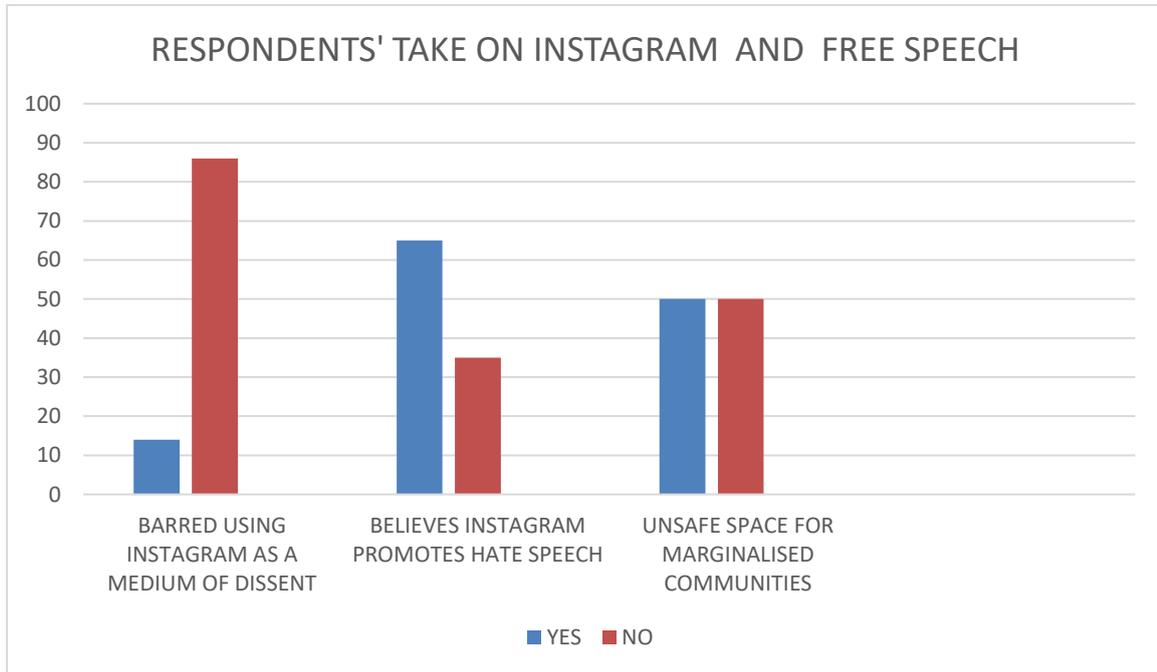
The pie chart shows that even though a majority of 55% of respondents have not increased their political participation, 45% of the respondents have in fact been more politically active.

#### 4. 16 GRAPHICAL REPRESENTATIONS OF RESPONDENTS ATTITUDINAL CHANGE ON HOLDING FRIENDSHIPS WITH PEOPLE THAT DON'T ALIGN TO THEIR IDEOLOGICAL ORIENTATION SINCE THE USE OF INSTAGRAM



Although 75% of respondents still make friends with people who don't align with their political views, about 25% of the respondents have admitted that they no more hold friendships with people who aren't ideologically similar ever since they used Instagram.

#### 4. 17 GRAPHICAL REPRESENTATIONS OF RESPONDENTS TAKE ON INSTAGRAM AND FREE SPEECH



The following graph shows that 14% of respondents have been barred on Instagram every time they used it as a medium of political dissent. About 65% of the respondents agree that Instagram also promotes hate speech and nearly 50% of the respondents agree that Instagram is an unsafe digital space for people from marginalized communities.

**CHAPTER – 5**  
**FINDINGS AND CONCLUSION**

## **CHAPTER - 5**

### **FINDINGS AND CONCLUSION**

The commencement of this project has been solely to trace the impact of surveillance capitalism on Gen Z as we have been born into the age of surveillance capitalism. This quantitative study opted to choose Instagram as the social media app for two requisite reasons. Firstly, Instagram is the most popular social media app among college students besides WhatsApp. And secondly, the impact of surveillance capitalism can most easily be identified through social media apps. Social media apps were in fact the site where surveillance capitalism began to grow exponentially.

This study has had five specific objectives which it meticulously tried to research and find conclusions too. They are written below as the following.

The first objective, almost as is obvious to try and understand the socio- economic background of the participants of the survey. The participants of the survey hail from middle class families where majority of the income ranges about and above 10-15 lacks annually, followed by the next majority below 10 lacks annually and only 14% of the respondents have an annual income below three lacks. The majority of the respondents follow Hinduism and Christianity by 82% percent. The data shows us that there are few Muslims, Atheists, Agnostics and Wicca making up under 16% percent of the sample size and rest 6% chose not to disclose their religious identity. Majority of the participants of the survey identified as women, followed by men. There were no transgenders in the survey, however, 2% of the respondents identified as non-binary.

Another observation made is that the majority of the participants have used Instagram from the past four years and 59% of the respondents who have spent more than four years on the app more than 28% of them believe that they are dependent on the app. This dependency has increased by 78% since the lockdown for various reasons like stress, boredom, keeping in touch with friends, entertainment, etc. Another observation made is that 20% of the respondents acknowledge their addiction to the app and about 34% are unsure if they may be addicted or not.

The second objective was to measure the impact of Surveillance Capitalism's privacy on respondents. The survey showed that 75% of the respondents do in fact try to read the privacy policy of the social media app before complying to its terms and conditions however, 77% of the respondents wished that Instagram would have their privacy policy written with brevity and clarity in laymen language instead of the cumbersome lengthy read that the app currently provides. It

must also be noted that 17% of the respondents had no opinion and 6% didn't mind their data being collected by the app. Another observation is that 71% of the respondents feel watched over while using Instagram, about 15% never thought about it and the remaining 14% did not feel watched or surveilled while using Instagram. Of the 71% respondents who feel watched 2% of them feel watched by the Govt, 18% feel watched over by commercial companies and 39% of them feel watched over by Instagram's parent company Meta. And finally, 91% of the respondents wished that they could use the services of Instagram without compromising their and the other 9% did not know about an inherent choice to actually keep their data to themselves yet enjoy the means of a social media app like Instagram.

The third objective was to measure the awareness about Surveillance Capitalism. About 54% of the respondents do not in fact know about the new economic order of surveillance capitalism that they are subjected to. On the contrary, 46% of the respondents have at least come across the term. It is daunting to note that only one in ten of respondents even understand the phenomenon of surveillance capitalism.

The fourth objective was to find the impact of surveillance capitalism on the behavioural modification it brought forth on people with respect to their political orientation, views and perspectives. It is concerning to note that among the users who consume news in this social media platform about 70% admit that targeted news impact their world views, 19% never thought about targeted news impacting their world view and 11% are confident that targeted news do not impact them. 45% of the participants also agreed to increased political participation after using Instagram and about 25 % of the respondents have admitted that they no more hold friendships with people who aren't ideologically similar to them ever since they used Instagram. This ideological divide may deeply be concerning for the harmony of our society.

The final objective was to understand the impact of surveillance capitalism on free speech. The collected data shows that 14% of respondents have been barred on Instagram every time they used it as a medium of political dissent. About 65% of the respondents agree that Instagram also promotes hate speech and nearly 50% of the respondents agree that Instagram is an unsafe digital space for people from marginalized communities.

The study also shows significant relation between surveillance capitalism and the gender and religion the respondents identified with.

## **SUGGESTIONS**

The only way to combat the impact of Surveillance Capitalism that trades in human futures and takes private human experiences as fungible tokens is spread awareness about this new unprecedented economic order that has no current law to stop it. By spreading awareness and raising collective consciousness alone will allow people to come together and fight big companies that decide the future of our societies. This alone can help bridge the widening gap of knowledge and power between people and surveillance capitalists and pave way for a more inclusive and healthy society. Individual understanding of the workings of surveillance capitalism also makes people mindful and aware each time they fall victim to it.

## **CONCLUSION**

From the study it can be concluded that there is a very real impact of surveillance capitalism among the youth in Kochi. Only a tenth of the respondents knew the workings of this new economic order. As this industry feeds on the attention span, it showed increased usage and dependency of the app among users who've been on the platform for more than four years. The study showed that even though respondents tried to read the privacy policy they still wished for laymen language with brevity to truly understand privacy concerns that the app leaves opaque. The survey also showed that about one tenth of the respondents could not separate technology from the ill practices of surveillance capitalism as they didn't know it was possible to keep their personal data to themselves and yet use the app. As the survey also tried to enquire about the impact of surveillance capitalism on people's political orientation and free speech, it is gravely concerning to note that majority of the respondents admitted that targeted news have changed their perspectives on current affairs, majority believe that Instagram doesn't hold a safe space for marginalized communities and promotes hate speech, 25% of them no more hold friendships with people whose ideological orientation isn't similar to them since using the app, and more than a tenth the of respondents have been barred on Instagram every time they used it as a medium of political dissent. All these malpractices are indeed a grave concern for the harmony of society, and therefore needs immediate attention.

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# APPENDIX

# **A SOCIOLOGICAL STUDY ON THE IMPACT OF SURVEILLANCE CAPITALISM ON COLLEGE STUDENTS THROUGH INSTAGRAM WITH SPECIAL REFERENCE TO KOCHI**

## **Questionnaire**

\*required questions

1. Age\*
2. Gender: Female / Male / Others (Specify)\*
3. Religion : Hindu / Christian / Muslim / Others (specify)\*
4. Annual Family Income:\*
5. How long have you been an Instagram user? \*
  - Above 6+ years
  - About 5 – 4 years
  - About 4-3 years
  - About 3-2 years
  - About 2-1 year
  - About a few months
6. How many hours do you think you spend each day using Instagram? \*
  - Less than 2 hours
  - 2-4 hours
  - 4-6 hours
  - 6-8 hours
  - 8+ hours
7. How many hours do you actually spend on the app? (Please check your activity time) \*
8. Do you agree that Instagram is an important part of your day-to-day activities ? \*
  - Yes
  - No
  - Somewhat

9. For what purposes do you use Instagram? \* (Please select all applicable options)
- To share memes and videos to friends
  - Entertainment
  - To share politically relevant posts and videos
  - To read the news
  - Promote business/ work
  - Follow celebrities
  - Make internet friends
  - Self-expression through thoughts, photos, videos and art
  - Others (please specify)
10. Do you think you may be addicted to Instagram? \*
- Yes
  - No
  - Maybe
11. Has the pandemic increased your usage of Instagram? \*
- Yes
  - No
12. If yes, why? (Please select all applicable options)
- Boredom
  - Stress
  - To keep in touch during lockdown
  - Others (specify)
13. Have you ever tried to read the privacy policy of Instagram? \*
- Yes
  - No
14. Do you think Instagram and other apps should have a brief and easy notice about its privacy policies so all users may understand? \*
- Yes
  - No
  - Don't know enough to give an opinion
15. Do you feel watched over while using Instagram? \*
- Yes
  - No
  - Never thought about it
16. If yes, who do you think is watching over you? (Please select all applicable options)
- The government
  - Meta (the company formerly called Facebook)
  - Others ( please specify)
17. Have you ever thought about what big tech companies do with your personal data? \*

- Of course
- Never
- Sometimes
- Not bothered

18. Do you think that allowing Instagram to access your contacts, audio, or phone's gallery may be safe? \*

- Yes
- No
- I don't think it is a problem as many people I know use it

19. Are you okay with your personal data being collected in exchange to use the services on Instagram? \*

- Yes
- No

20. Do you wish users had a choice to keep their data private and yet use services of Instagram? \*

- Yes, I always wish so
- Never thought about it

21. Do you feel uncomfortable about targeted ads and posts on your feed as it knows every product or subject you like? \*

- Yes
- No
- Sometimes

22. What are the other social media platforms that you use? \* (Please select all applicable options)

- Facebook
- Tumblr
- Reddit
- Snapchat
- Twitter
- Telegram
- Youtube
- Whatsapp
- LinkedIn
- Others (please specify)

23. Do you feel safe using other apps? \*

- Yes
- No
- Sometimes

24. Have you ever come across the term Surveillance Capitalism? \*

- Yes
- No

25. If yes, do you understand the phenomena?
- Yes
  - No
  - Somewhat
26. Have you ever felt that smartphones or smart watches that know about your location, purchases or even your heart rate could pose a threat to you? \*
- Yes
  - No
  - Never thought about it
27. Are you concerned about the breach of privacy due to technological innovations like smart phones or CCTV cameras as they saturate into public spaces like malls and streets? \*
- Yes
  - No
28. Do you trust big tech companies like Google, Meta (previously called Facebook), apple, Microsoft, Amazon, etc? \*
- Yes, they are ethical in their approach
  - No, the companies are secretive
  - I don't know
29. Do you consume news on Instagram? \*
- Yes
  - No
  - Sometimes
30. Do you think consuming targeting news according to your liking impacts how you view current affairs? \*
- Yes
  - No
  - Never thought about it
31. Do you think consuming targeted news on Instagram according to your liking makes you more emotionally charged? \*
- Yes
  - No
  - Never thought about it
32. Do you think the news you consume on Instagram is as reliable as daily newspapers? \*
- Yes
  - No
33. Have you become more politically involved due to using social media apps like Instagram? \*
- Yes

- No

34. Have you ever been reported or barred while using Instagram as a medium of dissent? \*

- Yes
- No

35. Do you think Instagram promotes hate speech? \*

- Yes
- No

36. Do you think Instagram is safe for marginalized communities like women, Dalits or the disabled? \*

- Yes
- No

37. Do you make friends with people who share different political views? \*

- Yes
- No
- Sometimes

38. Has this attitude changed since you have used Instagram? \*

- Yes
- No

39. Do you have internet friends on Instagram?\*

- Yes
- No

40. If yes, do they share your political views?

- Yes
- No

41. Do you think that our existing laws will protect us from exploitation of our data? \*

- Yes
- No
- Never thought about it

42. Would you like to mention any particular change(s) you have noticed in yourself that may be due to usage of Instagram?

- Yes
- No

43. Do you have any suggestions?



**ROLE OF KUDUMBASHREE IN SOLID WASTE  
MANAGEMENT WITH SPECIAL REFERENCE TO  
KOCHI CITY.**

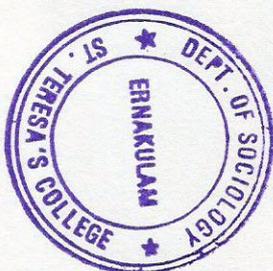


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**MARCH 2022**

**ROLE OF KUDUMBASHREE IN SOLID WASTE MANAGEMENT WITH SPECIAL  
REFERENCE TO KOCHI CITY.**

Thesis submitted to St.Teresa's College (Autonomous), Ernakulam in fulfillment  
of the requirements for the award of the degree of **Master of Arts in Sociology.**

By

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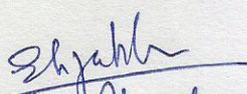
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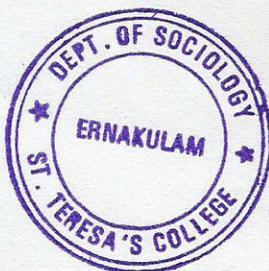
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March 2022



## CERTIFICATE

I certify that the thesis entitled "ROLE OF KUDUMBASHREE IN SOLID WASTE MANAGEMENT WITH SPECIAL REFERENCE TO KOCHI CITY" is a record of bonafide research work carried out by **JILSA JOSEY**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.

  
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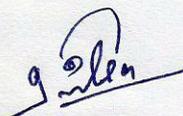
March 2022

## DECLARATION

I JILSA JOSEY hereby declare that the thesis entitled "ROLE OF KUDUMBASHREE IN SOLID WASTE MANAGEMENT WITH SPECIAL REFERENCE TO KOCHI CITY" is a bonafide record of independent research work carried out by me under the supervision and guidance of DR. SAJITHA J. KURUP. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



JILSAJOSEY

## ACKNOWLEDGEMENT

In this humble endeavour I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director **Rev. Sr. Emeline CSST** and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Dr. Sajitha Kurup for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

March 2022

JILSA JOSEY

# CONTENTS

<b>Chapter</b>	<b>Page</b>
<b>1. INTRODUCTION.....</b>	<b>1-11</b>
<b>2. REVIEW OF LITERATURE.....</b>	<b>12-22</b>
<b>3. METHODOLOGY.....</b>	<b>23-26</b>
<b>4. DATA ANALYSIS AND INTERPRETATION.....</b>	<b>27-52</b>
<b>5. FINDING AND CONCLUSION.....</b>	<b>53-58</b>

## **Bibliography**

## **Appendix**

## List of tables

<b>Table No:</b>	<b>Title</b>	<b>Page No:</b>
<b>4.1</b>	<b>Age of the respondents</b>	<b>28</b>
<b>4.2</b>	<b>Number of Earning members</b>	<b>32</b>
<b>4.3</b>	<b>Proper method of waste management</b>	<b>37</b>
<b>4.4</b>	<b>Health Problems of the kudumbashree members</b>	<b>47</b>

# List of Figures

<b>Figure No:</b>	<b>Title</b>	<b>Page No:</b>
<b>4.1</b>	<b>Educational qualification of the Respondent</b>	<b>29</b>
<b>4.2</b>	<b>Marital Status Of Respondent</b>	<b>30</b>
<b>4.3</b>	<b>Distribution on the basis of type of family</b>	<b>31</b>
<b>4.4</b>	<b>Number of Earning member</b>	<b>33</b>
<b>4.5</b>	<b>Amount of Monthly Income</b>	<b>34</b>

<b>4.6</b>	<b>Years of Experience in Kudumbashree</b>	<b>35</b>
<b>4.7</b>	<b>Reasons For Selecting this Job</b>	<b>36</b>
<b>4.8</b>	<b>Types of Waste Collected</b>	<b>38</b>
<b>4.9</b>	<b>Precautions While Collecting Waste</b>	<b>39</b>
<b>4.10</b>	<b>Training And Guidelines Provided By The Authority</b>	<b>40</b>
<b>4.11</b>	<b>Safety Equipments Provided by the Authority</b>	<b>41</b>

<b>4.12</b>	<b>Means of Transporting Waste</b>	<b>42</b>
<b>4.13</b>	<b>Number of Shift of Work</b>	<b>43</b>
<b>4.14</b>	<b>Mode of Income Savings</b>	<b>44</b>
<b>4.15</b>	<b>Problems Faced By Waste Collectors</b>	<b>45</b>
<b>4.16</b>	<b>Stigma And Harassment From The Society</b>	<b>46</b>
<b>4.17</b>	<b>Major Health Problems</b>	<b>48</b>
<b>4.18</b>		<b>49</b>

	<b>Financial Crisis Faced By Waste Collectors</b>	
<b>4.19</b>	<b>Main Challenges Faced By Waste Collectors</b>	<b>50</b>
<b>4.20</b>	<b>Satisfaction Level of this Job</b>	<b>51</b>

# **Chapter 1**

## **Introduction**

## **Introduction**

**Empowerment of women and their presents in the development process has been considered an essential feature of development. It is assumed that real development is possible only if the women and men work in equal terms. Gender equality and empowerment of women is recognized globally as important element to achieve progress in all areas. Rural women are normally considered as voiceless and weak. But instead of this the empowerment of women through different laws, legislations, activities and schemes is the most important concern of 21<sup>st</sup> century. Because women have a major role in framing a generation as well as prosperous nation. Today's women have better opportunities and avenues in all areas of national, social, political and economic life. In order to enjoy high standard of living and to give better facilities more income should be generated. Formal salaried job requires skill and high levels of literacy. But this may not be the case of the all womanhood. Most of the urban poor are unemployed or employed as casual laborers. They have no job security, poor assets, limited skills, few opportunities and no surplus to sustain themselves.**

**Almost in every country, no matter how progressive has a history of ill-treating women. women from all over the world have been rebellious to reach the status they have today. While the western countries are still making progress, third world countries like India still lack behind in Women Empowerment. In India, women empowerment is needed still more. India is amongst the countries which are not secure for women. There are various reasons for this. women in India are in danger of honor killings. Their family thinks its right to take their lives if they bring shame to the honor of their legacy. Moreover, the education and freedom is very regressive here. Women are not allowed to seek higher education, they are married off early. The men are still dominated women in some regions like it's the woman's duty to work for him endlessly. They do not let them go out or have freedom of any kind. Women must be given equal opportunities in every field, irrespective of gender. And they must also be given equal pay. So there is a need for women's participation in income generation. Women empowerment refers to the practice of making women**

independent so that they can take their own decisions as well as handle their lives without any familial or societal restrictions.

Kerala is one of the 28 states (provinces) of India, located in the southwest of the Indian subcontinent. It has a predominantly Malayalam-speaking population. The state of Kerala has a distinct history of poverty alleviation and development in comparison with the rest of India. This “Kerala model of development” forms the wider context for the formation of Kudumbashree Mission. The two immediate contexts for Kudumbashree are the following. First, in 1997, a three-member task force constituted by the Kerala Government recommended setting up a State Poverty Eradication Mission (SPEM). The Kerala Government announced the formation of SPEM in the state budget of 1997-98. Then Prime Minister of India, Atal Bihari Vajpayee, launched SPEM in May 1998. However, it became fully operational only in April 1999 with the name Kudumbashree Mission. It functions under the Local Self Government (LSG) Department of the Kerala Government. The second immediate context was the 73<sup>rd</sup> and 74<sup>th</sup> Constitution Amendment Acts. These Acts instituted local self-government institutions at the rural and urban level as constitutional bodies and as the third-tier of governance in India, distinct from the Central and State governments. The Kerala government used the amendment as an opportunity to deliver poverty alleviation programmes through local participation and self-government institutions.

The three-tiered structure and the concept of Neighborhood Groups have two distinct lineages. The first is efforts by individuals and civil society groups and the second is government initiatives.

#### **Individual and civil society initiatives:**

The Kudumbashree Mission is popularly called Ayalkootams which is the Malayalam term for neighborhood meetings or assemblies. The origins of the Ayalkootam lies in a 1970s experiment led by D Pankajakshan, a Gandhian teacher, in Kanjippadam village in Alappuzha District. This experiment also had a three-tiered structure. The first tier, called Tharakootam, consisted of members from ten to fifteen neighboring homes. They met every night in the courtyard of one of the houses. The next level was the Ayalkootam made of five Tharakootams. The third level comprising ten Ayalkootams was

the Gramakootam or the village assembly. Some of the central features of this experiment were voluntary sharing of resources, mutual self-help, and community ownership of local affairs. Apart from discussing local affairs, resolving mutual conflicts, and improving interpersonal relationships, the Tharakootams also discussed national and international matters in their meetings. The Alappuzha experiment inspired the formation of Neighbourhood Groups in other villages in Kerala. Neighbourhood Groups in Nalpathimala in Kottayam district, led by Thomas Abraham and the Mahatma Gandhi University in Kottayam, was one such experiment. Kurup's initiative was also the model for the experiments organized by Kerala Sastra Sahitya Parishad (KSSP), the Left-oriented People's Science Movement in Kerala, along with Centre for Development Studies (CDS), Thiruvananthapuram in the 1990s for a project called Panchayat Level Development Planning. This involved creating Neighborhood Groups for mapping local resources and planning development activities at the panchayat level.

#### **Government initiatives:**

The Kerala Government formed Neighbourhood Groups in 1986 for the implementation of Government of India's poverty alleviation programs for the urban poor. With the 74<sup>th</sup> Constitutional Amendment Act of 1992, which provided constitutional status to the urban local self-government institutions, a three-tiered structure consisting of Neighbourhood Groups, Neighbourhood Communities and Community Development Societies for community participation in local governance and development was established. The two pre-74<sup>th</sup> Constitutional Amendment Act examples cited by the government as success stories of community participation and involving Neighbourhood Groups are the Community Based Nutrition Programme in Alappuzha (started in 1991) and in Malappuram (started in 1994).

Kerala Government's Department of Local Self-Government directs, monitors, and supervises the Mission. Kerala Government allocates funds for the Mission in its budget and the Mission is also supported by the National Bank for Agriculture and Rural Development (NABARD), a bank owned by the Government of India. Despite being monitored by the Department of Local Self-Government in their activities and the functioning of the Neighbourhood Groups, Area Development Societies and Community Development

**Societies of the Mission are largely autonomous and work in coordination with the local self-government institutions where they operate. The Neighbourhood Groups meet weekly at the house of a member on a rotating basis. The members of the group elect a five-member volunteer committee (president, secretary, community health volunteer, income generation volunteer and infrastructure volunteer) for administrative purposes. The general body of the next level, that is, the Area Development Societies, consists of volunteer committee members from all affiliated Neighbourhood Groups. This general body elects a governing body of the Area Development Society consisting of a president, a secretary and five members. The Area Development Societies work in association with the ward member of the local self-government institution. These Societies meet every month to supervise the activities of the Neighbourhood Groups and to provide relevant guidelines to them.**

**The Community Development Societies, consisting of all Area Development Societies in a village panchayat or an urban local body, are the link between the local self-government institutions, the three-tiered set-up of the Mission and the government. The Community Development Societies also have a general body and a governing body. The general body consists of the Area Development Societies' governing body members. They meet every three months to discuss and evaluate the activities of the Mission in a village or a municipality. This general body elects a governing body comprising a Chairperson, a Vice Chairperson and seven members for the day to day administration of Community Development Societies.**

**At the government or the bureaucratic level, there are district coordinators and other officials. A senior bureaucrat acts as the Executive Director of the Kudumbashree Mission. The Mission conceives women empowerment and community development as central to poverty eradication. Thus, the membership of the Mission's community network is limited to women. During the initial phase, the membership consisted of women from below-poverty-line households but currently all adult women are eligible for membership to the Neighbourhood Groups – the basic units of Kudumbashree's community network. The membership follows a "one family, one member" rule. However, any women irrespective of this rule can participate in the discussion and activities of the Kudumbashree. With the government's permission, Special Neighborhood Groups can be constituted for physically and mentally challenged persons (or consisting of their mothers) and persons battling AIDS or any other special groups. There are more than 2500 Special Neighborhood Groups for**

elderly women and around 19 for Transgender people. Members of the Scheduled Tribes (official nomenclature for indigenous peoples in India) can also constitute Special Neighbourhood Groups for themselves.

Kudumbashree is basically a women's organization. It took birth in the specific developmental and political conditions of Kerala state, born in the center of the massive decentralisation of power to the local government institutions that the state government implemented. Kudumbashree was considered as an institutional system working closely with local governments. With its own history and rationale, kudumbashree differ from the self help group movement seen across the world during the 1980s and 1990s. Kudumbashree project was started Kerala in 1998. women empowerment is one of the important objective of kudumbashree along with poverty eradication. The main aim of the kudumbashree scheme is to improve the standard of living of poor women in rural areas by setting up micro credit and productive enterprises. It opened a new string of expected events in our development history. Kudumbashree is the poverty eradication programme of the state of Kerala. It is usually a community based self help institution involving poor women. Kudumbashree was considered as a joint programme of the government of Kerala and NABARD implemented through community development societies of poor women. As per the documents associated with this program, women want to identify their inner strength opportunities for growth and their role in reshaping their own destiny. So the well known kudumbashree imitative of the government of Kerala, a women-centred poverty eradication program has proved more popular and more enduring than any other poverty alleviation programs that targeted women. Kudumbashree also gives a new identity of worth to its members especially the poor. It has helped them in reinvent their roles in households and in society. Thus kudumbashree act as a guide for taking up many developmental and welfare activities for the poor women especially women in rural areas. Solid waste is one among them. Kudumbashree associate with local bodies, Haritha Keralam mission, suchitwa mission and clean kerala company in waste management efforts. As many as 22,119 kudumbashree workers are deployed as Green Task Force members in 689 local bodies across the state. They are part of 638 Green Task Force Groups in gram panchayats and 81 urban local bodies.

Kudumbashree is a program that was launched by the Government of Kerala in 1998 in the hopes of wiping out poverty from the State through concerted

community action under the leadership of local self-governments. Kudumbashree today is one of the largest women-empowerment projects in the country. Its mission is to encourage women to attend group discussions and improve their reading habits, debating skills and also to develop decision making qualities. Along with that it imparts Education to those women who were illiterate. In short the women have been shown the right path for a better tomorrow by this social movement. The program has nearly 4 million members and covers more than 50% of the households in Kerala. It is a cooperative run by the group of women with the help of government officials from the block level. It operates around three critical components, Micro Credit, Entrepreneurship and Empowerment. The Kudumbashree initiative has succeeded in addressing the basic needs of less-privileged women, which has helped them to live an independent & dignified life with a better future. With such an initiative, more than 90 percent of women in Kerala have gained self-confidence after being associated with Kudumbashree.

One of the leading strands of criticism on Kudumbashree had been by placing it against feminist interventionist programmes as well as against civil society initiatives. Kudumbashree had a development agenda of poverty eradication, and building up and strengthening women's community organisations was the strategic direction that it took for implementing the agenda. However, there had been a growing realisation within and outside Kudumbashree that there was a case for addressing certain larger issues, even while advancing its core agenda of poverty eradication. At the time of Kudumbashree's formation, its mandate was eradication of absolute poverty in Kerala. Kudumbashree was expected to achieve this over a period of ten years. The three-member Task Force that had recommended its formation was clear on the organisational form of Kudumbashree and its relationship with local government institutions. The government order setting up the new entity or the subsequent directions from the government did not insist on a programme design for Kudumbashree. Thus, Kudumbashree programmes as we see them today, came out of a system that promoted innovation and encouraged new ideas. Several of the schemes came out of inputs and demands from the field. The current programme domains evolved over the years. As of now Kudumbashree has three major programme domains:

1. Economic Empowerment

## **2. Social Empowerment**

## **3. Women Empowerment**

In addition to these, Kudumbashree also implements the urban poverty alleviation programmes of the Government of India. It organizes poor women at the grass root level and enhances their socio-economic standing through micro-credits and women empowerment initiatives via vocational training, education and healthcare. Its innovative poverty reduction approach is implemented through local self-government (LSGs). The project is decentralised in three tiers to avoid concentration of power with one party and therefore avoid unnecessary delay in the decision-making process, the performance of the scheme is largely attributed to the decentralised operations in the program. The three-tier structure has – Neighbourhood Groups or NHGs (The primary contact with beneficiaries), the second tier is Area Development Society or ADS (The conglomeration of all NHGs in the ward), and the third tier is Community Development Society or CDS (The conglomeration of all ADS at a Panchayat/Municipality level). In simple terms, NHGs are government-sponsored SHGs which bring the members together to share economic benefits, show solidarity and work towards development by integrating activities of various sectors. In the context of Kerala, J. Devika and Binitha Thampi has argued that Kudumbashree is part of a “new regime of empowerment.” This new regime emerges in the context of a diminished ability of the state to meet the financial needs of the people and reconfigures its role as “facilitators of the new self-help-centered philosophy of welfare.” Devika and Thampi argue that while the male worker as the political subject was at the center of the earlier regime and women were mere beneficiaries, the new regime casts women (“female worker in the informal sector”) as agents of development. Devika and Thampi also argue that the Mission is prone to the danger of bureaucratization where the three-tiered structure of Kudumbashree Mission is becoming a new bureaucracy. This they contend is not surprising given that the community network of the Mission is a “state-created civil society.” In her fieldwork, Devika found that the leaders of the Kudumbashree community network (the Chairpersons, Secretaries, Presidents etc.) perceive themselves as “members of the lower tiers of the development bureaucracy and not as local leaders.” A related problem is that the Mission can act as a parallel and competing institution to local self-government bodies. There

is a danger of state government bypassing the local bodies and using Kudumbashree as a vehicle for welfare and service delivery. This has created instances of tensions between the members of local bodies and the women leaders of the Mission's community network. Another issue that is common to both local self-governing bodies and community networks such as Kudumbashree is the control of dominant groups and local elites in the bodies. The community-based networks like Kudumbashree is often pitched as a counter to this dominance by creating alternative and special space for the marginalized sections [20] – poor women in the case of Kudumbashree. However, within community networks such as Kudumbashree, the most marginalized (the Dalit and Tribal (Indigenous) women) remain marginalized compared to women from other caste groups. Seleena Prakkanam, a Dalit activist with previous association to Kudumbashree, in an interview with Devika mentions how on crucial occasions Dalit women have to step aside in favor of women from more influential social groups. Despite these criticisms, Kudumbashree's have positive effect on the women's participatory capacity in Kerala. Kudumbashree has become the recruiting ground of women leaders for local politics. The Mission has given women "broader visibility within the public sphere." Women have reported that discussions in the weekly meetings of the Neighborhood groups have created solidarity among women on wider social issues, beyond the thrift and credit activities of the groups. The participation in weekly meetings of the Neighborhood Groups and public meetings of the local self-governing bodies have given self-confidence to the women and have made them more visible.

There are vast employment opportunities in urban areas. Because of low wages and unemployment in rural areas people began to migrate to these areas thereby increasing population. So there is rapid urbanization and increase in population lead to pollution and environmental problems. When the population increased more and more dwelling facilities had to be arranged within the limited area. Urbanization directly contributes to waste generation. Unscientific waste handling causes health hazards and urban environment degradation. Solid waste management is already a mammoth task in India is going to be more complicated with the increase in urbanization, changing lifestyles and increase in consumerism. New products in the market are also adding to the variety in the waste. The nature and characteristics of solid waste are changing from city to city.

Because of rapid urbanization, daily thousands of tones of solid waste is generated per day. According to M.R Gidde and S.S Subnis “The methods of disposal are conventional in developing countries”. Thus solid waste management has become a serious issue in urban and semi urban areas of Kerala. The quantity of waste is high in Ernakulam district especially in Kochi. Kochi generates 400 tones of solid waste per day from hospitals, trade, industries, domestic, streets and open spaces. These waste materials usually contains both organic and inorganic components. Because of growing population, waste generation increases year by year. Increased consumption and increasing presence of non degradable substances in the waste streams causes environmental pollution. Thus the environmental problems caused by waste material is a major health hazard. Also the left uncared materials get into water bodies, pollute air, clog sewers and drains and pollute water distribution networks. So waste collection and disposal play an extremely important role in the global cleanliness and sustain ability drive. Increasing solid waste generation and the increasing environmental issues are one of the major problem faced by big cities. The waste management of a city have major impacts on human health, water quality, air quality and development dimensions.

This study is mainly based on the role of kudumbashree in solid waste management in kochi. Kochi is considered as the industrial capital of the state of Kerala. There is a rapid increase in the waste generation in the city due to increasing population by migration from other areas. The corporation of kochi is responsible for the municipal solid waste management of the city. The health department and engineering department of the corporation is responsible for the municipal solid waste management. The collection, transportation and disposal of waste is the responsibility of the health department. While the engineering department assist them in planning, formulation of programs and in procurement of vehicles, equipment and developing the city. So they have mobilized the units of kudumbashree, which is the flagship poverty alleviation programme of government of Kerala, to take over door to door garbage collection and segregation in the city. Kudumbashree workers collecte the segregated waste from households. Kudumbashree members formed as several groups to collect segregate a transport solid waste from households, flats, hotels etc, which is helpful for employment generation, poverty alleviation

and thereby promoting economic growth. And also it improve the standard of living of the poor women.

## **Need and significance of the study**

Waste management include the activities and actions required to mange waste from its inception to it's final disposal. This includes the collection, transport, treatment and disposal of waste. It deals with all types of waste like industrial, bio-waste and households. It is intended to reduce adverse effects of waste on human health and the environment. Proper management of waste is crucial for building sustainable and livable cities, but it remains a challenge for many developing countries and cities. India faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal. Because there is large volume of waste generated by an increasing urban population and this impacts on the environment and public health. So waste management infrastructure has important in delivering sustainable development. Efficient management of solid wastes means exploring the possibilities for utilization, recovery of usable materials from them and recycling. Afterward a healthy ecology is the basis for a healthy economy, the policy makers and public must be aware of how our society and the economy will change in order to avoid environmental issues and thereby promoting and ensuring sustainable development. Through waste management in cities is the sole responsibility of municipal corporation. Since women represent almost half of the total population of our country. The globalization and especially technological transformation opened the door for women new opportunities towards their work life. Now a days, women occupy in all the occupations and professions which were occupied by men earlier. Kudumbashree which means 'prosperity of the family' through women empowerment starting from traditional activities like embroidery, retail trade, bakery, hotels, its journey continues to waste management the state. The study focus on "Role of kudumbashree in solid waste management with special reference to kochi". It also focused on the socio economic profile of the kudumbashree members.

# **Chapter 2**

## **Review of Literature**

## **Chapter 2**

### **Review of Literature**

A research literature refers to a collection of published information or materials on a particular area of research or topic. The literature may include article, abstract, books, dissertation and other research reports. This chapter include literature from various websites, past studies and other relevant aspects of this topic has reviewed in order to provide broader perspective for this study.

Jayakumari Devika, Binitha V Thampi points out that Micro-finance and its (purported) capacity to empower women is by now a well-explored field all over the world. In this study they attempt to critically assess the claims of the Kerala government's poverty eradication programme, the Kudumbashree, which combines a micro-finance model with other elements through critical feminist lenses. Given the fact that this major effort to popularise micro-finance in Kerala has the twin aims of poverty alleviation and women's empowerment, this seems justified. They try to place the 'micro-finance revolution' in Kerala within the larger historical trajectory of successive 'regimes of empowerment' in order to understand the different political stakes in each, and their implications for gender politics. While using some of the available tools that employ indicators of gender effectiveness to assess the impact of micro-finance in empowering women is certainly a basic exercise, the present approach allows us to draw lessons for effective gender politics through a comparison with earlier modes of empowering the deprived classes in Kerala.

Glyn Williams examines the operation of Kudumbashree, the Poverty Eradication Mission for the Indian State of Kerala. Kudumbashree operates through female-only Neighbourhood Groups, which aim to contribute to their participants' economic uplift, and to integrate them with the activities and institutions of local governance. As such, Kudumbashree echoes poverty alleviation programmes elsewhere in the Global South designed to link poverty alleviation to 'active citizenship'. This article evaluates the programme, looking in turn at its impacts on women's participation in public space, its attempts to engineer participatory citizenship through engagement with the local state, and

the wider consequences of its particular linking of participation and poverty alleviation for processes of exclusion within Kerala. It argues that although the programme has undoubtedly been successful in its scale and in supporting women's public participation, questions remain over both the autonomy of the 'invited spaces' it has created, and the underlying vision of poverty alleviation it embodies.

Suneetha Kadiyala pointed out that the factors that enabled and constrained the scaling up of a multisectoral poverty alleviation program called Kudumbashree, initiated by the government of Kerala (GOK), India, in 1998 to eradicate poverty by 2008. It also discusses some potential threats to and trade-offs of scaling up Kudumbashree. This report draws primarily upon the available literature and qualitative data collected during a five-day visit to Kudumbashree in March 2003. In 1991, the GOK, along with UNICEF, initiated the Community-Based Nutrition Program (CBNP) in Alleppey town to improve the health and nutritional status of children and women. CBNP facilitated collective action by forming and developing the capacity of three-tiered community development societies (CDS), the members of which are exclusively women. Women from families identified as poor using a nine-point nonincome-based index were organized into neighborhood groups (NHGs) comprising 20 to 45 families.

MA Oommen points out that Micro finance is an emerging reality in contemporary development discourse and has come to occupy a significant place in financial intermediation in India. Kudumbashree of Kerala, a community-based self-help organisation of poor women, although started as a micro-finance agency soon became an active subsystem of local governments and embarked upon several activities that address the question of poverty reduction. This paper attempts to narrate the story of Kerala's Kudumbashree as a women empowerment and anti-poverty programme, not only for its members but also for the wider community.

India Country Report, (1995), examines that the role of women as making women equal partners in the national development proceedings and equipping them to make informed choices in order to actualize their self worth through empowerment are goals to which the government is committed. There is a long way to go, but the effort is ceaseless.

Falaiye, (2002), in his study examines that 'On the Impact of Microcredit on Rural Nigerian Women' finds that, the Micro credit has positively changed the client's self-esteem and confidence, leadership abilities and decision making process,

contributing to their households well being and increasingly seeking out solutions to their own problems and the community.

KB Nidheesh in his study examines if membership in “Kudumbashree” leads to more equitable gender relations and economic advancement in rural area. The study reveals that women empowerment is the best strategy for poverty eradication. Rural women, who were regarded as voiceless and powerless started identifying their inner strength, opportunities for growth and their role in reshaping their own destiny. The process of empowerment becomes the signal light to their children, their families and the society at large.

*Indian Journal of Gender Studies* reflects on women’s presence in politics in Kerala where neoliberalised welfare now targets a very large number of women and inducts them into local governance. Offering a brief sketch of the shifts in the region in women’s roles and responsibilities from the pre-liberalisation period to the 1990s and after, the paper draws upon two spells of field- work to probe the unintended consequences that neoliberalised welfare has generated, the possibilities thrown up by institutional change in women’s self-help groups. This paper also attempts to view the commonalities and departures between the figure of the ‘Kerala Model Woman’, shaped in the laudatory literature on the ‘Kerala Model’ of development, and the emerging, apparently more troublesome, figure of the ‘Kudumbashree woman’.

VP Raghavan analysis that the State Poverty Eradication Mission-Kudumbashree- launched by the Government of Kerala State in India is a massive poverty eradication programme in contemporary history. It has proved without any doubt that women empowerment is the best strategy for poverty eradication Women who were regarded as voiceless and powerless started identifying their inner power, their strength, opportunities for growth , and their role in reshaping their own destiny. The process of empowerment becomes the beacon light to their children, their families and to the society at large. It opens a new vistas in development history. A new paradigm of participatory economics has been found emerging in “God’s Own Country”. Kudumbashree presents a unique model of participatory development ,which can very well be emulated by other developing countries. The strategy of participation and empowerment adopted in Kudumbashree mission ensures sustainable livelihoods to a many number of poor women- the positive outcome ,which a policy planner can always be enthused with.

Shoba Arun, Thankom Arun and usha Devi in their article explores to what extent decentralized structures can contribute to asset accumulation among disadvantaged groups, and improving livelihood choices. The process of asset accumulation is tied to the wider context of participatory institutions and opportunities within which social actors can transform assets into meaningful livelihood outcomes. Given its level of social development and civil society in the Indian state of Kerala, the *Kudumbashree* Initiative, an innovative community-based, decentralized participatory structure aims to build meaningful forms of assets at grassroots levels. Such participatory public action, based on social relationships as well as the combined efforts of the state and grassroots community organizations may provide valuable lessons for developing asset accumulation strategies.

Beg Raj Siwal discussed about kudumbashree in study. He reveals that Kudumbashree is innovative poverty eradication programme, it has gained reputation and goodwill at National and International Levels. It has also been appreciated for bringing about a silent revolution within the state; a reference to the quiet way in which lakhs of poor women have brought about positive changes in their life. The success of the government-initiated programme has made others take notice, lot of states across the country are seeking support from Kudumbashree for replicating the programme. It has been identified as one among the 20 best practices of the country by UNDP. In 2000, Kudumbashree model has won gold medal for " Best innovation" under auspices of Commonwealth Association for Public Administrations and Management (CAPAM).

Hyfa M Ali and Leyanna S George study “A qualitative analysis of the impact of Kudumbashree and MGNREGA on the lives of women belonging to a coastal community in Kerala”. This study reveals that Participation in Kudumbashree and MGNREGA was found to have a positive impact on the lives of these coastal women. They experienced social, economic and political empowerment along with an improvement in their leadership skills and decision making capacity. Their participation in these groups not only led to empowerment in various domains of their lives but also had an impact on their health awareness, needs and utilization of healthcare services. And they analyzed that Both Kudumbashree and MGNREGA were found to very useful platforms for the empowerment of women and thereby aiding in the eradication of poverty. Irrespective of a few lacunae's in

these programs, it has resulted in the creation of a cohort of empowered women who can be effectively used as future ambassadors for spreading health awareness in the community.

Alka Srivastava, (2006), identified that a self-help group is a socially and economically uniform group of 12-20 poor people willingly coming together to attain common goals. These groups start with savings and not with credit. The group then uses its savings to give loans to members to meet their emergency and other needs. The interest rates on the loans are market guided. The members decide on savings per member, maximum size of loans, guarantee mechanisms in loan sanction. They prioritize loan applications on the basis of need. The groups enjoy institutional autonomy and necessary flexibility to operate their business. Regular meetings are conducted in which savings are collected, loans are lent, recoveries affected and group decisions taken.

Ashutosh Kumar and Jasheena Rakhin analyzed that Women are the basic unit of the society. They become even more critical as a long-term solution to a sustainable livelihood. The women entrepreneurship through empowerment aims to create human resources within the productive sector and to sustain for the further development process. Kerala is only the state in India that attained a remarkable status fulfilling all the criterion of various social well-beings compare with some of the developed countries in the world, which is widely known as 'Kerala model of development'. This achievement reflects in respect of literacy level of women, salary or wage structure of employment, technical and professional services, women got equality with men. This Political and socio-economic scenario within the state, reinforce to redefine the consciousness about poverty concept. In this sense, poverty is dynamically viewed as freedom of choice from a socio-economic functioning than only the concern of income or money. Again, poverty reduction is not only the matter of an overall economic growth in a society, but also that interconnected with various social aspects like women empowerment and women entrepreneurship.

Annie John study the Socioeconomic changes and women empowerment through kudumbashree mission-study of mukkam municipality. In this she analyzed that Kudumbashree has improved the social status of women. Through Kudumbashree they have improved their confidence in banking and money transactions. They could improve their communication skills and their skills in planning and implementing projects. The participation of women in social programmes, public meetings has improved to a great

extent. Kudumbashree has enhanced entrepreneurship and leadership and the capacity of women to work and earn together.

PK Manoj identifies that that micro enterprises can play a vital role in rural development and women empowerment, particularly in developing countries like India. Micro enterprises are supposed to bring about poverty alleviation and promote socio-economic development of the poor. This in turn facilitates balanced and equitable economic development, and that too with relatively low capital investment. In the above context, this paper makes a critical analysis of the potential of micro enterprises in women empowerment by studying such enterprises promoted by women who are members of ‘Kudumbashree’—the poverty alleviation project sponsored by the Government of Kerala in India.

Ebrahim Kunju Sulaiman in his article examines the Women empowerment through micro-enterprises. In this he identified that Micro-enterprises foster the economic status of women as an effective mean to eradicate poverty. The income generating activities under individual and group initiatives to meet the livelihoods of the poor women are massively promoted under the schemes of Kudumbashree programmes in the state of Kerala. The study critically analyses the impact of micro-enterprises units run by the Kudumbashree programme in poverty eradication process and to compare the economic status of entrepreneurs before and after their membership in the enterprise.

Rural Organisation for Appropriate Development published an article related to Kerala model of women empowerment. In this study reveals that Women are important unit of our society. The development of women that indicates the development of the society. The Kudumbashree is the hope and excitement of economic and social changes in Kerala. It’s the highest priority movement of Government of Kerala. Poverty is one of the main issues faced by our nation. Poverty drop is not only a matter of an overall financial growth in a society, but also that is interrelated with several social facets like women empowerment.

Manjusha assessed the level of empowerment achieved by the womenfolk of ulladan tribe of the North paravur taluk in Ernakulam district of Kerala. The study is an attempt through kudumbashree units. The Findings show that a significant change has come about in the socio-economic profile of the women folk in the taluk. Change was also observed in the political avenues as well as the general skill of the respondents

through the kudumbashree units. The study suggested that for future development, training and awareness programs should be conducted for empowering the poor women in that area.

Kenneth and Seena studied the impact of various programmes that were introduced in order to raise the women from below poverty line in puthevelikkara grama panchayath of Ernakulam, Kerala. The questionnaire method was adopted in this study for collecting primary data. The results of the study show that economic development is the base for other developments and kudumbashree units drastically changed economic independence of the women and their living status.

Beevi and Devi conducted a study with an aim to assess the role of self help groups in empowering rural women and to identify the major constraints faced by women in Kollam district of Kerala. The study revealed that micro enterprises are a practicable path way for improving the economic status. Some factors like education, income and Mass media contact were positively and significantly related to the role of SHGs. The effectiveness of the SHGs in promoting women empowerment was found to be limited by only factors like hesitation to take up innovative scheme, difficulty in playing dual roles by women, lack of confidence, team spirit, effective leadership, managerial skills, working capital and transportation. These thus were found to be the major constraints faced by SHGs.

M Babu Gloria analyzed that the cultural constraints and kudumbashree in women empowerment. Women empowerment occupies the centre of discussions of social development and is carried by UNDP (United Nations Development Programme). It continues to be highly debated and contested. Different scholars have defined empowerment in a different ways depending upon the contextual variations. The study seeks to present varied theoretical perspectives on empowerment and reinforce them with current empowerment practices in Indian settings. Based on relevant literature on empowerment, an attempt has been made here to examine the definitions and its cultural and contextual variations. This provides a linkage between theory and practice of empowerment in Indian society. An ethnographic study of Kudumbashree, a women organization in Kerala is been carried out where the contextual variations of empowerment is covered.

Centre For Women's Development Studies analyzed lease and farming towards women empowerment. The study shows that Farming as an occupation and

agriculture as a means of livelihood is no longer a preferred choice for 76 per cent of farmers (CSDS, 2014), largely owing to price and production risks. The returns to households from tiny and fragmented land holdings are so meagre that many, largely rural men have moved out of agriculture to non-farm occupations within the village or nearby towns. Some have migrated either on a seasonal or permanent basis to far away cities and urban centres to work in low-paid informal jobs in precarious sectors like construction to support families left behind.

M AmritKiran and A Suresh identified that Kudumbashree is poverty eradication mission of the government of the Kerala with support from government of India and NABARD. Kudumbashree empowers women to strengthen the economic backward people in village areas. The peculiar situation in Kerala is that the framers increasingly move away from crop production and other agricultural activities for better paid jobs in the non-agricultural sectors. Kudumbashree aims at improving the productivity of women farmer groups. As Majority of these women are landless, the land is taken on lease for cultivation. The decline in farming hampers the food security of the state which is otherwise largely dependent on the neighboring states for food produce. They studied the various factors like age, educational qualifications, area under cultivation of the kudumbashree members of three districts Wayanad, Ernakulam, and Pathanamthitta and how these factors affect the overall development of the members. We have undertaken a literature review and conducted schedule to find out the impact after joining the self help group.

International journal for environment and health published an article on occupational health problems of waste workers. In this they analyzed that the work related health-problems were reported to be high. The prevalence of Respiratory, dermatological, eye problems and injury, musculoskeletal problems were reported to be high among municipal solid work handlers. Measures are needed to improve the work environment of waste handlers by ensuring availability protective gears based on ergonomic principles, clean drinking water and washing and sanitation facilities during working hours.

Selvi Permandy Kandasamy, Avinash B Akolkar, A Manoharan and Saranya Paranjith identifies that the reasonable concern of India is the health of municipal solid waste (MSW) workers (rag pickers in particular) who scavenge recyclables. A study

was conducted among the conservancy staff and rag pickers to examine the occupational health of MSW workers in India. A cross-sectional survey was conducted to collect data on the demographic and socio-economic characteristics of the rag pickers, conservancy staff and residents through a questionnaire survey.

Sandra van Niekerk and Vera Wegmann analyzed the municipal solid waste management in Africa. Public Services International (PSI) commissioned this report to inform the approach to, and activities in, the municipal waste management services sector of their affiliates in Africa.

Dr. Dhanalakshmi study the impact of waste management technology on women waste workers in composting. In this she analysis that the kudumbashree waste workers are doing a commendable job for the betterment of society by bringing about a healthier and cleaner living surroundings for the public. In spite of doing a vital job that is a prerequisite for any modern society. The lot of waste workers is often ends up as a thankless one. The most embarrassing situation is that waste workers by doing their dirty job find that their health, financial conditions as well as socio-economic situation are often at stake.

Siji S R conducted a study on role of kudumbashree in waste management in Ernakulam. This study is an attempt to examine the role of Kudumbashree in solid waste removal and disposal in the urban areas of Ernakulam district. Kudumbashree a women oriented poverty eradication programme of the Government of Kerala gave a new identity of worth to its members, especially the poor. It is the best vehicle through which the poor can be organized and the various income generating activities are helpful in improving the economic as well as social status of the poor women.

IJERT published an article related to waste management. This study introduces various alternatives for the municipal solid waste management (MSWM). The most economical and viable methods can be used for treating the waste from the city. The physical and chemical characterization of the waste indicates that the wastes are rich in biodegradables and plastics. The population forecasting details show that the waste produced in the future years are much higher and it keeps on increasing. Through the combined efforts of individuals from household and a proper MSWM system, Kochi city will be able to dispose waste generated and in future, piling up of legacy waste can be avoided.

**TROPICAL INSTITUTE OF ECOLOGICAL SCIENCES analyzed the municipal solid waste management in North paravur. In this study they also describes the role that are played by members of kudumbashree. It also evaluate the various issues and challenges faced by them.**

**Anjana Nandan and R Venkata Ravi conducted a study on kudumbashree. It reveals that Women are important unit of our society. The development of women that indicates the development of the society. The Kudumbashree is the hope and excitement of economic and social changes in Kerala. It's the highest priority movement of Government of Kerala. Poverty is one of the main issues faced by our nation. Poverty drop is not only a matter of an overall financial growth in a society, but also that is interrelated with several social facets like women empowerment.**

**Khaiwal Ravindra analyzed the Occupational exposure to the municipal solid waste workers in Chandigarh, India. It reveals that Manual handling of municipal solid waste is of serious concern owing to emerging occupational risks. Considering this, health risks of municipal solid waste workers involved in street sweeping, waste collection, waste processing and rag picking were assessed in Chandigarh, India, using an interview schedule as a study tool. Result shows that the waste worker profession is mainly dominated by males, except in rag pickers, and with a lower literacy rate.**

# **Chapter 3**

## **Methodology**

## **Chapter 3**

### **Methodology**

Methodology in research is defined as the systematic method to resolve a research problem through data gathering using various techniques, providing an interpretation of data gathered and drawing conclusions about the research data. Essentially a research methodology is the blueprint of a research or study (murthy and Bhojanna, 2009,p. 32).This study chooses quantitative approach and the research design used in this study is descriptive in nature. Descriptive research is defined as a research method that describes the characteristics of a population or the phenomenon that is being studied. In order to study the role of kudumbashree in solid waste management both primary and secondary data collection methods are used. In this chapter, the researcher briefly present the specific objectives, variables used and the methods and the techniques or tools employed for the collection of data.

### **Statement of the problem**

Waste management is considered as one of the main problem faced by both man and nature in the 21<sup>st</sup> century. Waste can be said as a by product of various human, agricultural, industrial and other activities. It is the human activity that has made waste as a problem that need to be managed. Solid waste management will not be a major problem in the earlier periods. Because there was less population and lots of fallow land. But in modern times, rapid urbanization, constant change in consumption pattern and social behavior have caused massive waste generation in the city beyond the assimilated capacity of environment and the supportive capacity of the existing waste management systems. There are lot of research works has been done about kudumbashree and women empowerment. But little attention was given to the urban poor women of kudumbashree who were engaged in waste management in kochi. So the present study attempt to

evaluate 'The role of kudumbashree in solid waste management with special reference to Kochi '.

## Objectives

### General objective

- To study the role of kudumbashree in solid waste management.

### Specific objectives

- To study the socio -economic profile of the members of kudumbashree engaged in solid waste management.
- To study the nature of the work of kudumbashree waste collectors.
- To identify the issues and challenges faced by kudumbashree waste collectors.
- To understand the level of satisfaction among the kudumbashree waste collectors.

## Operational definitions

- Kudumbashree :-In this study kudumbashree referred to an initiative who engaged in waste management in Kochi.
- Solid waste :-In this study solid waste being referred to the unwanted or useless solid materials from households in Kochi.

## Variables

### Independent variables

- Age
- Marital status
- Religion
- Educational level
- Family pattern

**Dependent variable**

**Level of satisfaction among kudumbashree waste collectors.**

## **Universe of the study**

**The universe of the study is Kochi city in Ernakulam district, Kerala**

## **Sample size**

**In order to study the role of kudumbashree in solid waste management a sample of 50 kudumbashree members were taken for the study.**

## **Method of sampling**

**The sampling method intended to use is simple random sampling.**

## **Tools of data collection**

**Questionnaire is used for data collection. The total number of expected responses was 50 and 50 respondents answered in cooperative manner.**

## **Chapter 4**

# **ANALYSIS AND INTERPRETATION**

# Chapter 4

## **Data Analysis and interpretation**

In this chapter the statistical analysis of the data and the interpretation of the results are presented. This chapter analyzes and interprets the four major objectives of this study. The collected data was edited and codified by the researcher.

Table no:4.1

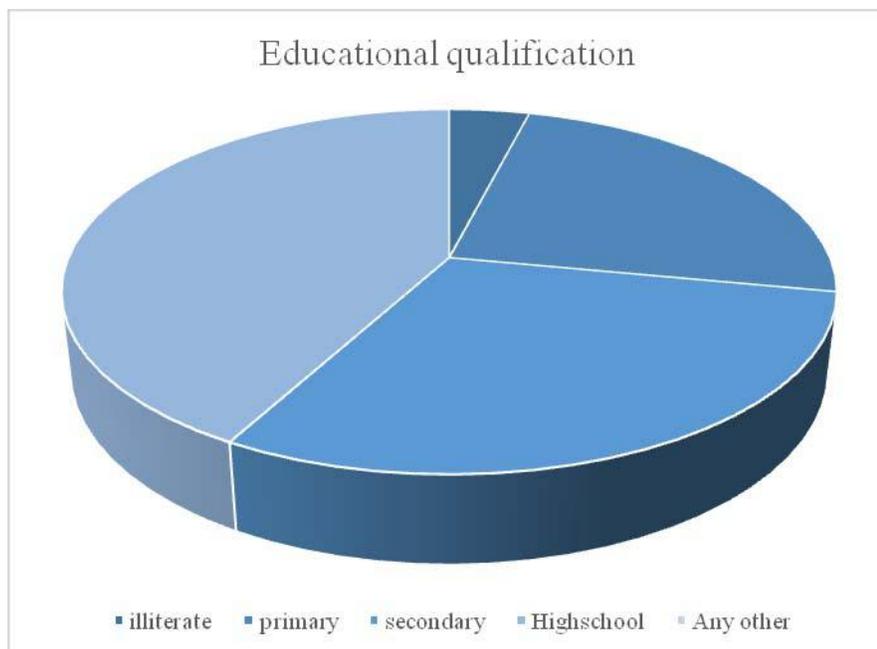
### Distribution of respondents on the basis of age

<b>Age</b>	<b>Number of respondents</b>	<b>Percentage</b>
<b>20-30</b>	<b>3</b>	<b>6</b>
<b>31-40</b>	<b>22</b>	<b>38</b>
<b>41-50</b>	<b>19</b>	<b>44</b>
<b>Above 51</b>	<b>6</b>	<b>12</b>
<b>Total</b>	<b>50</b>	<b>100</b>

The above table mentions the distribution of respondents according to their age. Respondents were categorized into four groups according to their age. This table shows that majority of the persons engaged in this activity belong to the age group of 41-50 years. 6% of respondents belong to the age group of 20-30 years. 38% of respondents belong to the age group of 31-40 years and 44% of respondents belong to the age group of 41-50 years and 12% of respondents belong to the age group of above 51 years category.

### Distribution of respondents on the basis of educational qualification

Figure 4.1

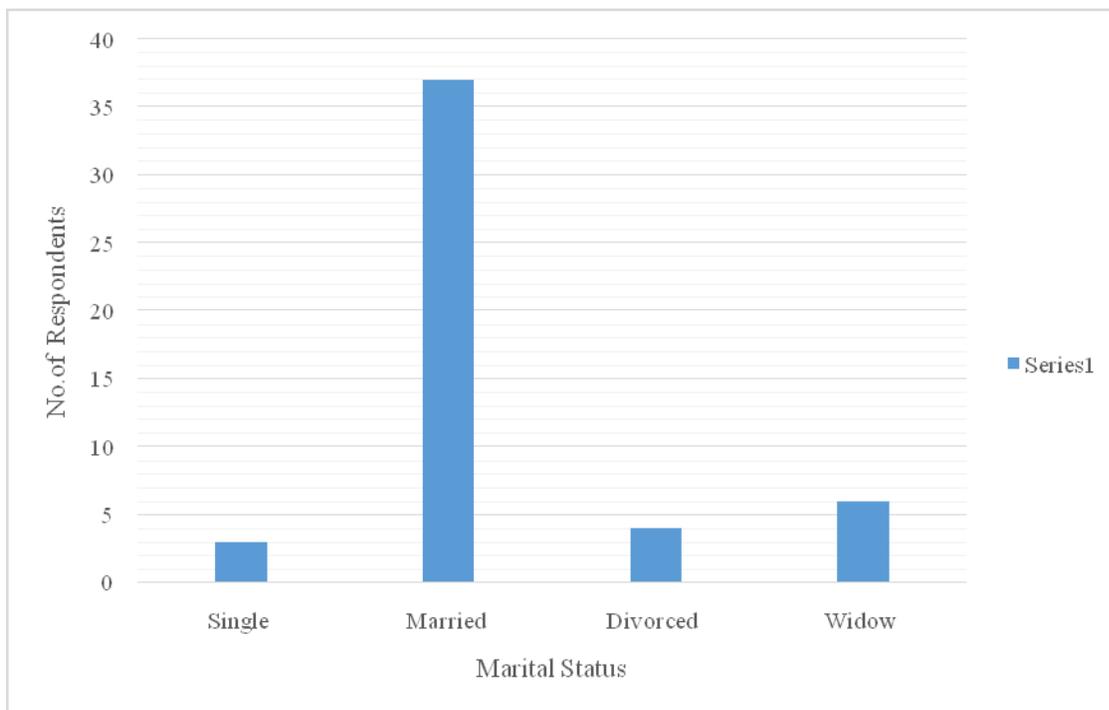


The above diagram shows that 42% of respondents have high school level education. 4% of respondents are illiterate. 24% of respondents have primary

level education, a few of them do not know how to read and write correctly. 30% of respondents have secondary level education.. And no one belongs to any other category. Among this analysis most of them have basic education, only few are illiterate.

### Marital Status Of Respondent

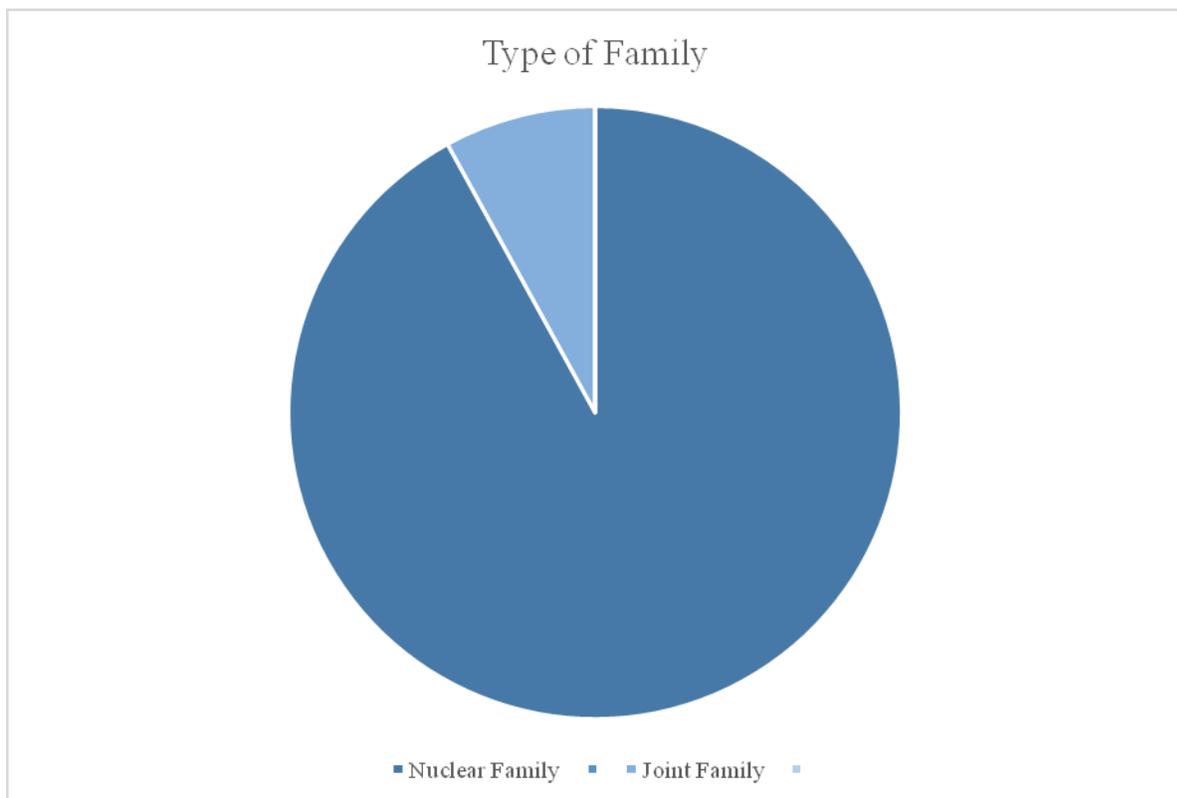
Figure 4.2



The above diagram shows that 74% of total population were married and majority among them were not depending on their husbands for livelihood. 6% of respondents were single and most of them belong to the age group of 31-40. 8% of respondents are divorced and 6 members were widows. In general the diagram shows a tendency that the kudumbashree women's

dependence on others has gradually come down and they have become self reliant.

**Distribution on the basis of type of family**



**Figure 4.3**

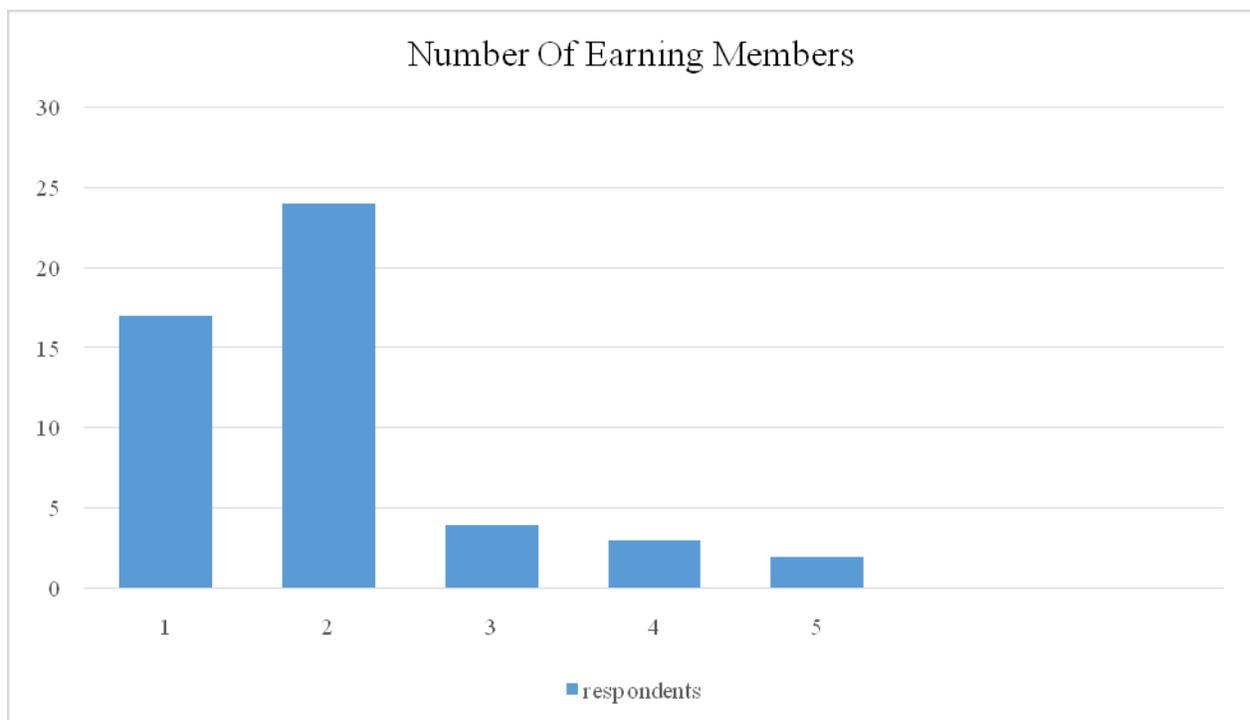
The figure 4.3 shows that 92percent of the respondents lead nuclear family and only 8 percent of the respondents were living in joint family system. So majority respondents are live in nuclear family.

### **NUMBER OF EARNING MEMBERS**

Table :4.2

<b>Number of Earning members</b>	<b>No. of Respondents</b>	<b>Percentage</b>
<b>1</b>	<b>17</b>	<b>34</b>
<b>2</b>	<b>24</b>	<b>48</b>
<b>3</b>	<b>4</b>	<b>8</b>
<b>4</b>	<b>3</b>	<b>6</b>
<b>5</b>	<b>2</b>	<b>4</b>
<b>Total</b>	<b>50</b>	<b>100</b>

The above table mentions that 48% of respondents have two earning members in their family and 34% of respondents have only one earning member in their family. 4% of respondents have 3 earning members. 6% of respondents have 4 and 4% of respondents have 5 earning members in their family. In this majority have two earning members in their family. The above table can be represented in the form of a bar diagram.



**Figure 4.4**

From the diagram it is clear that majority of the family has two earning members and number of five earning members are very low.

## Amount of Monthly Income

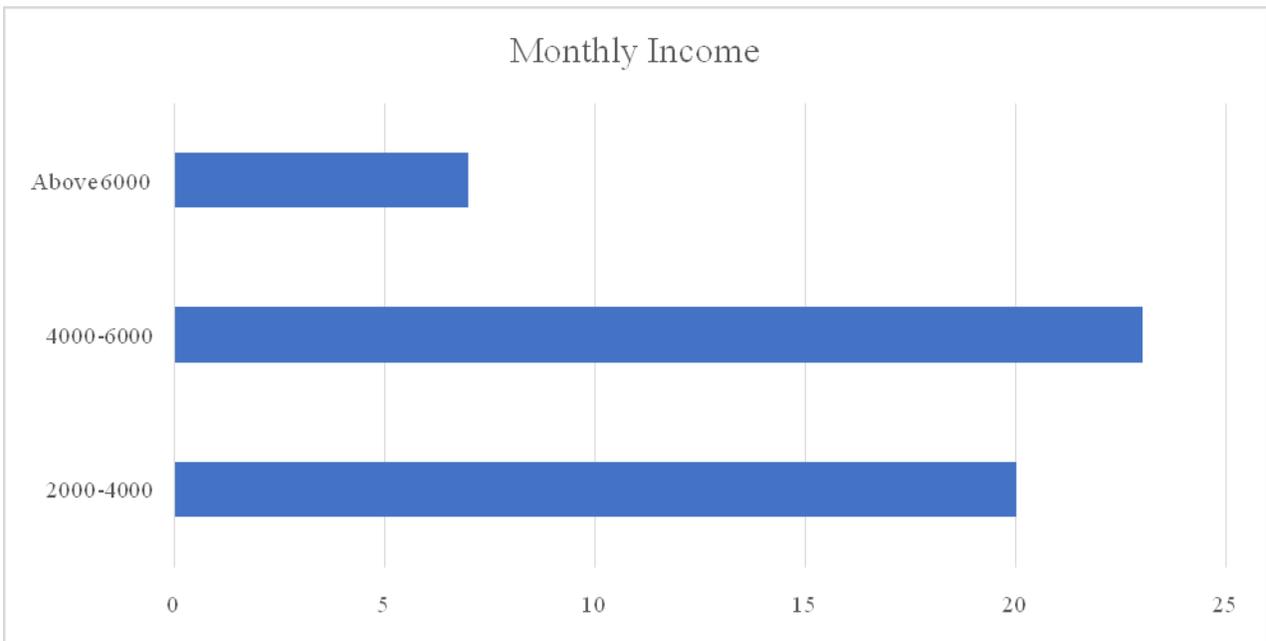
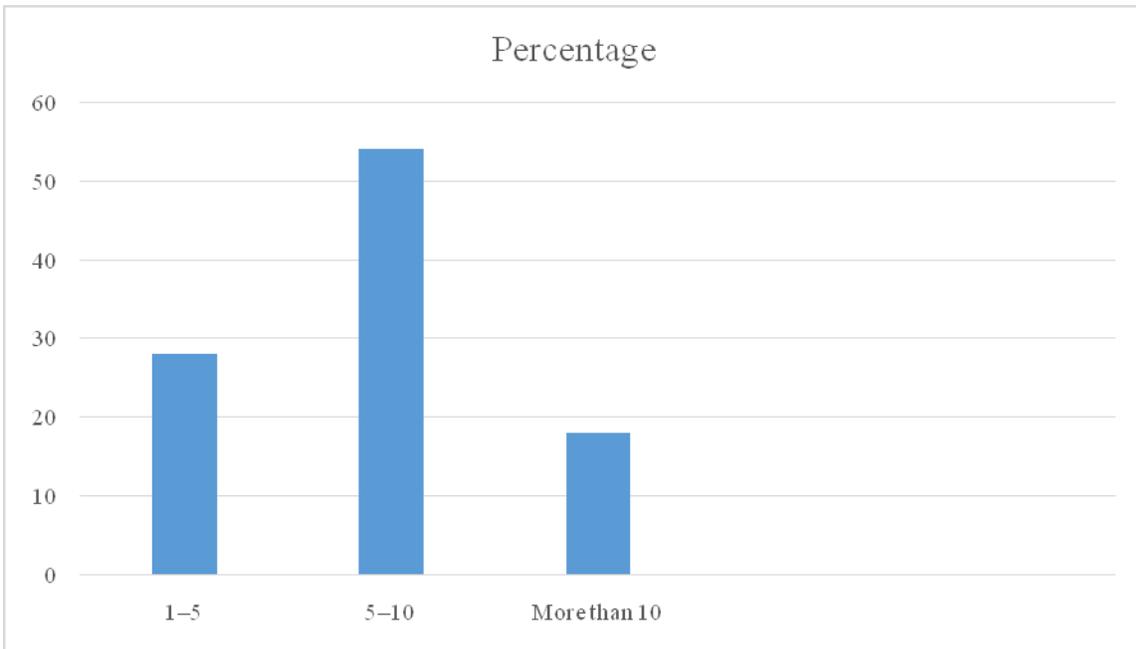


Figure 4.5

**Above diagram mentions the monthly income of the kudumbashree members. 46% of respondents have below 6000 income. 40% of respondents having income below 4000 and 46% of respondents have below 6000 income. 14% of respondents having above 6000 income. It shows that only few having income above 6000 and majority are belongs to 4000-6000 income category.**

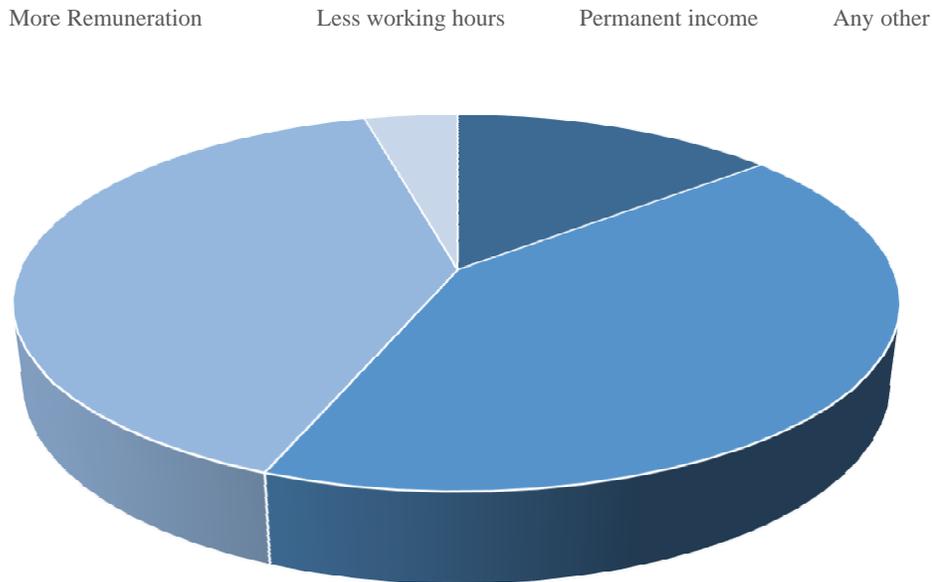
## Years of Experience in Kudumbashree

Figure :4.6



The above figure 4.6 mentions the years of experience in Kudumbashree. It shows that 54% of respondents having less than 10years of experience and 28% of respondents having less than 5years of experience in Kudumbashree.And only 18% of respondents having more than 10 years of experience.

## Reason For Selecting This Job



**Figure:4.7**

**The above diagram shows the reason for selecting this job. It mentions that 42% of respondents choose this job because of less working hours. So they can also engaged in other works. 40% of respondents choose this job because it gives permanent income and 14% of respondents choose this job because of more remuneration. And only 2 members choose this job for other reasons.**

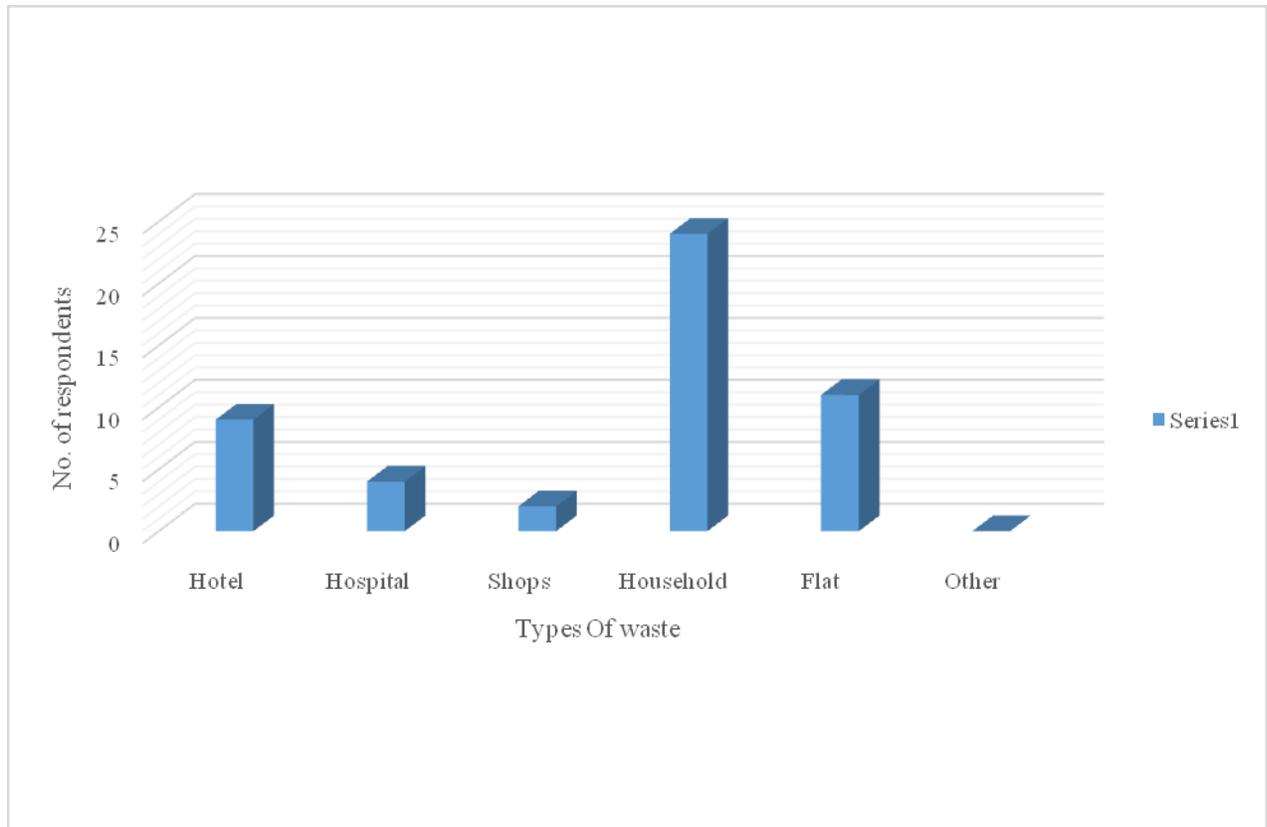
## **Proper Method of Waste Management**

<b>Proper method of waste management</b>	<b>No.of respondents</b>	<b>Percentage</b>
<b>Yes</b>	<b>46</b>	<b>92</b>
<b>No</b>	<b>4</b>	<b>8</b>
<b>Total</b>	<b>50</b>	<b>100</b>

**Table:4.3**

**Table 4.6 explains the proper method of waste management of the respondents. In this 92% of respondents have proper method of waste management and 8%of respondents don't have proper method of waste disposal.So majority have proper methods of waste management.**

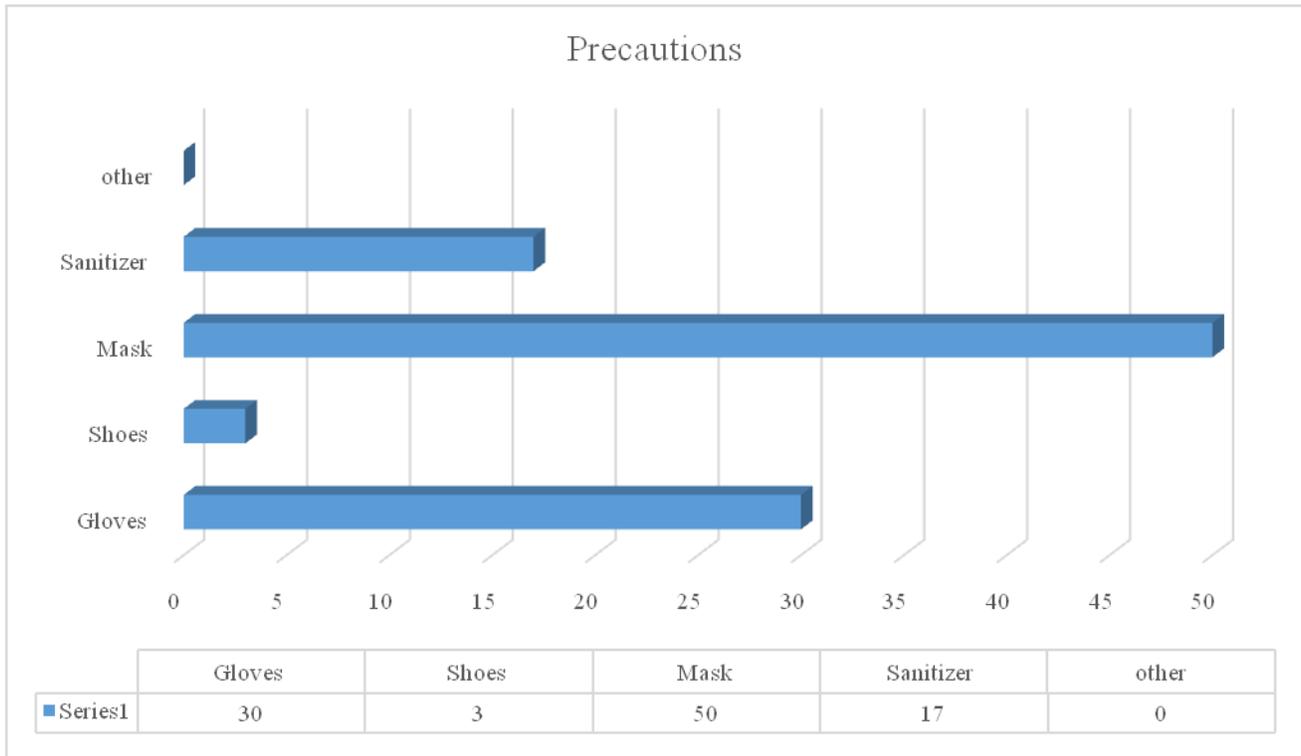
## Types of Waste Collected



**Figure :4.8**

**The above bar diagram shows that majority of the members are collecting waste only from houses. In this 48% of members are collecting waste from houses and 18% of members are collecting waste from hotels and 8% of members collecting waste from hospitals. 4% of members collecting waste from shops and 22% of members are collecting waste from flats.**

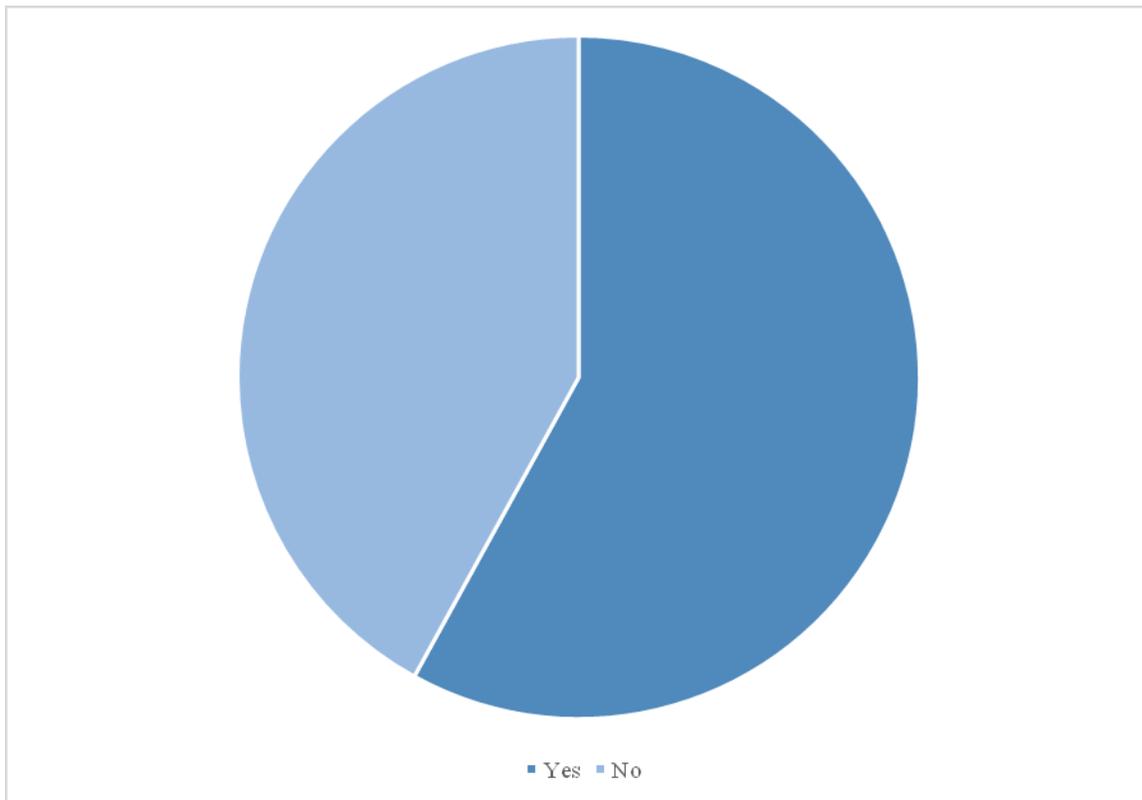
## Precautions While Collecting Waste



**Figure :4.9**

**The above diagram reveals that majority are take precautions while collecting waste. 60% of members are use gloves and all are wear mask because of this pandemic situation. 34% of members use sanitizer after collecting the waste and only 6% of members use shoes which is provided by the authority. So majority are use some precautions while collecting the waste.**

## **Training And Guidelines Provided By The Authority**



**Figure :4.10**

**In the above diagram mentioned that out of 50 members surveyed, 29 members got training. Remaining 21 members had no such training. Majority are responded that when a new worker joint there are some guidelines**

provided by the authority. And also in this pandemic situation the authority updates its guidelines.

## Safety Equipment Provided By The Authority

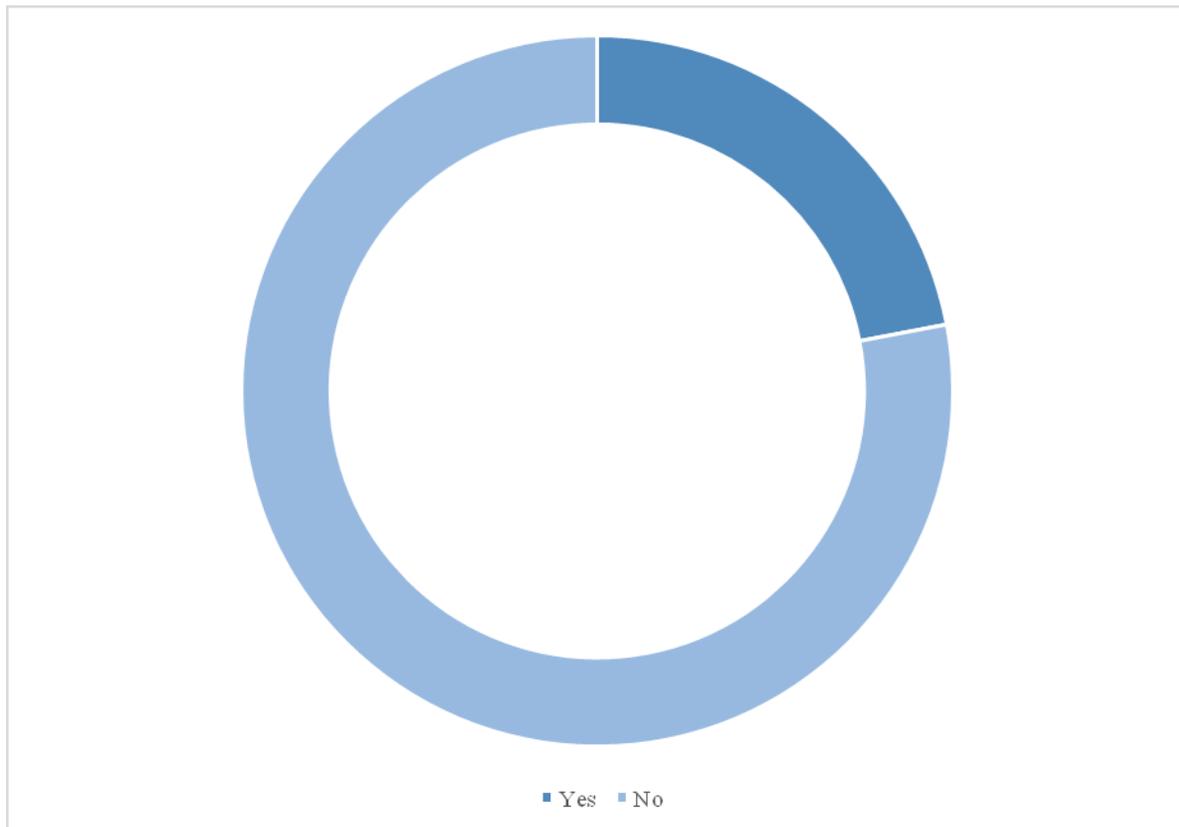


Figure :4.11

This diagram shows that out of 50 members only 11 members receive safety equipments from the authority. And 39 members don't receive any safety

measures from the authority. Majority members responded that they don't receive any safety equipment from the authority.

## Means of Transporting Waste

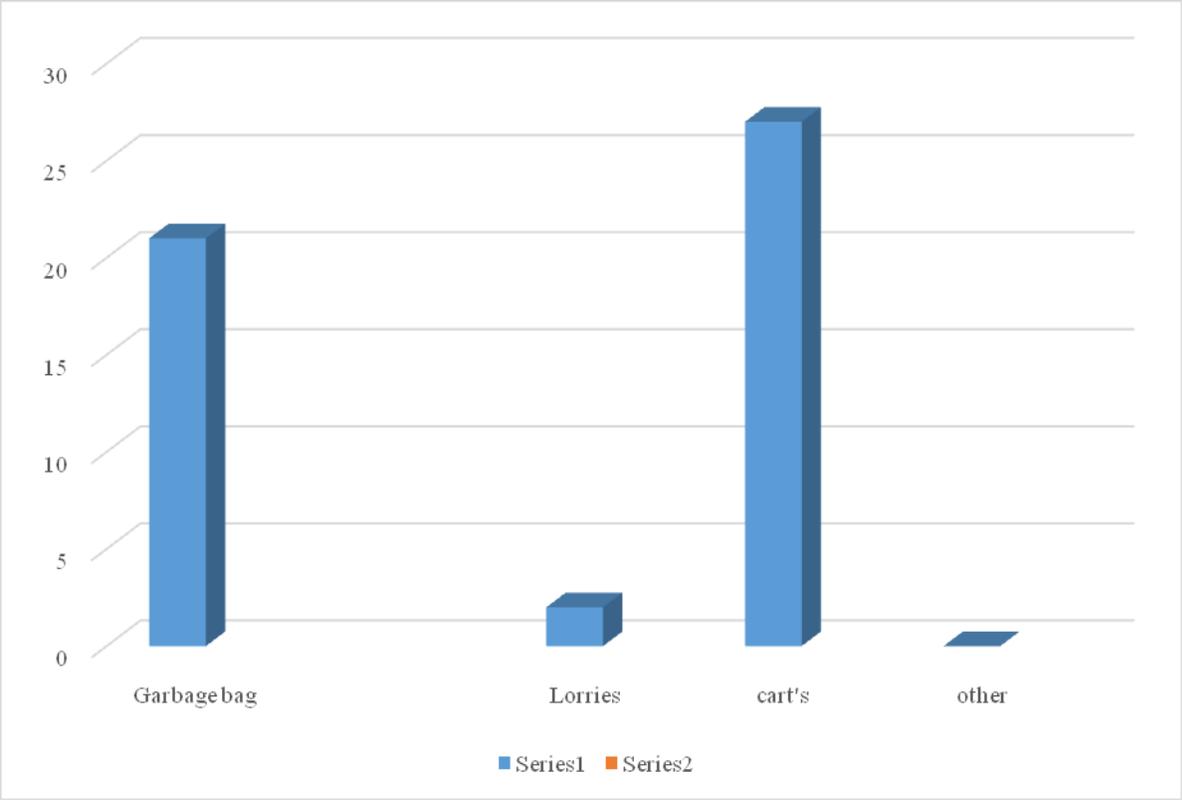


Figure :4.12

The above figure explains that 54% of respondents use hand carts for collecting waste from houses, flats, hotels etc. These carts are provided by the municipal corporation. 42% of respondents use garbage bags for collecting waste. And only 4% of respondents use small lorries to transport waste to the collection point.

### Number of Shift of Work

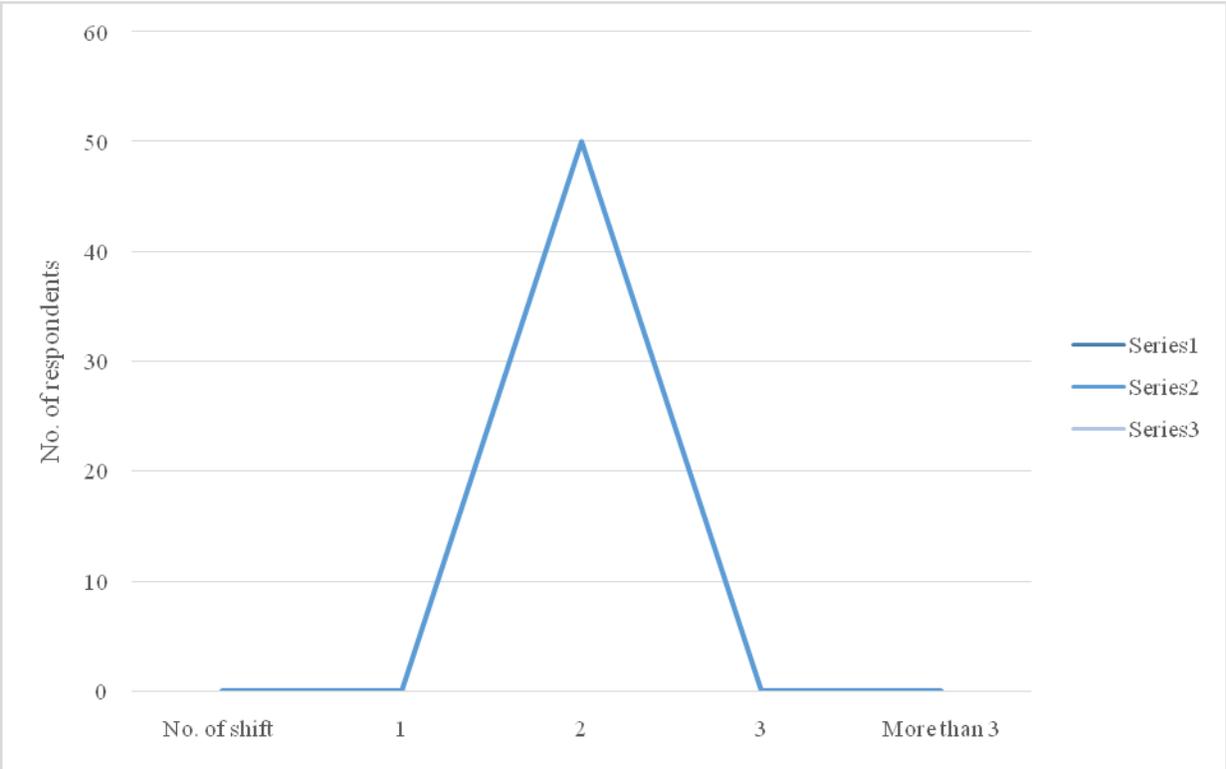
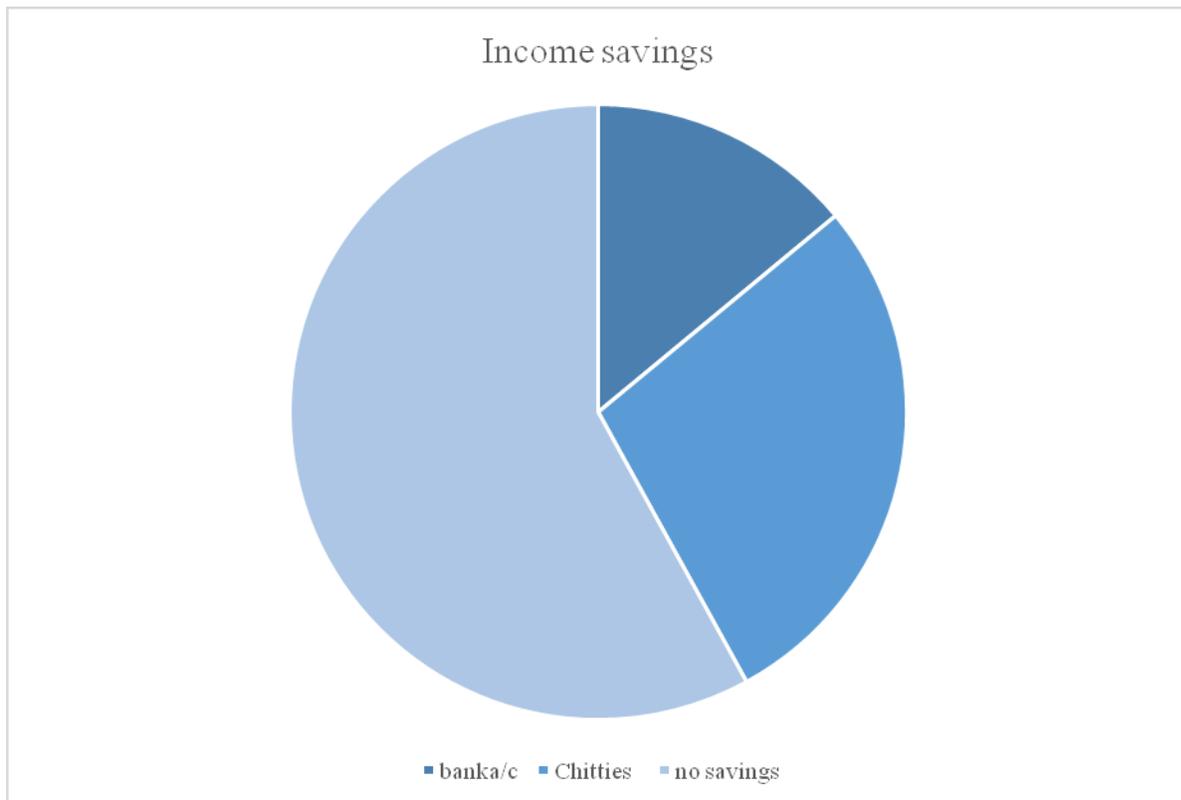


Figure :4.13

The above figure 4.13 reveals that all respondents have two shift of work and no one have 1,3 and more than three working shifts. So they can engaged in some other works and it give more income to the members of kudumbashree.

### MODE OF INCOME SAVINGS



**Figure :4.14**

From the above diagram, it is clear that majority have no savings. 14% of respondents save their income in bank accounts and 28% of respondents have Chitties as their savings. 58% of respondents have no savings.

## Problems Faced by Waste Collectors



Figure :4.15

The above figure shows that 52% of waste collectors face health problems and 38% of respondents face stigma and harassments from the society. Only 4% of members responded that they receive poor training from the authority and 6% of respondents face other issues. It is clear that majority waste face health problems.

### Stigma and Harassment's from the Society

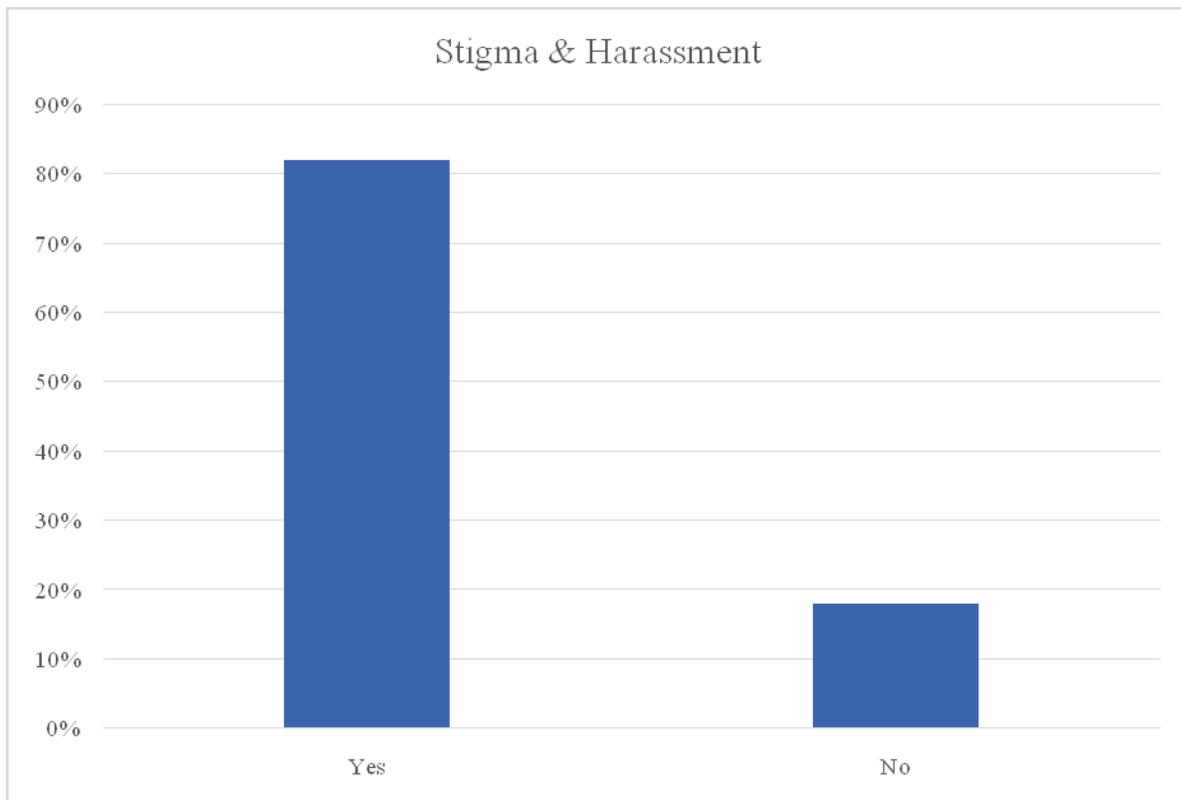


Figure :4.16

Above figure reveals that out of 50 respondents 82% of members face stigma and harassment from the society. 18% of members responded that they don't face any stigma and harassment from the society. So it is clear from the diagram that majority face stigma and harassment from the society and it affected their mental health. The reason they do this job is because of their poor financial situation.

## Health Problems of The Kudumbashree Members

Table :4.4

Health problems	No.of respondents	Percentage
<b>Yes</b>	<b>48</b>	<b>96</b>
<b>No</b>	<b>2</b>	<b>4</b>
<b>Total</b>	<b>50</b>	<b>100</b>

The above table shows that 96% of the respondents face health problems while collecting waste and 4% of respondents don't face health problems. Majority face different types of health problems in collecting waste. The authorities must convince the workers about the various diseases

and how they can be avoided by taking sufficient precautions by providing sufficient training programmes.

## Major Health Problems

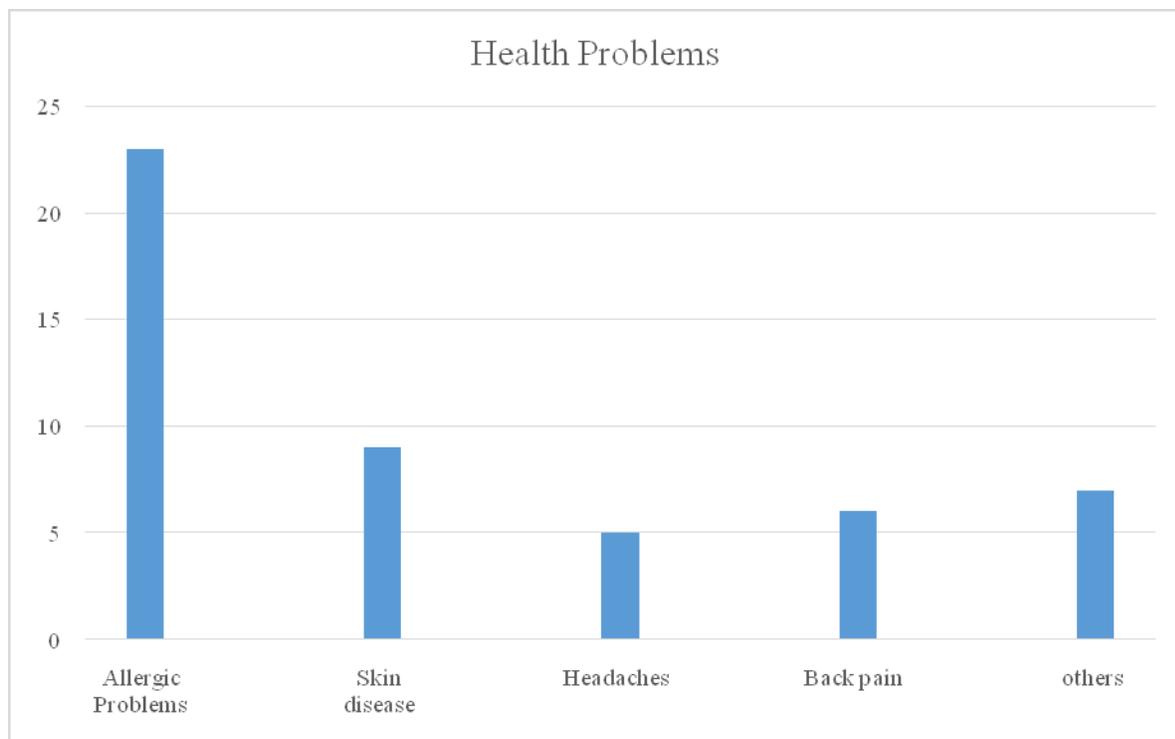
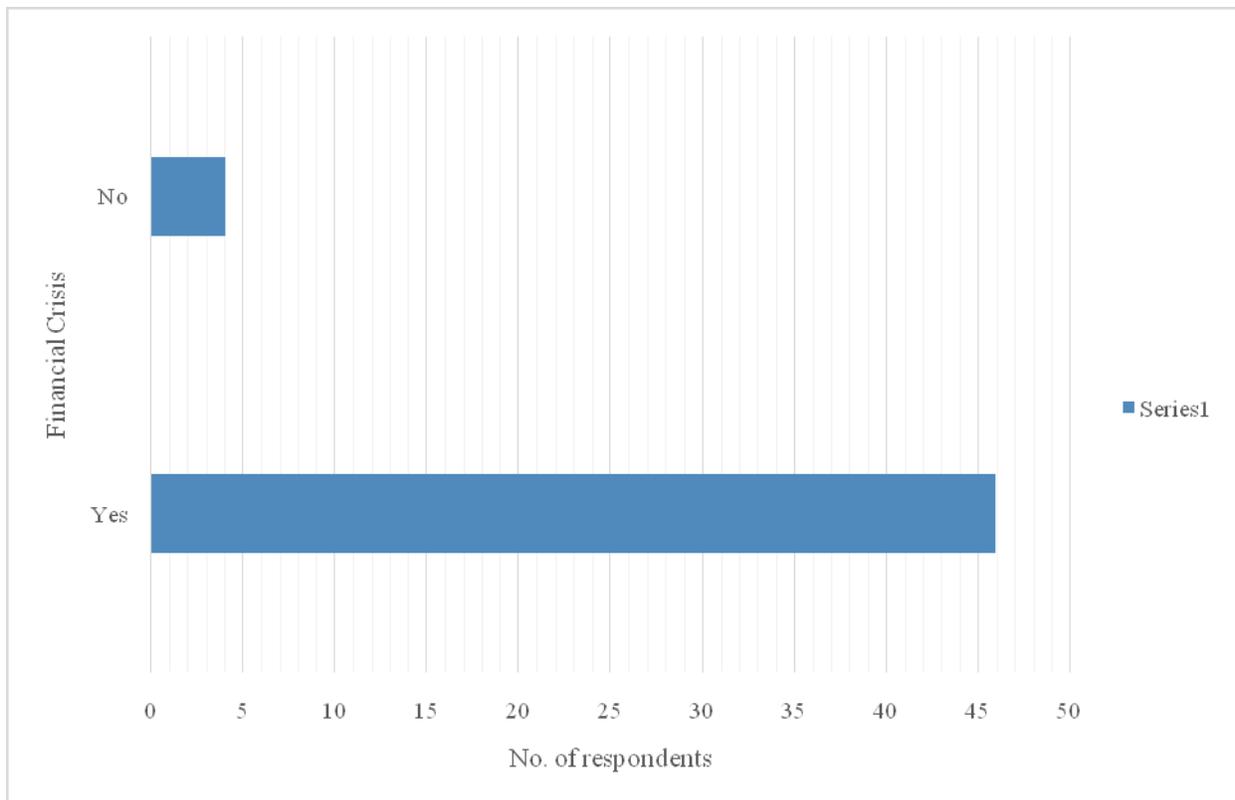


Figure :4.17

The above figure shows that 46% of respondents suffered from allergic problems and 18% of respondents suffered from skin diseases. 10% of members have headache's and 12% of members suffering from back pain. 7% of respondents suffered from other diseases like cholera, typhoid, asthma

etc. It is noted that most of the kudumbashree members covered under this study suffering from different kinds of problems.

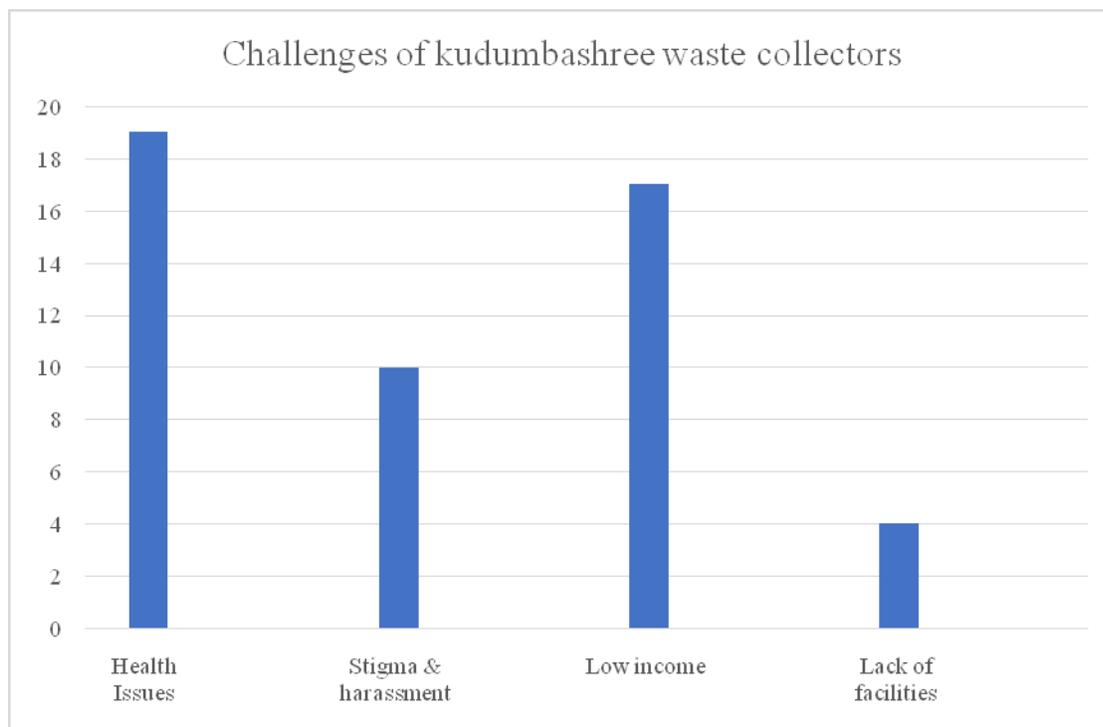
## Financial Crisis Faced By Kudumbashree Members



**Figure :4.18**

Above diagram mentions that 92% of respondents have loan or financial crisis and only 8% of respondents have no loan or financial crisis. The purpose of loan or financial crisis because of house construction, renovating house, taking house lease, marriage of their daughter, children's education etc.

## **Main Challenges Faced By Waste Collectors**



**Figure :4.19**

In the above diagram mentions the main challenges faced by kudumbashree waste collectors. It shows that 19 members are suffering from health issues and 10 members are suffered from stigma and harassment. 17 members responded that considering corporation workers they don't have minimum wages. It reveals that large number of them do not get paid enough for the service they provide. And 4 members responded that there are no basis facilities provided by the authority.

### Satisfaction Level of This Job

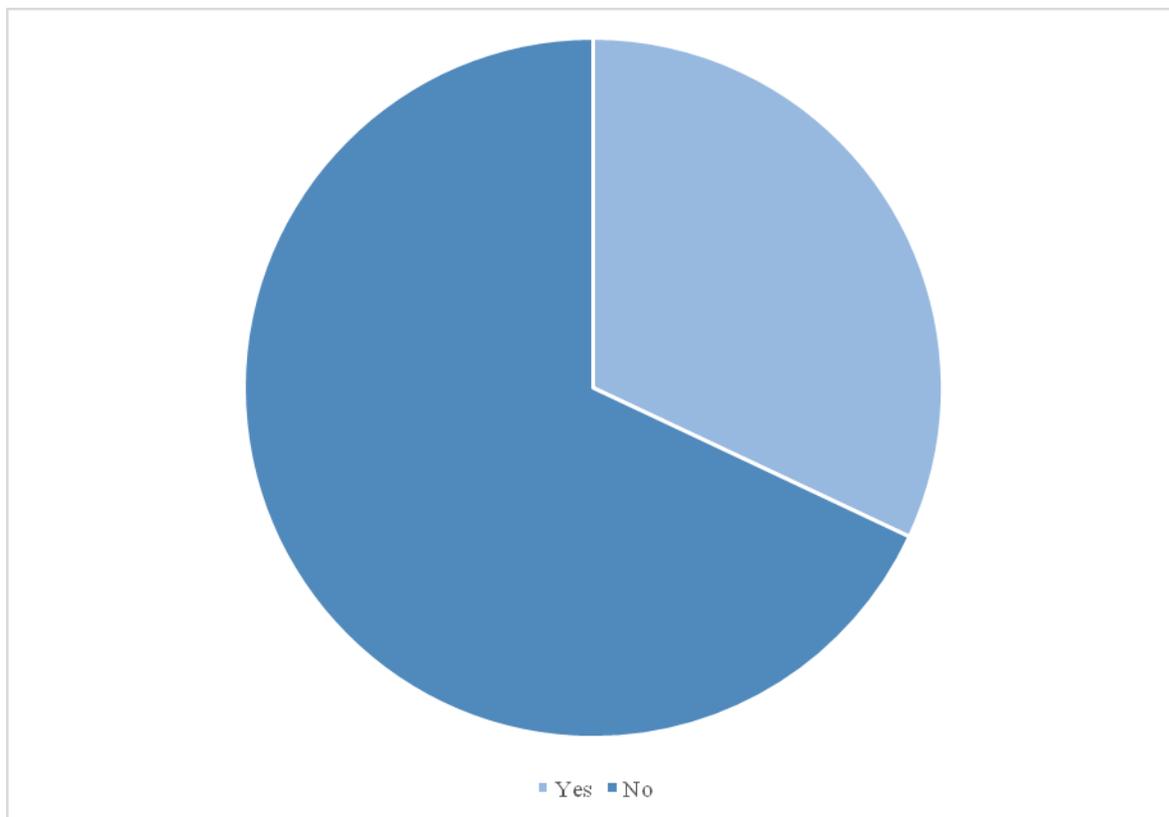


Figure :4.20

**In this figure, it is clear that out of 50 members 68% of respondents don't satisfied with this work. The reason for this was there is no support from the authority and the society. Because of the ill treatment from the society majority waste collectors suffer from depression and other mental issues. And also there are no basic facilities provided by the authority. Even in this pandemic situation majority of them don't get any safety equipments from the authority. The reason for they do this job is because of their poor financial situation. 32% of respondents are satisfied with this job.**

# **Chapter 5**

## **Findings And Conclusion**

## **Chapter 5**

# **Findings And Conclusion**

**This study was conducted to find out the role of kudumbashree in solid waste management with special reference to Kochi city. Here the independent variables are age, marital status, religion, educational level and family pattern and the dependent variable of the study is level of satisfaction among kudumbashree members. Simple random sampling method is intended to use for collect data.**

**The first objective of the research was to study the socio-economic profile of the members of kudumbashree engaged in solid waste management. In a sample of 50 respondents, the majority (44%) of respondents belong to the age group of 41-50 years and 6% of respondents belong to the age group of 20-30 years. 38% of respondents belong to the age group of 31-40 years and only 12% of respondents belong to the age group of above 51 years category. 42% of respondents have high school level education. 4% of respondents are illiterate and 24% of respondents have primary level education. 30% of respondents have secondary level education. 74% of total respondents were single and 6% of members were widows. Considering their type of family 92% of the respondents lead nuclear family and 8% of the respondents were living in joint family. In this 48% of respondents have two earning members and 34% of respondents have only one earning member in their family. 46% of respondents have below 6000 income and 40% of respondents having income below 4000. 14% of respondents having above 6000 income**

**The second objective of the research was to study the nature of the work of kudumbashree waste collectors. Considering years of experience in Kudumbashree 54% of respondents having less than 10 years of experience. 28% of respondents having less than 5 years of**

experience and only 18% of respondents having more than 10 years of experience. 42% of respondents choose this job because of less working hours and 40% of respondents choose this job because it gives permanent income. 14% of respondents choose this job because of more remuneration. 92% of respondents have proper method of waste management and 8% of respondents don't have proper method of waste disposal. 48% of members are collecting waste from house and 18% of respondents collecting waste from hotels. 22% of respondents collect waste from flats and 8% and 4% of respondents collecting waste from shops and hospitals. In this 60% of respondents use gloves and all are wear mask. 37% of respondents use sanitizer and 6% of respondents use shoes. In a sample of 50 respondents only 29 members got training and 21 respondents had no such training. Out of 50 respondents majority( 78%) don't receive any safety measure from the authority. 42% of respondents using garbage bag and 54% of respondents using hand cart's and 4% of respondents use Small lorries to transport waste to the collection point. Majority of the respondents have two shift of work and no one have 1,3 and more than three working shifts. And also majority (58%) of respondents have no savings.

The third objective of the study was to identify the issues and challenges faced by kudumbashree waste collectors. Among the 50 respondents 52% of waste collectors face health problems and 38% of respondents face stigma and harassments from the society. 6% of respondents face other issues. It is clear that majority waste collectors face health problems. Out of 50 respondents 82% of members face stigma and harassments from the society. Majority are face stigma and harassments from the society and it affected their mental health. 96% of respondents face health problems and 4% of them responded that they don't face any health problems. 46% of respondents suffered from allergic problems and 18% suffered from skin disease. 10% of respondents have headaches and 12% of respondents suffering from back pain. 7% of respondents have loan or financial crisis and only 8% of respondents have no loan or financial crisis. 38% of respondents suffering from health issues and 34% of respondents they don't have minimum wages and 20% of respondents suffered from stigma and harassment.

**The fourth objective was to understand the level of satisfaction among the kudumbashree waste collectors. In a sample of 50 respondents 68% of respondents don't satisfied with this work. The reason for this was there is no support from the authority and the society. Because of the ill treatment from the society majority waste collectors suffer from depression and other mental issues. And also there are no basic facilities provided by the authority. Even in this pandemic situation majority of them don't get any safety equipments from the authority. The reason for they do this job is because of their poor financial situation. 32% of respondents are satisfied with this job.**

## **Suggestions**

**After considering the problems which these workers are facing the following are some suggestions.**

- The main problem they face while collecting waste is that they don't receive any safety equipment from the authority. It is recommended that the authority should provide safety equipments to the waste collectors. Because it is essential in this occupation.**
- The authority must consider the health and hygienic of the workers in this field. Regular and free medical check -ups should be provided by the authority in the health department.**
- Another suggestion is that the authority should provide ID cards to the waste collectors.**
- The authority should provide sufficient training programs to the kudumbashree workers.**

- **There are no pension scheme introduced for the aged workers. Pension scheme must be introduced for the welfare of the workers.**
- **Local bodies must make a provision in their budgets to provide tools and equipments to the kudumbashree members.**

## **Conclusion**

**Kudumbashree project was started Kerala in 1998. women empowerment is one of the important objective of kudumbashree along with poverty eradication. The main aim of the kudumbashree scheme is to improve the standard of living of poor women in rural areas by setting up micro credit and productive enterprises. It opened a new string of expected events in our development history. Kudumbashree is the poverty eradication programme of the state of Kerala. It is usually a community based self help institution involving poor women. Kudumbashree was considered as a joint programme of the government of Kerala and NABARD implemented through community development societies of poor women. As per the documents associated with this program, women want to identify their inner strength opportunities for growth and their role in reshaping their own destiny. So the well known kudumbashree initiative of the government of Kerala, a women-centred poverty eradication program has proved more popular and more enduring than any other poverty alleviation programs that targeted women. Kudumbashree also gives a new identity of worth to its members especially the poor. It has helped them in reinvent their roles in households and in society. Thus kudumbashree act as a guide for taking up many developmental and welfare activities for the poor women especially women in rural areas. Solid waste is one among them. Kudumbashree associate with local bodies, Haritha Keralam mission, suchitwa mission and clean kerala company in waste management efforts. As many as 22,119 kudumbashree**

**workers are deployed as Green Task Force members in 689 local bodies across the state. They are part of 638 Green Task Force Groups in gram panchayats and 81 urban local bodies.**

**This study shows that Kudumbashree waste workers are doing a commendable job for the betterment of the society by bringing about a healthier and cleaner living surroundings for the public. But at the same time they face many problems like stigma and harassments, health risk, lack of adequate income and economic power etc. And also the authority don't provide any safety equipments to the members. So the government should take necessary measures for the betterment of the kudumbashree waste collectors. Because Thus a joint effort of Kudumbashree workers with other state workers and various service organizations are needed for the successful waste management programme in kochi city. The local bodies must provide enough support and help for this attempt.**

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# **Appendix**

# Questionnaire

1. Name of the kudumbashree member

2. Locality

3. Age

20-30  31-40

41-50  51&above

4. Educational level

Illiterate  primary

Secondary  High school  Any other

5. Marital status

Single  married  Divorced  Widow

6. Type of family

Nuclear family  Joint family

7. Number of earning members

1  2  3  4  5

8. Amount of monthly income

2000-4000  4000-6000  Above 6000

9. Years of experience in kudumbashree

1-5  5-10  More than 10

10. Reason for selecting waste management as an employment option?

11. Do you have a proper method of waste management?

Yes                      No

12. Which type of waste are collected?

Hotel  Hospital  shops  Households

Flats  Any other

13. Where exactly is the place where you store the collected waste for final disposal?

14. What are the precautions that you take while collecting waste?

Gloves  Shoes  Mask

Sanitizer  Any other

15. Do you receive training and guidelines from the authority for waste disposal?

Yes                       No

16. Do you receive any safety equipments from the authority?

Yes                       No

17. Means of transporting waste to the dumping area

Garbage bag  Lorries  Cart's  any other

18. Number of shift of work in a day

1     2     3     More than 3

19. Mode of income savings

Bank a/c                       Chitties                       No savings

20. What are the problems that you faced while doing this job?

Explain

21. Do you face any stigma and harassments from the society?

Yes      No

**22. Do you think that this job damage your health?**

Yes       No

**If yes which type of diseases ?**

**23. Do you have loan or other financial crisis?**

Yes       No

**24. What are the main challenges that you faced in this field?**

**Explain**

**25. Are you satisfied in this job?**

Yes       No

**26. Your suggestions**

**A SOCIOLOGICAL STUDY ON CLAN IDENTITY  
AMONG THE ANGAMI NAGAS AT KOHIMA  
DISTRICT**



By

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**MARCH 2022**



**A SOCIOLOGICAL STUDY ON CLAN IDENTITY AMONG THE ANGAMI NAGAS AT  
KOHIMA DISTRICT**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of Master of Arts in Sociology*

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Dr. Elizabeth Abraham  
Head of Department

**MARCH 2022**



## **CERTIFICATE**

I, certify that the thesis entitled **“A SOCIOLOGICAL STUDY ON CLAN IDENTITY AMONG THE ANGAMI NAGAS AT KOHIMA DISTRICT”** is a record of bonafide research work carried out by Kekhriengunuo Dztüvichü, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.



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**March 2022**

## DECLARATION

I, Kekhriengunuo Dzüvichü, hereby declare that the thesis entitled “A sociological study on clan identity among the Angami Nagas at Kohima District” is a bonafide record of independent research work carried out by me under the supervision and guidance of Dr. Lebia Gladis N.P. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

Place: Ernakulam

March 2022

*Kekhriengunuo*  
Kekhriengunuo Dzüvichü

## ACKNOWLEDGEMENT

This study would not have been a success without the support, guidance and effort of many people. First and foremost I thank God Almighty, for the abundant grace showed on me which helped me to carry on and complete the thesis.

I sincerely express my gratitude to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Matthew for giving me this opportunity.

My sincere gratitude to my research guide Dr. Lebia Gladis N.P, for her effort, constant guidance, supervision, support and patience throughout the course of this study, which greatly helped me in the completion of this thesis.

I also take this opportunity to thank the Head of the Department of Sociology Dr. Elizabeth Abraham and all the staffs of the Department for their never ending encouragement, support and supervision in accomplishing this work.

A very special thanks to all my respondents, for their honest and cooperative response to all the questions solicited in this study.

My thanks and appreciation also goes to the librarians of St. Teresa's College, Ernakulam.

I convey my deepest gratitude to my parents for their constant prayer, encouragement and support. Last but not the least; I would like to thank my families and classmates for their love and support. Thank you.

*Kekhriengunuo*  
Kekhriengunuo Dzüvichü

## CONTENTS

SL. NO	TITLE	PAGE NO
1	INTRODUCTION	1 - 27
2	REVIEW OF LITERATURE	28 - 39
3	METHODOLOGY	40 - 46
4	ANALYSIS AND INTERPRETATION	47 - 83
5	FINDINGS AND CONCLUSION	84 - 89
6	BIBLIOGRAPHY	
7	APPENDIX	

## LIST OF TABLES

<b>TABLE NUMBER</b>	<b>TITLE</b>	<b>PAGE NO</b>
Table 4.1	Age of the respondents	48
Table 4.2	Educational qualification of the respondents	50
Table 4.3	Occupation of the respondents	51
Table 4.4	Table representation of whether with the advent of modernity, the mutual social relationship that exists between clan members is fading away.	66
Table 4.5	Table representation of whether Angami Nagas have social gathering.	67
Table 4.6	Table representation of the important social gatherings among the Angami Nagas.	68
Table 4.7	Table representation of whether Angami Nagas follow any customs.	69
Table 4.8	Table representation of the customs practiced by the Angami Nagas.	70 - 71
Table 4.9	Table representation of the different kind of conflict resolution that exists among the Angami Nagas.	78
Table 4.10	Table representation of whether conflict resolution is losing its significance today.	79
Table 4.11	Table representation of whether customary conflict resolution among the Angami Nagas is based on social justice.	80

## LIST OF FIGURES

<b>FIGURE NUMBER</b>	<b>TITLE</b>	<b>PAGE NO</b>
Figure 4.1	Gender of the respondents	49
Figure 4.2	Marital status of the respondents	52
Figure 4.3	Locality of residence of the respondents	53
Figure 4.4	Family type of the respondents	54
Figure 4.5	Figure showing whether the clan members support each other in socio-economic activities.	55
Figure 4.6	Figure showing whether the economic status of the Angami Nagas determine their position in the community.	56
Figure 4.7	Figure showing whether the shift in residence to town from villages is a result of the rise in the standard of living among the Angami Nagas.	57
Figure 4.8	Factors for clan identity of Angami Nagas	58
Figure 4.9	Figure showing whether the Angami Naga give more loyalty to their clan than to their village.	59
Figure 4.10	Figure showing whether the clan members share a strong 'we feeling'.	60
Figure 4.11	Figure showing whether the strength of clans determine the village outlook.	61
Figure 4.12	Figure showing whether the Angami Nagas claim solidarity based on clan identity.	62

Figure 4.13	Figure showing whether the clan identity is losing its significance today.	63
Figure 4.14	Figure showing whether clan forms the backbone of the Angami social structure.	64
Figure 4.15	Figure showing whether clan members feel obligated to give mutual support to fellow clansmen in times of need.	65
Figure 4.16	Figure showing whether clan exogamy still exists in the strict sense among the Angami Nagas.	72
Figure 4.17	Figure showing whether the present generations respect the tradition of not marrying within the same clan.	73
Figure 4.18	Figure showing whether the Angamis are aware of anyone within their clan who followed endogamy.	74
Figure 4.19	Figure showing whether exogamy is important genetically.	75
Figure 4.20	Figure showing whether people in the society look down on those who followed endogamy.	76
Figure 4.21	Figure showing whether conflict resolution is effective among the Angami Nagas.	77
Figure 4.22	Figure showing whether conflict resolution among the Angami Nagas is depended on oral tradition of the past.	81
Figure 4.23	Figure showing whether modern traditions and rules have affected the conflict resolution among the Angami Nagas.	82 - 83

# **CHAPTER - 1**

## **INTRODUCTION**

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Peter Burke said, 'Identities tell us who we are and they announce to others who we are'. Identity is the qualities, beliefs, personality traits, appearance and/or expressions that characterize a person or group. Identity is the state of sameness. It is who or what a person or thing is. The state of being 'the same' connects or brings people or things together. This process creates and defines identity and explains who a person is or what a thing is. Identity refers to how people answer the question, 'Who are you?' This question may be posed explicitly or implicitly, at a personal or a collective level, to others or to oneself. In social sciences, the term 'identity' refers to a group's or individual's sense of who they are.

### **CLAN**

Clan is a kinship group or a distinct family based on actual descent from a common ancestor, as traced through the male (patriclan) or the female (matriclan) line. In simple words, we can say that a clan is a collection of particular families who have the same ancestors or a group of people who believe they share a common progenitor. A clan is an exogamous break-up of a tribe. The members of a clan have some common ties that bind them together. Thus, we can say that a clan is a collection of unilateral families who believe themselves to share the same lineage of a real or mythical forefather. A clan consists of many nuclear families and it is through these clans that men derive their identity, inheritance rights, social obligations and responsibilities and thereby, social recognition is gained.

The English word 'clan' is derived from the old Irish 'clan' which means 'children', 'offspring', 'progeny' or 'descendants'. According to the Oxford English Dictionary, the word 'clan' was introduced into English around 1425, as a descriptive label for the organization of society in Ireland and the Scottish Highlands.

The meaning of 'Clan' according to the Oxford dictionary is, 'group of families with common ancestors'. According to Majumdar and Madan, "A Sib or clan is often a combination of few

lineages and descent who may be ultimately traced to a mythical ancestor, who may be a human or human like animal, plants or even in animate”.

According to William P. Scott, Clan refers to a “unilateral kin-group based on either matrilineal or patrilineal descent”.

R.N.Sharma defines, “A clan is that collection of unilateral families whose members believe themselves to be the common descendants of real or mythical ancestors”.

The clan system is an important characteristic of a tribal society, in which each tribe is usually divided into several clan groups and each having its own name and identity. Clans give a sense of shared identity and descent to its members. Clan is strongly based on ‘we feeling’. The clan members are believed to be related to one another by some common ties such as the belief in descent from common possession of a common totem or the habitation of a common territory. The clan names are based on various grounds such as it may be after a totem, an animal, plants. Thus, we can say that clan is a collection of unilateral families in which the members believe themselves to be the common descendants of a real or mythical ancestor.

The membership in a clan is often defined in terms of descent from common ancestors. A clan is never make up by combining the lineages of both the mother and the father. It is unilateral which means that it may be only either of matrilineal or patrilineal lineage. Thus, Clan descent is traced through only one line that is either through the male or the female line.

The clans are usually exogamous in nature and marriage within the clan is forbidden and considered as an incest. All the members of a clan considered themselves to be the descendants of a common ancestor so they do not marry any member within their own clan. So marriage is contracted only out of one’s own clan.

Some of the major functions of clan are:

Providing mutual assistance and protection to the members of their own clan. The members shared a strong ‘we feeling’ because of their belief that they have descended from a common ancestor. The clan members not only provide assistance to each other but they are also provided protection to each other. When one clan’s member is harmed or injured, all the members get together to share his pain. The most common saying among clan members, which clearly express

their 'we feeling' are 'Strike my clan brother, and you strike me' and 'The blood of the clan is my blood'. The clan members provide assistance and support to each other during the time of death, marriage, important events etc. They also provide protection whenever one of their clan member is in trouble. Clan membership is useful in ensuring mutual support and defense as well as mediation of disputes such as disputes over property rights etc.

The clan also control over its members. Individuals who indulge in anti-social acts are extradited from the clan. Thus, in this way, the conduct of the clan members is controlled. It is also the universal legal function of the clan to punish the clan members who are involve in anti-social acts or who go against the rules and regulations laid down by the clan and thus, maintain peace and order within the clan.

The clan also performs all the administrative functions for its members. In case of conflict between different clans, the heads of the clans meet and appear as partisans to settle the conflicts between the clan members. They also take political decisions in times of war and peace. In addition to the above mentioned function, the clan also caters to the religious preferences of its members. Generally, the head of the clan is also its priest. And it is he who consummates the religious undertakings of all the members.

Clans have been found in all types of pre-industrial societies; including in China, India, among Australian Aboriginal peoples, in African tribes and among certain American Indian tribes. Clans were a phenomena of significant interest to anthropologists until the late twentieth century, but they have become less prominent in analyses of cultural organization since then. Clans, from a functional standpoint, aid in the unification of communities by cross-cutting other forms of social organizations, such as settlement, post marital housing patterns and age groups. Allied clans usually have reciprocal relationship, giving mutual support and defense and with emotionally or financially taxing services such as funerals. Some clans demonstrate their unity through the possession of a common emblem, which may signify the member's ancestral being or common origin and as such, is often an object of reverence.

## **CLAN IDENTITY**

Clan identity is an identity shared by members of one same clan. It is an identity shared by a group of people who claim to have a common ancestor. More precisely, it is a concept which revolves around who we are. Clan identity is the feeling of identity, loyalty and oneness that the members of a particular clan shared with each other, the clan members think of themselves as one people. Blood-relation is the strongest tie and most influential force in creating a sense of unity and identity among the clan members. Unity and togetherness are the foundation of a clan.

In other words, we can also say clan identity is a feeling of solidarity among a group of people interrelated by ancestry and who are united by common characteristics, aims or interest. Clan identity is linked to the culture of a tribal group, nation or society of people. When the word clan identity is used, it can apply to an individual, a group or a nation.

Spencer and Taylor (2004) defined the concept of clan identity as ‘ [clan] identity is a work in progress, a negotiated space between ourselves and others; constantly being re-appraised and very much linked to the circulation of cultural meanings in a society’.

Erikson T. (2002) described clan identity as: [clan] identity becomes crucial important the moment it is perceived as being under threat. Since clan is an aspect of a relationship, the importance of boundaries may thus be said to be conditional on the pressure exerted on them... expressions of clan identity also be regarded as symbolic tools in political struggle.

Simon and Loewy (1998) describes clan identity ‘as a place in society. It is a place which is a metaphorical expression for any positions on social relevant dimensions such as ethnicity, tribe and so on’.

The clan is an informal identity network based on kinship ties and is common in semi modern societies. In such societies, clan-based identities are stronger than ethno national and religious identities that are legally institutionalized. Based on a data collected from three central Asian countries namely- Uzbekistan, Kyrgyzstan and Tajikistan, it is found out that clan identity is more important than ethno national and religious identities.

Among the Angami Nagas, it is obligatory for him to give his loyalty to his clan and identified himself with his own clan. An Angami man identifies himself by the name of his clan and his

loyalty to his clan is very strong. This clan identity was so distinct that a clan almost acts like a village within a village. L.Lam Kan Piang in his study among the Zo people mentioned that even though the colonial ethnographers introduced an alien concept of identity like tribe, primordial identity like clan and lineage could not be superseded and completely erased. Identity such as clan is rather strangely and tenaciously survived, as it is the traditional grouping system, which has culturally functional importance. Piang said that the role and importance of clan identity in the Zo culture could not be taken over by other identities like dialect based or tribe identity.

### **BRIEF BACKGROUND ABOUT NAGALAND**

Nagaland is the land of the Nagas. Nagaland is a hilly state in the North Eastern part of India. Nagaland is bordered in the north by the state of Arunachal Pradesh, in the west by the state of Assam, the state of Manipur in the south and in the east by the Sagaing Region of Myanmar. Nagaland covers an area of 16,579 square kilometers with a population of 1,980,620 as per the 2011 Census of India, making it one of the smallest states in India. There are various theories of migration of the Nagas recorded by foreign writers and native writers. They have been for centuries dwelling in the land they inhabit today. The Nagas were formerly head hunters, and that is about all that the outside people knew about them.

The indigenous people of the North-Eastern Indian state of Nagaland are commonly known as 'Nagas'. Nagas are tribesmen belonging to the Indo-Mongolian group of people. The word Naga is applied to a group of tribes which are distinct from other tribes. And such distinction not only exists in terms of physical appearance but also chiefly in terms of cultural and social aspects. While Naga tribes differ from other tribal tribes, they also have some differences among themselves in terms of culture and social organization. There is also a significant difference in their language and political organization. However, regardless of their differences, all the Naga tribes constitute one distinct group of tribes.

Nagaland urban population is relatively low, accounting for only 28.86 percent of the total as per the 2011 India census. In fact, it is much lower than in the rest of the country, which is about 31.16%. This is due to Nagaland lack of industrial centres. The vast majority of the population of

Nagaland is tribal. According to the census of India 2011, the percentage of Nagaland rural population is 71.14 percent.

Nagaland is home to 17 major tribes - Angami, Ao, Lotha, Sumi, Chakhesang, Chang, Khiammiungan, Kuki, Konyak, Phom, Pochury, Rengma, Sangtam, Yimkhiung, Tikhir, Zeliang and Kachari. Each of these major Naga tribes lives in a clearly identifiable area of Nagaland. These tribes have their own distinctive dialects and cultural features. Each tribe is distinct in character from the other in terms of customs, language and dress. All the seventeen Naga tribes are different and unique in their customs and traditions these customs and traditions are further translated into festivals which revolve around their agriculture cycle.

Colorful life and culture are an integral part of the Naga tribes of Nagaland. It is a land of folklore passed down the generation through word of mouth. Songs and dance forms an integral part of the Nagas, where folk songs eulogizing ancestors, warrior's valliant acts, traditional heroes, poetic love songs immortalizing ancient tragic love stories. The Nagas social life was marked by traditional institutions feast of merit, traditional festivals and games. Nagaland is known as the land of festivals because the different tribes celebrate their festivals throughout the year. Majority of the Nagas are Christians as a result of the missionary efforts during the British occupation of the area in the 19<sup>th</sup> century. Although most of the Nagas have now become Christians, they still preserve some of the remnants of their early animist and ancient culture.

Naga society is patriarchal and patrilineal. The Nagas is non-class, non-caste with autonomous culture. Each tribe comprises of a number of villages and are bound together by political, social and religious ties. The Nagas were and still fond of the social and community life. Tribe and clan traditions and loyalties play an important part in the life of the Nagas. Tribal organization has ranged from autocracy to democracy and power may reside in a council of elders or tribal council. Descent is traced through the paternal line and clan and kindred are fundamental to social organization.

The Naga tribes were endowed with a very rich heritage that had been passed down from one generation to the next through oral tradition. The Nagas do not have a written history but what we do know comes from folksongs, folklore, dances, British administration/authors, research works, local writers etc.

## **BRIEF BACKGROUND ABOUT KOHIMA DISTRICT**

Kohima is the capital of Nagaland and it is the second largest district of Nagaland. Kohima is bordered on the west by Dimapur district; on the north by Wokha district; on the east by Zunheboto and Phek district; and on the south by the state of Manipur. Kohima has a total area of 1,041 sq.km. According to the 2011 census, the population of Kohima District was 270,063, with 140,118 men and 129,945 women. The literacy rate is 85.58%, with males accounting for 89.28% and female accounting for 81.56%. The sex ratio of Kohima is 927.

The main occupation of the people in the district is agriculture and most of the villagers are agriculturists and medium farmers. Floriculture, small-scale enterprises, fashion designing and making, running stores and hotels are some of the common occupations of the urban inhabitants. Apart from these traditional occupations, people from all walks of life also work in the government and private institutions.

The name 'Kohima' is a British version of Kewhira. Kohima is famous in the history of World War II. Under the British rule, Kohima became the headquarters of the Naga Hills. The Angami tribe known as Tenyimia are the inhabitants of the district. However, the capital town Kohima has a cosmopolitan outlook, where people of different Naga tribes and people from outside Nagaland also live in Kohima.

## **BACKGROUND ABOUT THE ANGAMI NAGAS**

The Angami is a major Naga ethnic group native to the state of Nagaland in North-East India. The Angamis is the fourth largest Naga tribes inhabiting the present Kohima district and parts of Dimapur district. The population of the Angami according to 2011 census is 141,732. The Angamis are divided on the basis of their geographical location; they are divided into four geographical groups- Northern Angami, Western Angami, Southern Angami and Chakhroma Angami. The Northern Angami comprises of people living in and around Kohima; while the people living in the West are called the Western Angami; the people inhabiting the south constitute the Southern Angami and the Chakhroma Angami comprises of those people living on the slopes of the national highway from Kohima to Dimapur.

The history and origin of the Angami is mainly narrated orally since there is no written historical records. Oral tradition in the form of folk songs and folk tales passed down from generation to generation has been used to trace back to their origins. Folk songs and folk tales are especially significant to the Angamis as their origin, culture and traditions are passed on through these mediums.

According to a legend, the Angami Naga tribe originated from Khezhakenoma, a village in the present are of the Chakhesang tribe. Legend has it that a man named Koza came from the East and he prayed to God for guidance and direction when he arrived in Mekroma (Makhel) in the present day Manipur. Suddenly, a bird flew by and landed on his mithun (bison) horn before flying off in the direction of Khezhakenoma. In order to check the divine guidance, he sighted an omen with the help of his walking stick, which he dropped on the ground. The sticks fell on the ground, pointing in the same direction as the bird. Koza considered this as heavenly advice and continued on his journey to Khezhakenoma. And on reaching his destination, he saw the same bird resting on a stone. Koza noticed that on the same stone, a toad had brought grains and left on the stone. Then soon, the grains multiplied into double the amount. After observing the strange multiplication of grains, Koza dried a basket full of rice on the same stone and to his surprise, the rice multiplied into double the amount. From then, Koza decided to settle in khezhakenoma. Koza had three sons. And the three sons carried on the tradition of spreading paddy on the stone. The three sons took turns drying their grain on the stone until one day they quarreled bitterly over whose turn it was. Fearing bloodshed, their parents cracked an egg on the stone, covered it with brushwood and set it on fire. The spirit of the stone went up to heaven in a cloud of smoke after the stone slab burst with a loud sound. And from that day onwards, the treasures stone magical power was lost. The three sons separated in search of a new place to settle and became the ancestors of Angami, Lotha and Sema tribe respectively.

Before Kezhakenoma, Angami oral narratives also ascribed their origin to a former existence in Mongolia from which they migrated or were brought to China to work on the Great Wall.

The Angami are commonly known as ‘Tenyimia’ and this name is derived from the word ‘Tounyümia’ meaning the ‘swift walker’. This name is given to Angami by his two brothers Lotha and Sema. According to their oral tradition, it is said the word ‘Tounyümia’ was given to Angami because he was always walking ahead of his two brothers, Lotha and Sema

The Angami Nagas are traditionally hill people who rely primarily on agriculture and livestock – rearing. The Angamis are noted for their terraced wet – rice cultivation; as a result of this labor – intensive cultivation, land is their most valuable asset. Angamis are one of only two tribes of Nagas, out of seventeen, who practice wet-rice cultivation on terraces made on a hill slopes. And allows them to cultivate the same plot year after year. The Angamis rely on slash-and-burn cultivation to a modest extent.

The Angami’s social lives were linked with their religious lives and religious festivals coincided perfectly with the agricultural seasons. Some of the notable festivals are Sekrenyi, Ngonyi, Kerunyi, Chadanyi and Terhünyi. Dance and songs are an essential part of the Angami Naga tribes. The people sing and dance on every religious and social event. Dance and singing are related with expressions of joy following agricultural activities, such as a good harvest, the success of a hunting expedition and expression of joys in festivals. Other dances include spear dance, bamboo dance and harvest dance.

The highest form of polity among the Angami was the village. All of their laws, institutions, codes of conduct, social relationships, social behavior, religious performances and so forth were restricted to the village. And each village was an independent unit by itself. As a result, there are some differences in the customs and traditions from village to village. An Angami village was a social unit in which all of the institutions were interconnected, interdependent and interconnected, with kinship serving as the primary foundation for all of these relationships. The Angami did not have any established government but a democratic way of life was the essence of their living. There was neither chieftainship nor hereditary system like some other tribes of Nagaland. The Angamis were never ruled by autonomous chiefs and no individual ever had the authority over the entire village. The Angamis has the ‘kemovo/Phicü-u’ who was referred to as the social and religious head, but no real power was vested in him. They are greatly respected but not authorized to give orders without the consent of the villagers. Among the Angami tribe, village administration was very much a matter of settling disputes according to the law of the land by the village council of elders. The main function of administration in the Angami villages was to deal with law and order.

In the Angami Naga tribal society, every individual was primarily concerned with his family, clan and village. He regarded this as his culture; he is closely attached to his land, to the system

of land-tenure, the structure for the management of his village, the organization of cultivation and the administration of justice through the village court or council. Everyone felt a sense of responsibility for the village well-being and it is not untrue to say that majority of the Angamis still feel the attachment to ones village.

In the Angami community, there is no social stratification. Property was traditionally divided equally among the sons, with daughters also receiving a share in some families. The paternal residence 'kithoki' is inherited by the family's youngest male, which also implies that he is responsible for the parents care until they pass away. Customary laws have traditionally regulated all parts of the Angamis life; in fact, in Angami society, customary laws can be described as ways of community life that are practiced with the lawful consent of the entire community.

The present Angami society stands at the cross roads of traditional and modern culture locked in a negotiation. Unfortunately, the rich old customs and traditions are slowly disappearing or are been modified beyond recognition and many good old beliefs, which for ages had been held closed, are being forsaken. Traditional practices such as head hunting, shaving one's head, food taboos, gennas on birth, death, marriage etc are no longer prevalent. However, many other traditional values, like simplicity, honesty and hospitality are still relevant in modern Angami society and may co-exist with modernity.

## **ANGAMI CLAN**

Unlike the western societies, an Angami finds it impossible to imagine a situation in which a person has no family members. An Angami child is born not just into a nucleus family but also into a large family – the clan. Every individual is a member of a clan group. For the Angamis Nagas, the clan is a fundamental aspect of an individual self identity and it manifests itself in the mutual obligation that clan members owe to one another. The most important features of the Angamis is that they first owe allegiance to their clan, then followed by the village, the tribe and lastly to the Naga community. Thus, an individual status or wealth may not be valued unless given a due respect to his clan.

The Angami clan is a collection of families, commonly bearing the same surname and supposed to have common ancestors. Clan among the Angamis is known as 'Chienuo'. The 'Chienuo' which consisted of multiple groupings of agnatic kin, was next to the family. The Angami chienuo origins can be traced back to a single family in the past, from which many generations arose but managed to remain connected. The Chienuo was a continuation of the family unit on the paternal side, which maintained as a separate entity of their own under the leadership of 'Phichümia', a member of the elders. A group of consanguineous families descending from common ancestors who occupied a definite and permanent region was known as the 'chienuo'. The multiplication of a family into several family units throughout time has resulted in the formation of 'Putsano' (first cousin). The establishment of chienuo resulted from the emergence of a more closely knit kinship among various putsano. Thus, in its early stages, the chienuo was made up of the families of one household's sons joined by the families of male cousins from the father's side. The Angamis did not have any clan head. On the contrary, the head of the clan was the same as the head of the original family whose sons and paternal cousins joined to form the clan. Thus, the head of the clan, which settled first in a village automatically, become the first head of the village. And no clan enjoyed a special position in the Angami social structure.

The Angami Nagas practiced strict clan exogamy, to the point that the members of the same clan consider each other as brothers and sisters and marriage within the same clan is considered as incest.

'Chienuo' (clan) is of paramount importance in the Angami society. Commenting on the paramount importance of a chienuo in Angami social structure, John.H.Hutton in his book 'The Angami Nagas'(1921) says that, "although the village may be regarded as the unit of the social organizations , political and religious sides of Angami life, the real unit of the social side is the clan . So distinct is the clan from the village that it forms almost a village in itself". However, clan loyalty and unity was so strong that there was frequent interference of one's clan by another unfriendly clan among the Angamis. And indeed, the antagonism and rivalry within the clan in the village sometimes led to jealousy and suspicion. As mentioned earlier, although the village may be regarded as the unit of political and religious life, the real unit of the social life of the Angami was the clan. It was the 'chienuo' that decide on any major disputes that come up before the elders ranging from land settlements to thefts and homicides.

The position of the clan is so strong among the Angami tribe. The clans form the backbone of the Angami village social structure. The Clan is the real unit of the Angami social life. Clan membership is of prime importance among the Angami Nagas as clan membership helps in ensuring mutual support and defence as well as in the mediation of disputes over property rights and misunderstanding which arises within a clan or with other clans of the same village. In cases of disputes, the clans-men appear as partisans to settle the disputes among themselves as far as possible. The clan members also help and support each other in times of need. At conventions like marriage, death, birthdays, fellow clansmen find it obligatory to attend. Clan members are linked with all the socio-economic activities such as administration and marriage ceremonies in the village.

Among the Angami Nagas, there is a strong feeling of oneness and closeness among the fellow clansmen, which is stronger than the village feeling or tribal feeling. It is obligatory for an Angami to give his loyalty to his clan and identified himself with his own clan. An Angami man identifies himself by the name of his clan and his loyalty to his clan is very strong. This was mainly because of his brought up within the well-marked boundaries of the clan and because he belonged to the social and political set up of the clan. This clan identity was so distinct that a clan almost acts like a village within a village.

## **ANGAMI ECONOMY**

The Angami Nagas's main economic resources are land, forest and water. Land is a valuable asset among the Angami Nagas, not just for farming but also for achieving high social status and respect. And a person who does not own land is looked down in the Angami society. Thus, if a person possesses a great amount of land, he is highly regarded in society. Because land is such a valuable asset among the Angami, all households whether it is large or small, wealthy or poor had to own their own land.

For the Angami, agriculture is their main source of livelihood. The main economic activity of the Angami Nagas is subsistence agriculture, with rice as the primary crop. One of the unique feature of agriculture practiced by the Angami's is that they practiced settled cultivation in the form of terrace cultivation. Terrace cultivation is the most common and favoured method of land

usage among the Angami. Traditionally, the Angamis used irrigated water from streams to practice terrace cultivation on hill slopes with terrace benches. Another option is to collect water from upper catchments in ponds and utilize it to grow paddy, fish and snails during the kharif season and to cultivate vegetables during the rabi season. The land under terrace cultivation resembles a stairway. Along with terrace cultivation, jhum cultivation is also practiced. Terrace cultivation continues to be the dominant and most preferred form of the land use among the Angamis. The Angamis are also known for their arts and crafts, and women are mostly involved in weaving traditional clothes when they are not engaged in agricultural work or household chores. Men are involved in weaving baskets, wood carvings and carving spoons and plates etc. Blacksmithy is another important industry after cultivation which is undertaken exclusively by men.

In the traditional Angami society, a woman's primary occupation is that of a housewife and mother, followed by that of a farmer. The fact that women are limited within the home while men are involved in activities outside the home distinguishes the economic roles of men and women. Women are often held accountable for the village income because she watches over agricultural activity all year. Women are the ones who take care of the home, agricultural work and other activities, despite the fact that men are regarded 'bread-earners' and women as 'home-makers'. However, Christianity and Western education have given the Angami people a new light. Women's education has extended their worldview and inspired them to pursue their passions. The Angami society is male dominated both in the pre-Christian and Christian eras, however, today the status of women has improved considerably compared with the traditional society. Today, with the progress in the field of education and the coming of Christianity, the conservative view has slackened giving scope to the women folk to come to forefront of the society. Thus, as a result of all this, Angami women are now involved in the economic activities outside their home and becoming financially independent. For example, the Angami women are now working in the government service which is very rare in the past, they are also working in various fields such as business, in the private sector etc which has boost their family income.

With the advent of modernity, agriculture previous technique altered and machines replaced labour, resulting in more intensive agricultural operations. With the passage of time, an increasing number of people began looking for government jobs. Their attitude toward

commercializing agricultural products has obviously changed as a result of their encounter with the outsider

The village economy that depends on the barter exchange is now producing goods from agricultural products. Trading and marketing economy developed. With the influence of modernity came greater communication and commercial development. Village traders, who has previously been cut off from the plains and hostile neighbors, were able to trade and travel farther, boosting the Angamis economy. In today's Angami society, the traditional economy is being replaced with a modern technology oriented economy. Agriculture was and is still the most important occupation of the Angamis, however, today; the Angamis are practicing other occupations along with agriculture. Angamis today are employed in a variety of fields as a result of enhanced formal education. Many Angami Nagas work for the government and others are engaged in other occupations like weaving, carpentry, horticulture, animal husbandry, construction, rubber and other commercial plantation, business, small scale household production etc to earn their livelihood.

### **ANGAMI FAMILY SYSTEM**

Family among the Angami Nagas is known as 'Kikru'. The 'Kikru' is the most significant social unit in traditional Angami society.

The smallest social unit in the Angami society was the family, which consisted of a husband, wife and their offspring, known as kikru. The Angami usually favour big family and the children are seen as a family's riches. Thus, a man who has a large number of children is considered to be extremely fortunate. Big family was valued in traditional Angami patriarchal society because they gave more security and protection to the family. It was also seen as a way to increase farm labour and production.

The social structure of the Angami is patrilineal, patrilocal and patriarchal. The married woman leaves her natal home to live in her husband's house and the children trace their lineage, descent and surname from the father's line. Because of the patriarchal structure, the birth of a male child is traditionally celebrated with a special feast. Despite the fact, that the birth of a female child is

welcome, the family desires for a son. One of the reasons for large families is because of this. Even now, many families want a son despite having two or more daughters. The rationale for preferring the male child could be that after marriage, women are regarded other's property or someone else's property and it is the man who will carry on the family lineage and look after the family and clan property.

The Angami family usually consists of a nuclear type of family; the joint family system is rare among the Angami Nagas. The Angami society's customs do not favour the joint family system. They believe that a person who is getting married is in a position of independence a responsible adult and is capable of providing for his family's needs. The joint family is found only in rare cases especially like when there is a physically challenged member in the family who need his family members to look after him or when one or both parents are unwell, when the family is poor or when there are some family problems.

A father, mother and their unmarried offspring made up the nuclear family. Among the Angami, the nuclear family system is a common practice where a son has to leave his father's house after marriage and start his own family and also build his own house where he become the head of the family. He is the bread winner of the family and he shoulders all the responsibility of the family. It was the father's responsibility to teach his children about the demarcation of land or boundaries, customs and to pass along the oral tradition to his offsprings. It is the father who represents the family in all social settings in respect to clan and village gatherings. In the Angami family, it is a rule that the eldest son shoulders all the family responsibility after the death of the father. The head of the family who is eloquent and intellectual is honoured and respected not just by his immediate family, but also by his entire clan. In most clan, such a man usually becomes a clan leader and maintains a prominent position in the village. Due to the nature of their obligations, men have always been held in high regard. They gave their family and village, security and safety. Thus, most of the domestic works were carried out by the women.

In the past, the family was responsible for nurturing and moulding their children into respected and committed individuals in accordance with the tribe's accepted norms and values, teaching them honesty, respect for elders, compassion for the sick and the needy, obedience, politeness, competitive spirit and social prohibition. However today, the educational and religious institution has taken over the role of teaching the younger generations.

## **ANGAMI MARRIAGE SYSTEM**

Marriage among the Angamis is known as 'Kiya'. 'Kiya' was a vital aspect of the social life. The Angamis regarded 'kiya' as a sacred institution and it was a taboo to marry with the same clan. The ceremonial and non-ceremonial marriages are the two types of marriages among the Angamis. The ceremonial marriage was carried out in accordance with the rituals and was held in great regard. The non-ceremonial marriage took place without any formalities. Both types of marriages were accepted and socially accepted, though ceremonial marriage is held in higher regard and honors than non-ceremonial marriage. Today, the traditional marriage system is replaced by the church law, but there are non-Christians who follow the traditional way.

The marriage system among the Angamis is monogamous and exogamous in nature. Monogamous marriage was the pattern adhered to. Angamis like many other clan based communities practiced exogamy. Marriage within the same clan is very rare and it is regarded with great disapproval in an Angami society. It is believed the clan members have descended from a common ancestor and that they are blood related so marriage within in the same clan is strictly prohibited. It is believed that if a couple from the same clan marries, they will be infertile or they will produce diseased offspring's. And infact, there are cases where couples who marry within the same clan turn out to be infertile, for example, there is a case in Kohima village, where a man who married his father's brother's daughter was childless. Another case of clan endogamy happen in Kohima village, where a man marries his paternal uncle daughter and their offspring's was born with dwarfism even though there was no history of dwarfism in the family. There is also a belief that couple who marry within the same clan would not produce a mixture of female and male offspring's, they will either produce only male offspring's or female offspring's. They considered marriage as a sacred institution and marriage within the clan was forbidden. Thus, marriage within the same clan is highly disapproved.

Marriage used to be a significant part of life for Angami tribes and the rituals associated with marriage varied from village to village, based on taboos around women's purity, chastity and innocence. The strict observance of such taboos was strictly enforced and rigorously observed. In the Angami tradition, marriage takes place with the consent of both the man and the woman. The morung (youth dormitory) have a big influence on how boys and girls choose their marriage mates. Traditionally, it was a taboo for a woman to have long hair before marriage. Growing hair

by unmarried women was regarded 'Kemetho tha' (meaningless life). Hence, shaving the hair of the Angami girl child was related with the concept of purity. Getting married was the only way to get long hair and this demonstrates how important marriage is to the Angamis. Unmarried woman were seen as unlawful and abnormal; and so they were forced to marry whether they liked it or not. However, such practices are no more prevalent in the Angami society.

Among the Angamis, there is no social stigma regarding remarrying after obtaining a divorce. Though it is rarely practiced and is not well received by the community.

The Angamis do not have dowry practice but it is their custom to offer some presents to the girl's parents. 'Thema' and 'Thesa' are the two terms referred to bride price among the Angamis. Thema used to denote bride price which was not a dowry but a gesture of unification between the two families. The groom gave 'thema' to the bride's family in the form of animals. Thema generally consisted of a spear, two pigs and fifteen or sixteen fowls, which may or may not be demanded by the bride's family. 'Thesa', on the other hand, was a kind of gift in cash or kind (a cock) given to the girl's 'Thetshsü' (age group). In return, the 'thetshsü' blessed the newlywed couple and delighted the audience through songs, jokes and variety shows.

However, with the coming of Christianity, the Angami traditional marriage has changed drastically. Christian marriage has become prominent and the rituals associated with the traditional Angami marriage are no longer practiced by the Christians.

## **CONFLICT RESOLUTION AMONG THE ANGAMI NAGAS**

The Angami tribe followed their own customs and usages for regulating social related relationships, and never tolerated lawless behavior. Customary law has traditionally regulated all parts of their life; in fact, in Angamis society, customary law can be described as ways of community life, which are practiced with the lawful consent of the entire community.

As mentioned earlier, although the village may be regarded as the unit of political and religious life of the Angamis, the real unit of the social life was the clan. It was the clan that decided on any major disputes that came up before the elders ranging from land settlements to thefts and homicides. Among the Angami, every clan is administered by a team of elected clan leaders and

clan elders who is selected for a specific tenure to look after the welfare and smooth functioning of the clan. The elected clan leaders are thought to be a person, who speaks the truth in settling cases, knows the people's history, has diplomatic, and has oratory abilities and leadership traits. They cannot and do not give orders but can only guide the community in decision making that benefit the society. They are responsible for maintaining peace and harmony in the clan. The executive function of the clan leaders and clan elders is that they settle all the disputes within the clan such as land dispute, property dispute, robbery, quarrel, fight, the disputes and misunderstanding that arise between individuals and families and all the issues relating to the clan. And they ensure peace, harmony and smooth functioning of the clan.

The conflict resolution among the Angami Nagas is significant. Whenever a problem or disputes arises between an individual or a group, the people involved would always first approach their clan leaders and clan elders to settle the disputes for them. For conflict resolution, a meeting will be called, which is attended by the people involved and the clan leaders and clan elders. In this meeting, the issues or disputes will be discussed and the clan leaders and clan elders will settle the disputes and render a decision, only after extensive cross-examination and inference of the case. All the matters of the clan were traditional decided with the participation of the male members. Since, the Angamis strictly follows patriarchy; the women do not have any say in the decision making. All the issues and disputes are settled without any biases. Some instances are- there is no case settlement in the matter of 'themou' (accidental killings), and justice is served as it should be. The guilty offender and his family are banished for seven years. When it comes to theft, a thief who is caught red-handed must pay the family whose property he has stolen, a penalty of 'se thenie' which means seven livers. The penalty entails paying seven times the value of the stolen goods. In the past, there exist a ritual called 'tshieya' which is performed to apprehend a thief. To clear their names of thievery, a plantain tree is planted beyond the village gate, and all of the men strike the tree with their spears. If a man steals animals but still spears the tree, he is responsible for his own death. And oaths are used to settle land disputes. An oath must be taken if either party refuses to accept the clan's judgment. A man who lies under oath will be detected because his falsehood will have serious effects and reveal his wrongdoing.

Traditionally, there are several ways on which land disputes is resolved by men among the Angami Nagas. They are-

The first way is 'kejo vakechü' which means forgiveness. Forgiveness is a means of resolving a land dispute in a peaceful manner. Here, the role of Phichü Kehou, notably Peyumia (those having qualities of oratory skills, in-depth knowledge of history, rituals, ethical values, wisdom, diplomacy, honesty), is to act as the Capi or adjudicator for the conflict resolution, using the customary procedure in which the two parties eventually agree on a settlement. The wisdom of the Peyumia is highly regarded and the decision is of utmost importance for the disputing parties. Once the conflict is resolved, the disputed land may be shared evenly between the two parties. If a land dispute arises in the village, the first step is the involvement of Peyumia; however, if the disputing parties disagree to the peaceful method of Peyumia, they may go to the second step which is the 'Thecha thebie'.

Thecha thebie which means might is right, may take in the form of 'Kene' (wrestling) as well as force. The traditional Kene technique of resolving land disputes has both objective and emotional aspects. As a result, if two sides agree to take on the deal of wrestling, men from both sides will gather at the disputed site/land on a specific day. And then the two persons involved in the conflict would wrestle. And whoever emerges as the winner would eventually become the owner of the land. So the wrestler who loses has no right to claim that piece of land again.

Rüse which means Oath taking is the last resort of resolving the land dispute. A person who decides to take Oath may, therefore, speak the words as 'a chie pu ketha a kijü a vie zo, a ketidzü pu liero, tei kidzu ko donu, lhu mia ketu keruo, lhu kenyüpfü, keka kemhe, kero kerei tsü tuo we', which may be interpreted as 'my now words spoken, false speak-if, sky earth-from between, grow men equal-other, let me be forbidden, ruin burnt-out-fire, twine rotted let me do'. Oath taking with greater numbers of the lives of one's own kinsmen, is regarded as an indicator of deriving a favorable verdict, when swearing is involved, with confidence based on truth. It's also said that when a person takes a false oath, his nose starts to bleed before he finishes it. Oath taking is regarded as the step of marking the end of the dispute.

Thus, it is understood that the clan leaders and clan elders settle all the major disputes according to the customary laws of the Angamis and ensure that punishment when executed is according to the law prescribed by the village.. And it is an interesting fact, that even today, property rights, laws of inheritance and transfer of property are all decided on the basis of the customary laws

despite of the existence of the modern civil law. However, sometimes the issues and disputes are also settled at the civil court.

## PHOTO GALLERY OF ANGAMI NAGAS



Photo by angami\_ko via Instagram



Photo by Kenny\_soru via Instagram



Photo by asetozaio\_photography via Instagram



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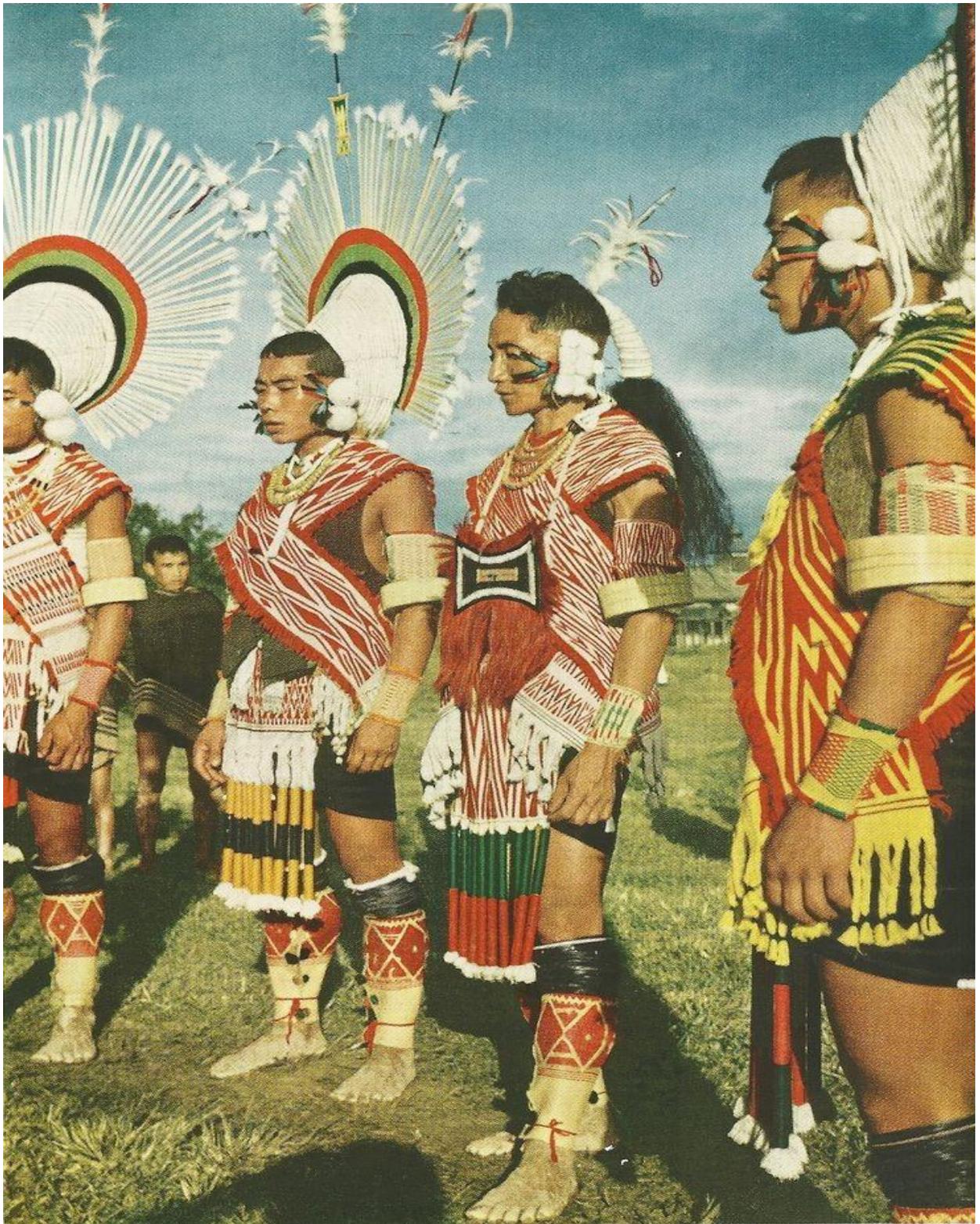


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**CHAPTER – 2**

**LITERATURE REVIEW**

## **LITERATURE REVIEW**

Literature review is the review of scholarly articles, books and other similar discourses and sources that are encompassed within a specific issue, research area or theory, with the goal of providing a critical analysis, evaluation, summary and descriptive discourse of the concerned works that are related to the research problem under investigation. The objectives of these literature reviews is to provide a sketch of the sources that have been read while conducting research on a certain topic, as well as to demonstrate that the reviewer's research fits well within the confines of a larger area of research or study.

This chapter deals with the secondary data which is used by the researcher to study the clan identity among the Angami Nagas. The secondary data used in this chapter includes books, journals articles and newspaper.

J.H. Hutton (1921) in his book 'The Angami Nagas' gave a detail account of the traditional cultures, religious life and social life of the Angami Nagas. Hutton's noted that the clan is the real unit of the Angami social life. "Although the village may be regarded as the unit of the social organization, political and religious sides of Angami life, the real unit of the social side is the clan. So distinct is the clan from the village that it forms almost a village in itself, often fortified within the village inside its own boundaries and not infrequently at variance almost amounting to war with other clans in the same village" (Hutton : 1921). And it is a fact that this rivalry and hostility that exists among the different clans within a village has colored the whole of Angami life. In times of war, even if the village is united, the feeling of jealousy and suspicion that one clan have for another clan, will certainly proved to be a weakness. Furthermore, it has also been noted that even in times of peace, the village would break out into riot from time-to-time, while it is also incessantly troubled by the internal bickering. And in almost every dispute that happen between two individuals belonging to different clans, the clansmen of each individual appear as partisans to resolve the dispute. However, for certain purposes, such as religious observances and cases of a serious breach of the social code, in almost any village the different clans would come together. This implies that though sometimes, certain incidents bring the different clans of a village together, usually the clans of most of the

villages normally live in peace and unity together. However, this peace and unity does not include the peace and unity at the village level or tribal level, which highlight the non-existence of oneness and unity in the olden days. Hutton's mentioned that the clan is more or less a very definite section of society, though it is not to be regarded as a rigid institution and incapable of fluctuation or development. However, on the contrary, the clan is always inclined to split up into components clans, which is a process in almost every Angami village. It is also noted that the Angami are completely patrilineal and patronymic and there is also no trace of totemism among the Angamis. The Angamis also strictly followed the practice of exogamy; marriage within the same clan is strictly prohibited and regarded as incest.

Easterine Kire (2019) in her book, 'Walking the Roadless Road – Exploring the Tribes of Nagaland' pointed out that every Angami village is divided into three or four clans, and each of which is further subdivided. Members of the sub-clan are not allowed to marry each other. Kire's also notes that a man's clan is his identity and he is fiercely loyal to his clan.

According to the study conducted by S.V. Ngachan, Anupam Mishra, Swati Choudhury, Ramesh Singh and Bendangla Imsong on the topic, 'Nagaland – A world of its own' noted that, " In the Naga society, elaboration of the descent group provides a scaffold for organizing social relationship amongst the territorially divided social groupings, particularly the clans and lineages". In Nagaland, a tribe is usually comprised of subdivisions called clans and these clans are strongly exogamous in nature. Thus, marriage within in the same clan is strictly prohibited and it is considered as taboo as clan members are related by blood. A Naga village can be defined as "a cluster of independent clans occupying distinct clan-territories" (Ngachan, Mishra, Choudhury, Singh, Imsong: Nagaland – A world of its own). And during the British rule, these clan localities came to be known as khels. It has also been noted that the clans traditionally enjoys its autonomy over its complete political, economic and jural rights over land and forest areas which also include the water resources and the fishing areas.

Varrier Elwin (1961) in his book 'Nagaland' mentioned that before the advent of the British, the world of the Naga revolved around his village, family, clan, which basically defined the scope of his interest and commitment. A Naga is said to be passionately dedicated to his land, his system of land tenure, the arrangements for his village's administration, the organization of cultivation and the administration of tribal justice through village and tribal courts.

Khriereizhünuo Dzüvichü (2010) in her study, "Colonial State and The Emergence of Naga Identity: 1881-1947" had pointed out about the Naga clan system. It is noted that a Naga clan is a collection of families, who are subjected to a single chieftain and where the clan members usually bear the same surname and have a common ancestor. The clan members are said to be related to each other through blood-tie relation, however, clan relation is also set up through adoption but this practice is usually held to be decidedly objectionable. Generally, a man with no sons can adopt a young man from another clan or village, on the ground that the adopted son will completely denounce his former group and joins his adoptive father group, whose property he will be inheriting. In the Naga society, the clan forms the unit of traditional government. Every tribe in Nagaland has a number of villages and again the village is divided into a number of clans. Thus, it is said that villages constitute a tribe while the clans constitute a village. And the number of clans in a village differs among every Naga tribes. "The Sema tribe is reckoned to have about twenty-two clans and a number of other sub-clans. The Rengma tribe, being divided into western and eastern Rengmas has a clan system that fall under six exogamous groups, within which there are more than twenty-three clans and a number of sub-clans. The Ao tribe fall under three broad clans, namely Chongli, Mongsen and Changki, under which there are more than sixty sub-clans or phratries" (Dzüvichü: 2010).

Dzüvichü also mentioned that the position of a clan can vary from one tribe to the other tribe; an example is that among the Angami tribe, the position of the clan is very strong unlike the clan of the Sema tribe. It is also noted that the emergence of various clans, has led to the formation of village among many Naga tribes. This study also mentioned that the strength of members of a clan can make the clans of a particular village either powerful or weak. During the olden days, the clan is usually fortified within the village inside its own boundaries and often wars take place between one clan with another clan of the same village. Thus, this reveal the absence of unity in

the village level, though the clan feeling was strong. And in almost every dispute that happen between two individuals belonging to different clans, the clansmen of each individual appear as partisans to resolve the dispute. Dzüvichü's also mentioned that the Naga clan practice exogamy where marriage within the same clan is strictly prohibited. Clan membership in the Naga society is of upmost importance in ensuring mutual support and defense as well as in the mediation of disputes such as property rights. There is also a strong feeling of oneness and closeness among clansmen in Naga society, which is infact stronger than the village feeling or tribal feeling. An individual finds it mandatory to attend the funeral, marriage and other important events of his fellow clansmen. And also, during the times of conflict and disputes, clansmen of the disputing parties always try to resolve and settle the disputes among them as far as possible.

Thus, in a Naga village, an individual gave his loyalty to his own clan and identified himself with his own clan. "This was mainly due to his brought-up within the well-marked boundaries of the clan, and because he belonged to the social and political set up of the clan. The clan feeling was reinforced by a more or less permanent confrontational relationship among the constituent clans of a village, while the village and tribal feeling remained dormant for long" (Dzüvichü:2010).

Marwah. I.S. and Srivastava Kumar Vinay (1987) in their book, 'Khel Gate and Social Structure: A Study of their Relationship and a Note on the Place of Material Culture in Anthropology', mentions a clan territory is an autonomous unit within the village and it is named after the founding ancestors. "In former times, each khel was surrounded by a wall to protect it from outsiders, including members of the khels in the village. Entry into a khel was only through the gates, which were guarded at all times and closed at night. In fact, the so called 'village gates' of the Angami are really khel gates" (Marwah. I. S. and Srivastava Kumar Vinay: 1992).

Pauthang Haokip (2018) in his article, 'Clans, Tribes and Unions of Tribes Nomenclature of North East India' has written about how the people from the North East India are usually "identified by the outside world on the basis of the nomenclature associated with their clans, tribes and union of tribes" (Haokip: 2018). Haokip's mentioned that the nomenclature of the

people of North East India can be divided into three hierarchical levels. The first and highest level is where a union of tribes comes together under a larger classification usually called an ethnic group. The second level is the community of clans, which form the tribal nomenclature. Lastly, the third level is where a group of families comes together under a single clan. A Northerner is generally known to the outside world “by their ethnic and tribal nomenclature at the regional or state level and by their clan at the local or village level” (Haokip: 2018). Thus, people from North East India may have to answer questions like, ‘Are you a Mizo, Naga, Assamese or Manipuri?’ when they are outside their state. And when they are in their own state, they might have to answer questions like ‘Are you an Angami, Sumi, Lotha or Ao?’. And in the same way, when they are outside their clan’s territory, they might be asked, ‘Are you a Sailo, Sangma, Jamir or Goigoi?’. Hence, a Northerner identity is identified on the basis of their membership with these three nomenclature (clans, tribes, union of tribes) levels.

In the study, ‘Clan, Dialect and Tribe Identity: Emergence of Crosscutting Identity among the Zo People in Manipur’ by L. Lam Kan Piang (2008), the author has given an account about the formation of clan and the emergence of various dialects amongst the Zo people. This study argues “that even though the colonial ethnographers introduced an alien concept of identity like tribe, primordial identity like clan and lineage could not be superseded and completely erased. Identity such as clan is rather strangely and tenaciously survived, as it is the traditional grouping system, which has culturally functional importance” (Piang: 2008). In contrast to other numerous tribal societies that are grouped into tribes and then into the clans, the Zo people of Manipur as a whole are divided into a number of clans and they are scattered randomly, inhabiting a contiguous geographical areas which they consider as their native place. The Zo people called clan as ‘Beh’ which is an agnatic group which is based on the consanguine relation that claim common ancestors. The Beh is an unbreakable bond of relationships for its members. The Zo society is patrilineal in nature, which means that an individual is born as a member of his or her father’s clan. And to claim membership in the Zo community, an individual must be able to trace and identify genealogical links to any one of the Zo clans. Furthermore, the Zo clan is classified into many branches of lineages or sub-clans. In the Zo society, the social solidarity is based on the Beh (clan), thus clan is considered as an important base for the Zo social structure. In the Zo

society, the chieftainship system is linked to the formation of the clan because a powerful chief can form a new clan using his name as the name of the clan. Therefore, to study the formation of clan among the Zo, it is important to study the system of their chieftainship. Furthermore, it has been observed that among the Zo people the formation of new clan always leads to the founding of new settlements. And the formation of new clans has led to the emergence of many clans within the Zo society. It has also been mentioned that the existing clans are either the names of the progenitors or the name of a popular chief.

Among the Zo clans, the unity and oneness can be seen through the practice of ancestor worship, the social obligations of the clansmen's to each other and the role played by the clan in the functioning of social institutions such as 'Inndongta' which means the household council. It has been mentioned that the relationship and solidarity that the clansmen have for their fellow clansmen is not only limited within a village but far beyond. Among the clan members, the feeling of 'we-feeling' is generally regulated by their traditional religious practice, thus the 'we-feeling' within a clan is stronger and it also has structural importance as compared to the 'we-feeling' which exists within the village community among the different clans. "So, all these contributed, besides descent from common ancestors, for the existence of 'we-feeling' among clan members. The significance of clan as a social identity is manifested in many ways in the Zo society more particularly in the aspects of social relationship" (Piang: 2008). It has also been mentioned in this study that in the Zo culture, the role and importance of clan identity could not be taken by over by other identities like dialect based or tribe identity. Hence, in the Zo social structure, the solidarity and unity based on clan is considered as the most crucial bond of relationship.

Rajmoni Singha (2014) in his article, 'Kinship and Marriage System Among the Khasis of Bangladesh: A Study of Khasi Culture and Identity' gave an account about the Khasi matrilineal system, where the children belong to their mother's clan and the father's has no kin relation with his children because he belongs to his mother's clan. After marriage, a Khasi man becomes a new member in his wife's family but he remains as a member of his mother's clan. "After death, a Khasi's burnt ashes are taken to the mother's grave to meet in heaven. According to Khasi law, a woman has no right to keep her husband's burnt ashes, because a man belongs to his mother's

clan” (Singha: 2013). “Long Kur Na Kakynthei means woman produce clan” (Singha: 2013). The woman is considered as the founder of the clan and thus, she is respected by every clan members. It is also mentioned that in the Khasi culture, it is believed that the women are the protector and guardian of the clan. In every clan, there is an ‘iing’ (natal house) which is a house of solidarity; it is a centre for all the family rituals and gathering centre for all the families.

Singha noted that for the Khasi, the clan is of prime importance. Every clan also has their own clan council ‘kur darbar’ which have supreme authority over the clan. The clan council is usually headed by the eldest maternal uncle, who also has an important role to play in the lives of his sister children. All the internal clan problems and other problems were monitored and resolve by the clan head and the clan elders. Singha also mentioned that the Khasi society rigidly follow the exogamy marriage system, the Khasi law strictly prohibits marriage within the same clan. The greatest sin in the Khasi society is said to be marriage within the same clan. Couples who marry within the same clan are punished by the Khasi punji (village) and they are declared as ‘shang’ which means prohibited people. It is said that the soul of the couples who marry within the same clan will not be able to meet their ancestors after their death.

Budha Kamei (2013) gave an account about the clan system of the Zeliangrong tribe in his article, ‘Traditional social system of the Zeliangrong’. In a traditional Zeliangrong society, class and caste system do not exist, however, the clan system exist. Zeliangrong “clan in its earliest stage is the combination of the families of the sons of a household joined by the families of male cousin’s from father’s side. In order to meet an external aggression raids several family combined on the basis of paternal line, and thus, formed a clan” (Kamei: 2013). The Zeliangrong clan is patriarchally organized and a woman after marriage changes her clan to that of her husband clan. Kamei mentioned that all the Zeliangrong clan has a totem which acts as the symbol of the clan. The Zeliangrong clan is classified into four totemic clans- Kamei, Gonmei, Gangmei and Rongmei. And all the Zeliangrong clans follow the practice of clan exogamy since clan members are believed to have common ancestors or common possession of totem. Marriages within the same clan is strictly prohibited and considered as a taboo. Kamei’s mentioned that for marriage within the same clan, no ritual ceremony is performed and the couple is also not recognized by the society. They are also not permitted to engage in the socio-

economic activities of their clan. Kamei's also noted that one of the prominent factors that have kept the different clans of the Zeliangrong tribe closely connected is the practice of exogamy. Clan is the base of unity in the Zeliangrong society.

R. Soanes and Q. Marak (2013) in their work titled, 'The Clan system in a Matrilineal Society- Its Organization, Importance and Functions' studies about the clan structure of the Bhois of Umden Village in Nongtluh in Meghalaya Ri-Bhoi District. The clan known as 'kur' plays a pivotal role in the society of the matrilineal Bhois. It is said that clan exogamy is very strong and each member of a clan is required to follow the rules and laws of their respective clans. It is also mentioned that all the clans are lead by a clan head who is known as 'u kni rangbah' and the clan head is influential in many facets of life such as social, political, economic and religious matters. This paper is interesting as it studies the clan organization system of the Bhois of Umden Village, the position of each member in their individual clan, the clan members' role and interaction with one another and the relationships among all of the clans.

According to Ashok K. Jain (1988), in his study 'Tribal Clans in Central India and Their Role in Conservation', the clans play a key role in the social set-up of any community. In this study, Ashok K. Jain mainly focused on the Sahariyas clan in Madhya Pradesh, a state in Central India. The Sahariyas is a tribal community and they inhabit the four northern districts of Madhya Pradesh. Among the Sahariyas tribal community, there are about 50 clans, who are related to their paternal family. The Sahariyas strictly prohibits the practice of endogamy as members of the same clan are considered to be brothers and sisters. There are certain clans among the Sahariyas which are based on plants while some other clans are related to animals. And the clansmen do not even touch the plant to which their clans name belongs to or eat the meat of the animals to which their clans are related to.

Gerald D. Berreman (1962) in the study, 'Sib and Clan among the Pahari of North India' has given an account about the sib and clan system prevalent among the Pahari of North India. The

Pahari are traditional patrilineal people. “The Pahari have what Murdock (1949:225-226) calls a ‘normal Guinea’ type of social organization in that they have exogamous patrilineal kin groups, patrilocal residence, and cousin terminology of the Hawaiian type” (Berreman: 1962). In this study, Berreman focused on the distinction between the patrilineal exogamous ‘sib’ and the comprise kin group ‘clan’, which is essential for a better understanding of the system of inheritance, ritual participation, descent and the kinship terminology among the Pahari. Among the Pahari, the sib is a named exogamous group while on the other hand, the clan is unnamed and unrecognized. The clan consists of the local members of the patrilineal sib and their wives and at times, it also includes an adopted son and matrilocal resident son-in-law. However, a daughter or sisters who live elsewhere after marriage and son or brother who is adopted elsewhere or settle in a matrilocal residence is excluded from the clan. Hence, though the clan among the Pahari is ground on the patrilineal core, it includes some members who are not from the patrilineal group and also excludes some members from their own group. Berreman’s also mentioned that even though the Pahari clan is not recognized as a group, they function as a group in times like ritual occasions, in particular during funeral and other life-cycle rites.

Meyer Fortes (1940) who studied the kinship and marriage system of the Ashanti, says that, the political history and structure of the state decisively influences the whole social order of Ashanti. Among the Ashanti there are eight clans and every lineage belongs to one or other of these clans and every clan is usually represented in every domain of their chief. Thus, tribe among the Akan tribals or particularly, the Ashanti is a number of clans who occupied a certain area or territory, where the clan chiefs acknowledge one chief among themselves as a king.

Walter Hough (1899) in his journal titled ‘Korean Clan Organization’ wrote about the clan organization in Korea. In the journal, Walter Hough mentioned that it is interesting that in an ancient country like Korea, the strength of a clan organization has for a long time possessed a general scheme of government. The Korean clan was headed by a clan head, who is the direct male descendant of the ancestors by primogeniture. Regarding the clan names of the Korean clan, some of the clan names were taken from natural objects but there were no totemic devices.

In the journal, Hough mentioned that “Meetings are called on many matters connected with the interests of the clan, such as the death of a prominent member, congratulations on the advancement of members of the clan, questions relating to burial grounds over which disputes may arise, or for the expulsion of members from the clan, etc.” Hough also mentioned that one of the laws of the Korean clan is that marriage among the clan members was strictly prohibited and there is a penalty for infraction, if members marry within their same clan group. The Korean clan laws also take heed of some offences against the clan and reward punishment for the offences committed. Some of the offences are – if a clan member becomes a betrayer of his country, he is expelled and excommunicated from the clan and prohibited to use the clan surname. Illicit intercourse between families is another offence and the clan penalty for this offence is excommunication. Another serious offence is the disrespect to parents and to old people and this offence is often rectify by the clan, however if the offence is repeated again, then the person is punished by the civil law.

Grenville Goodwin (1937) in his study, ‘The Characteristics and Function of Clan in a Southern Athapascan Culture’ mentioned that there are ten clans among the White Mountain Apache namely “’iyà’ ’áiy’ ( a species of plant ), “Hills Running Down to the River in a Line People,” “Rock Jutting Into the River People,” “White Water People,” “Black Water People,” “Long People” (because they ate from a tall tree), “Narrow Peak Jutting Upwards People,” “Adobe Bank on Wash People,” “Notch Between Hills People,” and “Cottonwoods Meeting from Two Lines People” (Goodwin: 1937) . Besides the first clan name, all the other clan names refer to the traditional places of clan origin. And these clans are classified into three phratries and one unrelated clan, with interrelationship among the clans of each phratry. Goodwin’s also mentioned that all the ten clans of White Mountain Apache are represented in both the Eastern and Western White Mountain Bands, however it is perceive that a clan belongs to the band in whose territory, the clan has traditionally originated. Grenville Goodwin had studied various characteristics and function of clan in Southern Athapascan Culture such as-

The clan system - It is said that all members of a clan are related by blood, regardless of whether it is traceable or untraceable. But it does not suggest the origin from a single woman. The members of a clan can readily differentiate between his clan mates who is related to him by

blood and those who are related to him by blood. The recognized blood kin consists of only the mother, true siblings and those with whom “blood connection can be traced through the intermediacy of females of the clan irrespective of generation”(Goodwin: 1937). And to explain the relationship that exists between clans, it is often believed that all the clans are offshoots from one root or parent clan. It is also said that an individual belongs to his mother clan yet an individual is said to be the child of his father’s clan.

The clan and phratries are exogamous in nature. And marriages within the same clan are considered to be incestuous and examples of witchcraft. “Marriages into the father’s clan are not only acceptable but preferred: compilations show a decided tendency in this direction” (Goodwin: 1937). It has also been noted that a widow and a widowers are often compel to remarry into the same family and clan. If a widow or a widower had to remarry outside the family, he or she must marry within the clan or phratry.

Mutual responsibility of clan members – In a clan, the feeling of kinship solidarity is highlighted through a gambling custom which required the opponents to be of unrelated clans in games of high stakes but two players. Because opposition between two clansmen is not socially acceptable. This study mentioned that the clan played a pivot role when it comes to cases like rape, murder and injury, whether it is done with an intention or accidentally. Furthermore, a blood feud is sure to take place unless the settlement is resolved through payments between the clans involved. And according to the extent of harm and the social position of the injured individual, the material payment is made accordingly. The settlements are usually done by considerate tactful members of the offender’s clan and after the payment was made, it is emphasized that no bad feelings should exist between the clans. However, it is noted that there are some instances where the injured individuals or his close kin seek revenge.

Clan and death customs – The clan also engaged in the observation at death. When an individual is in his deathbed, he is look after and attended by his clan members. And this is regarded as an expression of sympathy and fulfillment of duty as fellow clansmen’s. Thus, through this study, Goodwin has given a detail description about the characteristics and functions of clan in a Southern Athapascan culture.

# **CHAPTER – 3**

# **METHODOLOGY**

This chapter deals with the methodology being used by the researcher to study the clan identity among the Angami Nagas at Kohima District. This chapter includes the research design, research setting and the tools used for data collection.

### **STATEMENT OF THE PROBLEM**

Studies and researches have been conducted on the history, society, cultural and traditions of the Angami Nagas through various disciplines. And it has contributed to the literature and broadened the knowledge of research academics and readers interested in the subject. It has also sparked interest towards further and newer studies of the Angami Nagas. And this study is also relatively new and there is limited studies that study about the clan identity among the Angami Nagas.

Thus, the study undertaken is entitled “A Sociological Study on Clan Identity among the Angami Nagas at Kohima District”.

### **SIGNIFICANCE OF THE STUDY**

- This study is significant because it studies the Angami clan in which clan are the real unit of the Angami social life.
- This study explores how clan was the point of identity among the Angami Nagas.
- This study helps in understanding how loyalty to clan among the Angami Nagas is stronger than the loyalty to the village.
- This study gives a new light into the different functions of the Angami clans.
- This study is also significant because there is limited studies on social institutions like clan which is an integral part of community life among the Angamis, not only in the past but even today.

### **OBJECTIVES**

General objectives

- To study the clan identity among the Angami Nagas at Kohima district.

#### Specific objectives

- To find out the socio-economic profile of the Angami Nagas
- To study the extent of clan identity among the Angami Nagas
- To understand the social relationships among the clan members of the Angami Nagas
- To study the exogamy within the clan among the Angami Nagas
- To examine the extent of conflict resolution among the Angami Nagas

### **CLARIFICATION OF THE CONCEPT**

#### Theoretical definition

- Clan : According to the Oxford dictionary, a clan is 1. a group a people with a common ancestors, esp. in the Scottish Highlands. 2. a large family as a social group.

According to the Merriam-Webster dictionary, a clan is – a) A Celtic group especially in the Scottish Highlands comprising a number of households whose head claim descent from a common ancestor.

b) A group of people tracing descent from a common ancestor.

c) A group united by a common interest or common characteristics.

- Clan identity: Clan identity is an identity shared by a group of people which claim to have a common ancestor. More precisely, it is a concept which revolves around who we are. [Hassan Mudane (2018)]

- Angami Nagas: The Angami is a major Naga ethnic group native to the state of Nagaland in North-East India. The Angami Nagas known as Tenyimia is the fourth largest Naga tribe, inhabiting the present Kohima District, Nagaland. The term ‘Tenyimia’ is derived from the Angami word ‘Tounyümia’ which means ‘swift walker’. The Angamis are identified by their geographical location into four groups: namely, the Northern, Southern, Western and Chakroma groups. The groups living in Kohima and the villages

surrounding it are known as the Northern Angami; those living in the west are called the Western Angami; those living in the south are the Southern Angami; and those who established themselves along the national highway, from Kohima to Medziphema and around Dimapur, are known as the Chakroma group. [Pienyu Medonuo (2017). The Angami Naga Society: Continuity and Change ]

- Kohima: Kohima is the capital city of India's North-Easter state of Nagaland. With a resident population of 100,000, it is the second largest city in the state. Originally known as 'Kewhira', Kohima was founded in 1878 when the British Empire established its headquarters of the then Naga Hills District of Assam Province. The name 'Kohima' was given by the British as they could not pronounce the Angami name 'Kewhira'. [<https://en.m.wikipedia.org/wiki/kohima>]

According to the Collins dictionary, Kohima is a city in NE India, capital of Nagaland, near the Burmese border: centre of fierce fighting in World War II, when it was surrounded by the Japanese but not captured (1944).

- Exogamy: According to the Collins dictionary, exogamy is 'the custom or an act of marrying a person belonging to another tribe, clan, or similar social unit'.

According to Merriam – Webster dictionary, exogamy is the 'marriage outside of a specific group especially as required by custom or law'.

According to Oxford Reference, exogamy is 'the cultural practice of marriage between people of different clans, tribes, or other groups of related individuals; more generally outbreeding, or the fusion of gametes from parents that are not closely related'.

- Conflict resolution: According to Oxford Reference, conflict resolution is 'the methods and process of negotiation, arbitration, and institution building which promote the peaceful ending of social conflict and war'.

Conflict resolution is conceptualized as the methods and processes involved in facilitating the peaceful ending of conflict and retribution.

[[https://en.m.wikipedia.org/wiki/conflict\\_resolution](https://en.m.wikipedia.org/wiki/conflict_resolution)]

## Operational definition

- Clan: In this study, the term clan that is being referred to is the Angami clan, which is a collection of families, commonly bearing the same surname and supposed to have common ancestors.
- Clan identity: In this study, the clan identity that is being referred to is the feeling of identity, loyalty and oneness among the Angami Nagas, who thinks of themselves as one people.
- Angami Nagas: In this study, the Angami Nagas that is being referred to is a major Naga ethnic group native to the State of Nagaland in North-East India.
- Kohima: In this study, Kohima that is being referred to is the native place of the Angami Nagas. It is the home of the Angami Nagas.
- Exogamy: In this study, the term exogamy refers to the practice and custom of marrying outside one's own chienuo (clan).
- Conflict resolution : In this study, the term conflict resolution that is being used refers to the settlements of disputes that arises among the Angamis ranging from land disputes, property disputes, misunderstanding among the clan members or even with members from other clans, theft and so on.

## **VARIABLES**

### Independent variables

- Age
- Gender
- Educational qualification
- Occupation
- Marital status
- Locality of residence
- Type of family

Dependent variables

- Clan identity among the Angami Nagas

### **RESEARCH DESIGN**

The research design used in this study is Descriptive research design since this study requires an in-depth and detailed study. The research is designed to study the clan identity among the Angami Nagas.

### **UNIVERSE**

The universe of the study is the Angami clan of Kohima District, Nagaland.

### **SAMPLE SIZE**

The sample size for this study is 50 samples.

### **SAMPLING METHODS**

The sampling method intended to use in this study is Snowball sampling.

### **TOOLS OF DATA COLLECTION**

In this study, questionnaire is used as a tool for data collection. Due to the Covid situation, Google forms were used for collecting the data. The questionnaire was prepared in English and for those respondents who cannot understand English, the questions was interpreted in Angami native language 'Tenyidie'.

## **DATA COLLECTION**

The data collection was completed in three weeks during the month of March 2022 and the respondents were cooperative throughout the research.

## **DATA ANALYSIS**

The data collected in this study was tabulated, analysed and interpreted using Microsoft excel.

**CHAPTER – 4**

**ANALYSIS AND**

**INTERPRETATION**

## ANALYSIS AND INTERPRETATION

This chapter deals with the analysis and interpretation of data, collected through the questionnaire. One of the most important aspects of research is data analysis and data interpretation. The data is analyzed in accordance with the study's objective. The data collected in this study was documented and analyzed in a systematic and thorough manner in order to determine the study's objectives.

**Table 4.1**

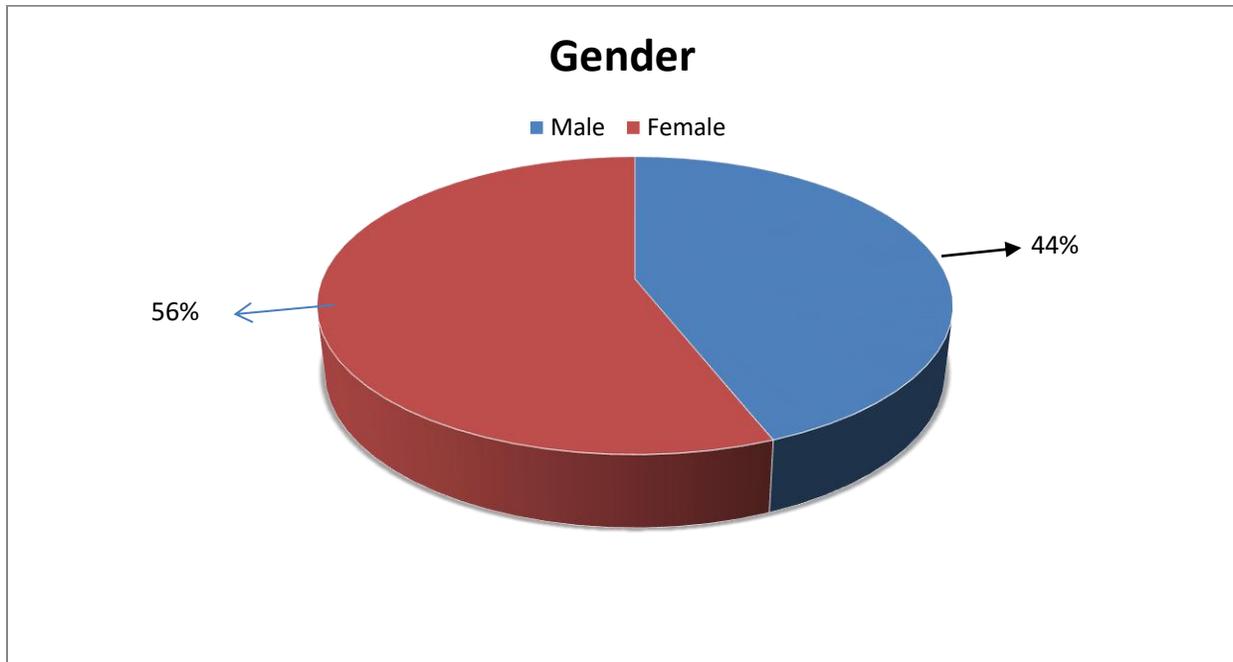
Age of the respondents

Age	No of respondents	Percentage
20 - 30	13	26
30 - 40	9	18
40 - 50	13	26
50 - 60	6	12
60 - 70	3	6
70 - 80	5	10
80 - 90	1	2
<b>Total</b>	50	100

According to the above table, it is inferred that majority of the respondents belong to the age category of 20-30 and 40-50, with both the age category constituting 26 percent each. The third highest number of respondents fell under the age category of 30-40 with 18 percent. 12 percent of respondents belong to the age category of 50-60, 10 percent of respondents belong to the age category of 70-80 and 6 percent of respondents belong to the age category of 60-70 and the rest 2 percent of respondents belong to the age category of 80-90. Thus, from the entire sample, it was found out that majority of the respondent's falls under the age group 20 – 30 and 40 – 50.

**Figure 4.1**

Gender



The above figure represents the gender of the respondents. The table clearly indicates that majority of the respondents are female and they constitute 56 percent of the total number of respondents. While the male respondents constitute 44 percent of the total number of respondents. Thus, the majority of the respondents are female.

**Table 4.2**

Educational qualification of the respondents

<b>Educational qualification</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Illiterate</b>	7	14
<b>High school</b>	3	6
<b>Higher secondary</b>	10	20
<b>Graduate</b>	17	34
<b>Post graduate</b>	10	20
<b>PhD</b>	3	6
<b>Total</b>	50	100

Table 4.2 represents the educational qualification of the respondents. From the above table, it is inferred that majority of the respondents are graduate with 34 percent, 20 percent of the respondents are post graduate, 20 percent of the respondents are higher secondary passed, 14 percent of the respondents are illiterate, 6 percent of the respondents are high school passed and the rest 6 percent of the respondents are PhD holder. Thus, from the entire sample, it was found out that majority of the respondents are educated.

**Table 4.3**

Occupation of the respondents

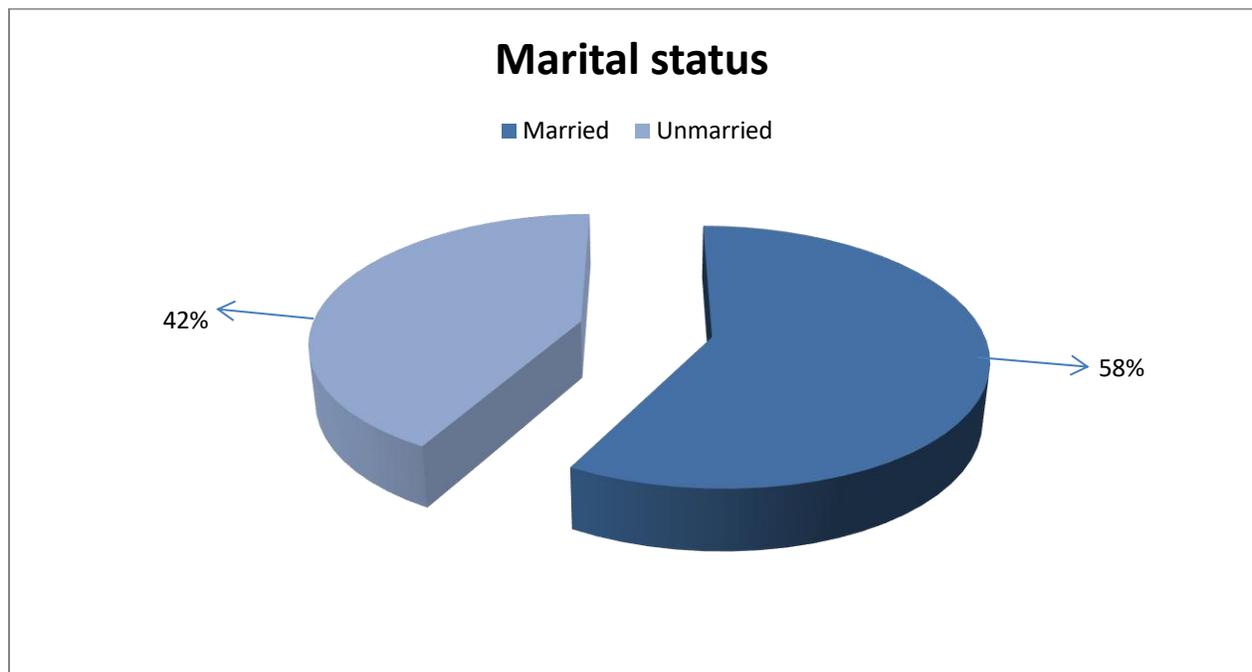
<b>Occupation</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Unemployed</b>	10	20
<b>Farmer</b>	9	18
<b>Business</b>	8	16
<b>Student</b>	7	14
<b>Teacher</b>	5	10
<b>Educationist</b>	2	4
<b>Government servant</b>	7	14
<b>Retired government servant</b>	1	2
<b>Social worker</b>	1	2
<b>Total</b>	50	100

Table 4.3 represents the occupation of the respondents. In this study, it has been found out that 20 percent of the respondents are unemployed, 18 percent of the respondents are farmers, 16 percent of the respondents are doing business, 14 percent of the respondents are student, 14 percent of the respondents are government servant, followed up by teachers who made up 10 percent of the total number of respondents, 4 percent of the respondents are educationist, 2 percent of the respondents are retired government servant and the rest 2 percent of the respondents is working as social worker. From the above table, it is understood that the Angamis Nagas practiced different kind of occupation. Though agriculture was and is still the most important occupation of the Angamis, today with the advent of modernity and modern education, the Angamis is practicing other occupation either in the private sector or the government sector along with agriculture. However, unemployment is also a major setback prevalent in the Angami society and as indicated in the above table, 20 percent of the respondents are unemployed because of factors like the dependency on government jobs, scarce job opportunities both in the

private and government sectors, lack of industrial culture, lack of inability and infrastructure to venture into new areas of entrepreneurship etc.

**Figure 4.2**

Marital status of the respondents



The above figure represents the marital status of the respondents. From the figure, we can see that majority of the respondents are married and they made up 58 percent of the total number of respondents while 42 percent of the respondents are unmarried. Thus, it is understood that majority of the respondents are married.

**Figure 4.3**

Locality of residence

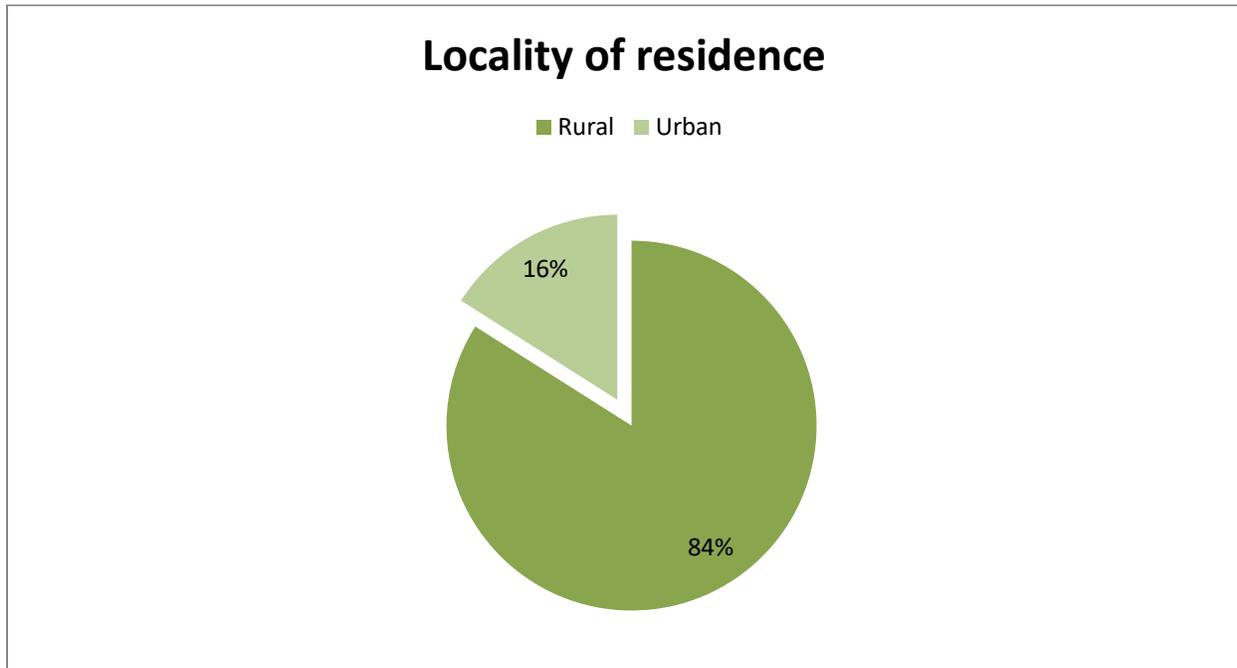


Figure 4.3 shows the locality of residence of the respondents of the study. The figure gives the status of the locality of residence of the respondents whether they are from the rural or urban area. And it has been found out that majority of the respondents (84%) residence is located in the rural areas while the residence of the rest of 16 percent of the respondents is located in the urban areas. The majority of the respondents reside in the rural areas because Angami is a tribal community and majority of their ancestral lands are in the rural areas thus most of its members dwell in the rural areas.

**Figure 4.4**

Family type of the respondents

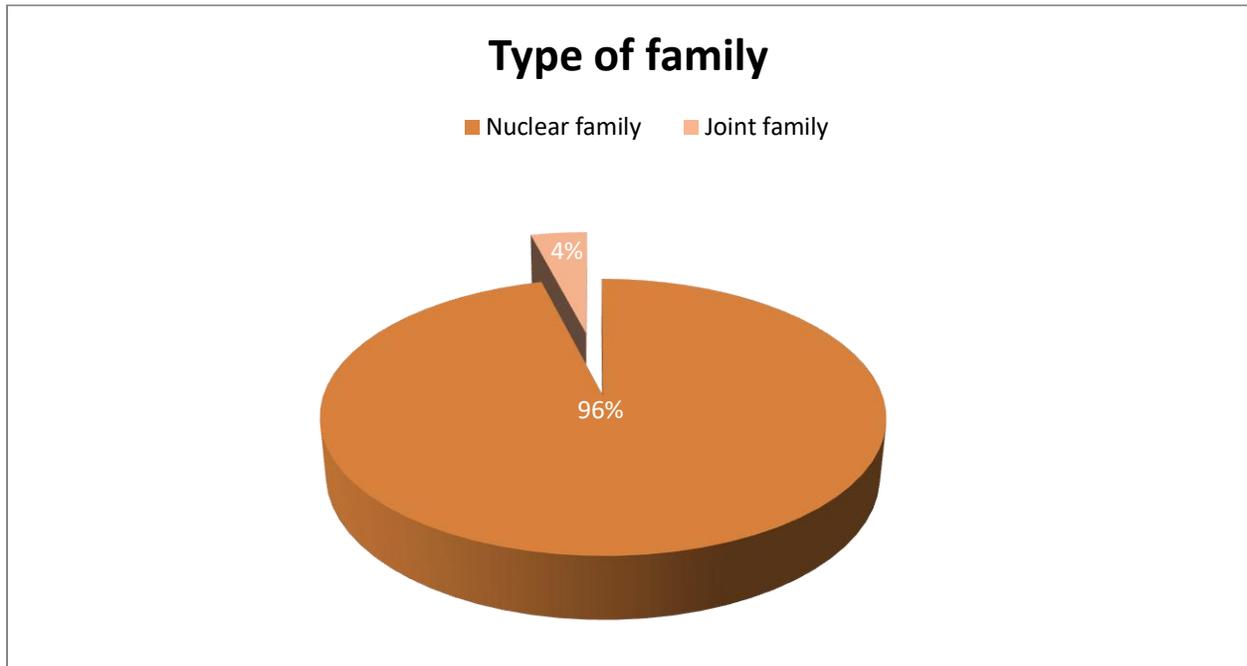


Figure 4.4 represents the family type of the respondents whether they belong to the nuclear type of family or joint type of family. And from the above figure, it is inferred that majority of the respondents that is 96 percent belongs to a nuclear type of family and only 4 percent of the respondents live in a joint family. This prevalence of nuclear type of family over joint type of family is mainly because the traditional Angami did not favour the joint family system. They believe that a person who is getting married is in a position of independence, a responsible adult and is capable of providing for his family needs. Thus, a son has to leave his father's house after marriage and start his own family.

**Figure 4.5**

Figure showing whether the clan members support each other in socio-economic activities.

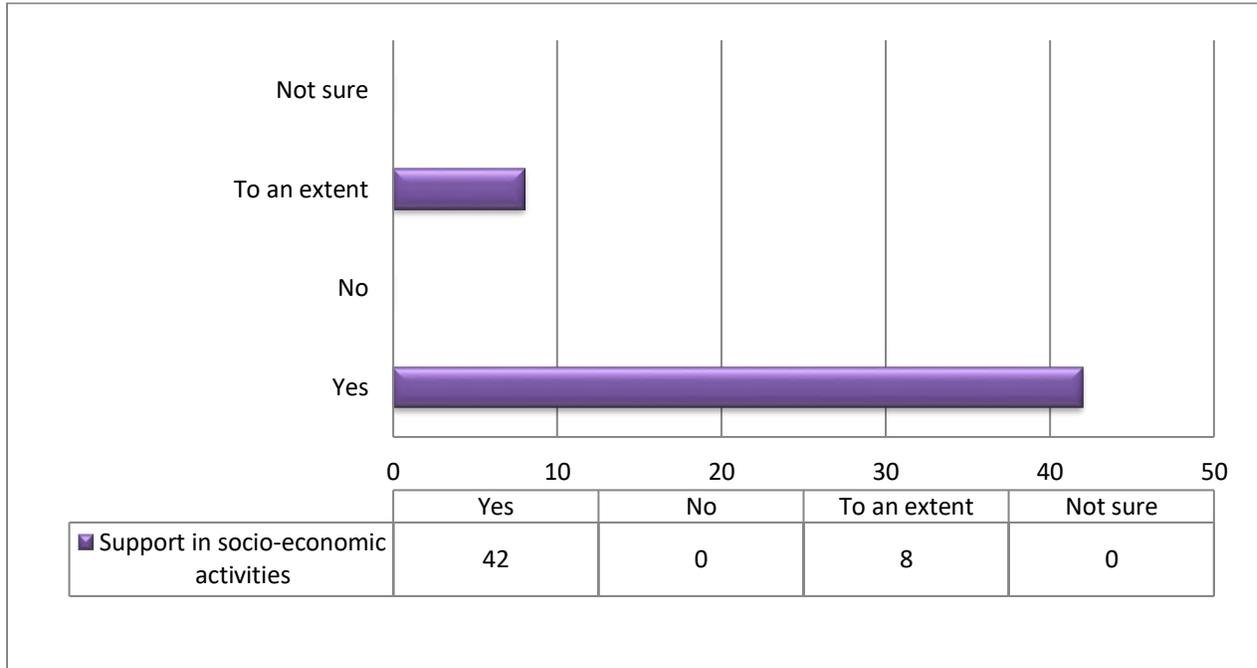


Figure 4.5 shows whether the clan members support each other in socio-economic activities. According to the above figure, 84 percent of the respondents agree that the clan members support each other in socio-economic activities while 16 percent of the respondents agree to an extent that clansmen support their fellow clansmen in socio-economic activities. The clan members are linked with all the socio-economic activities such as administration, marriage ceremonies, death etc in the village. Thus, from the entire sample, it was found out that majority of the respondents support their clan members in socio-economic activities.

**Figure 4.6**

Figure showing whether the economic status of the Angami Nagas determine their position in the community.

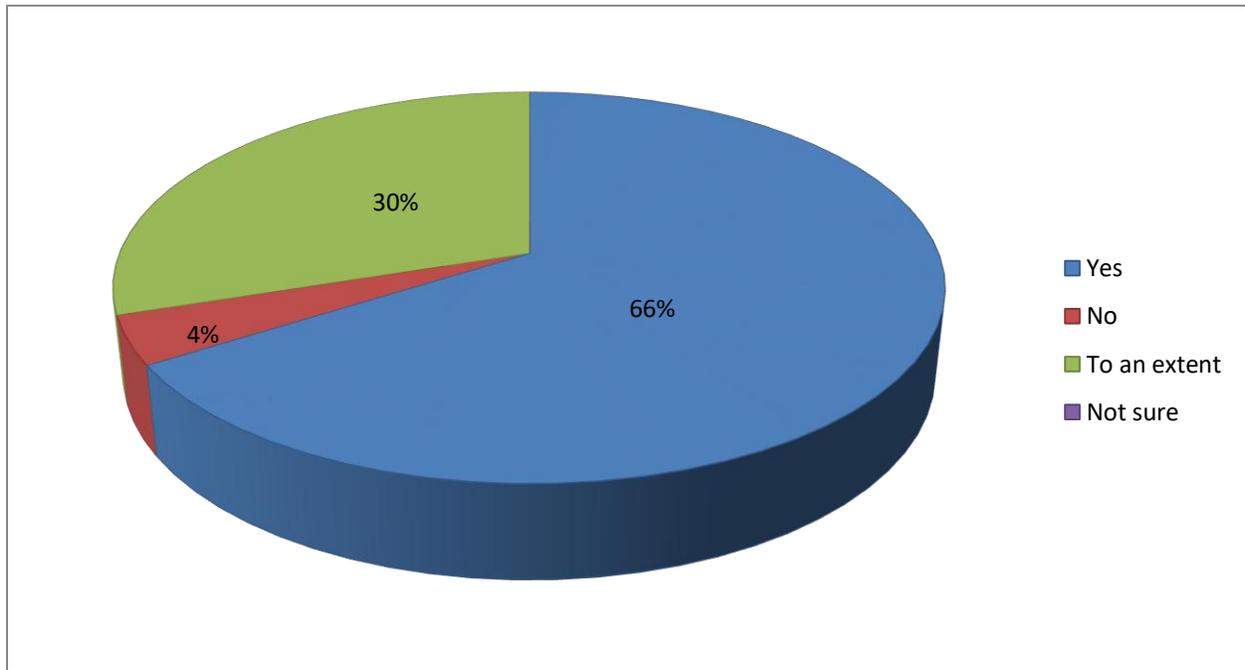
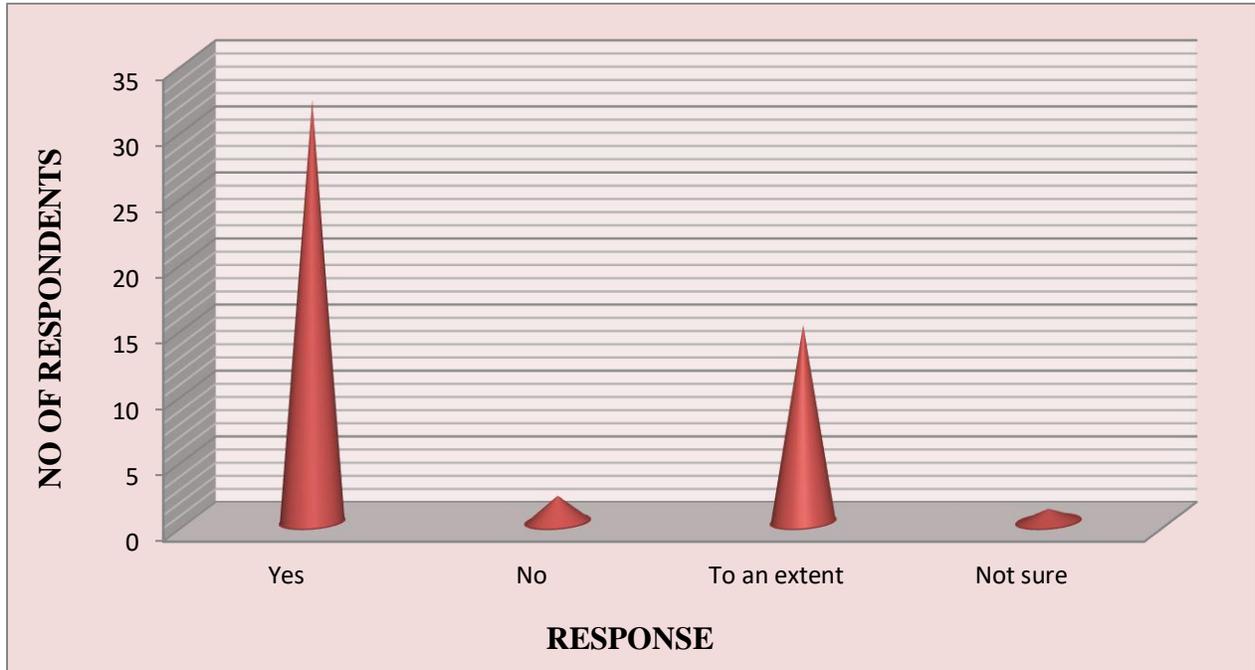


Figure 4.6 shows whether the economic status of the Angami Nagas determine their position in the community. And the figure indicates that 66 percent of the respondents agree that the economic status of the Angami Nagas determine their position in the community and 30 percent of the respondents agree to an extent. While 4 percent of the respondents are of the opinion that the economic status of the Angami Nagas do not determine their position in the community. The economic status of the Angamis does have a profound influence in determining their position in the community. An Angami man with high economic status is well respected in the society, while a man with lower economic status is sometimes looked down upon. Thus, from the above figure, it has been found that most of the respondents are of the view that their economic status does determine their position in the community.

**Figure 4.7**

Figure showing whether the shift of residence to town from villages is a result of the rise in the standard of living among the Angami Nagas.



From the above figure, it is inferred that majority (64%) of the respondents agree that the shift of residence to town from villages is a result of the rise in the standard of living among the Angami Nagas while 30 percent of the respondents agree to an extent with this. And 4 percent of the respondents do not agree while the rest 2 percent of the respondents is not sure whether shift of residence to town and village is a result of the rise in the standard of living among the Angami Nagas or not. Due to prevalence of better living standard in the towns as compared to the village and the rise in the standard of living, the Angami Nagas are shifting to the towns. Thus, from the entire sample, it has found out that majority of the respondents are of the opinion that the shift of residence to town from villages is a result of the rise in the standard of living among the Angami Nagas.

**Figure 4.8**

Factors for clan identity of Angami Nagas

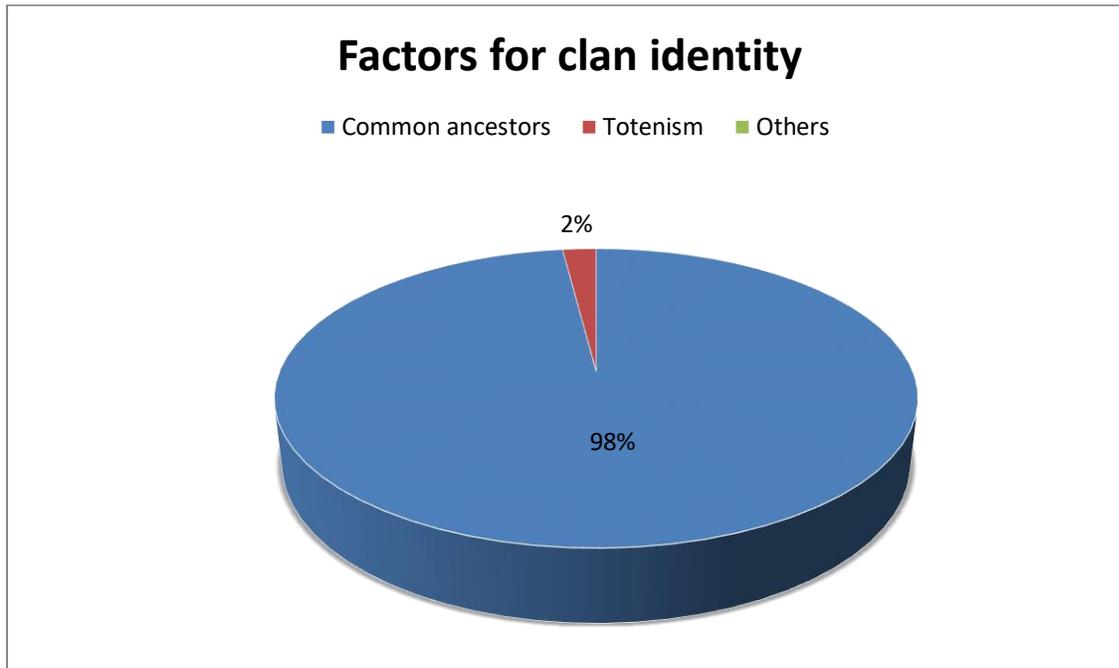


Figure 4.8 showed the factor for clan identity among the Angami Nagas. And from the figure, we can see that majority of the respondents that is 98 percent acknowledged that common ancestors is the factor of clan identity among the Angami Nagas while 2 percent of the respondents opted for totenism as the factor of clan identity among the Angami Nagas. The Angami clan believe that they have descended from a common ancestor, thus, from the above figure, it is understood that majority of the respondents are of the view that common ancestor is the factor for clan identity among the Angami Nagas.

**Figure 4.9**

Figure showing whether the Angami Nagas give more loyalty to their clan than to their village.

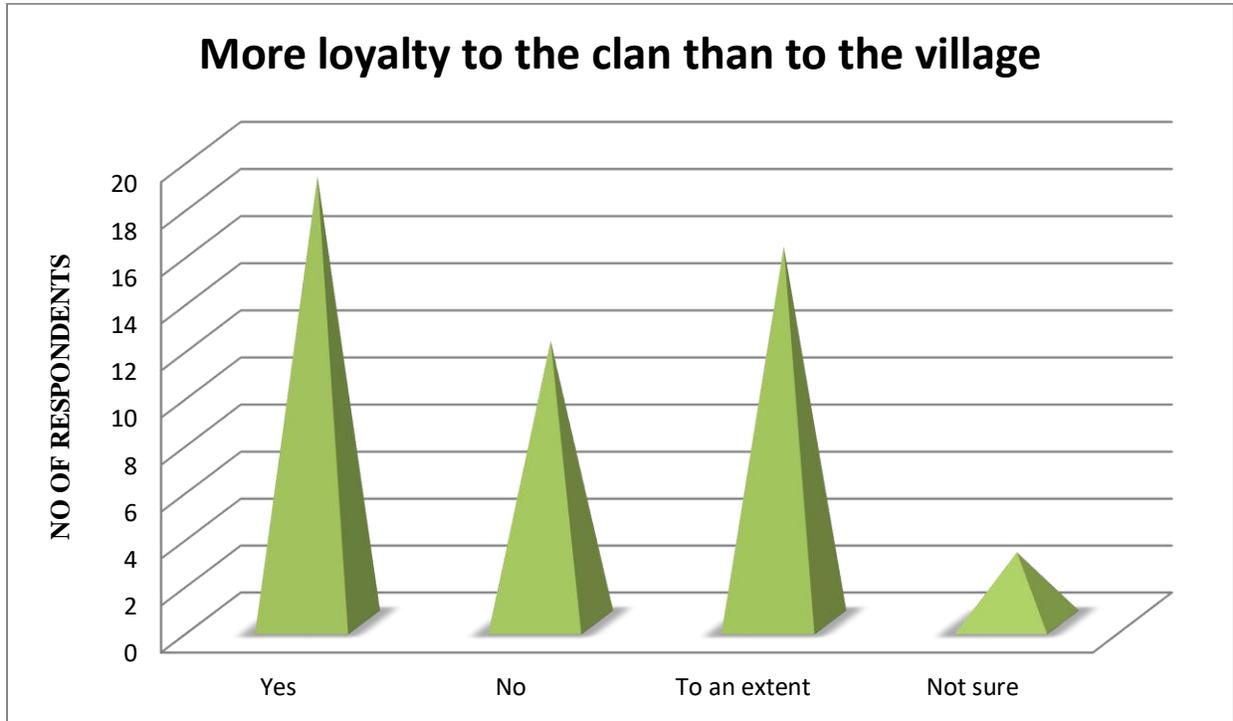


Figure 4.9 showed diverse opinions with regard to giving more loyalty to the clan than to the village among the Angami Nagas. According to Figure 4.9, 38 percent of the respondents agree that the Angami Nagas give more loyalty to their clan than to their village and 32 percent of the respondents agree to an extent that the Angami Nagas give more loyalty to their clan than to their village while 24 percent of the respondents disagree with this. And the rest 6 percent of the respondents is not sure whether Angamis gives more loyalty to their clan than to their village or not. From the above figure, it is inferred that majority of the respondents i.e. 38 percent agree that the Angamis give more loyalty to their clan than to their village because it is obligatory for an Angami to give his loyalty to his clan and identified himself with his own clan. An Angami identifies himself by the name of his clan and his loyalty to his clan is very strong.

**Figure 4.10**

Figure showing whether the clan members share a strong ‘we feeling’.

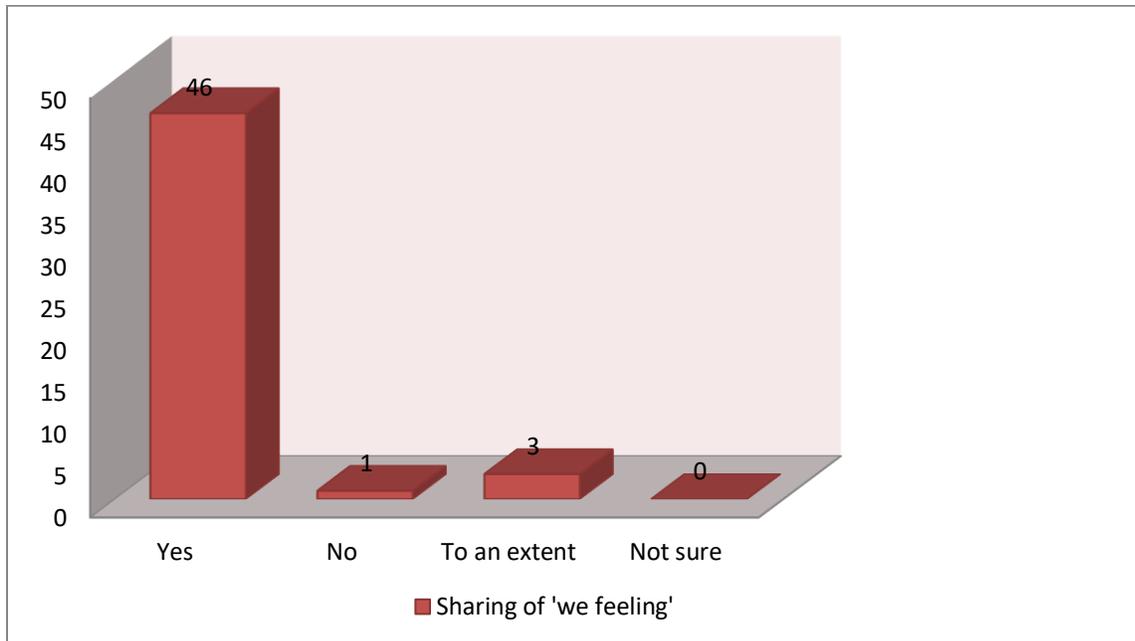


Figure 4.10 shows whether the clan members share a strong ‘we feeling’. The majority of the respondents that is 92 percent of the total number of respondents acknowledged that among the Angami Nagas, the clan members share a strong ‘we feeling’ while 6 percent of the respondents agree to an extent. And the rest 2 percent of the respondents are of the opinion that the clan members do not share a strong ‘we feeling’. Majority of the respondents are of the opinion that the Angami Nagas share a strong ‘we feeling’ because the Angami Nagas consider themselves as one people and there is a strong feeling of oneness and closeness among the fellow clansmen, which is stronger than the village feeling or tribal feeling.

**Figure 4.11**

Figure showing whether the strength of clans determine the village outlook

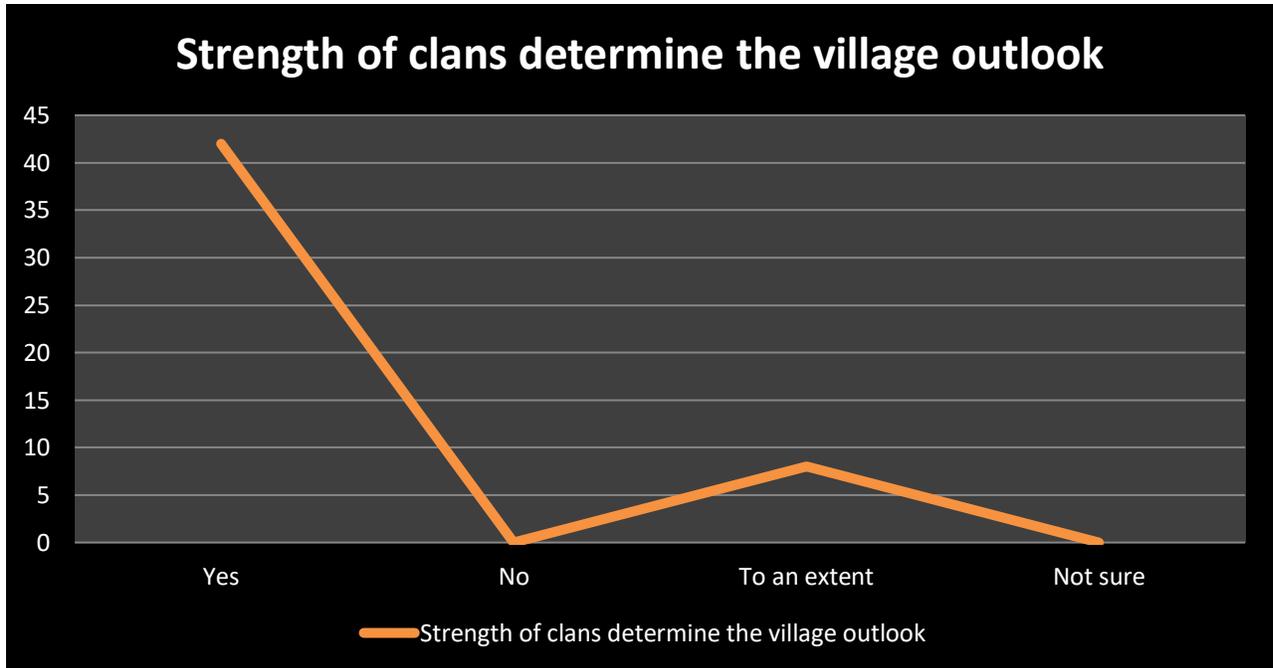
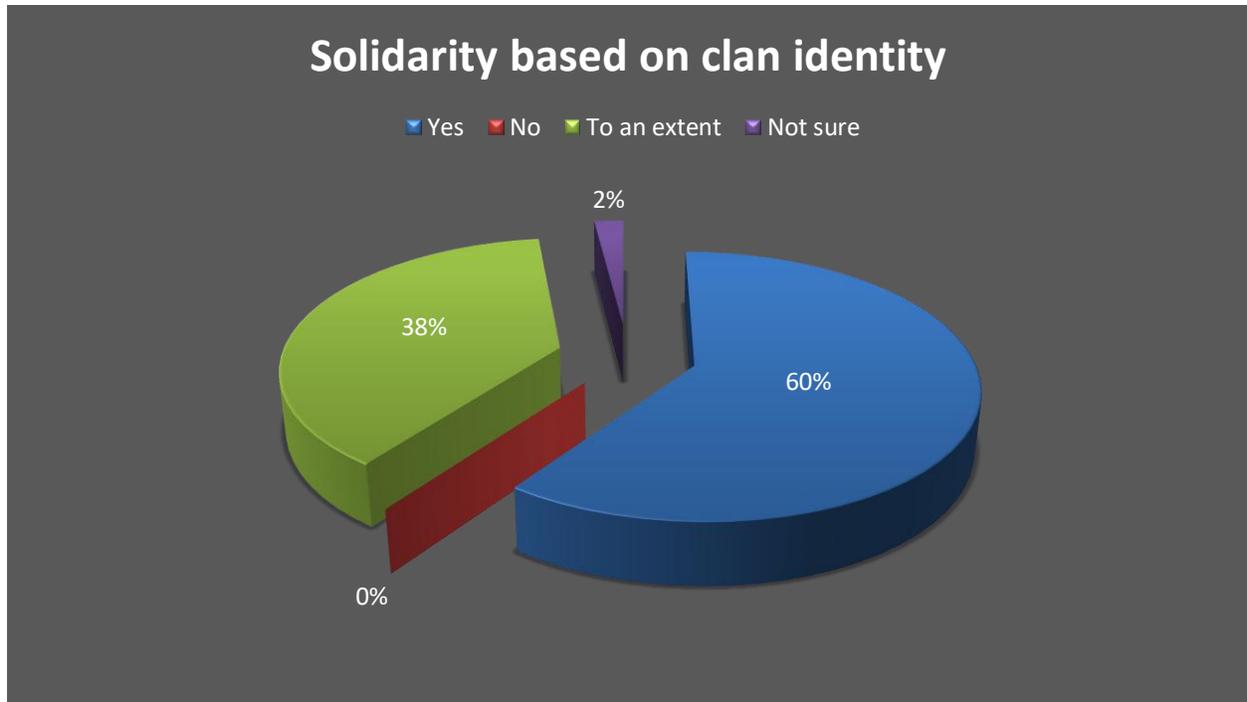


Figure 4.11 represents whether the strength of clans determine the village outlook. And we can see from the above figure, that majority (84%) of the respondents agree that the Angami Nagas, the strength of clans determine the village outlook while 8 percent of the respondents agree to an extent that the strength of clans determine the village outlook. From the entire sample, it is understood that majority of the respondents agree that the strength of clans determine the village outlook because the strength of clans can make a village either powerful or weak.

**Figure 4.12**

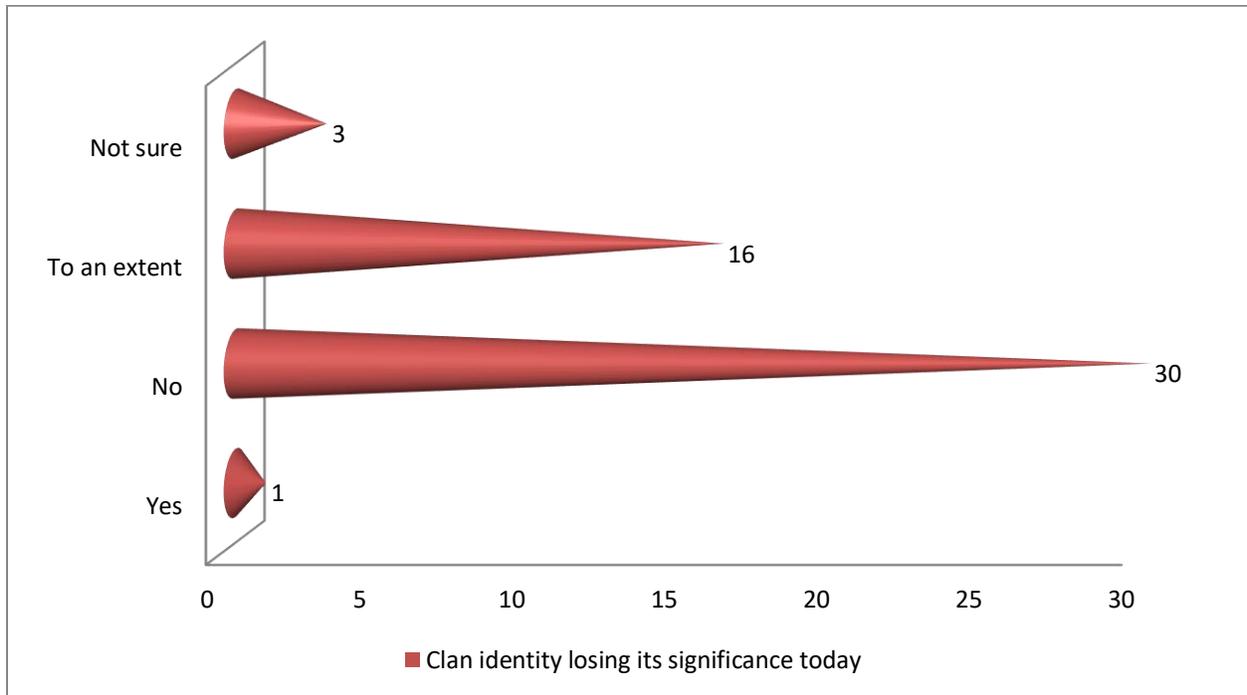
Figure showing whether the Angami Nagas claim solidarity based on clan identity



According to the above figure, 60 percent of the respondents agree that the Angami Nagas claim solidarity based on clan identity and 38 percent of the respondents agree to an extent. While 2 percent of the respondents are not sure whether the Angami Nagas claim solidarity based on clan identity or not. The above figure indicates that majority of the respondents agree that the Angami Nagas claim solidarity based on clan identity because they believe they have descended from a common ancestor and they consider themselves to be one people. And as a result, they claimed solidarity based on clan identity.

**Figure 4.13**

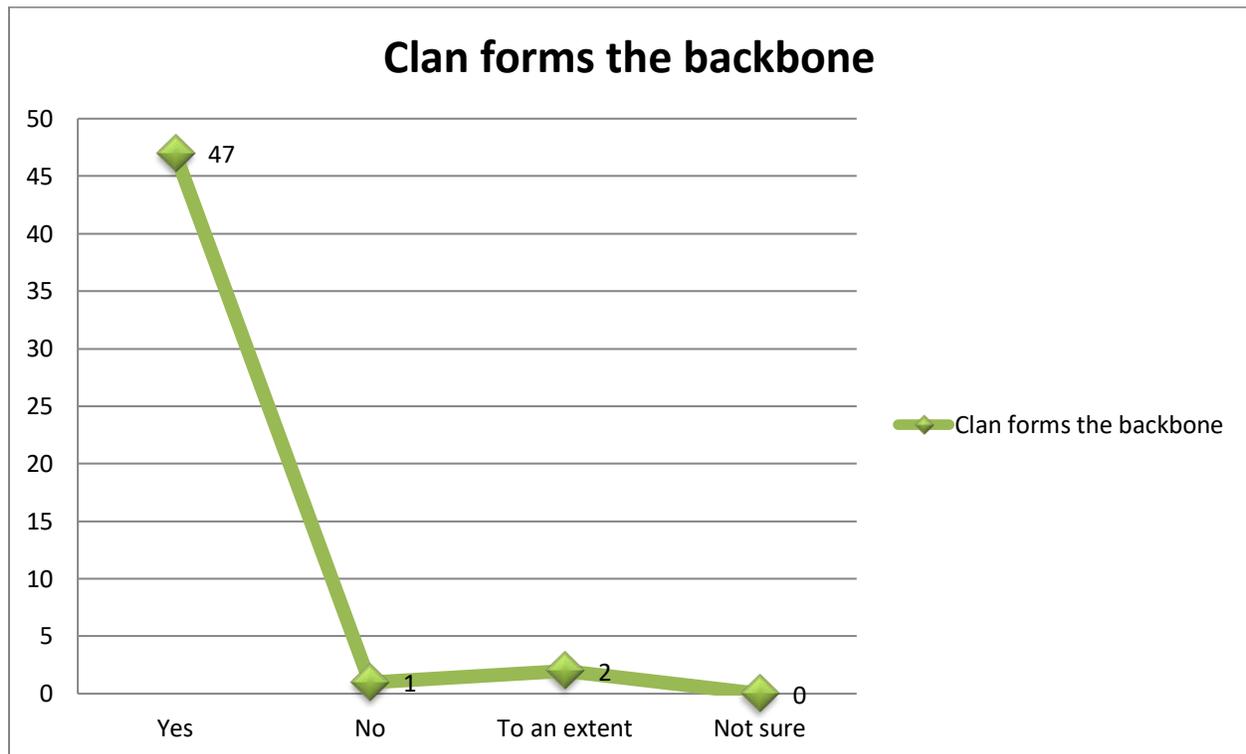
Figure showing whether clan identity is losing its significance today



From the above figure, we can see that 60 percent of the respondents believe that clan identity among the Angami Nagas is not losing its significance today while 32 percent of the respondents agree to an extent that clan identity is losing its significance today. 6 percent of the respondents is not sure about clan identity losing its significance today and the rest 2 percent of the respondents agree that clan identity is losing its significance. The above figure indicates that majority of the respondents are of the view that that clan identity is not losing its significance today because the Angamis still give utmost importance and loyalty to their clan and identify themselves with their clan. While 2 percent of the respondents agree that clan identity is losing its significance today because of reasons like change in the thought process, the rising need of a pan Naga identity and the decline of clan significance.

**Figure 4.14**

Figure showing whether clan forms the backbone of the Angami social structure



The above figure showed whether the clan forms the backbone of the Angami social structure. And according to figure, majority of the respondents (94%) agree that clans form the backbone of the Angami social structure while 4% of the respondents agree to an extent. And the rest 2 percent of the respondents disagree that the clans form the backbone of the Angami social structure. From the above figure, it is understood that majority of the respondents agree that clan forms the backbone of the Angami social structure because the clan is the real unit of the Angami social life.

**Figure 4.15**

Figure showing whether clan members feel obligated to give mutual support to fellow clansmen in times of need.

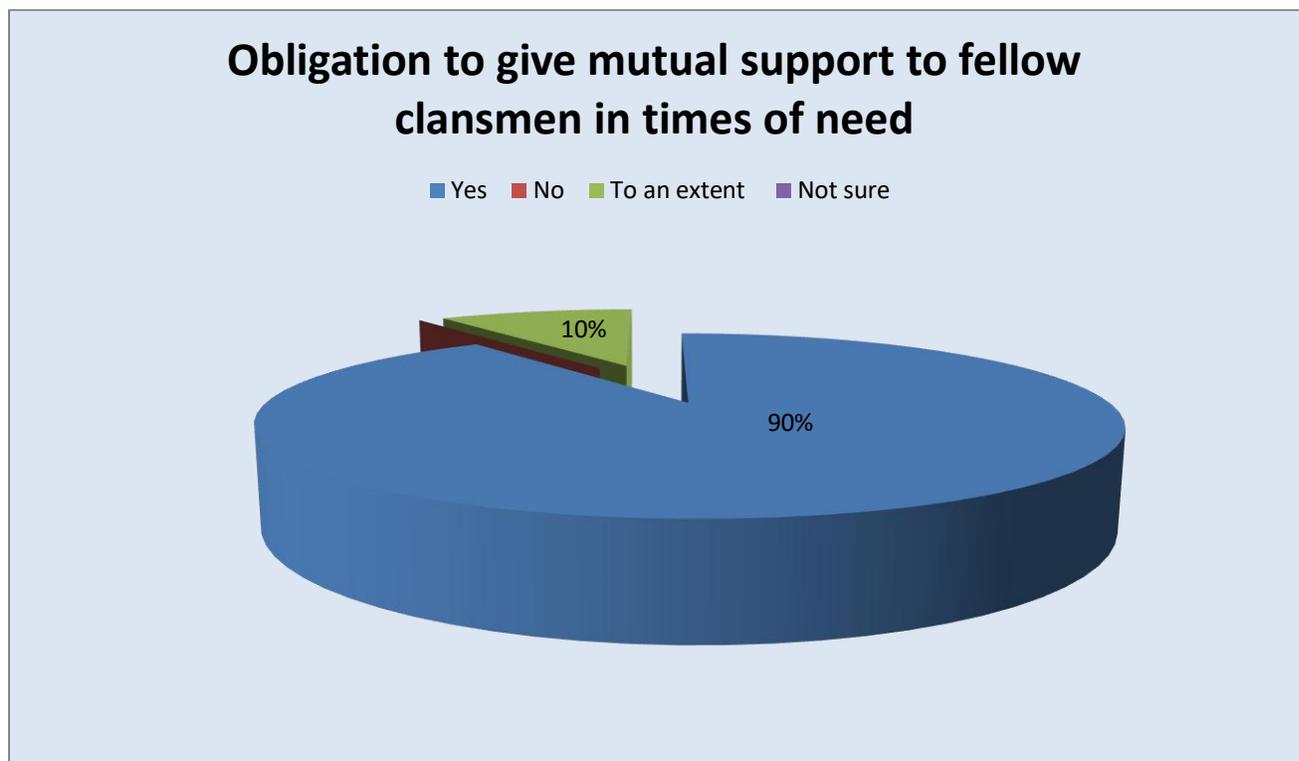


Figure 4.15 showed whether the clan member's feels obligated to give mutual support to their fellow clansmen in times of need. And from the above figure, it is inferred that majority of the respondents that is 90 percent feels obligated to give mutual support to their fellow clansmen in times of need. While 10 percent of respondents agree to an extent that clan member's feels obligated to support each other in times of need. Majority of the respondents agree that clans members feels obligated to give mutual support to their fellow clansmen because they believe that have descended from a common ancestor and they are blood related thus they feel a mutual responsibilities to help out each other in times of need as they considered themselves as a family.

**Table 4.4**

Table representation of whether that with the advent of modernity, the mutual social relationship that exists between clan members is fading away.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Yes</b>	8	16
<b>No</b>	14	28
<b>To an extent</b>	28	56
<b>Not sure</b>	0	0
<b>Total</b>	50	100

Table 4.4 shows that whether with the advent of modernity, the mutual social relationship that exists between the clan members is fading away. And the table clearly indicates that 56 percent of the respondents agree to an extent that the advent of modernity, the mutual social relationship that exists among the clan members is fading away. And 28 percent of the respondents are of the view that with modernity, mutual social relationship among the clan members is not fading away. While 16 percent of the respondents are of the view that with the advent of modernity, the mutual social relationship that exist among the clan members is fading away. Thus, it is understood from the above figure that majority agree to an extent that social relationship that exists among clan members is fading away with the advent of modernity. While 16 percent said that the social relationship that exists among the clan members is fading away because of major reasons like change in the mindset of people, the growth of Christianity and the decline of clan significance.

**Table 4.5**

Table representation of whether Angami Nagas have social gathering.

<b>Do Angami Nagas have social gathering</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Yes</b>	50	100
<b>No</b>	0	0
<b>Total</b>	50	100

The above table represent whether the Angami Nagas have any social gathering. And according to the above table, we can clearly see that all the respondents that is 100 percent of the respondents acknowledged that the Angami Nagas have social gathering. Among the Angamis, social gathering is a common occurrence.

**Table 4.6**

Table representation of the important social gatherings among the Angami Nagas

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Festivals</b>	26	52
<b>Marriage</b>	8	16
<b>Funeral</b>	4	8
<b>Clan's day</b>	2	4
<b>Village day</b>	1	2
<b>Sports meet</b>	3	6
<b>Community feast</b>	4	8
<b>Christmas</b>	2	4
<b>Total</b>	50	100

Table 4.6 shows the important social gathering among the Angami Nagas. From the above table, it is inferred that majority of the respondents that is 52 percent of the respondents said that festivals is an important social gathering among the Angami Nagas. While 16 percent of the respondents said that marriage is an important social gathering for the Angamis, followed by 8 percent of the respondents said that funeral is an important social gathering, 8 percent of the respondents pointed out community feast as an important social gathering, 6 percent of the respondents said that sports meet is an important social gathering among the Angami Nagas, 4 percent of the respondents pointed out clan's day as an important social gathering, 4 percent of the respondents said that Christmas is an important social gathering and the rest 2 percent said that village day is an important social gathering among the Angami Nagas. From the entire sample, it is clearly understood that festival is the most important social gathering among the Angami Nagas. Among the Angamis, festivals are a part of their culture and it is a gathering where the members come together to revive their rich culture and display its traditions and the festivals are celebrated with much pomp and fervour.

**Table 4.7**

Table representation of whether Angami Nagas follow any customs.

<b>Do Angami Nagas follow any custom</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Yes</b>	50	100
<b>No</b>	0	0
<b>Total</b>	50	100

Table 4.7 represents whether the Angami Nagas follow any customs and it has found that all the respondents that is 100 percent of the respondents acknowledged that the Angami Nagas followed customs. There are different kinds of customs prevalent among the Angami Nagas.

**Table 4.8**

Table representation of the customs practiced by the Angami Nagas.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Disputes solved through customary laws</b>	6	12
<b>Respect for elders</b>	9	18
<b>Patrilineal and patriarchal system</b>	4	8
<b>Solving property and land issues by the community leaders</b>	5	10
<b>Greeting each other</b>	5	10
<b>Kenyü (taboo)</b>	4	8
<b>Traditional costumes</b>	3	6
<b>Different customary laws practiced</b>	1	2
<b>Taboo to commit crime such as killing, adultery, telling lies, robbery.</b>	2	4
<b>Festivals</b>	4	8
<b>Traditional wrestling</b>	1	2
<b>Ancestral property given only to the male members</b>	6	12
<b>Total</b>	50	100

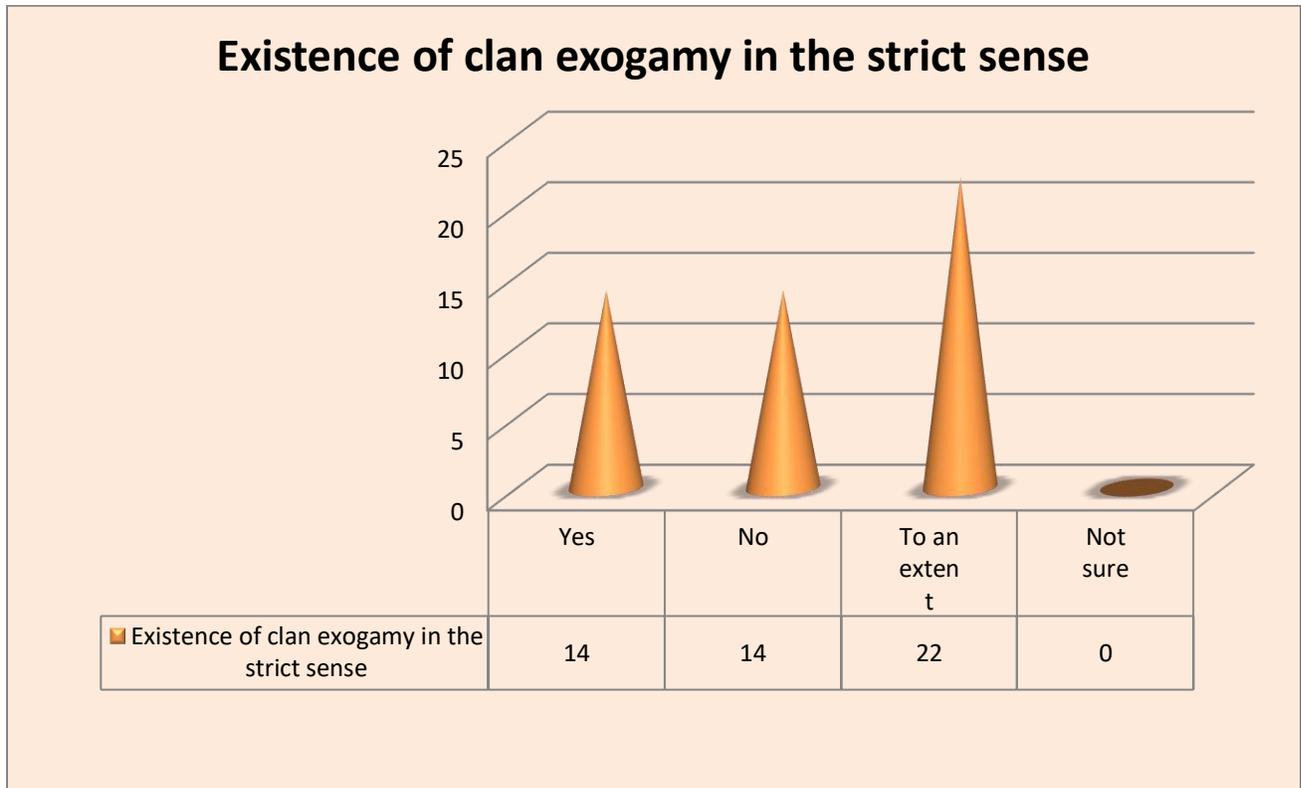
Table 4.8 represents the customs practiced by the Angami Nagas. It shows a variety of customs practiced by the Angami Nagas. From the above table, we can see that 18 percent of the respondents said that respect for the elders is a custom practiced by the Angamis, followed by 12 percent of the respondents who said that disputes solved through customary laws is a custom of the Angami, 12 percent of the respondents said that ancestral property given only to the male

members is a custom of the Angami, 10 percent of the respondents said that solving property and land issues by the community leaders is a custom of the Angami, 10 percent of the respondents said that greeting each other is a custom of the Angami, 8 percent of the respondents said that the practice of patrilineal and patriarchy system is a custom of the Angami, 8 percent of the respondents said that Kenyü (taboo) is a custom of the Angami, 8 percent of the respondents said that festivals is a custom of the Angami, 6 percent of the respondents said that traditional costumes is a custom of the Angami, 4 percent of the respondents said that the taboo to commit crime such as killing, adultery, telling lies, robbery is a custom of the Angami, 2 percent of the respondents said that different customary laws practiced is a custom of the Angami and the rest 2 percent of the respondents said that traditional wrestling is a custom of the Angami.

Elders were thought of as next to 'Ukepenuopfü' (God). Thus, from the entire sample, it is clearly understood that majority of the respondents said that respecting the elders is a custom practiced by the Angami Nagas. In an Angami society, a person is expected to give utmost importance and respect to the elders and if a person failed to do so then he is regarded as uneducated, shameless, and mannerless. Respecting the elders is one of the highest value among the Angamis.

**Figure 14.16**

Figure showing whether clan exogamy still exists in the strict sense among the Angami Nagas.



The above figure shows whether clan exogamy still exists in the strict sense today. 44 percent of the respondents agree to an extent that clan exogamy exists in a strict sense while 28 percent of the respondents agree that clan exogamy exist in a strict sense and the rest 28 percent of the respondents are of the view that clan exogamy do not exist in the strict sense among the Angami Nagas. From the above table, it is inferred that majority of the respondents (44%) agree to an extent that clan exogamy still exists in the strict sense because even today clan exogamy is strictly followed, but the prevalence of marriage within the same clan is also visible to some extent.

**Figure 4.17**

Figure showing whether the present generations respect the tradition of not marrying within the same clan.

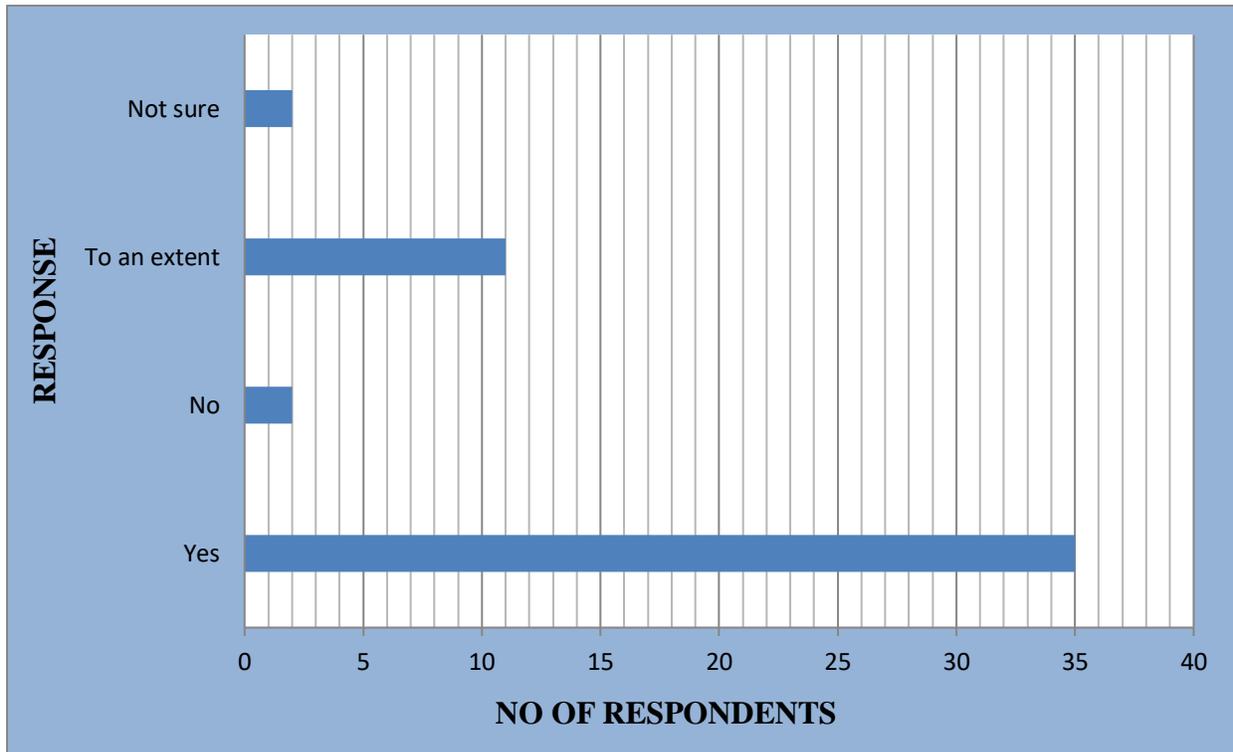


Figure 4.17 shows whether the present generation respect the tradition of not marrying within the same clan. Majority of the respondents that is 70 percent agree that the present generations respect the tradition of not marrying within the same clan and 22 percent of the respondents agree to an extent. While 4 percent of the respondents is of the opinion that the present generations do not respect the tradition of marrying within the same clan and the rest 4 percent of the respondents is not sure whether the tradition of not marrying within the same clan is respected by the present generations or not. From the entire sample, it has been found out that majority of the respondents agree that the present generation respects the tradition of not marrying within the same clan because marrying within the same clan is still considered as a taboo in the Angami society.

**Figure 4.18**

Figure showing whether the Angamis are aware of anyone within their clan who followed endogamy.

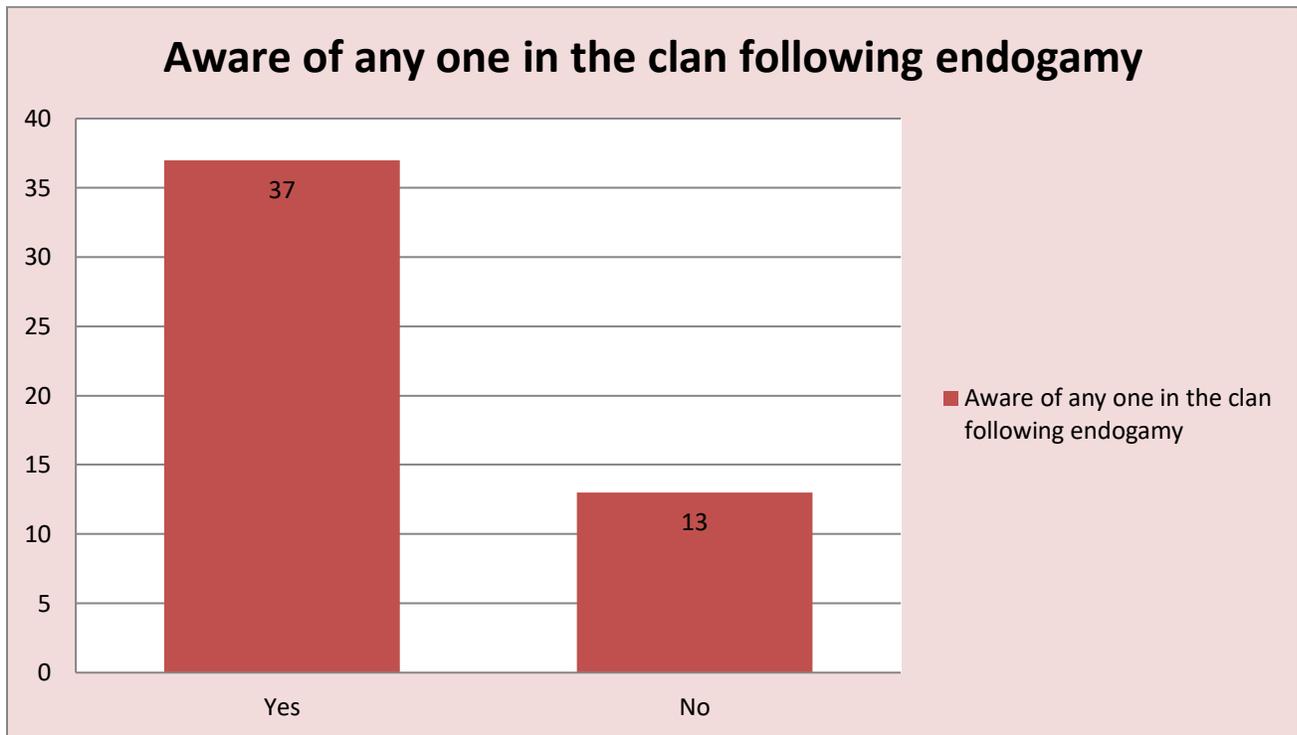
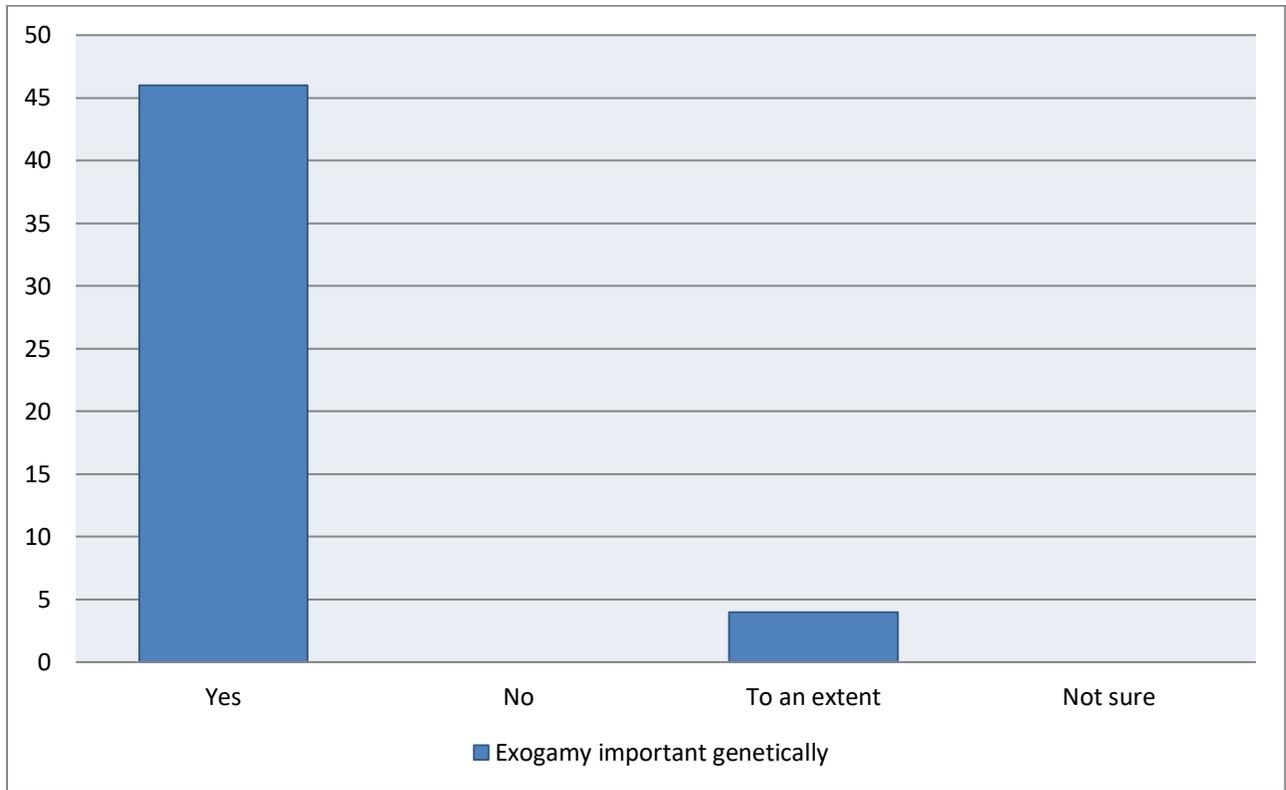


Figure 4.18 showed whether the Angami Nagas are aware of anyone within in their own clan who followed endogamy. And it has been found out that majority of the respondents that is 74 percent of the respondents are aware of people within their own clan who followed endogamy while the rest of 26 percent of the respondents are not aware of anyone within their clan who followed endogamy. Though clan endogamy is considered as taboo, both in the past and present Angami society, there are still instances of marriages within the same clan. Thus, from the above figure, it has been found out that majority of the respondents (74%) are aware of people within their own clan who followed endogamy.

**Figure 4.19**

Figure showing whether exogamy is important genetically.



The above figure showed whether exogamy is important genetically. And according to the above figure, it is inferred that majority of the respondents that is 92 percent of the respondents are of the opinion that exogamy is important genetically while 8 percent of the respondents agree to an extent that exogamy is important genetically. Among the Angami Nagas, it is believe that, if a couple from the same clan marries, they will be infertile or they will produce diseased offspring's. Thus, majority of the respondents are of the view that exogamy is important genetically.

**Figure 4.20**

Figure showing whether people in the society look down on those who followed endogamy.

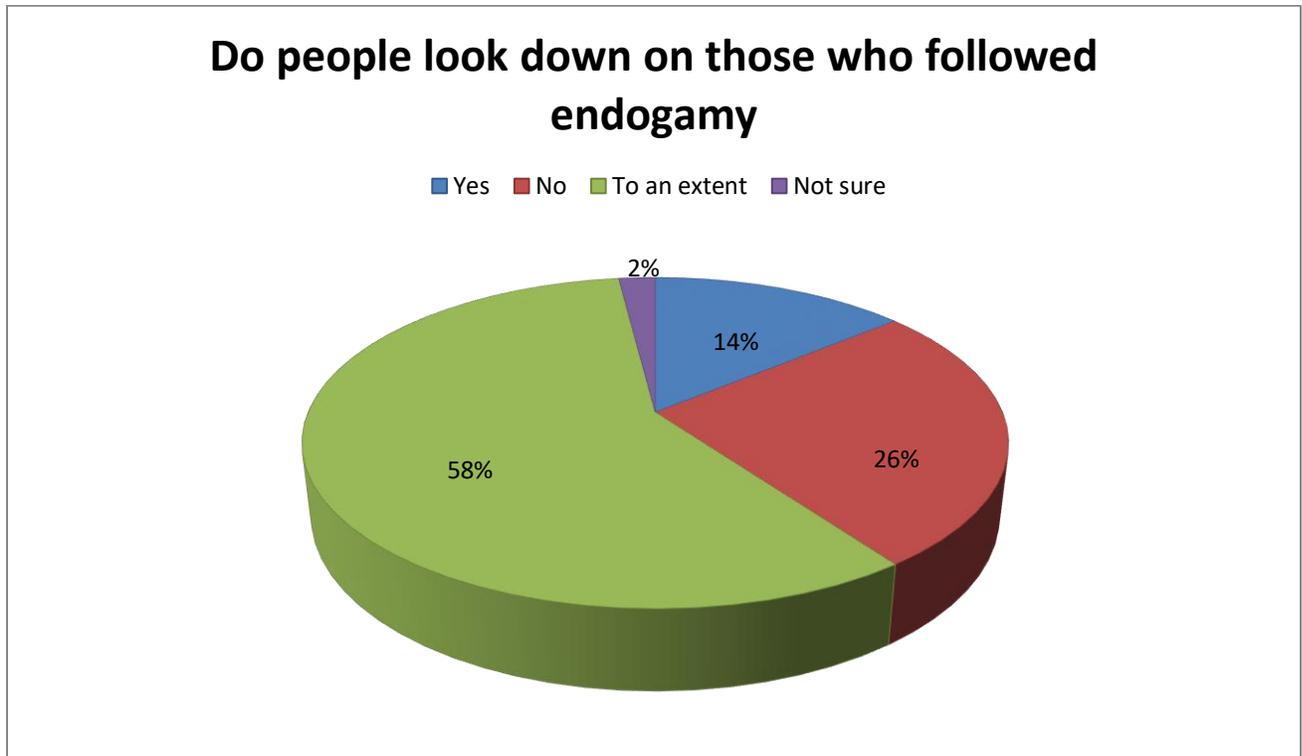
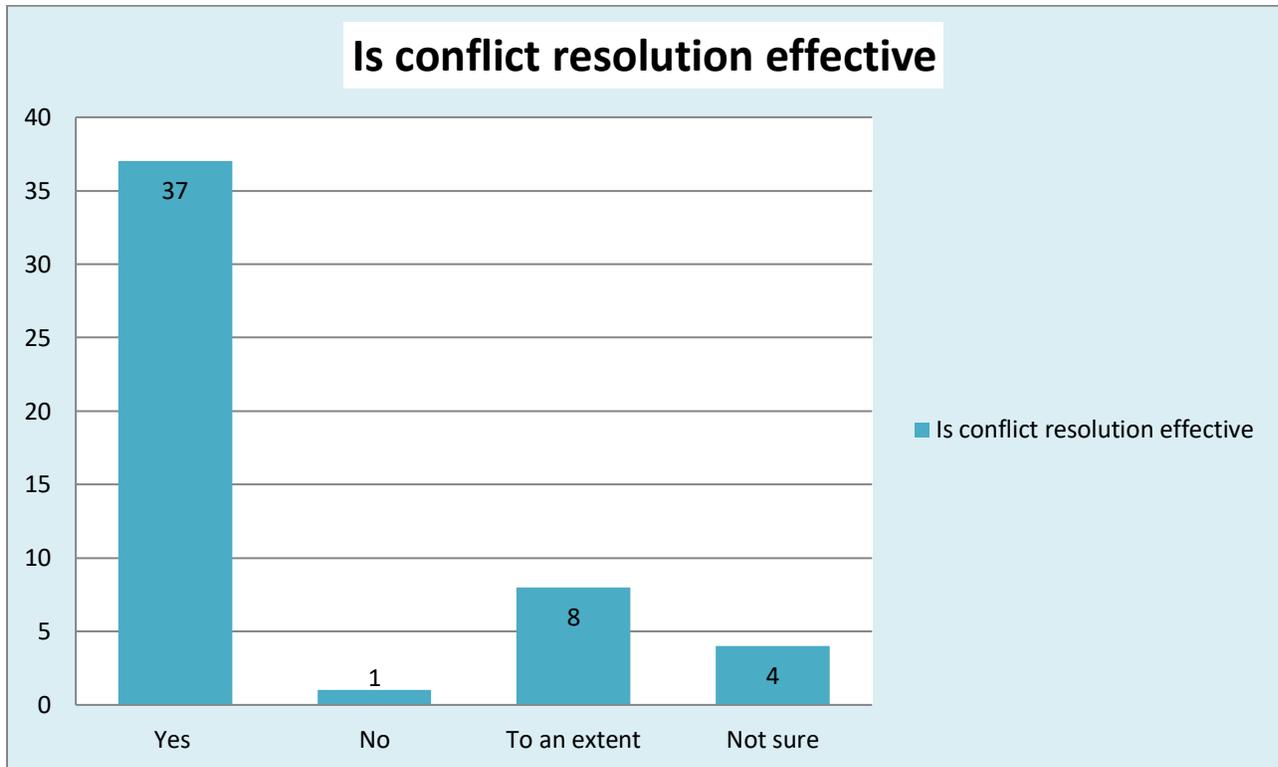


Figure 4.20 showed whether the people who followed endogamy are look down by the people n the society. The figure shows that majority of the respondents that is 58 percent of the respondents agree to an extent that people in the society look down on those who follow endogamy , 26 percent of the respondent are of the view that people who followed endogamy are not look down by the people in the society, 14 percent of the respondents are of the view that people in the society look down on people who followed endogamy and the rest of 2 percent of the respondents are not sure whether people who followed endogamy are look down in the society or not. Thus, from the entire sample, it has found that majority of the respondents (58%) agree to an extent that people in the society look down on those who follow endogamy because the Angami Nagas considered marriage as a scared institution and marriage within the same clan is forbidden and since they have went against the law of the Angamis, they are look down to some extent in the society.

**Figure 4.21**

Figure showing whether conflict resolution is effective among the Angami Nagas.



The above figure represents whether the conflict resolution is effective among the Angami Nagas. And according to the figure, it is inferred that majority of the respondents that is 74 percent of the respondents are of the view that conflict resolution is very much effective among the Angami Nagas, 16 percent of the respondents agree to an extent, 8 percent of the respondents are not sure whether among the Angami Nagas the conflict resolution is effective or not while 2 percent of the respondents are of the view that the conflict resolution is not effective among the Angami Nagas. From the above figure, it has been found that majority of the respondents are of the view that conflict resolution is still effective among the Angami Nagas. Conflict resolution is still effective among the Angami Nagas because the decision of conflict resolution is decided in a very truthful way and it also dealt immediately with the issues without pending, unlike the modern law which drags on for a longer time.

**Table 4.9**

Table representation of the different kind of conflict resolution that exists among the Angami Nagas.

<b>Responses</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Land disputes</b>	23	46
<b>Property disputes</b>	7	14
<b>Fights/arguments</b>	6	12
<b>Robbery/theft</b>	4	8
<b>Cow grazing conflict</b>	2	4
<b>Settlement of misunderstanding</b>	5	10
<b>Not sure</b>	3	6
<b>Total</b>	50	100

Table 4.9 shows the different kind of conflict resolution that exists among the Angami Nagas. The above table indicates that 46 percent of the respondents mentioned land disputes as a kind of conflict resolution that exists among the Angamis. Followed by 14 percent of the respondents who mentioned property disputes as a kind of conflict resolution among the Angamis, 12 percent of the respondents mentioned fights/arguments as a kind of conflict resolution among the Angamis, 8 percent of the respondents mentioned that robbery/theft as a kind of conflict resolution among the Angamis, 4 percent of the respondents also mentioned cow grazing conflict as a kind of conflict resolution among the Angamis, 10 percent of the respondents mentioned that settlement of misunderstanding as a kind of conflict resolution among the Angamis while the remaining 6 percent is not sure about the different types of conflict resolution that exists among the Angamis. Land is a valuable asset among the Angami Nagas, not just for farming but also for achieving high social status and respect. In the Angami society, a person who does not own land is looked down thus; all households had to own their own land. Because of the importance of land in the Angami society, land disputes are also very prevalent. Thus, it is understood from the

entire sample that majority of the respondents mentioned land disputes as a kind of conflict resolution among the Angamis.

**Table 4.10**

Table representation of whether conflict resolution is losing its significance today.

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Yes</b>	10	20
<b>No</b>	40	80
<b>To an extent</b>	0	0
<b>Not sure</b>	0	0
<b>Total</b>	50	100

The above table represents whether the conflict resolution is losing its significance today. In this study, whether conflict resolution is losing its significance today is analyzed and it has been found that majority of the respondents that is 80 percent of the respondents are of the view that conflict resolution is not losing its significance today while 20 percent of the respondents are of the view that the conflict resolution is losing its significance today. Conflict resolution among the Angami Nagas is still not losing its significance despite of the existence of the modern civil law and magistrate courts because the Angamis believe and rely on the conflict resolution provided by the clan elders and leaders and also because the issues is dealt immediately without pending unlike the modern laws which drags for a longer time. So they would always first approach their clan elders and leaders to settle any issues or disputes for them. Thus, from the above table, it is clear that majority of the respondents are of the view that the conflict resolution among the Angamis is not losing its significance today. While 20 percent of the respondents pointed out that the conflict resolution is losing its significance today because of major reasons like the rising popularity of Magistrate courts, change in people preference for justice from more reliable jury and decline in the populations of clan others.

**Table 4.11**

Table representation of whether customary conflict resolution among the Angami Nagas is based on social justice.

<b>Customary conflict resolution based on social justice</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Yes</b>	26	52
<b>No</b>	3	6
<b>To an extent</b>	17	34
<b>Not sure</b>	4	8
<b>Total</b>	50	100

Table 4.9 represents whether the customary conflict resolution among the Angami Nagas is based on social justice. The table clearly indicates that majority of the respondents that is 52 percent of the respondents agree that customary conflict resolution among the Angami Nagas is based on social justice, 34 percent of the respondents also agree to an extent, 8 percent of the respondents is not sure whether the customary conflict resolution among the Angami Nagas is based on social justice, while the rest of 6 percent are of the view that the customary conflict resolution among the Angami Nagas is not based on social justice. From the entire sample, it is clear that majority of the respondents (52%) agree that customary conflict resolution among the Angami Nagas is based on social justice. All the conflict resolution are settled without any biases and based on social justice because the clan elders and leaders will settle the disputes and render a decision, only after extensive cross-examination and inference of the case. While 6 percent of the respondents is of the view that the customary conflict resolution among the Angami Nagas is not based on social justice because of reasons like limited knowledge and application of social justice in the modern sense, partiality to one's own family member or influence of oral tradition of the past.

**Figure 4.22**

Figure showing whether conflict resolution strategies among the Angami Nagas is depended on oral tradition of the past.

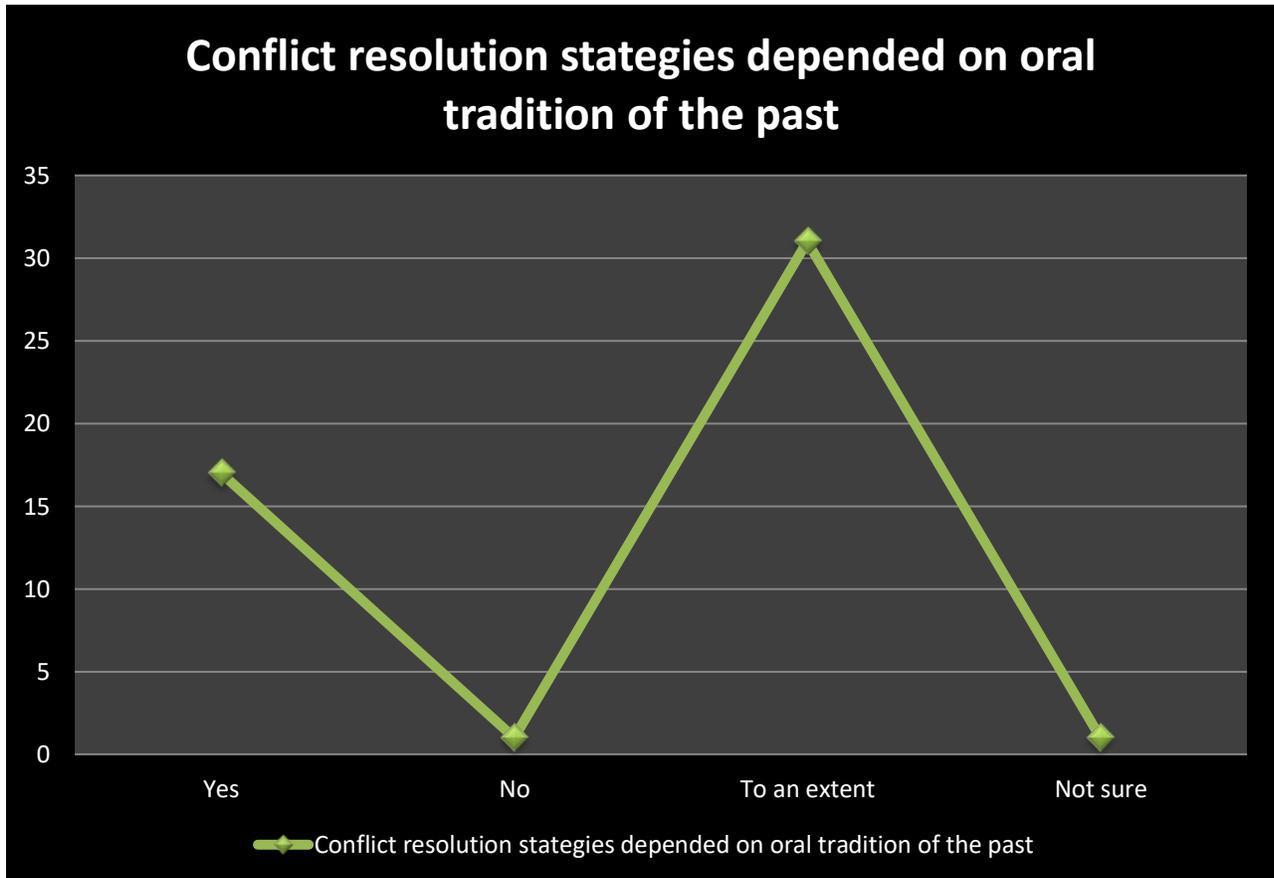
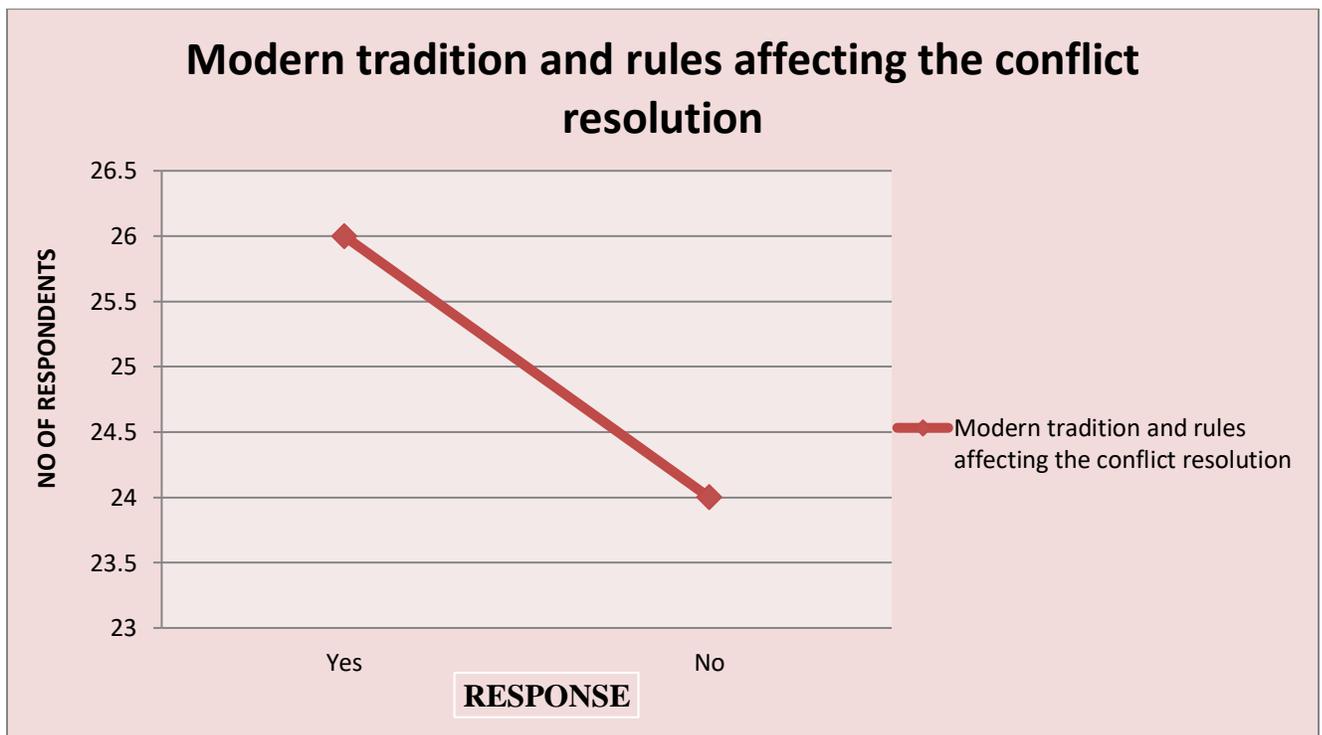


Figure 4.22 showed whether the conflict resolution strategies among the Angami Nagas depended on the oral tradition of the past. And from the above figure, we can see that majority of the respondents that is 62 percent of the respondents agree to an extent that the conflict strategies among the Angami Nagas depended on the oral tradition of the past, while 34 percent of the respondents agree that the conflict strategies among the Angami Nagas depends on the oral tradition of the past. And the rest 2 percent of the respondents are of the view that the Angami Nagas do not depend on the oral tradition of the past for conflict resolution strategies and the other 2 percent of the respondents is not sure whether Angamis depends on oral tradition of the past for conflict resolution strategies. Conflict resolution strategies mostly depend on the oral

tradition of the past because the Angamis do not have not any written historical records, everything is passed down from one generation to another generation through oral narration, and so even the strategies of conflict resolution are orally narrated and passed down from one generation to the other. Thus, majority of the respondents agree to an extent and agreed that the conflict resolution strategies among the Angami Nagas depended on the oral tradition of the past.

**Figure 4.23**

Figure showing whether modern tradition and rules has affected the conflict resolution among the Angami Nagas.



The above figure showed whether the modern tradition and rules has affected the conflict resolution among the Angami Nagas. And from the figure, we can clearly understand that there are two views regarding this question. While 52 percent of the respondents are of the view that

modern tradition and rules has affected the conflict resolution among the Angami Nagas, the rest 48 percent do not agree with the view that modern tradition and rules has affected the conflict resolution among the Angami Nagas. Majority of the respondents i.e. 52 percent is of the view that modern tradition and rules has affected the conflict resolution because with modern tradition and rules, the educated Angamis have started to made use of the modern civil law rather than just relying on the customary conflict resolution.

**CHAPTER 5**

**FINDINGS AND**

**CONCLUSION**

## **FINDINGS AND CONCLUSION**

Social institutions like clan forms an integral part of the community life among the Angami Nagas. Clans are the real unit of the Angami social life. And this study is conducted to study the clan identity among the Angami Nagas at Kohima District. This study provides information about the extent of clan identity among the Angami Nagas. This study also study about the socio-economic profile of the Angami Nagas and it also helps to understand the social relationship among the clan members of the Angamis Nagas. And this study, also examines the extent of conflict resolution among the Angami Nagas.

The first objective was to find out the socio-economic profile of the Angami Nagas. In the sample of 50 responses, it has been found out that majority of the respondents belong to the age category of 20-30 and 40-50 (26% each). And 56 percent of the respondents are female and 44 percent of the respondents are male. Majority of the respondents (86%) are educated while 14% of the respondents are illiterate. It is also found out that majority of the respondents (80%) are employed in different private and government sector while 20 percent of the respondents are unemployed. The majority of the respondents are married (58%) and 47 percent of the respondents are unmarried. It has also been found that most of the respondents (84%) reside in the rural area, with only 16 percent of the respondents residing in the urban area. Lastly, 96 percent of the respondents in this study belong to a nuclear type of family while only 4 percent of the respondents belong to a joint type of family.

The second objective is to study the extent of clan identity among the Angami Nagas. In this study, 84 percent of the respondents said that they support their clan members in the socio-economic activities and 16 percent said that they agree to an extent with this. Most of the respondents (66%) also mentioned that their economic status determine their position in the community, while 30 percent agree only to an extent and 4 percent do not agree with this. It has also been found that majority of the respondents (64%) agree that the shift of residence to town from villages is a result of the rise in the standard of living among the Angami Nagas, 30 percent agree to an extent, 4 percent do not agree and 2 percent is not sure about this. Most of the respondents (98%) responded that common ancestors is the factor of clan identity among the Angami Nagas while 2 percent said that totemism is the factor of clan identity. There is a diverse opinion's when it comes to Angami Nagas giving more loyalty to the clan than to the village

where 38 percent agree that the Angamis give more loyalty to their clan than to their village while 32 percent agree to an extent, 24 percent do not agree and 6 percent is not sure about this. The majority of the respondents (92%) also said that the clan members share a strong 'we feeling' while 6 percent agree to an extent and 2 percent do not agree with this. It is also found that 84 percent of the respondents said that the strength of clans determine the village outlook and 8 percent agree to an extent with this. Most of the respondents (60%) also said that they claim solidarity based on clan identity, 38 percent agree to an extent while 2 percent is not sure about this. Lastly, it is also understood in this study that majority of the respondents (60%) mentioned that clan identity is not losing its significance today, 32 percent agree to an extent, 6 percent is not sure and 2 percent agrees that clan identity is losing its significance today because of change in the thought process, the rising need of a pan Naga identity and the decline of clan significance.

The third objective is to understand the social relationship among the clan members of the Angami Nagas. In this study, 94 percent of the respondents said that the clan forms the backbone of the Angami social structure, 4 percent agree to an extent and 2 percent do not agree with this. 90 percent of the respondents also said that they feel obligated to give mutual support to their fellow clansmen in times of need. The respondents (56%) also agree to an extent that with the advent of modernity, the mutual social relationship that exists between the clan members is fading away, 16 percent agree because of reasons like change in the mindset of people, the growth of Christianity and the decline of clan significance while on the contrary 28 percent do not agree. In this study, it has also been found that all the respondents acknowledged that the Angami Nagas have social gathering and customs. All the respondents mentioned that the Angami Nagas have social gathering like festivals, marriage, funeral, clan's day, village day, sports meet, community feast, Christmas. All the respondents also said that the Angami Nagas have customs like disputes solved through customary laws, respect for elders, patrilineal and patriarchal system, solving property and land issues by the community leaders, greeting each other, Kenyü (taboo), traditional costumes, different customary laws practiced, taboos to commit crime such as killing, adultery, telling lies, robbery, festivals, traditional wrestling, ancestral property only given to the male members.

The fourth objective is to study the exogamy within the clan among the Angami Nagas. Most of the respondents (44%) agree to an extent that clan exogamy exist in the strict sense among the Angami Nagas, 28 percent agree fully and 28 percent do not agree. It has been found that majority of the respondents (70%) are of the view that the present generation respect the tradition of not marrying within the same clan, 22 percent agree to an extent and 4 percent do not agree. The majority of the respondents (74%) said that they are aware of people within their own clan who followed endogamy while 26 percent said that they are not aware. And regarding the genetically importance of exogamy, 96 percent of the respondents agree that exogamy is important genetically and 8 percent agree to an extent. It has also been found out that 58 percent of the respondents agree to an extent that the society look down on those who follow endogamy, 26 percent do not agree, 14 percent agree and 2 percent of the respondents is not sure whether the society look down on people following endogamy.

The last and fifth objective was to examine the extent of conflict resolution among the Angami Nagas. In this study, most of the respondents (74%) said that the conflict resolution among the Angami Nagas is effective, 16 percent agree to an extent, 8 percent is not sure and 2 percent do not agree. In the sample of 50 responses, it also understood that there is different kind of conflict resolution among the Angami Nagas such as land disputes, property disputes, fights/arguments, robbery/theft, settlement of misunderstanding, cow grazing conflict. Most of the respondents (80%) are of the view that conflict resolution is not losing its significance today, on the contrary, 20 percent said that conflict resolution is losing its significance because of reasons like the rising popularity of magistrate courts, change in people preference for justice from more reliable jury and decline in the population of clan elders. 52 percent of the respondents also said that the customary conflict resolution among the Angami Nagas is based on social justice, while 34 percent agree to an extent, 8 percent is not sure and 6 percent do not agree because of factors like limited knowledge and application of social justice in the modern sense, partiality to one's own family members or influence of oral tradition of the past. In this study, it is also understood that majority of the respondents (62%) agree to an extent that the conflict resolution strategies among the Angami Nagas depended on the oral tradition of the past while 34 percent agree and 2 percent do not agree. Lastly, it also found out that most of the respondents (52%) said that the modern tradition and rules has affected the conflict resolution among the Angamis, on the contrary, 48 percent do not agree with this.

## **SUGGESTION**

- Clan members should support one another and maintain the strength of the clan.
- Building natural social relationship through social gathering. Clan gatherings should be held more often where the clan members can come together and socialize with their fellow clansmen's so that the social relationship that exist among them can remain intact.
- Living close to one another and keeping in touch.
- The clan members should maintain clan exogamy.
- The present generation should be taught about their clan setup and practice their customs and traditions.

## CONCLUSION

Clan identity is an identity shared by a group of people who claim to have a common ancestor. More precisely, it is a concept which revolves around who we are. The clan is an informal identity network based on kinship ties and is common in most tribal societies. And in such societies, clan-based identities are stronger than any other form of social identities.

For the Angamis Nagas, the clan is a fundamental aspect of an individual self identity and it manifests itself in the mutual obligation that clan members owe to one another. However there is very limited studies on clan identity which is an integral part of community life among the Angami Nagas, not only in the past but even today. Thus, the present study proposes to study the clan identity among the Angami Nagas.

After a detail study on clan identity among the Angami Nagas, it was found out that the Angamis claims solidarity based on clan identity and the factor of clan identity is common ancestors. The Angamis give their loyalty to their clan and they also share a strong we feeling. It has also been found that despite of the fact that with the advent of modernity which has in some way affected the social relationship among the clan members, the social relationship among the clan members continues to be strong and clan remains as the backbone of the Angami social structure.

Thus, in conclusion we can say that the Angamis Nagas give utmost importance and loyalty to their clan and the clan identity among the Angami Nagas is strong.

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## **APPENDIX**

### **A SOCIOLOGICAL STUDY ON CLAN IDENTITY AMONG THE ANGAMI NAGAS AT KOHIMA DISTRICT**

#### **QUESTIONNAIRE**

1. Age :
2. Educational Qualification :
3. Occupation :
4. Gender (Female/Male/Others) :
5. Marital status : (Married/Unmarried) :
6. Locality of residence (Rural/Urban) :
7. Type of family (Nuclear family/Joint family) :
8. Do you think clan members support each other in socio-economic activities?  
a) Yes    b) No    c) To an extent    d) Not sure
9. Do you think the economic status of the Angami Nagas determine their position in the community?  
a) Yes    b) No    c) To an extent    d) Not sure
10. Do you agree that the shift of residence to towns from villages is a result of the rise in the standard of living among the Angami Nagas?  
a) Yes    b) No    c) To an extent    d) Not sure
11. What are the factors for clan identity of Angami Nagas?  
a) Totenism    b) Common ancestors    c) Others
12. If others, please mention one factor for clan identity of Angami Nagas.

13. Do you think Angami Nagas give more loyalty to their clan than to their village?  
a) Yes    b) No    c) To an extent    d) Not sure
14. Do you think the clan members share a strong ‘we feeling’?  
a) Yes    b) No    c) To an extent    d) Not sure
15. Do you think the strength of clans determine the village outlook?  
a) Yes    b) No    c) To an extent    d) Not sure
16. Do you think the Angami Nagas claim solidarity based on clan identity?  
a) Yes    b) No    c) To an extent    d) Not sure
17. Do you agree that the clan identity is losing its significance today?  
a) Yes    b) No    c) To an extent    d) Not sure
18. If yes, why?  
a) Because of change in the thought process  
b) Because of the rising need of a pan Naga identity  
c) Because of the decline of clan significance  
d) All of the above  
e) Others
19. Do you agree that the clan form the backbone of the Angami social structure?  
a) Yes    b) No    c) To an extent    d) Not sure
20. Do you agree that Angami Nagas feel obligated to give mutual support to their fellow clansmen in times of need?  
a) Yes    b) No    c) To an extent    d) Not sure
21. Do you agree that with the advent of modernity, the mutual social relationship that exists between clan members is fading away?

a) Yes   b) No   c) To an extent   d) Not sure

22. If yes, what do you think is the major reason for it?

- a) Because of change in the mindset of people
- b) Because of the growth of Christianity
- c) Because of the decline of clan significance
- d) All the above
- e) Others

23. Do the Angami Nagas have social gathering?

- a) Yes   b) No

24. If yes, which are the important social gatherings?

25. Do the Angami Nagas follow any customs?

- a) Yes   b) No

26. If yes, what are the customs practiced among the Angami Nagas.

27. Do you think clan exogamy still exists in the strict sense among the Angami Nagas?

- a) Yes   b) No   c) To an extent   d) Not sure

28. Do you think the present generations respect the tradition of not marrying within the same clan?

- a) Yes   b) No   c) To an extent   d) Not sure

29. Are you aware of anyone within your clan who followed endogamy?

- a) Yes   b) No

30. Do you think exogamy is important genetically?

- a) Yes   b) No   c) To an extent   d) Not sure

31. Do people in the society look down on those who followed endogamy?  
a) Yes    b) No    c) To an extent    d) Not sure
32. Do you think conflict resolution is effective among the Angami Nagas?  
a) Yes    b) No    c) To an extent    d) Not sure
33. What kind of conflict resolution exists among the Angami Nagas?
34. Do you think the conflict resolution within the clan is losing its significance today?  
a) Yes    b) No    c) To an extent    d) Not sure
35. If yes, what do you think could be the reason for conflict resolution losing its significance today?  
a) The rising popularity of Magistrate courts  
b) Change in people preference for justice from more reliable jury  
c) Decline in the populations of clan elders  
d) All the above  
e) Others
36. If yes, what kind of conflict resolution is losing its significance today?
37. Do you think the customary conflict resolution among the Angami Nagas is based on social justice?  
a) Yes    b) No    c) To an extent    d) Not sure
38. If yes, what type of conflict resolution among the Angami Nagas is based on social justice?
39. If no, why?  
a) Partiality to one's own family member

- b) Limited knowledge and application of social justice in the modern sense
- c) Influence of oral tradition of the past
- d) All the above
- e) Others

40. Do you think the conflict resolution strategies among the Angami Nagas depended on oral tradition of the past?

- a) Yes
- b) No
- c) To an extent
- d) Not sure

41. Do you think modern tradition or rules has affected the conflict resolution among the Angami Nagas?

- a) Yes
- b) No

**A SOCIOLOGICAL STUDY ON THE TRADITIONAL  
INHERITANCE PRACTICE OF CHAKHESANG TRIBE WITH  
SPECIAL REFERENCE TO PHÜSACHODÜ VILLAGE,  
NAGALAND**



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**MARCH 2022**



**“A SOCIOLOGICAL STUDY ON THE TRADITIONAL INHERITANCE  
PRACTICE OF CHAKHESANG TRIBE WITH SPECIAL REFERENCE  
TO PHÜSACHODÜ VILLAGE, NAGALAND”**

Thesis submitted to St. Teresa’s College (Autonomous), Ernakulam in *fulfillment of the  
requirements for the award of the degree of Master of Arts in Sociology*

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**MARCH 2022**



## CERTIFICATE

I certify that the thesis entitled “**A SOCIOLOGICAL STUDY ON THE TRADITIONAL INHERITANCE PRACTICE OF CHAKHESANG TRIBE WITH SPECIAL REFERENCE TO PHÛSACHODÛ VILLAGE, NAGALAND**” is a record of bonafide research work carried out by **KENEIPHRUONUO KERETSÛ**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.

Smt. Elizabeth Abraham



Head of the Department,

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March 2022

## DECLARATION

I, Keneiphruonuo Keretsü, hereby declare that the thesis entitled “A SOCIOLOGICAL STUDY ON THE TRADITIONAL INHERITANCE PRACTICE OF CHAKHESANG TRIBE WITH SPECIAL REFERENCE TO PHÜSACHODÜ VILLAGE, NAGALAND” is a bonafide record of independent research work carried out by me under the supervision and guidance of Smt. Elizabeth Abraham, Head of the Department, St. Teresa’s College, Ernakulam. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

Ernakulam

March 2022

  
Keneiphruonuo Keretsü

## ACKNOWLEDGEMENT

In this humble endeavour, I have received a great deal of support and guidance from different quarters. With great appreciation I thanked all those who have contributed to this venture of success. First and foremost, I thank the almighty God for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I sincerely expressed my gratitude to the Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me the opportunity to conduct this study.

I am highly indebted to my guide and my source of support Smt. Elizabeth Abraham, Head of the Department, for her constant support, guidance, patience and inspiration without which this study would not have been possible.

I also take this opportunity to express my gratitude to all the staff members of the department for their encouragement and guidance in accomplishing the study.

I would also like to express my heartfelt gratitude to my parents for their unconditional love, support and encouragement throughout the venture of the study.

I would like to take this opportunity to expressed my sincere gratitude to Ania (Aunty) Sasietuonuo Kotso and Vüdülü Tetseo (of Phüsachodü village) for their support and contribution in this study and also to all those whom I may not mention all the names but I'm highly grateful to each one of you all, for your sincere support and contribution in helping me out with this study. May God bless you all.

I also take this opportunity to deeply expressed my gratitude to all the respondents of the study without whose cooperation this study would not have been conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's College (Autonomous). Last but not the least, I take this opportunity to thank my classmates and friends for their love and support towards me throughout the study.

Ernakulam

March 2022

*Keneiphruonuo*  
Keneiphruonuo Keretsü

# **CONTENTS**

<b>TITLE</b>	<b>PAGE NO.</b>
<i>ACKNOWLEDGEMENT</i>	
LIST OF TABLES	
LIST OF FIGURES	
CHAPTER 1: INTRODUCTION	1-17
CHAPTER 2: REVIEW OF LITERATURE	19-30
CHAPTER 3: METHODOLOGY	32-36
CHAPTER 4: DATA ANALYSIS AND INTERPRETATION	38-76
CHAPTER 5: FINDINGS AND CONCLUSION	78-83
<i>BIBLIOGRAPHY</i>	85-87
<i>GALLERY</i>	88-92
<i>APPENDIX</i>	94-101

## LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
4.1	Age of the Respondents	38
4.2	Sex of the Respondents	39
4.3	Educational Qualification of the Respondents	39
4.4	Occupation of the Respondents	40
4.5	Distribution of Property Assets	40-41
4.6	Whether the inheritance practice of ‘Labü’ is given to daughters only	41
4.7	Whether ‘Kalu’ is considered to be one of the oldest forms of traditional inheritance practice in the village	42
4.8	Whether the traditional inheritance practice is still rigid in the village today	42-43
4.9	Position/status of a Phüsachodü man in the village structure	43-44
4.10	Whether the male members in the village play a significant role in the traditional inheritance practice	44
4.11	Do the Phüsachodü men still dominates over the village activities today	45
4.12	Changes are seen in the position of men in the village today	45-46
4.13	Position of a Phüsachodü woman in the village structure	46
4.14	Types of property inherited by the Phüsachodü women in the village	47
4.15	Phüsachodü women are given fair share of property holdings like the male members in the village	48
4.16	Changes taking place in the traditional inheritance practice due to the impact of the modern society	49
4.17	Whether the ‘Gifted land or Acquired land’ property is practiced among the people in Phüsachodü village	50
4.18	In the case of ‘gifted-land’, the woman’s property can be inherited by	51

4.19	Whether fair share of property holdings/ownership between the gender is seen today in Phüsachodü village	52
4.20	'Customary Law' plays a significant role in the traditional inheritance practice	53

## LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
4.1	Religion of the Respondents	54
4.2	Whether Land is an important property asset in Traditional Inheritance Practice	55
4.3	Rightful Heir for the Inheritance of Ancestral Property, according to the Traditional Inheritance Practice	56
4.4	In case of no heir, the village elders decide to pass down the property of the deceased person to the claimer by tracing the claimer's	57
4.5	How the village elders make decision regarding the passing down of property assets to the next heir or next person in the family or among the village members	58-59
4.6	Whether 'Shesüh' is still practiced in the village today or not	60-61
4.7	As per the traditional inheritance practice, the youngest son gets to inherit his father's house and the best plot of land are also given to him as his share of property inheritance - is such system of inheritance still practiced in Phüsachodü Village today	62
4.8	As per the traditional inheritance practice, the gender it favors the most is	63
4.9	Aware of the traditional inheritance practice in the village	64
4.10	Whether the villagers still practice the old traditional system of inheritance	65
4.11	Whether the men in the village are the rightful owners for the inheritance of the village properties	66
4.12	Whether the Phüsachodü men are economically independent than women in the village	67
4.13	Phüsachodü village is a highly Patriarchal society	68

4.14	Whether property rights are given to female members in Phüsachodü village	69
4.15	Phüsachodü women are treated equally at par with men in the village	70
4.16	Whether the Phüsachodü women are economically independent	71
4.17	Whether the Phüsachodü people practiced the system of 'Will'	72
4.18	Due to the patriarchal outlook, the traditional inheritance practice can change the people's attitude towards different gender	73-74
4.19	Should the traditional inheritance practice still be continued in this 21 <sup>st</sup> century	75
4.20	'Traditional practices need to be preserved in order to safeguard and keep our cultural identity alive'	76

# **INTRODUCTION**

# CHAPTER-1

## INTRODUCTION

The history of the world is traced by the heritage that each generation receives, as a gift passed down through a transaction based not on market economy principles, but on a concept that is inextricably linked to issues of inheritance and identity. Leaving aside the legal meaning of inheritance, its moral meaning can only be recognised and assessed within the innumerable cultural differences that it encounters; not only in different geographical areas, but also within a single country.

The practice of passing down of properties, titles, debts and liabilities after a person's death is known as "**Inheritance.**" It has long played a crucial role in human communities, prompting the development of a number of inheritance laws to control the process. According to the New World Encyclopaedia (Sociology), it states that "A less common – but no less important - use of the term has to do with the notion that, as **human beings**, we receive an inheritance at **birth** from our **family, society, culture, nation, and world**. This second kind is cultural or social inheritance, and is also known as heritage."

According to the **Collins English Dictionary**, Inheritance means 'the right of an heir to succeed to property on the death of an ancestor.'

According to the **Encyclopaedia of Social Science (Sociology)**, Inheritance is the process whereby wealth is transferred from one generation to the next, upon the death of the older members. Systems of inheritance vary and are sociologically important for the distribution of wealth in society.

According to the **Britannica Encyclopaedia**, Inheritance is also called '**Succession,**' the devolution of property on an heir or heirs upon the death of the owner. The term 'Inheritance' also designates the "property itself." This process is governed in 'minute detail by Law' in modern society.

'Inheritance' is ultimately a "natural process." As every 'Individuals' have the right to pass on their goods and heritage to their children, who inherit not only the property and traditions, but also the responsibility for how they are used.

Inheritance also refers to the conditions, cultural practises, and environment in which a person is born. Customs, beliefs, traditions, and values are all examples of this. The cultural legacy of

each person varies widely depending on factors such as the era, geographical area, and socio-economic status of one's family. The era in which a person is born and nurtured, for example, has its own "merit of the age," which might have an impact on the events in a person's life. A person's upbringing and worldview are also influenced by whether they were born in an eastern or western society.

Each person integrates their cultural legacy into their lives in their own unique way, selectively accepting certain components while rejecting or disregarding others. This is a continuous process that might happen knowingly or unintentionally. Many people let go their entire lives without ever questioning the nature of their heritage, while others construct or find new, often unusual, paradigms for living in order to improve or increase the quality of their lives.

Inheritance may sometimes or most of the time may create/stir social stratification or inequalities among the people in society. Inequalities in both material and social dimensions of inheritance might be considered to be unfair and should be regulated in order to promote a more egalitarian society and globe. These sorts of heredity, on the other hand, are equally as natural and difficult to regulate as biological attributes like eye or hair colour, facial features, and body build. Inheritance is not chosen, nor is it even required; it occurs spontaneously as a result of lineage. Individuals do, however, have the flexibility to decide what to do with their inheritance, as well as the duty to use it for good or evil. Finally, the greatest advancement in human civilization occurs when individuals accept responsibility for their heritage, whether it is an asset or a liability, and put it to good use for the benefit of all.

Thus, the laws of inheritance vary by society and have evolved over time.

## **A Glimpse of Northeast India**

Northeast India is India's eastern-most area in the country. The contiguous **Seven Sister States** - **Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura** as well as the Himalayan state of **Sikkim** make up this region. They are known as "**Seven Sisters and one brother.**" These eight states in India are significant not only for their geographical location but also for their cultural and historical diversity. These states are distinct from the rest of the country due to their terrains, diversity of communities, geographical and biological diversity.

These states cover 2,63,179 sq.km or about 8% of the country's overall geographical area and house around 3.76% of the country's total population. Around 98% of these state's borders have international borders (NCERT,2017).

The Northeast India states are officially recognized under the North Eastern Council (NEC), constituted in 1971 as the acting agency for the development of the eight states.

The North-eastern region is bordered by five foreign countries – China, Bhutan to the north, Nepal to the west of Sikkim, Myanmar to the east and Bangladesh to the west.

The North-east states are surrounded by hills and lovely rivers which are part of the eastern Himalayan ranges and Patkai-Naga Hills as well as the Brahmaputra-Barak River systems and valley plains. Mountain ranges, plateaus, low hills and valleys make up the hills and basins. The region is said to be the '**Gateway to East and South-east Asia**' blessed with abundant of natural resources and flora and fauna.

The states are a great illustration of "**Unity in Diversity**" because they have a diverse cultures and ethnic groupings. The states multi-cultural nature is reflected in the diversity of ethnic groups, languages and religions thereby exemplifying the state's multi-cultural nature.

Over 200 of the country's 635 tribal groups live in the region, speaking a range of the Tibeto-Burman languages and dialects (NCERT,2017). Tribals comprising of the majority of the population in states like Arunachal Pradesh, Meghalaya and Nagaland have a wide range of tribes.

## **Culture of Northeast India**

The North-eastern region is a slice of heaven on earth, with breath-taking natural beauty and its vibrant flora and fauna. The regions scenic position of meandering water bodies, waterfalls,

its lush green forest and blue mountain ranges along with favourable weather, provides a stunning vista. It is well known for its unique culture and traditional way of life.

The Hindu, Christian, Muslim and Buddhist cultures all co-exist in the North-east.

The people of the North-eastern Indian states are classified into tribes and sub-tribes and their lifestyles vary from one place to the other. Each of these states – the tribal groups have its own tribal culture, folk dancing, food and crafts. Due to their habitation in the hilly or high mountain regions they have a primitive lifestyle, with hunting and fishing as their primary professions.

Tea plantation, traditional handicrafts, agriculture and weaving are the main activities of these people.

Nearly a hundred million tribal people is said to make up India's population. The North-eastern states of India, bordering China and Burma, and the highlands and plains of peninsular India are considered to be the two main areas of tribal settlement in the country. Thus, **North-East** India is the '**Home**' to diverse **Indigenous** populations with distinct cultural, linguistic, religious, and historical backgrounds of the country.

## **A WINDOW TO NAGALAND – IT'S LAND AND PEOPLE**

Nagaland state is primarily a '**Tribal state**' on India's eastern border which is mostly hilly and is known for being the 'Home to the Nagas,' a brave ethnic group in the region. With 'Kohima' as its state capital. During the **World War II**, when the Japanese invaded British India, its capital – **Kohima** was the key '**battleground**' during the war. Today it stands as a prominent tourist destination as the "Kohima War Cemetery," which was built in remembrance of the soldiers slain in the '**Battle of Kohima in 1944.**'

The state of Nagaland was formally inaugurated as the 16<sup>th</sup> state of the Indian Union on December 1<sup>st</sup> 1963. It is bordered on the west by Assam, on the east by Myanmar (Burma), on the north by Arunachal Pradesh and part of Assam, and on the south by Manipur.

Nagaland has an area of 16,579 sq.km (6,401 sq. mi) and a population of 1,980,602 as per the 2011 census. Out of this 71.03% of the population live in rural areas and 28.97% population live in the urban areas. The density of the population is 119 per sq. km (according to 2011 census). As per the 2011 census, Nagaland state has literacy rate of 80.11% with female literacy rate of 76.69% and male literacy rate is 83.29%.

The state is divided into 16 administrative districts which are home to 17 major tribes and sub-tribes. In terms of customs, language and dress, each tribe is distinct from the others.

The **Tribes** in Nagaland are: Angami, Ao, Chakhesang, Chang, Dimasa Kachari, Khiamniungan, Konyak, Kuki, Lotha, Phom, Pochury, Rengma, Sangtam, Sumi, Tikhir, Yimchunger and Zeliang. The **Districts** in Nagaland are: Chümukedima, Dimapur, Kiphire, Kohima, Longleng, Mokokchung, Mon, Niuland, Noklak, Peren, Phek, Shamator, Tseminyu, Tuensang, Wokha, Zunhebphoto (out of the 16 districts four districts are the recent created districts, they are- Chümukedima district, Nuiland district and Tseminyu district which are carved out from Dimapur and Kohima districts on 18<sup>th</sup> December, 2021 while on the 19<sup>th</sup> January 2022, Shamator district was also carved out from Tuensang district).

### **PHYSICAL FEATURE**

The state of Nagaland lies between 25°6' and 27°4' latitude north of equator and between the longitudinal lines 93°20' and 95°15' east. Geographically, the state of Nagaland is mountainous with elevations ranging between 194m and 3048m above sea level. Many villages in the state are said to be located between 1000m and 2000m above sea level, this is due to security concerns the Naga villages are typically located on hilltops and at a higher elevation.

The Mt. Saramati is considered to be the highest peak in Nagaland as it stands as an altitude of 3,840m above sea level located in Tuensang District. While Mt. Japfü and Mt. Paona which stands at 3014m and 2841m respectively are considered to be other important mountains in the state.

### **THE PEOPLE**

The indigenous people of Nagaland are considered to be predominantly of the 'Mongoloid descent.' As their lifestyles are heavily influenced by mongoloid characteristics. There are various ideas about the origin and the meaning of the word "Naga," but no single hypothesis has been agreed upon. The people of Nagaland are divided into various tribes and sub-tribes with each of them having their own distinct languages and cultures. Each tribe of this exotic hill state wore colourful and intricately designed costumes, jewellery and beads which can be easily be distinguished from one tribe to the other.

## **RELIGION OF THE STATE**

The state has a population of 1.978 million people, with 88% of them being Christians. The state's Christian population was estimated to be 1,739,651 as per the 2011 census thereby making it one of India's three Christian-majority states, along with Meghalaya and Mizoram. In both urban and rural regions of the state, church attendance is relatively high.

Other religions such as Hinduism, Islam, Buddhism, Sikhism, Jainism are also prevalent in the state but in minority category that is because of the non-locals residing in the state. But the indigenous people of Nagaland are all Christians. And only few groups belonging to the Zeliangrong and Rongmei Nagas practice folk religions. Otherwise, the state is dominated by Christian religion.

## **ECONOMY OF THE STATE**

The state's economy is dominated on agricultural activities.

Since time immemorial, Jhum cultivation (i.e., slash and burnt cultivation or dry Farming) has been the principal employment of the people in rural areas. Jhum cultivation, Terrace cultivation and Shifting cultivation are the important cultivation system practiced by the people in Nagaland.

With the attainment of statehood, the state government has given incentives to the farmers thereby demonstrating how to undertake wet farming using the technical knowledge of 'Village Level Workers or Gram Sewak's' (V.L. Ws) who were trained from outside the state. Mechanical farming has become popular in Dimapur and Peren districts in recent years. Nagas nowadays, engages in floriculture, sericulture, horticulture, bee-keeping, handloom and handicrafts, plantations, cottage and small-scale industries, thereby adopting the modern technologies for their livelihood.

Nagaland state is considered to be a "Land of Folklore" which are passed down through generations by word of mouth/orally. Music plays an important part in the lives of the Nagas as their folk songs eulogising their ancestors, the brave deeds of their warriors and traditional heroes, poetic love songs immortalising ancient tragic love stories, etc. Nagaland is richly blessed by mother nature and due to its stunningly picturesque landscapes, vibrantly coloured sunrise and sunsets, its lush and verdant flora it is being referred as the "Switzerland of the East."

Nagaland is blessed with pleasant climate throughout the year. Its lush and beautiful sub-tropical rain forests which are also a treasure trove of a myriad of medicinal plants. It is blessed with a diversity of flora and fauna. And it is considered to be the home to many medicinal plants in the region.

Nagaland is famously known as the “Land of Festivals” because it is truly a festival place as all the tribes in the region celebrate their unique seasonal festivals with colour pageantry along with a music feast. Agriculture is the mainstay of ‘Naga society,’ hence most of these festivities focus around it. Although some religious and sentiments are woven into secular ceremonies and rituals, the main focus of the festivals is the offering of prayers to a ‘supreme being’ known by various names in different Naga languages. The spirit of the God is propitiated with offerings by the village shaman/priest for a bountiful harvest either before planting or on the eve of harvest at these festivals. These celebrations dates way back before the arrival of Christianity in the region.

Nagaland’s agriculture employs over 85% of the inhabitants, who live in villages perched atop steep ridges or slopes overlooking beautiful valleys teeming with whispering streams. And ‘monocrop agriculture’ is prevalent in most areas.

Nagaland has also a diverse ‘linguistic heritage,’ with as many languages as tribes and each distinct from the others. Inter-tribal and intra-tribal communication is extremely difficult. As a result of the circumstances, ‘English’ has become the official language, while ‘Nagamese’ a pidgin Assamese has become the common lingua.

Thus, Nagaland is a hill state with a diversity of vibrant and colourful tribal groups in the region.

## **CHAKHESANG TRIBE**

Chakhesang tribe is also another majority tribes in Nagaland. This Chakhesang tribe previously was under the jurisdiction of the Angami tribes as the ‘**Eastern Angami**’ but later it got separated from the Angami tribe in August, 1964. The term Chakhesang is an umbrella term for the three sub-clans/communities that are “**cha**” which refers to ‘**chokri**’, “**khe**” refers to ‘**khezha**’ and “**Sang**” refers to ‘**Sangtam**’ (today it has been referred as Pochury) due to which the people of Chakhesang tribe uses three – local dialects they are – Chokri, Khezha and Poula. It is said that till today, the creation of Sangtam tribe as a separate tribe did not interrupt the word ‘**Chakhesang**.’ It is clear that the founders of the Chakhesang tribe had a clear vision

about the multi sub-tribes within their tribe. Thus, the three primary communities created Chakhesang. The district headquarter of Chakhesang tribe is located in the **Phek district** of Nagaland situated in the eastern most part of India.

The Chakhesang Tribe is said to come from the ‘Mongoloid race’ and their languages are classified as ‘Tibeto-Burman.’ Their community is said to be multilingual in nature. The Chakhesangs are also said to be mostly a **land-owning group**. They engage in terrace farming, jhum farming and agroforestry. It is said that the Chakhesang tribes are blessed with great skills in weaving as well as art and crafts.

### **ORIGIN OF THE PEOPLE**

Most Naga tribes in the state, including the Chakhesang, are thought to have migrated from ‘Makhel.’ Migration from the northwest to Kohima is mentioned in Chokri folklore. The British used to call the Chakhesangs as ‘Eastern Angamis’ (but it is no longer in use today as they have separated from the Angami tribe due to their geographical location as they settled in the eastern most part of the region) and they also have a similar migration history to the Angamis. But there is no written record to show which hamlet/village was home to the Chakhesang people’s earliest inhabitants, but history has it that ‘Khezhakenoma Village,’ also known as the Naga Legendary Village, was the birthplace of many of the Southern Naga tribes.

### **FESTIVALS OF THE PEOPLE**

The Chakhesang tribes are said to have several festivals but the agricultural cycle, namely rice plantation, is said to be the focus point of the major traditional festivities of the people. Sükrü nye (‘nye’ means festival), Khutho nye, Shoda nye and Thüri nye are some of the major festivals of the Chakhesang tribe.

### **VILLAGE STRUCTURE**

The kinship system was the foundation of the traditional Chakhesang villages. Any new village is founded after surveyors examined the regions habitation potential, that is by taking into account the aspects such as abundant water supplies for cultivation and an abundance of flora and fauna.

There are no social classes or economic distinctions among the Chakhesang tribe. There are, however, specific social duties within the society, and the entire village looks to an able and wise man known in the name of ‘Thüvomi,’ who was chosen by the people to offer leadership.

In Khezha dialect it is known in the name of 'Mewumi.' He is aided by few elders who have specific tasks to fulfil. The Thüvomi is both the religious and social leader. He observes religious fasts and ceremonies, he also counsels the villagers on issues such as law and order, discipline, war, peace, health and economy. Thüvomi's role is sometimes passed down to his son after his death. But if the son is determined to lack the qualities and abilities necessary to be an effective leader, another man from a good family who is familiar with the Thüvomi ways or the most capable man is nominated by consensus.

The Chakhesang culture is said to promote conformism because it secures the tribe's survival as conformist values among its members; nonetheless, merit is praised and fostered. At the same time, it demonstrates enough tolerance to accommodate the two-language situation, which results in dialect, dress and attitude in all 73 Chokri speaking villages and 13 Khezha-speaking villages, yet there is a celebration of many colors of a people who are connected by their Chakhesang identity.

Smaller communities from different tribes of Nagaland are also found among the Chakhesang tribes and it is also believed that one can trace the origin of some few Tangkhul people or families from the Chakhesang tribe. This makes the Chakhesang tribe a unique tribe amongst the Naga tribes of Nagaland.

With its diverse socio-cultural aspects, the people speak different dialects among them. It is considered a natural phenomenon that the Chakhesang tribe could easily converse in other tribe's dialect. They also use **Angami** dialect which is "**Tenyidie**" in their Bible and Hymn books as their official language in church which provides them an easier communication with the Angami tribes of Nagaland. With all such connections there is no doubt about this tribe's richness in its traditional folklores, songs and other traditional practices. Another significant feature about this tribe is its unique topography (place/sites). It also shares boundaries with Moa, Poumai, Tangkhul, Sumi, Angami and Pochury tribes of Nagaland which gives them an easier way of connection or relation with the neighboring tribes residing both in Manipur and Nagaland states. Regarding all the advantages access to them in various fields they are becoming successful in all aspects of life be it in the socio-political and religious field as well. Today, almost all the Chakhesang tribe practices Christianity as their primary religion.

## **CUSTOM AND TRADITIONAL SYSTEM OF INHERITANCE PRACTICE**

The system of land holdings is described as the local people's traditional possession or inheritance of land in their customs and traditions. In the traditional system of land ownership, the individual who owns the land has absolute right of ownership of the section of land that he or she owns or has. He or she has the absolute traditional right of possession of a certain precise piece of land, as well as the rights and advantages that come with it. Such specific property is either inherited from his forefathers or purchased by the individual himself or herself.

Land holding refers to the ownership and possession of land in native custom and tradition, and there are numerous types of land holdings practiced by the natives. They are-

- a) Individual land
- b) Land of one ancestor's family
- c) Sub-clan land
- d) Clan land
- e) Land of the major clan/khel
- f) Land of the village community

Sequence of Succession preferences according to the traditional custom of the natives-

1. When a deceased father has not made any testamentary disposition during his lifetime, the eldest son of the family is typically given the first priority for inheritance and succession and it goes down from the eldest to the youngest in preference for a single property.
2. When there are too many immovable possessions, they are occasionally divided and, in such circumstances, the brothers of the customary heirs are bound to share terrace fields, plots of land, jhum fields, woodlands and the house.
3. According to the custom, the debt and associated expenses shall be paid and cleared by the son or sons who inherited their father's property.

In this modern day, the landed properties of unmarried boys and girls, if any is said to be inherited solely by their fathers, without any preference or sharing. And if, the father is no longer alive, the mother is said to take the responsibility of her children's property.

There is also a custom and tradition of the natives that when a male child is adopted, the boy's title is transferred to the person who adopts him and at the same time, the boy becomes the flesh and blood of his adopted father and inherits his lineage. When the adopted father dies, the

adopted son becomes his adopted father's customary heir, assuming there is no other true blood and flesh son to inherit the father's property.

As per the custom and traditional system of inheritance practice of the natives, when someone claims to inherit someone else property without ascertaining the inheritable lineage and rights against the deceased person's property through a wrongful claim as a customary heir is strictly prohibited and it is considered to be taboo according to the natives. This is because the native's belief that the unseen God will punish the wrong doer as there is no such cure available to redeem the wrong doer from the wrath of an unseen God. And also, the children of the wrongdoer may also face adversity and disasters in their near future. Furthermore, taking an oath on such a subject of ambiguity for inheriting lineage in one's life is usually disallowed in the community.

There is no provision in the custom and tradition of the natives for the female to inherit the immovable properties from the ancestor's line in any way. Only males can become the inheritable heir for his father or ancestral properties, according to the native's customary law. The reason for restricting the female members to inherit such ancestral properties is that the lands are conquered land by the ancestors from nobody's land. They had conquered by defeating the enemies. The lands are conquered and acquired by the forefathers by taking oath with the counterpart's opponents by the man folk only. The land inherited from the descendant of the ancestral lineage cannot be lost by the marriage of a female child. As the title of the female can be change after marriage but the title of the land cannot be changed because of marriage ties, as land holds a very important integral part in the lives of the natives.

But another striking feature of the native in giving landed properties to female child is that there are some exceptions in the custom and tradition that if the land is not an ancestral property than the landed properties are given to female child on the basis of 'Udo Unyü' which means that it can be given to a girl child indefinitely, where the girl child can own and cultivate the land till her lifetime.

With regard to landed properties there is restriction to transfer properties to non-ancestral lineage as it is against the local custom and tradition to sell or transfer properties inherited from the forefathers to families from other clans, even within the same village. As a result, it is customary law that prohibits the sale of immovable properties inherited from the ancestral lines as it is voidable unless the headmen of the clan or sub-clan give their prior consent. Hence, the

transaction of such sale is voidable and shall not be regularized unless the elders and headmen of the clan or sub-clan give their prior consent.

Such traditional practices are still practiced and kept alive by the natives of the Chakhesang tribe.

Today, Phek district is the home place for almost all the Chakhesang tribe as the majority of the tribe is under this district.

### **GEOGRAPHICAL AREA**

With a geographical area of 2026 sq.km, Phek district is located in India's easternmost region, sharing borders with Zunheboto and Tuensang districts in the north, Kohima district in the west, Myanmar in the south. It has a mix population of both the Chakhesang and Pochury residents but the former (i.e., Chakhesang tribe) is the majority.

### **POPULATION**

According to the 2011 Census, the Phek district has a population of 163294 people and 104 villages under its belt. Agriculture is said to be the main source of income for the locals.

### **LITERACY RATE**

According to the 2011 census, the Chakhesang tribe has a literacy rate of 79.13%, which is extremely similar to Nagaland state's literacy rate of 80.11%.

### **LANGUAGE**

The Chakhesang people speak in three major languages namely: Chokri, Khezha and Poumai, with subtle tonal differences according to the range, location and village. They can also interact in Sumi, Tenyidie and English.

The majority of the Chakhesang people live in rural areas as their roots can be trace back to villages. They have expanded their base to towns and cities in modern times, but the family system and values have remained mostly unchanged. Even when they leave their communities to pursue an education degree outside of their comfort zones it is said that the tribe mostly live a basic traditional life. Thus, Chakhesang tribe are well known for their folk songs, dance such as 'War dance and cultivation dance' and their indigenous games such as the 'Greased bamboo climbing', Wrestling, and also for their art and handicrafts. Hence, they still value their traditional practices and take pride in their culture till date.

## **PHÜSACHODÜ VILLAGE**

Phüsachodü is a village in Phek district which is located approximately 60 kilometres from Kohima district. It is situated in the north-west ward between the two prominent peaks of **Zaneibou** and **Kapamedzü** inhabited by the Chakhesang mainly '**Chokri.**' Phüsachodü Village is considered to be the '**largest village**' among the 'Chokri' area. Hesühmi Khel, Müdetsomi Khel, Sakhamotsomi Khel, Rühotsomi Khel, Thelütsomi Khel, Veromi Khel and Chüzhonumi Khel are the seven Khels in the village.

The Phüsachodü Village is considered to be about 14 - 15 generations old and it is believed that the '**location**' of the village was a '**path way for the warriors**' during the times of head-hunting mainly for the purpose of the expansion of their territory and fight for their supremacy to control over the neighbouring villages. The term "Phüsachodü", etymologically refers to "A new settling place at the straight upward path leading to the place traditionally known as 'Sühsazu', 'Sühthohüzu', 'Tsüshephüzu' or 'Tüphozhieu'; prior to human settlement or simply means 'Hamlet settled on the way.' Thus, the natives take great pride for being regarded as 'brave people' and it was traditionally believed that only brave warriors had settled over the edge. Hence, this village was considered to be the pathway for the warriors in the olden days.

### **ORIGIN OF PHÜSACHODÜ VILLAGE**

It is belief that most of the ancient people of this village was said to have immigrated from the village of the '**Eastward Foothills of Japfü**' range, thus, there was no racial difference with them.

### **NATURE AND FEATURES OF PHÜSACHODÜ PEOPLE**

The people of Phüsachodü village are said to be simple, peaceful, honest, sincere and good-natured people. The people were typically short in stature, like the other Mongoloids, because their bone structure was shorter and smaller than that of the Aryans/Dravidians. They appeared to be more muscular, powerful, stalwart in appearance and well proportioned. The faces are typically lozenged-shaped, with a flat profile, small eyes, black hair and a yellowish or dark skin colour.

## **RELIGION OF THE VILLAGE**

The name of the religion during the pre-Christian era was usually referred to as “Thürunami” since the people worshipped “Thürümi” (means Unseen God). It was animism, where there were so many different kinds of God. “Thürümi” was a typical name for their Gods, who includes both good and malicious spirits. Benevolent spirits aided the people while Malevolent spirits caused havoc. The people believed that in an unseen God who was said to be the giver of everything and the creator of life. People used to refer “Thürümi” or “Unseen God/spirit” in their formal spoken prayer whenever a religious rite was conducted. In addition, the locals believed that this Phüsachodü village was guarded by two good high Gods known as “Shüde and Deshulü.” The sun and the moon, for example, were revered as sacred objects. In ancient religious life, natural items such as unusual stones, trees, rivers, mountains and particular regions were also viewed as sacred objects or the dwelling of the spirits. Offerings and sacrifices were made on occasion to satisfy their Gods. Offering ‘gennas’ and sacrifices was how people purified themselves. Before eating, harvesting, sowing, gaming, hunting, war and childbirth there were customary prayers and worships.

But with the advent of Christianity into the State of Nagaland by the English missionaries the people were converted to Christianity and no longer such animism type of religion was practiced by the locals. Today the majority of the people of Phüsachodü village are Christians.

## **LOCATION OF THE VILLAGE**

Phüsachodü village is situated at an altitude of 1838m above sea level between 25°24’ and 25°37’ north latitude, and 94°19’ and 94°14’ east longitude.

## **POPULATION OF THE VILLAGE**

According to the 2001 Census, Phüsachodü village had a population of 5849 consisting of 2857 males and 2992 females with a sex ratio of 1047.

But today, Phüsachodü has a total population of 7885 with 1917 households (According to the 2020 census).

## **LITERACY RATE OF THE VILLAGE**

According to the 2001 census, the literacy rate of Phüsachodü village is 75.5% out of which 83.8% are male and 67.8% are female.

## **ESTABLISHMENT OF VILLAGE**

It is believed that the founders of the Phüsachodü village came from two villages that is - Hesühmi Khel and Müdetsomi Khel from Mima village; and the second village was Sakhamotsomi Khel from Viswema village. As the population grew, people began to migrate to other regions and villages (24 villages) for various reasons and many new villages were formed.

For the people of Phüsachodü village, 'Land' is the most valued asset. As being an agriculturalist society since time immemorial, their life revolves around agriculture and is depended on the produce of land. Property can be essentially classified into two types- movable and immovable. Movable properties include items such as traditional attires/clothing, jewellery, household items, automobiles, etc. while in immovable property it includes landed properties. There are four different categories of land ownership -

- a) Land that belongs to a community or village
- b) Clan lands
- c) Lineage or ancestral Lands
- d) Individual land

Lands are said to be passed down via the male bloodline from generation to generation, whether inherited or self-acquired, and have been in the family or lineage for multiple generations and continue to be. Phüsachodü village is a 'Patriarchal and Patrilineal society.' Land is said to be bought and sold inside the village community and residents are instructed not to sell their properties to outsiders. Das argues that land ownership pattern was unique in the sense that customs did not allow inter-tribe transfer of land. Even people of the same tribe but belonging to different villages were not allowed to own land as per the village customs (Das, 1995). Land is held in several ownerships, but no alienation outside the clan is permitted. In cases where attempts have been made to dispose off the land to persons who were neither members of the clan nor members of the village, public opinion has dealt very severely with the offender (Hodson, 1911).

Due to the patrilineal system in the village, the people of Phüsachodü follows the 'patrilineal system' of inheritance practice since time immemorial where the male members in the village is considered to be the rightful heir for the inheritance of the 'ancestral property' as well as the 'village properties' as per the traditional customs of the village. Property is said to be passed down through the male blood line, with men inheriting both movable and immovable assets.

The youngest son is considered to be the most fortunate among the sons because he can inherit not only the ancestral properties but also the other property assets such as plot of land or paddy fields which are cultivated by his parents is also said to be given to him. The property of households with only a daughter and no boys is said to be passed down to the nearest male bloodline. Barthakur (2010) states that a man with no son and only female children cannot pass on his properties to his daughters and after his demise his property is inherited by his brother's sons. Though women cannot inherit the ancestral properties according to the traditional inheritance practice they are given land ownership for her to cultivate till her life time by her parents during the time of her marriage.

Till date the traditional inheritance practices are still followed by the people of Phüsachodü village in spite of the advancement with time they still have the traditional touch in the system of inheritance practice.

Phüsachodü village also holds a significant position among the villages of Chakhesang tribe because all the important events are said to be taken place from this village. That is starting from the first "Chakhesang Student conference" was held from this village which lead to the formation of 'Chakhesang Student Union,' the first "Chakhesang Region NNC Conference,1955" was also held from this village and the Chakhesang Cultural Day,1978 was also celebrated from this village. In 2003, the first Chakhesang Senior Citizen Conference was also held from this village. Phüsachodü village is said to have 'Friendship Treaties' with many villages namely – Pudunamai village (1880), Chüzho Runa Suh-Zapami (1923), Leshimi, Lusami, Jakhama and Chedemi village (1940). The friendship treaty with Pudunamai village in 1880 was considered to be the 'first friendship treaty' among the Nagas.

Thus, Phüsachodü village is a village that has involvement in the formation of different frontal organisation as well as land marks undertakings among the Chakhesang villages. Hence, is also famous for preserving its traditional practices and cultural identity till date.

Therefore, this study focuses on the traditional inheritance practice of Chakhesang tribe with special reference to Phüsachodü village.

## **SIGNIFICANCE OF THE STUDY**

Inheritance plays a very crucial role in the lives of every humankind. In fact, it is linked with the society since time immemorial. Inheritance is the process of obtaining private property, titles, debts, entitlements, advantages, right and duties. Sometimes, it can also stir social inequalities among genders or the common masses in the society.

This study is significant because studies on the traditional inheritance practice of Chakhesang tribe is limited and rare especially with Phüsachodü village.

It is significant because the study stresses upon the traditional system of inheritance practices of the Chakhesang tribe with special reference to Phüsachodü village, Nagaland. It also tries to highlight both the position of the two genders in the traditional inheritance practice. This study also provides information regarding the different types of traditional inheritance practices of the locals. It tries to highlight the various changes or the new trends taking place in the traditional inheritance practice due to the advancement of modernity in the society. Thus, from this study, we can understand how the traditional inheritance practice impacts and binds the tribal society together.

**REVIEW**  
**OF**  
**LITERATURE**

## CHAPTER-2

### REVIEW OF LITERATURE

A literature review is a critical assessment of past research on a topic that classifies, compares and critically assesses what has already been published on that topic. It enables the researcher to summarize and contextualize the relevant research and scholarly publications. It aids in mapping of several approaches to a particular subject and the discovery of patterns. It lays the groundwork for the researcher's later research works and establishes the importance of the new study.

This chapter deals with the secondary data that is used for the study of the traditional inheritance practice. It includes the works of previous research in relation to tribal studies, articles, books and periodicals.

**Shupao** (2019) conducted a study on “**Naga Customary Laws and its Relevance in Present Society: A Study of Zhavame of Chakhesang Tribe of Nagaland**” where he states that “Customary Laws are those sets of belief of traditional laws which are passed down by the forefathers” (p.131). These traditional laws differ from region to region and culture to culture. The researcher's main aim is to focus mainly on the customary practices among the Chakhesang tribe of Nagaland and its relevance with the present society today. It also looks into how the customary laws are affecting the people of the ‘**Old Generation**’ with the ‘**Present Generation**’ thereby bringing out the comparative views on the traditional as well as the modern structure with the help of both the qualitative and interview methods used in these findings with special reference to Zhavame Village of the Chakhesang tribe of Nagaland. This study highlights the identities and its social practices among the Naga society. Shupao (2019) states that “As tribal, the Nagas have its own unique social fabric cultures with various dialects, tribes, ethnic groups and different customs and its usages” (p. 131). Through the detailed study conducted by the researcher on Zhavame village of Chakhesang tribe it is founded that this village is one of the biggest village under the Chakhesang tribe with a **population** of **4567** and the **total household** to be of **1170**, this data was recorded from the village council chairman at the time of data collection by the researcher. This village is mainly a patriarchal based system.

This village is said to be governed and function together by the traditional and customary laws practice by the people in this village. This research work is done by utilizing both the qualitative and more descriptive in design. This study also looks into the relation of “Marriage and Inheritance” it has mentioned that during the ancient days the marriage ceremonies in Zhavame village are conducted through the animism and ritual practices but with the coming of Christianity in the village area the people had accepted the church marriage system of Christianity. The people of Zhavame village practices the system of monogamy and in the case of extra marital affairs penalty or actions are taken against the offender. There is no bride price or any price in relation to the marriage. The parents of both the bride and the groom can present them land, fields, etc. in terms of gifts to them. The gift of a paddy field to the newly wedded couple is known as ‘**Luphra**’ (Shupao, 2019, p.134). Luphra is an old traditional practice whereby if the husband dies his widow wife and his offspring’s can continue to cultivate and use the land for various purposes as it is their every right to do so and no other relatives have the right to interfere to take away the land but in case the widow remarries or die the paddy land will be handed over to the concern relatives.

In relation to women status the researcher has mention in this study that with the practice of patriarchal system in the society, there is no hesitation that the male members are prefer more and they are given the opportunity to take part in the decision-making process, the ancestral properties are passed down to them, they also take part in the administrative process in the village. But at the same time the women folk of this village enjoys a rightful social position as compare to other women in many parts of the country. The women of Zhavame village are also given the opportunity to get education, receives equal love from both the parents, they are also given land, paddy rice, etc. during the time of their marriage as gifts from their parents. Both man and woman are seen to work side by side together in the present context today. As the women folk of Zhavame village holds a rightful position in the society, they also hold another important organization under the banner “**The Zhavame Women Society**” where cases such as rape, sexual harassment, domestic violence, adultery, selling of alcohols, etc. are solve under this women organization jurisdiction falling under the authority of the village council. The Zhavame women does not hold a low-level status when we look at the external surface but when looking at the internal matters the women folk are still deprive from participating in the administrative level as well as the property inheritance are still given to the male members. But with the impact of modern education among the present generations the women of todays are becoming more active and competitive than compared to the olden days.

The researcher also mentions that “**Land**” and its production are one of the important sources of income to this village. The villagers have the full authority of land ownership in their community land holdings. Under this land ownership the preferences are given more to the male members in the village and the womenfolk does not have much land holdings. Land disputes is another main issue in the village which occurs both within or outside the village jurisdiction. When land disputes arise within the village jurisdiction the village elders as well as the clan members come together and solves the issues but if any individual or the clan are caught in the act of conspiracy, they lose their share over the community land. If land dispute cases occur outside the village jurisdiction the village council members of the two villages come together to solve the issue but if the cases become even worse the third party which is the other neighboring villages come into the issues as the mediator to solve the cases.

Therefore, this study concludes by highlighting the significant role played by the customary laws among the tribal societies and the changes brought about by the modern education and Christianity in the society.

In the study of **Adino Vitso (2001)** which she had conducted a case study in Khezhakeno Village with regard to “Customary Law and Women Among the Chakhesang Nagas,” she had also mention about the ‘**Inheritance of properties**’ among the Khezhakeno Village. Thereby, stating that when it comes to ‘Inheritance’ the main priority is given to the ‘**Sons.**’ Property assets such as – ‘houses, lands, fields are always inherited by the males whether rich or poor’ and ‘**fields**’ was said to be given to the **daughter** in the name of “**Lüna**” but it does not stay as a permanent property because it has to be ‘reverted back after seven generations’ (Vitso,2001, p.108). But such system of practice is said to be vanishing from the village thereby indicating the upswing of the economic status of women in the society. According to the natives, women are denied of ‘landed properties’ after marriage because once a woman get married all the things owned by her belongs to her husband and she becomes a part of her husband’s clan. The main reason for this is that when a wife commits adultery or has an extramarital affair than the husband has the right to take away all the properties of the wife. Or else whatever possession of the wife has would be passed on to her children. The notion of all the things that are owned by a woman after marriage it all belongs to her husband this set of rules does apply the same for the husband also because once married the properties of the husband also becomes the possession of his wife as long as they stay together as a married couple but in the case of divorce the women lose her rights to claim any properties.

If **'Immovable Properties'** were given to the women it would definitely become a possession of others after marriage and in order to avoid such circumstances in the village most of the properties given to their daughters are **'Movable Properties.'** Such properties inherited by women are – 'shawls, mekkelas, household articles like pots, cups, weaving implements, rice, baskets, etc.,' (Vitso,2001, p.108). In this study, it states that even though the women in the village own such properties they do not have the liberty to trade it at their own will as the decision of both the couple is mandatory as to whether or not to dispose of such things.

As according to this study, it mentions that if a 'daughter' is unmarried than she can keep the 'properties of her parents' but at the same time she does not have the liberty to trade the properties of her parents at any time she wants or desires. While the 'sons' have all the liberty and control over all the properties that their parents have acquired. And the daughter is said to lose her right to keep her parental properties once she gets 'married.'

According to the conduct of the study it has found out that women during the time of their marriage, they can be or are gifted with **'Landed Properties'** such as field, plots of forest land and even house but not the ancestral properties. 'The giving of such properties to women depends on the economic status of the family whether they can afford to give or not' (Vitso,2001, p.109). It is stated in this study that according to the **traditional inheritance practice** system the **'Eldest Daughter'** is said to inherit her mother's properties known as **"Labu."**

A **'widow'** is said to have the right over her **'husband's properties'** as long as she lives under her **'husband's roof.'** And if she wishes to go back to her parent's house or get married with the approval of her 'in-laws' than her share of properties is said to be given out to her. In this matter, the children can either reside at the father's house or can leave and stay with their mother. In case a widow gets married without the 'knowledge' of her 'in-laws' than she gets 'nothing' and not even the 'custody' of her children. In this case, the 'widower' is said to have more 'privilege' than the 'widow' because 'unlike the widow' the "the consent of the in-laws or relatives are not very important" (Vitso,2001, p.109).

In this study it had also mention that according to the tradition of the village "Properties can be of two types when it comes to **'inheritance'**, i.e., properties which can be willed to others and those that become the **absolute property of the clan** or simply **ancestral property** which cannot be given away to the daughters or others except one from the same clan" (Vitso,2001, p.110).

Properties such as **'Paddy fields'** which are given to the woman during the time of her 'marriage' is said to be known as **'Lüna'**, this property is said to be passed down to her daughters only but in case of no daughters then it is pass on to her son. This traditional practice of inheritance was said to be temporary or not permanent as it needs to be return back **'after seven generations'** which can be also given to the 'sons' but today such system of practice is said to be disappearing as the people no longer follows it rigorously. But there are some arguments or disagreements with regard to the **'reversion of Lüna'** as due to the changes taking place in the **'traditional laws.'** In order to acknowledge the **'relationship'** between the **'reversioners'** and the **'inheritors'** of the Lüna over the years the villagers have adopted a practice that "whoever inherits it has to give a part of the product of paddy to the reversioners" (Vitso,2001, p.110). Apart from the 'Lüna', there is other movable properties such as **'Labu'** which is said to be given to the 'daughters' especially the eldest daughter after her mother's death but today it is stated that there are changes in the 'custom' of the society.

In this study the researcher has stated that in the case of 'divorce' the women are said to 'get half of the husband's properties, excluding the ancestral property, which cannot be given away to others' (Vitso,2001, p.112). But such decision is said to be depended on three factors as mention in this study and they are – **Wife's Infidelity, Husband's Infidelity and Divorce by Mutual Consent.** In the case of wife's infidelity, it is stated that she is send away with nothing but her clothes upon her. It is stated that her 'personal properties' as well as the 'sole custody' of her children will not be given to her as the punishment of the wife is so severe that not even a change of clothes is given to her. This highlights the 'high moral values prevalent in the old Khezha Naga Society.' But in the case of the husband's infidelity, properties are said to be equally shared between the husband and wife. Though the wife gets the 'custody' of her children they still belong to her husband's clan. Even though the husband commits adultery he still gets the properties which he 'rightfully can lay claim on.' "Whatever be the reason children belonged to the father in the Khezha society. The **Motsotsüli** were divided into two equal parts: one half to the husband and the other half to the wife, or the property could be divided into three equal parts: one third to the children, one third to the husband and another one third to the wife" (Vitso,2001, p.113). And in the case of divorce by mutual consent, the properties are said to be 'divided in the ratio of 3:1' between the husband and the wife which also depends upon the 'proportion of the marriage settlement' (Vitso, 2001, p.113).

In this study it has also mention that in cases of 'childless couple', they can give their properties to anyone of their choice particularly to those who have 'helped or looked after them' yet again

such properties are inherited by the husband's side. And if they adopt a son or a daughter, they have the right and freedom to inherit the parental properties as long as they remain in the **'clan.'**

In the study it has also mention about the 'disputes over the Inheritance of properties' and in such cases the family members will first try to solve the problem and if the problem cannot be solved it will be hand over to the higher authority. As there is no written law for settling disputes the final decisions of the disputes may differ and at times it can be very much settled cordially and sometimes it can be settled by swearing.

Therefore, the study concludes by stating that the 'Customary laws' of Khezhakeno village has a direct impact on the family, marriage and kinship system thereby mentioning that the traditional customs form the 'essence' of the society as it could be seen from the various laws documented from the study. Hence, customary laws are said to be based on the needs of society and its influence can be observe in every aspect of the people's. Lastly, it has also mention that though the women do not enjoy an equal status with men in the customary law, she does play a significant role for the proper and peaceful functioning in the village.

**"Commemorating the Chakhesang 75th Anniversary"** (2021), in this book, under the chapter of the **'Chakhesang Customary Laws and Traditional Practices'** it has mention that with regard to the topic of the **"Inheritance of Properties by Customary Heirs"** it has stated that as per the tradition of the customary law of the natives that after the death of a person only the **'rightful customary heir'** can inherit its properties. But in the case of a **'inter-village migration'** and **'adoption of adult male,'** the adopted person who has given up all his **'paternal and biological lineage'** such cases create a problem to 'ascertain the customary heir after such a person's dead' (Chakhesang Public Organisation,2021, p. 237).

And in the case of 'no male child' than the village customary court members shall decide and investigate carefully the **'patriarchal lineage'** and find out the heir from the **'ancestral lineage'** before handing over the properties to the claimer.

This book also mentions that according to the principles of the native customary law, certain 'criteria' are laid down for the **'buyers and sellers'** of property land on the ground of **'what immovable properties can be sold or cannot be sold?'** as the conditions for **'sale, void, and voidable sale'** the duties and responsibilities of the seller and buyer are all been specified according to the tradition of the customary law. It also states that an adult person having the

“absolute traditional right of ownership only can sell the immovable properties” (Chakhesang Publication Organization, 2021, p.236).

### **“Naga Women’s Right to Inheritance takes Centre Stage”**

in this newspaper article it compares the past and present scenario of the Naga women right to inheritance of property. It states that for the past centuries Naga women were not able to inherit property land due to patriarchal traditional system. But in today’s present context some parents especially from the **“Educated and Wealthy Families”** write wills and gift deeds are practice by them to leave behind for their daughters as according to **Adani Ngullie**, an Assistant Professor of History at Unity College, Dimapur (**“Naga Women’s Right to Inheritance Takes Centre Stage,”** 2019). Ngullie address on **‘The Concept of property in Naga Customary Tradition’** at a second day of a national seminar held at Immanuel college where she states that this system is yet to reach the rural areas **‘where women are usually found to be poor’** (**“Naga Women’s Right to Inheritance Takes Centre Stage,”** 2019). Ngullie spoke on the **Lotha tribe of Nagaland** where this tribe in Nagaland practices two types of marriage that is an **‘Arrange marriage’** and **‘Negotiated marriage.’** Negotiated marriage is said to be a common marriage system practice among this tribe. While **polygamy** also existed in this tribe but this such type of polygamy was practice among the **Village Chiefs, the great warriors and the wealthy people** of the village. In Lotha community, if a married women is said to be infertile the husband is said to have every right to remarry another woman to him an offspring. It is stated by Ngullie that being a patriarchal society the birth of a male child was preferred and favored the most than the birth of a female child. And it is not an unusual thing to look down upon a barren woman or a woman who fails to give birth to a son in Lotha tribe. But Ngullie also stated that in the present scenario, there are cases where the husband divorces his wife for not bearing a son to him and marry another woman thereby the custody of the children goes to the father in whatsoever the issue of the divorce may be. But in some rare cases, if the child is a girl she goes to the custodian of the mother. But in the case of a widow woman if she remarries again the children are taken away by the husband’s relatives. In the matters of inheritance of property, the property lands and the ancestral property are given to the male heir and not the women in the family. In the case of no male member or heir in the family the nearest cousin or relatives will take over the properties. In the customary law, the youngest son has all the property share comprising of the ancestral home of the family. The daughter in the family has no power over the family properties and has no voice to say in the matters of land selling or over her parent’s property as she is only a visitor and a keeper of the family as one day, she

will be sent off to her husband's home someday. Ngullie also stated the Article of 371(A) has a stern adherence to the customary law that denies the fundamental rights of Naga women granted by the constitution of India. To add on this Ngullie stated that it would be good if the customary laws are to be **'redefine'** ("Naga Women's Right to Inheritance Takes Centre Stage," 2019) with special references on the issues of divorce and inheritance of the parental properties so that it would give a new life to the economic status of the women as well.

With special references to Khezhakeno, Velhou Koza an Assistant Professor of Sociology Don Bosco College, Kohima spoke on the topic **"The Marriage Implications on Property Rights: Some reflections with special references to Khezhakeno Village"** ("Naga Women's Right to Inheritance Takes Centre Stage," 2019). He stated that **'Endogamy'** was a common form of marriage practices among the Khezhakeno village. Thereby the mate selection was done on the basis of **'endogamy'** and **'exogamy.'** According to Koza, he stated that the marriage ceremonies held at Khezhakeno village was organized in a detailed manner comprising of instructions and guidelines to be followed by the people in the village. 'Cross-cousin marriage' was strictly forbidden in the village. Koza stated that the nature of patriarchy system in Chakhesang community follows the practices of passing down the property rights to the male members only while the status of women was a state of dependence as she has limited rights without full ownership of property rights. He also mentions that according to the customary laws of Khezhakeno, men have better rights in the property distribution than compared to women. But in the cases of misunderstanding or fights between the husband and the wife for any other reason resulting the wife leaving the husband than the wife gets the share of one third of the marital property but if the husband leaves the wife, the marital properties are shared equally between them. Thus, the property distribution among the gender differs thereby the male holds a better opportunity than the female in the society.

In the book of **Verrier Elwin (1969) "The Nagas in the Nineteenth Century,"** **A.W. Davis** under 'Angami Marriage Customs,' has pointed out the differences of custom among the Angami tribes because he states that "Daughter's received no share in their father's property except amongst the certain of the Eastern Angami villages," in this context of 'Eastern Angami' he was referring to the present day Chakhesang tribes. As to learn the history of the Chakhesang tribe and its people from written records especially before 1946 one has to go through written books entitle as "Angamis" because Chakhesangs were once apart of the Angami tribes known in the name of 'Eastern Angamis.'

In the works of **Mehta (2021)**, where she conducted a study on “**Women and Property Inheritance Practice**” in Chiechama Village of Nagaland. This study was based on a ‘micro-survey’ where she gathered the narratives and opinions of Chiechama Village on women and property inheritance. With this motive, the study tried to locate the reasons as to why women do not have the right to inherit land properties. The major findings of the study are the realm of property in the Angami society in general and in the study area, Chiechama village in particular, includes land, its production, residential houses, animals, granaries, ornaments, traditional attires, weapons, furniture’s, agricultural equipment, and so on. The people of Chiechama village are said to follow a patriarchal inheritance system, in which the father is considered the rightful owner of inherited ancestral and self-acquired properties both movable and immovable, which is passed down to his male children. Women, on the other hand, have no rights when it comes to inheriting property. The women are said to received only the movable properties at the time of her marriage. The main reason for denying women inheritance rights was based on customary law. This law, they argued, was fundamental to their identity and should not be modified. Another reason that has been found in the study to the argument was to keep and maintain the property within the village because not all the women may not get married within their village. As a result, when women marry outside of the village, customary ensures that the land property remains inside the village.

**Paul (2019)** in her works on “**Socio-economic and Cultural Status of Naga Women,**” she has mentioned that the Naga society follow the ‘**patriarchal**’ and ‘**patrilineal**’ system thereby tracing their decent from the male line. This proved that the Naga women still does not have an equivalent status with men due to the patriarchal system in the society. It also further adds that the status of women in the Naga society is closely connected with its role in the social participation in the society. From the study it is found that the Naga women are considered to be hard working and they are taught all the domestic tasks since childhood as she is entrusted with all the household works. In Naga family if the first-born child is a female the entire family becomes happy since the girl child will lend a helping hand to her mother. With concern to economic aspect the Naga women does not occupy a bad position but enjoy her position in the economic level. Dowry system has no place in the Naga society but during the marriage the parents of the bride can give their daughter ‘property’ which in term can be both ‘**movable or immovable**’ which becomes more or less type of an absolute property to her. But an **ancestral property** is **prohibited** to be given to the daughters. In this journal article it throws lights on the inheritance system of Naga society. It

also states that the Naga women are seen as the ‘sustainer and manager of the home’ thereby standing equivalent to man in every aspect of their life without depending on their husbands earning. With the progression in the areas of education there are many women who has become salaried wives and daughters. Therefore, it concludes by stating that with the coming of Christianity into the Naga hills, it has created a transformation in the cultural belief systems but at the same time the traditional inheritance practices are still prevalent and practice among the people of Nagaland today also.

In the newspaper article **“Denied for Centuries, Naga Women get Right to Own Land Now,”** the writer states that for decades, the Naga Women was denied to get the ancestral property or land property due the practice of patriarchal customary law. But there has been a recent **“Silent Revolution”** which has been started in Nagaland where the parents are preparing **‘wills’** and **‘gift deeds’** for their daughters of what they have acquired during their life time. According to T.L Kuisumona Tikhir, Additional Deputy Commissioner of Kohima, says that **“In urban areas of Nagaland it is happening at large scale these days, parents are transferring ownership of land to daughters, which was earlier unheard of”** (Das, 2018). **‘Gifted land’** are those lands considered to be an **acquired land** whereby **‘ancestral land’** cannot be sold to any member of any tribes or give to daughters because they will be married into another tribe and which may result in decrease of the village land which was an unimaginable notion for the Nagas. So acquired land in the urban areas are considered to be less troubled and it would not disturb the **‘tribal boundaries.’** **“Land Rights”** is always a sensitive subject in Naga community for the past periods. This is because according to a Naga Social Activist, S. Varah, says that **“for Nagas, land is identity. He belongs to a village and he has his forefathers buried there. Therefore, he can never forsake his ancestral village”** (Das, 2018). It also further adds that today, highly educated parents are coming up with the concept of writing the wills and gift deeds in terms of land for their daughters. An IAS lady named Anenla, she put **‘education’** first before land for the empowerment of her daughters thereby stating that **“I am the commissioner secretary to the government of Nagaland today because my father gave me the best education”** (Das, 2018). With the conception of education being empowered among the women in Nagaland they are now able to buy their own. To make the statement stronger, according to Toshimenla Jamir an HOD of Sociology at Nagaland University says that **“given the high literacy rate and subsequent growth of women professionals in every field, there is an increasing trend of women buying their own land and property in Naga society today.”**

In the works of **Kamei (2011)** “**Customary Inheritance Practices and Women among the Kabui Naga of Manipur,**” this research aims to place the Kabui Naga women in Manipur in relation to traditional land inheritance practices. According to the study, it is found that ‘Gender Inequality’ is an intrinsic part of the Kabui Naga society with ramifications for women’s economic and political standing. However, it claims that Kabui women are not passive viewers, using the examples from Imphal. They strive to get around the customary laws and manipulate them to their advantage. Another aim of this research is to demonstrate that gender inequality is ingrained in Kabui society by analyzing the ‘Kabui Naga customary laws’ relating to inheritance and using examples from the cases of Imphal. The women of this community employ a variety of tactics in an attempt to resist and manipulate the situation to their favor. The researcher further adds on that there are many written extensive works on ‘Naga’s system of inheritance and customary law’ in general and the Kabui in particular but none of them have looked at it from a ‘gender perspective.’ As a result, the current study, the researcher has used the ‘exploratory study’ into the Kabui land inheritance system and how women are positioned within it. This study is based on ‘unstructured interviews,’ field visits to Imphal and secondary materials on the subject.

In the works of **Christina (2006)** on “**Changing Land Relations in an Angami Village,**” a study on the land relation of the Angami village states that every individual owner of land has absolute rights under Angami traditional law, allowing him or her to do whatever they want with it. From the study is found that he or she losses the possession of land as a result of a sale or a gift. He or she is free to leave it to his or her offspring in any way he or she sees fit. However, there are some prohibition or limitations on bequeathing ‘ancestral land’ to daughters. The study points out that according to the customary law, only males are eligible to inherit the ancestral properties. The study states that there are no prohibitions on giving or bequeathing personally ‘Acquired land’ to daughters. If a daughter receives land as a gift from her parents, she is free to do whatever she wants with it. However, in most situations, she will give that land to her daughters, resulting in a situation where some land is passed down through the female line. From the findings, it states that the lineage, clan or village is in charge of the communal land ownership. But to be a part of it an individual must be a member of that particular group or unit that owns ‘Kayie’ land (which means inheritance of ancestral property) in order to enjoy ownership rights. It has also found out that only by being adopted or assimilated into a patrilineage or clan through a recognized process can get an outsider accorded to such rights. However, communal ownership is not absolute because

even individuals without ownership rights have some access to it as long as they are village members. Thus, the goal of this study was to determine the changes in land relations in a tribal group, specifically the Angami tribe in Nagaland. The patriarchal principles are so strong that a member obtains his or her identity only from the father's side. Furthermore, due to the agrarian nature of the Angami community, land is the most highly valued type of property. Hence, the traditional Angami law recognizes property ownership by people, houses, lineages, clans, khels and the community as a whole due to the practice of terrace agriculture. As a result, the Angami have a tradition that both individual and communal land have ownership which are passed down from generation to generation.

Therefore, in a nutshell, from the above literature reviews which are taken from various sources, we can see that patriarchy has a strong ties or relation when it comes to the practice of inheritance among the tribal societies especially with regard to the tribes in Nagaland. Mostly, the majority of the tribes give their ancestral properties to the male members only. In most cases of the tribes, we can find similarities with regard to the traditional inheritance of property especially with the succession of the 'Ancestral properties.' And only in few communities or tribes (e.g., Chakhesang tribe) landed properties are given to women in the society. Otherwise, the women are not entitled of such immovable property assets due the patriarchy system in the region.

Thus, there are only few and limited studies on the traditional inheritance practice system with regard to Chakhesang tribes.

# **METHODOLOGY**

# **CHAPTER-3**

## **METHODOLOGY**

“Research Methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them” (Kothari, 2004).

This chapter deals with the information with regard to the statement of the problem, objectives, conceptual and operational definition, variables, universe, sample size, sampling method, research design, tool of the study, pilot testing, pre-test, analysis of data and limitation of the study.

### **STATEMENT OF THE PROBLEM:**

The distribution of inherited wealth varies greatly across cultures and legal traditions. The practice of passing on property, titles, debts and liabilities after a person’s death is known as ‘Inheritance.’ It has long played a crucial role in human communities. It also has an impact on the societal allocation of wealth. It also plays an important role in the tribal societies with regard to property rights, entitlements of one’s identity, titles and obligation within the tribal groups.

Thus, the problem undertaken in the study is entitled as “A Sociological Study on The Traditional Inheritance Practice of Chakhesang Tribe with special reference to Phüsachodü Village, Nagaland.”

### **OBJECTIVES:**

#### **General objectives-**

- ♣ To study the traditional inheritance practice of Phüsachodü Village.

#### **Specific Objectives-**

- ♣ To study the position of men in the traditional inheritance practice of Phüsachodü Village.

- ♣ To find out the place of women in the traditional inheritance practice of Phüsachodü village.
- ♣ To study the various changes taking place in the traditional inheritance practice in Phüsachodü village.

## DEFINITIONS –

- **Conceptual Definition:**

- ❖ **Phüsachodü:** Etymologically, Phüsachodü means ‘A new settling place at the straight upward path leading to the place traditionally known as ‘Sühsazu’, ‘Sühthohüzu’, ‘Tsüshephüzu’ or ‘Tüphozhieu’; prior to human settlement or simply means ‘Hamlet settled on the way’ (Phüsachodümi Student’s Union,2015).

- ❖ **Chakhesang:** “The name ‘Chakhesang’ is an acronym of the three allied sub-clans taking ‘Cha’ from the name ‘Chokri,’ ‘Khe’ from ‘Khuzha’ and ‘Sang’ from ‘Sangtam.’ It is a name unanimously selected by the leaders of the three sub-clans in a joint meeting in order of the alphabetical serial of arrangement giving full recognition and equal respect to each individual sub-tribe’s entity. It is said, the name Chakhesang was approved on the day it was formed by the British government. Since then, Chakhesang has been fully recognised tribe” (Vitso, 2001).

- ❖ **Inheritance:** According to the Encyclopaedia of Social Science (Sociology), Inheritance is the process whereby wealth is transferred from one generation to the next, upon the death of the older members. Systems of inheritance vary and are sociologically important for the distribution of wealth in society.

- **Operational Definition:**

- ❖ **Phüsachodü:** In this study the term Phüsachodü is being referred to is a village in Phek district known for its legacy of the long-lasting traditional practices among the Chakhesang tribe of Nagaland.

- ❖ **Chakhesang:** In this study the term ‘Chakhesang’ is being referred to a major Naga ethnic group found in the state of Nagaland. They are the former ‘Eastern Angamis’, now recognised as a separate tribe.
  
- ❖ **Inheritance:** In this study the term ‘Inheritance’ is being referred to the traditional practices of passing on the properties, titles and obligations to an individual among the Phüsachodü village of Chakhesang tribe of Nagaland.

### **VARIABLES:**

- ✓ **Independent variables:**

Age

Sex

Traditional

- ✓ **Dependant variables:**

Inheritance Practice

### **UNIVERSE:**

The universe of the study is on the Phüsachodü people of Chakhesang tribe, Nagaland.

### **SAMPLE SIZE:**

In this study 50 samples are selected from among the Phüsachodü people with the age group starting from 20 to 50 years above.

### **SAMPLING METHOD/TECHNIQUE:**

The sampling method used in this study is ‘Simple Random Sampling.’

As Simple Random Sampling method is a probability sampling technique that gives each element in the population an equal probability of getting into the sample and all choices are independent of one another.

### **RESEARCH DESIGN:**

The research design used in this study is 'Quantitative' research design.

Quantitative research design is used for describing the collected data and a detailed explanation on the opinions of the respondents was able to analyzed through their responses.

### **TOOL OF THE STUDY:**

Questionnaire is used for the collection of the data.

Due to the Covid-19 situation, Google form was used for the data collection which consists of 35 questions respectively.

### **PILOT STUDY:**

Before the conduct of the study, a Pilot study was conducted among some few members of Phüsachodü people in order to analyse the feasibility of the study.

### **PRE-TEST:**

A Pre-test was conducted to check whether the tool for data collection is appropriate or not and to make necessary correction. A Pre-test on the Questionnaire was conducted among five Phüsachodü people who are residing in Kohima district. The researcher approached them and they were cooperative and gave sincere answers which lead to the process of redesigning the parts of the Questionnaire was possible.

### **ANALYSIS OF DATA:**

The primary data was collected using the Questionnaire method which was analyzed and interpreted using Microsoft Excel.

### **LIMITATION OF THE STUDY:**

The researcher had to face some difficulties in getting the responses from the respondents immediately since all of them were busy with their profession and even though the respondents were cooperative few were reluctant to give their responses due to their busy schedule.

# **DATA ANALYSIS AND INTERPRETATION**

## CHAPTER-4

### DATA ANALYSIS AND INTERPRETATION

The process of attributing meaning to the data obtained and deciding the conclusions, relevance and consequences of the findings is known as ‘**Data Analysis and Interpretation.**’ It plays an important role in the study process because it identifies and improve the problems at the same time it explains, compare and contrast the data acquired for the study. Thus, it can also make future predictions based on the information obtained from the data of the study.

This chapter deals with data analysis and interpretation of the study on the traditional inheritance practice of Phüsachodü village.

**Table 4.1 Age of the Respondents**

Age Group	No. of Respondents	Percentage
21 – 30	28	56
31 – 40	11	22
41 – 50	5	10
Above 50	6	12
<b>Total</b>	<b>50</b>	<b>100</b>

From the table, it is evident that the majority of the respondents belong to the age group of 21-30 with a percentage of 56%. Followed by the age group of 31-40 with a percentage of 22% in the second highest category of respondent and the age group above 50 has a percentage of 12% of respondents. While 10% of the respondents fall under the age category of 41-50.

**Table 4.2 Sex of the Respondents**

Sex	No. of Respondents	Percentage
Male	25	50
Female	25	50
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clear that 50% of the respondents are Male and the rest of the 50% of the respondents are Female.

**Table 4.3 Educational Qualification of the Respondents**

Qualification	No. of Respondents	Percentage
Under-Graduate	36	72
Post Graduate	14	28
<b>Total</b>	<b>50</b>	<b>100</b>

In the present study there are no illiterate respondents as the total 50 respondents are all literate/educated.

As from the table above, it clearly highlights that the majority of the respondents are Under-Graduates with a percentage of 72%. Followed by the qualification category of Post Graduate with a percentage of 28%.

**Table 4.4 Occupation of the Respondents**

Occupation	No. of Respondents	Percentage
Student	12	24
Govt. Service	25	50
Private Firm	13	26
<b>Total</b>	<b>50</b>	<b>100</b>

As from the table above, the majority of the respondents fall under the occupation category of ‘Govt. Service’ with a percentage of 50%. Followed by the occupation category of ‘Private Firm’ with a percentage of 26% and the occupation category of ‘Student’ with a percentage of 24%.

Thus, the majority of the respondents falls under the occupational category of ‘Govt. Service’ as compared with the other two occupational category of the respondents that is the ‘Private Firm’ and ‘Student.’

**Table 4.5 Distribution of Property Assets**

Distribution of Property Assets	No. of Respondent	Percentage
Sons Only	47	94
Clan Members	1	2
Relatives	0	0
Kinship (relation by blood, marriage or adoption)	1	2
All the above	1	2
<b>Total</b>	<b>50</b>	<b>100</b>

As from the above table, it is clear that properties are distributed among the sons only.

Hence, the majority of the respondents agreed with the option “Sons only” with a percentage of 94 %. And only few opted for the remaining option that are – ‘Clan Members’, ‘Kinship’ and ‘All the above’ options with a percentage of 2% respectively.

Thus, the property assets in Phüsachodü village are said to be distributed among the sons only. This is followed due to the strong patriarchal system in the village.

**Table 4.6 Whether the inheritance practice of ‘Labü’ is given to daughters only**

<b>‘Labü’ is inherited by daughters only</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Yes	50	100
No	0	0
Don’t know	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

As from the above table, it is clear that the inheritance of ‘Labü’ is given to daughters only. As the total 50 respondents has opted for the option ‘Yes’ with a percentage of 100%.

The term ‘Labü’ is a local dialect/term of the Phüsachodü village which is a traditional practice of inheriting the mother’s property. This traditional inheritance practice of the mother’s property in the name of ‘Labü’ is inherited by the daughters and not sons. This is because ‘Labü’ is a traditional basket which is woven from bamboo splits which contains the mother’s ornaments, shawls/mekhelas or the traditional women attires. Such properties according to the traditional custom is given to the daughters only and the sons cannot inherit such properties. This is the main reason why the total 50 respondents agreed with the option ‘Yes’ and did not opt for the other two options.

Hence, from the table it is clear that the traditional inheritance of ‘Labü’ is given to daughters or girl child only.

**Table 4.7 Whether ‘Kalu’ is considered to be one of the oldest forms of traditional inheritance practice in the village**

<b>‘Kalu’ is considered to be of the oldest forms of traditional inheritance practice in the village</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Strongly Agree	24	48
Agree	26	52
Neutral	0	0
Disagree	0	0
Strongly Disagree	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

As from the above table, it is clear that ‘Kalu’ is considered to be the oldest form of traditional inheritance practice in the village as the total respondents has opted both for the options – ‘Strongly agree’ and ‘Agree’ which has clearly substantiate the statement.

The word ‘Kalu’ is a local dialect/term of the Phüsachodü people which means ‘Inheritance of Ancestral property’ or simply as ‘Ancestral property.’

Hence, from the responses of the respondents it is verified that ‘Kalu’ is the oldest form of the traditional inheritance practice in the village.

**Table 4.8 Whether the traditional inheritance practice is still rigid in the village today**

<b>Rigidity of the traditional inheritance practice in the village today</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Yes	18	36
No	1	2
Partially	31	62
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it highlights that the majority of the respondents has opted for the option ‘Partially’ with a percentage of 62%. Followed by a few responses which had opted for the option ‘Yes’ with a percentage of 36% while the remaining few has responded with the option ‘No’ with a percentage of 2%.

By taking into account the total 50 responses, it can be pointed out that for the older generation the traditional system of inheritance is still rigid as compared to the olden times while with the responses to the option ‘Partially’ such opinion may arise due to modernisation in the society, the rigidity may have loosened a bit. But still the traditional inheritance practice continues to remain in the society. As a tribal society such traditional practices are deep-rooted within the communities and thereby it cannot be shaken by any force.

Hence, from the table above, we can observe that there are two view point with regard to the traditional inheritance practice being rigid or not in the village today. Such opinion or responses may have arisen due to the generation gap or differences between the ‘Old’ and the ‘Young’ generations as the younger generation may not be well versed in such old traditional practices in short, they may not have wide knowledge with regard to such traditional practices.

**Table 4.9 Position/status of a Phüsachodü man in the village structure**

Position of a Phüsachodü man in the village structure	No. of Respondents	Percentage
Decision Maker	28	56
Head of the family	13	26
Bread earner	0	0
Leader	0	0
Option 1,2 & 3	9	18
All the above	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it clearly highlights that the majority of the respondents has opted for the option ‘Decision Maker’ with a percentage of 56% while 26% has opted for the option ‘Head of the family.’ And only few has opted for the option 1,2 & 3 with a percentage of 18%.

Such responses can be seen in the table due to the impact of patriarchal mindset/system in the society thereby making the male member a leading factor in every aspect of the society.

Hence, the majority of the respondents has agreed that a Phüsachodü man occupies a position of decision maker, head of the family and bread earners in the village structure.

**Table 4.10 Whether the male members in the village play a significant role in the traditional inheritance practice**

Male members in the village plays a significant role in the traditional inheritance practice	No. of Respondents	Percentage
Strongly Agree	17	34
Agree	32	64
Neutral	1	2
Disagree	0	0
Strongly Disagree	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clear that the male members in the village plays a significant role in the traditional inheritance practice as the majority of the respondents has opted for both the options of ‘Strongly Agree’ and ‘Agree’ with a percentage of 34% and 64%. While only 2% was opted for the option ‘Neutral’ and for the rest of the options none has opted for it.

The majority of the respondents has strongly agree/agreed that the male members play a significant role in the traditional inheritance practice in the village. This is due to the patriarchal system in the village where the male members play a dominant role in the village.

Hence, from the above table it is clear that the male members play a significant role in the traditional inheritance practice.

**Table 4.11 Do the Phüsachodü men still dominates over the village activities today**

Do the Phüsachodü men still dominates over the village activities today	No. of Respondents	Percentage
Yes	48	96
No	1	2
Partially	1	2
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clear that the majority of the respondents has opted for the ‘Yes’ option with a percentage of 96%. And only a few has opted for the remaining options that is option ‘No’ and ‘Partially.’

From the majority of the responses, one can observe that the patriarchal system can be clearly reflected upon their responses.

Hence, from the above table, it is clearly evident that till today the Phüsachodü men still dominates over the village activities.

**Table 4.12 Changes are seen in the position of men in the village today**

Changes are seen in the position of men in the village today	No. of Respondents	Percentage
Strongly Agree	6	12
Agree	43	86
Neutral	1	2
Disagree	0	0
Strongly Disagree	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clear that the majority of the respondents has opted for the options – ‘Strongly Agree’ and ‘Agree’ with a percentage of 12% and 86%. And the remaining few

has opted for the option ‘Neutral’ with a percentage of 2%. While none of the respondents has opted for ‘Disagree’ or ‘Strongly Disagree’ options.

Hence, it is clearly evident from the responses of the respondents that there are changes seen in the position of men in the village today. Such changes are taking place in the village due to social change in the society as well as the influence of modernity.

**Table 4.13 Position of a Phüsachodü woman in the village structure**

Position of a Phüsachodü woman in the village structure	No. of Respondents	Percentage
Caregiver	0	0
House keeper	42	84
Peace maker	0	0
All the above	8	16
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clear that the majority of the respondents has opted for the option ‘House keeper’ with a percentage of 84%. While some few has opted for the option ‘All the above’ (which comprises of – caregiver, house keeper and peace maker) with a percentage of 16%.

It is clearly evident from the table above that a Phüsachodü woman occupies a position of house keeper as majority of the respondents has opted for this option.

From the responses of the respondents, it can be observed that a stereotypical mindset of patriarchy can be clearly seen from the responses.

Hence, from the above table, it is clear that a Phüsachodü woman occupies a position of house keeper in the village structure.

**Table 4.14 Types of property inherited by the Phüsachodü women in the village**

Types of property inherited by the Phüsachodü women in the village	No. of Respondents	Percentage
Plot of land/fields	0	0
Shawls/Mekhelas and ornaments	45	90
Household articles-pots, cups, weaving implements, rice, baskets, etc.	0	0
All the above	5	10
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that the types of property inherited by the Phüsachodü women in the village are shawls/mekhelas and ornaments as the majority has opted for this option with a percentage of 90%. While some few has opted for the option ‘All the above’ with a percentage of 10% which comprises/includes – plot of land/fields, shawls/mekhelas and ornaments, household articles such as pots, cups, weaving implements, rice, baskets, etc.

The majority has response to shawl/mekhelas and ornaments because in a patriarchal tribal society women can only inherit movable properties rather than immovable properties. As the immovable properties are inherited by male members only.

Hence, from the above table it is clear that the types of property inherited by the Phüsachodü women in the village are shawls/mekhelas and ornaments.

**Table 4.15 Phüsachodü women are given fair share of property holdings like the male members in the village**

Phüsachodü women are given fair share of property holdings like the male members in the village	No. of Respondents	Percentage
Strongly Agree	0	0
Agree	1	2
Neutral	5	10
Disagree	42	84
Strongly Disagree	2	4
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that the majority of the respondents have disagree with the statement that Phüsachodü women are given fair shares of property holdings like the male members in the village with a percentage of 84%. Followed by the option ‘Neutral’ with a percentage of 10% while the remaining few has opted for the option – ‘Agree’ and ‘strongly Disagree’ with a percentage of 2% and 4% each. And no one has opted for the option ‘Strongly Agree.’

From the responses one can observe that there is less possibility that the women are given fair share of property holdings like the male members in the village. This is because of the patriarchal system as well as the customary law in the village.

Hence, it is clear from the table above that Phüsachodü women are not given fair shares of property holdings like the male members in the village.

**Table 4.16 Changes taking place in the traditional inheritance practice due to the impact of the modern society.**

Changes taking place in the traditional inheritance practice	No. of Respondents	Percentage
Strongly Agree	9	18
Agree	26	52
Neutral	13	26
Disagree	2	4
Strongly Disagree	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that there are changes taking place in the traditional inheritance practice as the majority of the respondents have agreed with a percentage of 52%. While some has opted for the option 'Neutral' and the remaining few respondents have opted for the options 'Strongly Agree' with a percentage of 18%. And only few respondents have disagreed with a percentage of 4%.

The majority has agreed that there are changes taking place in the traditional inheritance practice the reason for this may be due to modernization as well as the younger generation being ignorant towards the traditional inheritance practice which may lead to less practices of such traditional inheritance practices.

Hence, it is clear from the table above that there are changes taking place in the traditional inheritance practice as the majority of the respondents have agreed upon this statement.

**Table 4.17 Whether the ‘Gifted land or Acquired land’ property is practiced among the people in Phüsachodü village**

‘Gifted land or Acquired land’ property is practiced among the people in Phüsachodü village	No. of Respondents	Percentage
Yes	49	98
No	0	0
Partially	1	2
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that the Phüsachodü people practiced the new trends in the system of inheritance practice such as ‘Gifted Land or Acquired land’ as the majority of the respondents has opted for the option ‘Yes’ with a percentage of 98%. While only few has opted for the option ‘Partially’ with a percentage of 2%.

‘Gifted land/Acquired land’ are those type of land which are gifted to the daughters by their parents where the parents buy the land property with their own savings.

Hence, from the table above it is clear that such type of trends of inheritance are practiced among the Phüsachodü people.

**Table 4.18 In the case of ‘gifted-land’, the woman’s property can be inherited by**

In the case of ‘gifted-land’, the woman’s property can be inherited by	No. of Respondents	Percentage
Girl Child	42	84
Sisters	2	4
Son	0	0
Both option 1 & 2	6	12
<b>Total</b>	<b>50</b>	<b>100</b>

From the table above, it is clearly evident that in the case of ‘gifted-land’, the woman’s property can be inherited by the Girl child. This is because the majority of the respondents have opted for the option ‘Girl child’ with a percentage of 84%. While the remaining few respondents have opted for the option ‘Both option 1&2’ with a percentage of 12% and the option ‘Sisters’ with a percentage of 4%. And none have opted for the option ‘Son.’

In the case of ‘gifted-land’, the woman’s property is given/inherited by the girl child because according to customary law women are not entitle to inherit landed properties it is only entitle for male members to inherit the landed properties this may be the reason why a girl child is given the ‘gifted-land.’ Or it may depend upon the parent of the child to whom they will give such properties but mostly such ‘gifted-land’ are given to the girl child since the sons will get landed properties by no means.

Hence, from the table above it is clear that ‘gifted-land’ are given to girl child or the sisters.

**Table 4.19 Whether fair share of property holdings/ownership between the gender is seen today in Phüsachodü village**

Fair share of property holdings/ownership between the gender is seen today in the village	No. of Respondents	Percentage
Yes	1	2
No	39	78
Partially	10	20
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that the fair share of property holdings/ownership between the gender is still not seen today in Phüsachodü village as the majority of the respondents have opted for the option ‘No’ with a percentage of 78%. While some has opted for the option ‘Partially’ with a percentage of 20% and very few has opted for the option ‘Yes’ with a percentage of 2%.

The majority of the respondents have opted for the option ‘No’ because of the patriarchal system as well as the rigidity of the customary law. As customary law is strictly followed till today by all the inhabited tribes in Nagaland. And customary law is considered to be the ‘back-bone’ of all tribal societies.

Hence, from the table above it is clear that fair share of property holdings/ownership between the gender is still not seen today in Phüsachodü village. Though the women may occupy a stable position in the village yet still there is no fair share of property holdings seen among the gender today.

**Table 4.20 Statement - ‘Customary Law’ plays a significant role in the traditional inheritance practice**

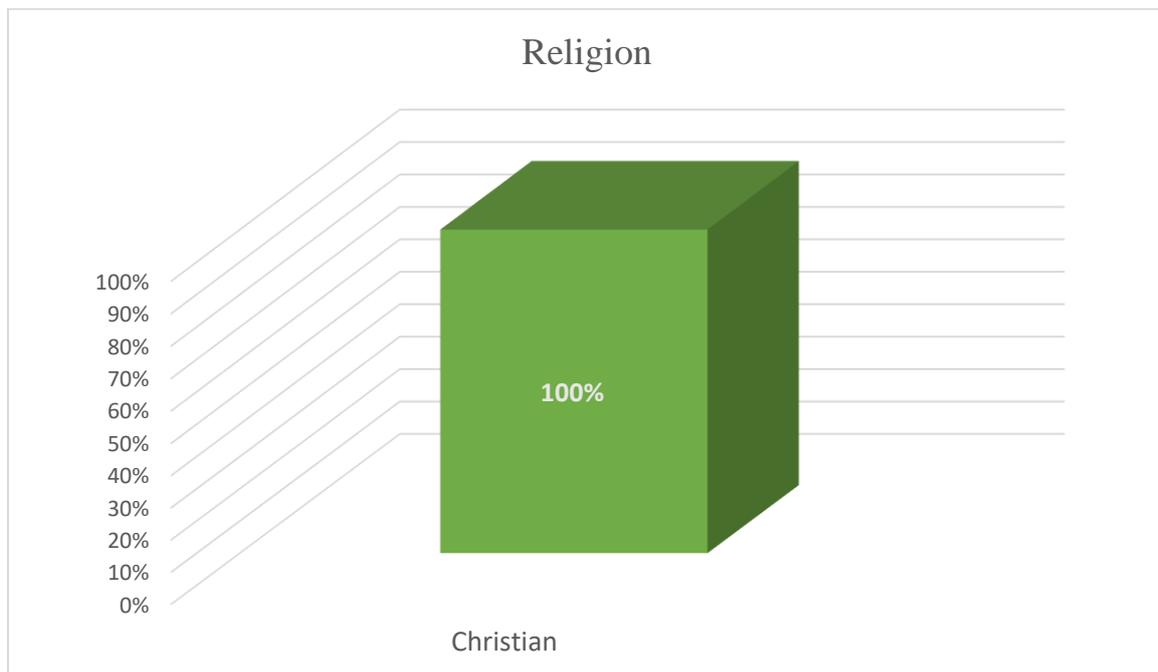
<b>‘Customary Law’ plays a significant role in the traditional inheritance practice</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Strongly Agree	5	10
Agree	38	76
Neutral	7	14
Disagree	0	0
Strongly Disagree	0	0
<b>Total</b>	<b>50</b>	<b>100</b>

From the above table, it is clearly evident that ‘Customary Law’ plays a significant role in the traditional inheritance practice as the majority of the respondents have opted for the option ‘Agree’ with a percentage of 76%. The remaining respondents have opted for both the options – ‘Neutral’ with a percentage of 10% and ‘Strongly Agree’ with a percentage of 14%. And none of the respondents have disagree with the statement.

The majority have agreed that customary law play an important role in the traditional inheritance practice because customary law help to resolve problems in the community when conflicts or disputes emerges. And also, the Naga society are governed by the customary law. Among these tribal societies, customary law serves as a guardian/protector.

Hence, it is clear from the table above that customary law plays a significant role in the traditional inheritance practice.

**Figure 4.1 Religion of the Respondents**

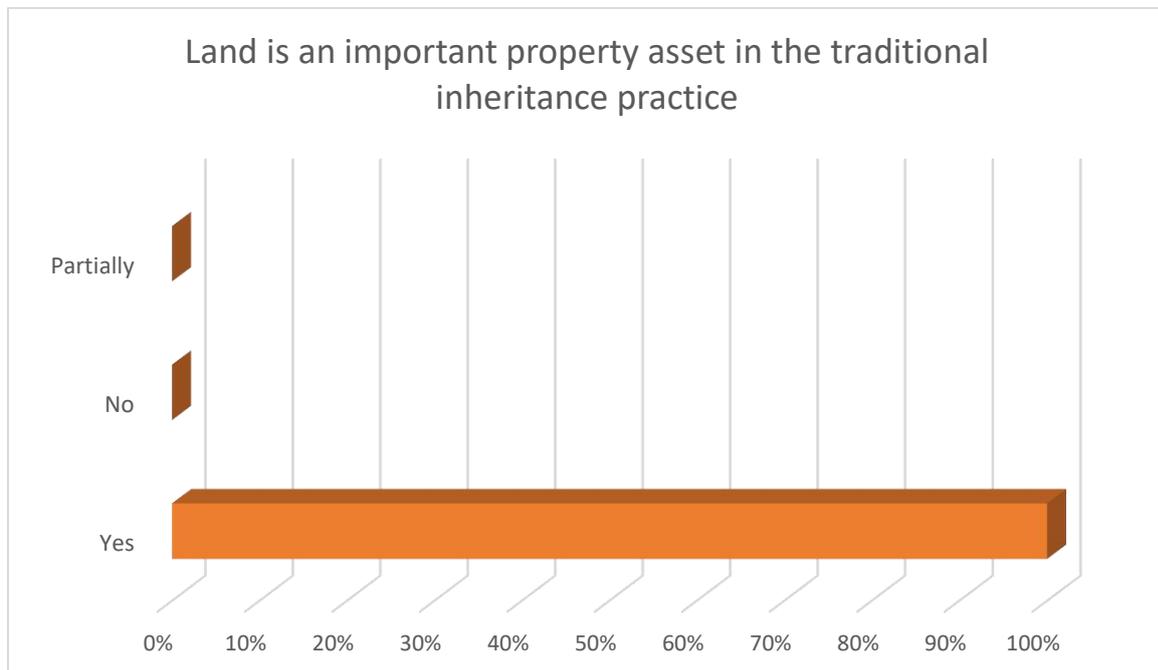


From the above figure, it clearly highlights that the total 50 respondents are all Christians with a percentage of 100%.

Hence, in this study the total 50 respondents are all Christian. This is because Nagaland is a state where the majority of its total population are all Christians. As according to the 2001 Census, the state's Christian population was estimated to be 1,739,651 making it one of India's three Christian-majority states, along with Meghalaya and Mizoram.

Nagaland is also known as "the world's sole predominantly Baptist state" and "the world's most Baptist state." Other Christian denominations include Catholics, Revivalists, and Pentecostals. Catholics can be found in large numbers in parts of Phek, Wokha, and Kohima districts, as well as in Kohima and Dimapur's urban regions.

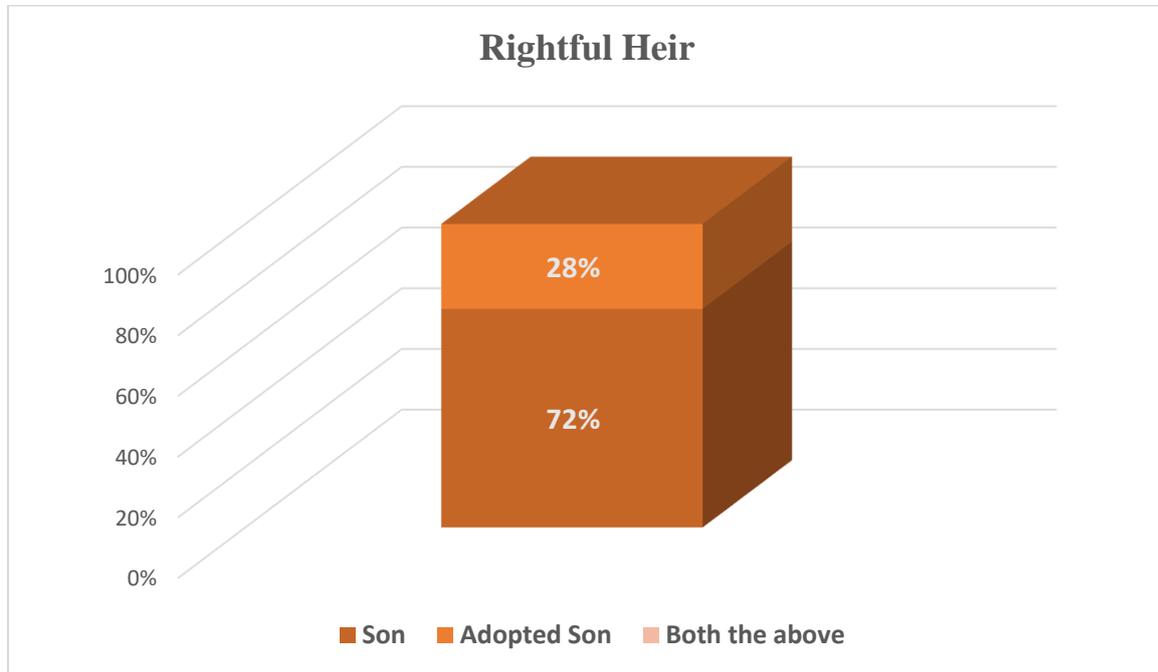
**Figure 4.2 Whether Land is an important property asset in Traditional Inheritance Practice**



From the above figure, it is clear that ‘land’ plays an important role in the traditional inheritance practice among the Phüsachodü people as the total number of the respondents all responded with the option “Yes” with a percentage of 100% and no one had opted for the other two options that is “No” and “Partially.”

Hence, from this figure, it is evident that ‘land’ plays an important property asset in the traditional inheritance practice among the Phüsachodü people.

**Figure 4.3 Rightful Heir for the Inheritance of Ancestral Property, according to the Traditional Inheritance Practice**

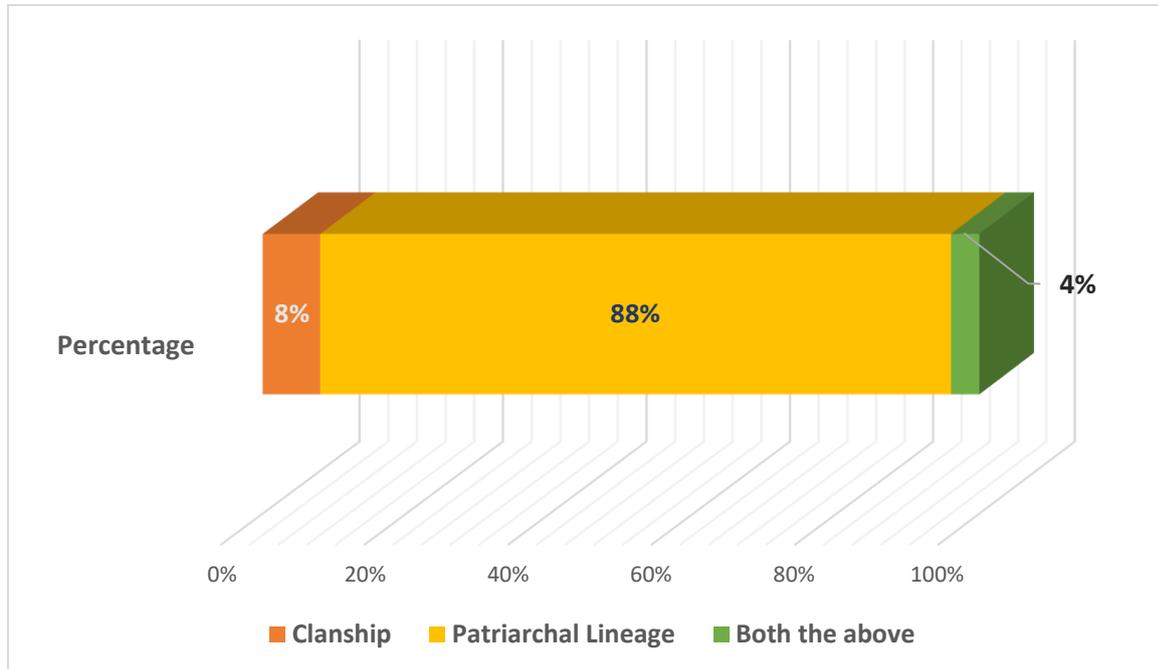


From the above figure, it is clear that for the inheritance of Ancestral property ‘Son’ are the rightful heir and are preferred the most for inheriting such properties. As the majority of the respondents opted for the option ‘Son’ with a percentage of 72%. Followed by the option ‘Adopted Son’ with a percentage of 28% responded by some few respondents. And no one opted for the option ‘Both the above’ since the respondents had two opinions regarding the two option that is ‘Son’ and ‘Adopted Son.’

The option ‘Adopted Son’ is given in the option list for cases such as in case of no heir or off springs the ancestral properties are given to the adopted son.

Hence, from the study it is clear that according to the traditional inheritance practice the inheritance of the ‘Ancestral Property’ is inherited by the sons and they are the rightful heir for such entitlements.

**Figure 4.4 In case of no heir, the village elders decide to pass down the property of the deceased person to the claimer by tracing the claimer's**

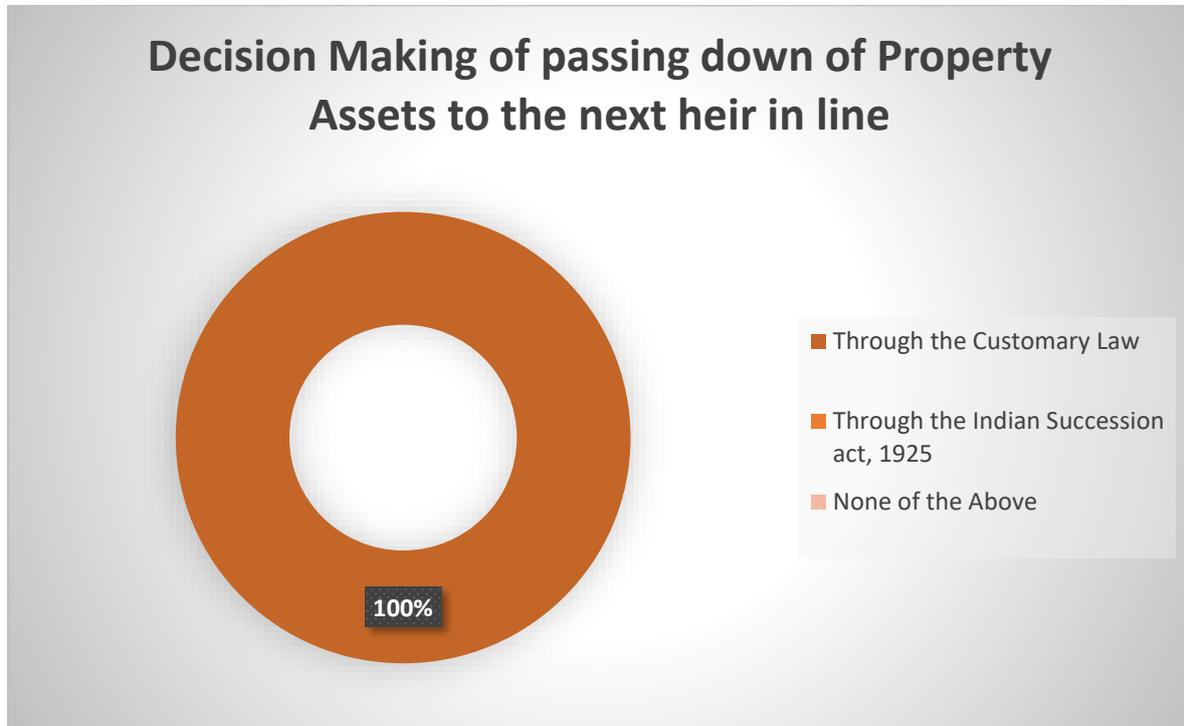


From the above figure, it is clear that the majority of the respondents have opted for the option 'Patriarchal Lineage' with a percentage of 88%. While some respondents have opted for the option 'Clanship' with a percentage response of 8% and very few respondents have opted for the option 'Both the above' with a percentage of 4%, this last option is an option that includes both the options of 'Clanship' and 'Patriarchal Lineage.'

But the majority of the respondents agreed with the option 'Patriarchal Lineage' and it also got the highest number of responses among the remaining two options this is because of the Patriarchal system in the village which have reflected upon the responses of the respondents.

Hence, from the figure above it is clear that in the case of no heir, the village elders decide to pass down the property of the deceased person to the claimant only after tracing/thorough investigation of the claimant's patriarchal lineage, the property is handed down to the claimant.

**Figure 4.5 How the village elders make decision regarding the passing down of property assets to the next heir or next person in the family or among the village members**



From the above figure, it is clear that all the 50 respondents had opted for the option ‘Through the Customary Law’ with a percentage of 100%. And none of the respondent had opted for the other two options that is ‘through the Indian Succession Act, 1925’ and the option ‘None of the above.’

All the respondents had opted for the option ‘Through the Customary Law’- this is because Customary Law plays an important integral part in the tribal society especially in a State like Nagaland. As every tribe in Nagaland has its own customary practices and Law.

Customary Law are those natural law which does not have a written records but are passed down orally to the next generations. Customary Laws are those sets of conventional beliefs that have been passed down from generation to generation.

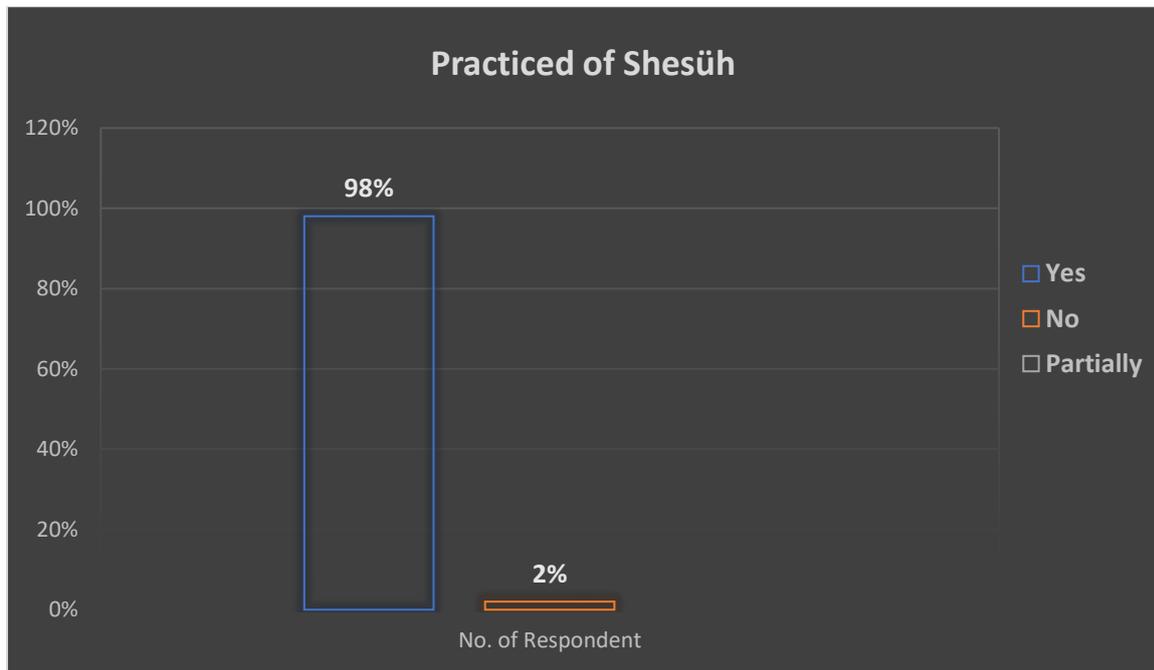
The Nagas are said to be bounded by the customary laws to which they belief that these laws are passed down by their forefathers to the next generation who are well verse in the field of experience and wisdom. They pay respect to such customary laws because it solves the

problems when such conflicts or disputes arises in the community. The customary law plays the role of a protector among these tribal societies.

With the creation of the new statehood of **Nagaland** on the **1<sup>st</sup> December 1963**, the Union parliament of India has allotted the **article 371(A)** under the thirteen Amendment Act, 1962. This article provides a special safeguard to the state of Nagaland with respect to religious, social and customary practices, ownership and transfer of land and rules for administration of justice. Thus, the Customary Laws are said to serve as a fence between the good and the bad citizens of every Naga community.

Hence, this is the reason why all the total 50 respondents had responded/opted for the option - 'through the customary law' the village elders make decision regarding the passing down of property assets to the next heir or next person in the family or among the village members as the customary law plays a very important role in the Naga society.

**Figure 4.6 Whether ‘Shesüh’ is still practiced in the village today or not**

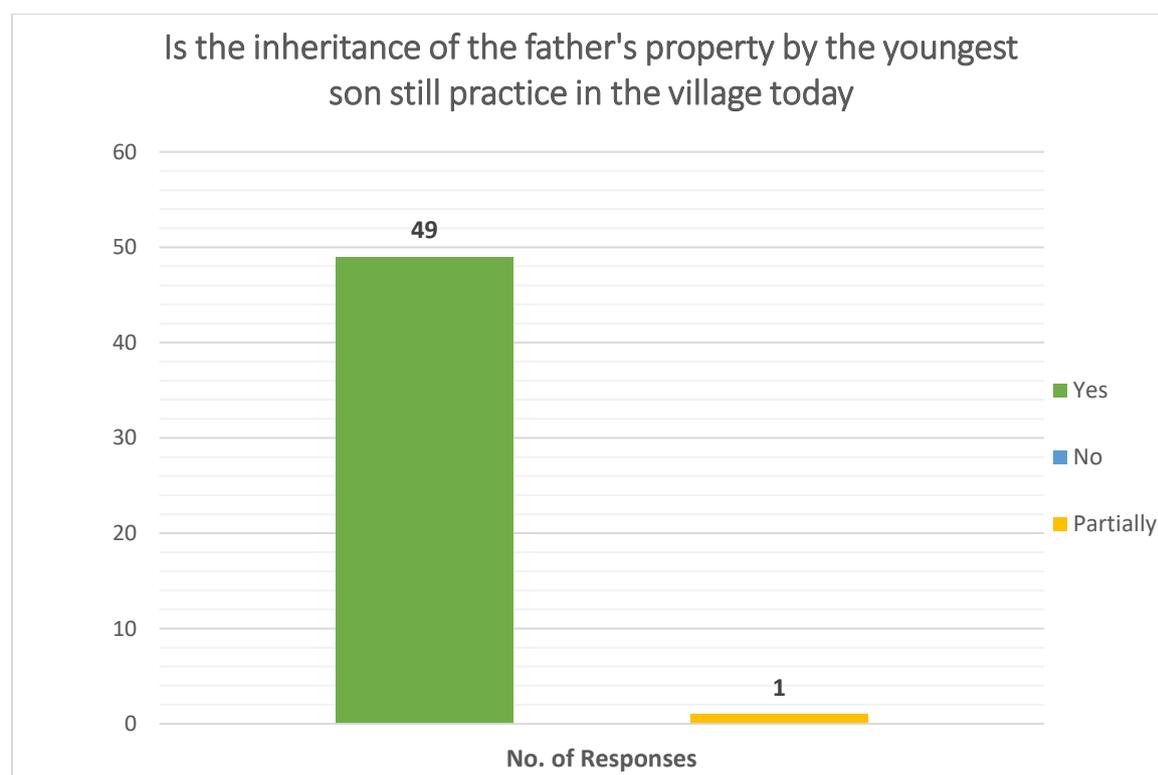


From the above figure, it is clear that ‘Shesüh’ is still practiced in the village today as the majority of the respondents had opted for the option ‘Yes’ with a percentage of 98% while the remaining few has opted for the option ‘No’ with a percentage of 2%. None has opted for the option ‘Partially.’

The term ‘Shesüh’ is a local term/dialect of the Phüsachodü village. The term ‘Shesüh’ is an old traditional practice which means ‘temporal land-ownership’ where paddy fields or a plot of land is given to the woman during her marriage. In this traditional practice, a particular plot of land is given to her so that she can cultivate till her lifetime but after her death the land is taken back by her father or brothers. With regard to this, the property of the deceased will be taken back by her family inheritance line (that is her father or her brothers) only after they pay the price of the properties or property to the deceased husband that is by killing cows or pigs and sharing it to the whole village or family members in the memory of the departed soul. They (deceased brothers and father) also prepare all the necessary things for the funeral that is starting from her ‘Casket’ to her burial ceremonies. Here the real value of the property is given less important than the ‘act of love and family connection.’

Thus, from the figure above it is clear that the practice of ‘Shesüh’ is still prevalent in the village today as the result can be clearly seen from the figure itself as the majority of the respondents had responded that the practice of ‘Shesüh’ is still practiced today in the village. The reason behind this is because Phüsachodü village is best known for the preservation of its old traditional and cultural practices as compared to other villages among the Chakhesang tribe. This maybe the reason behind the responses of the majority respondents who had opted for the option ‘Yes.’

**Figure 4.7 As per the traditional inheritance practice, the youngest son gets to inherit his father’s house and the best plot of land are also given to him as his share of property inheritance - is such system of inheritance still practiced in Phüsachodü Village today**



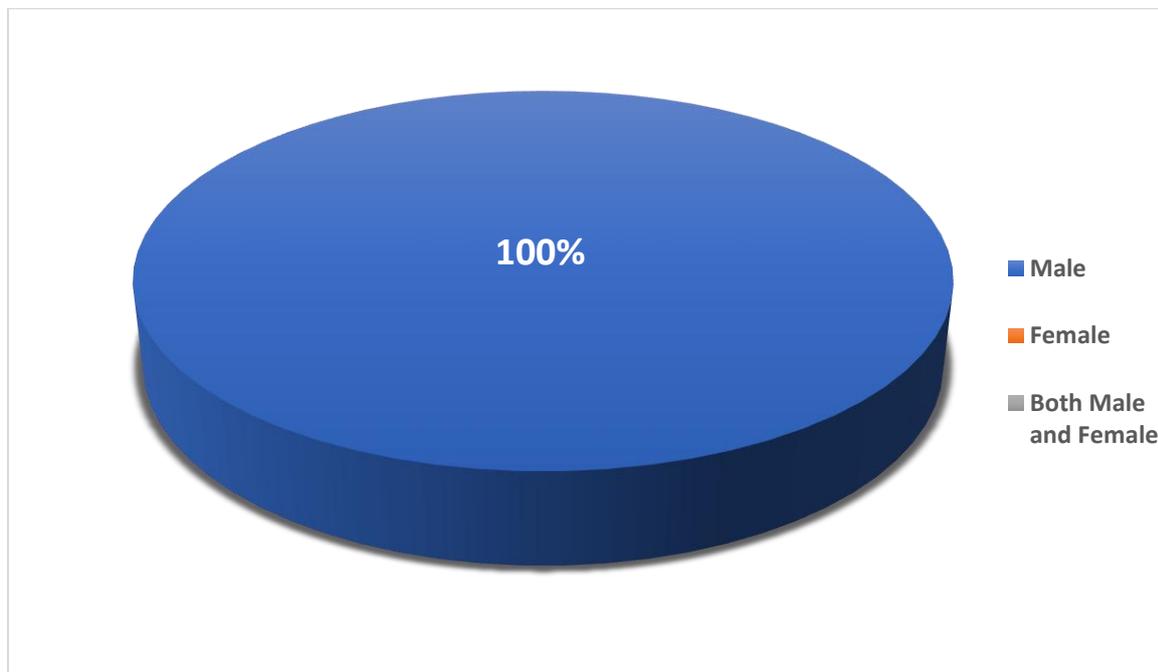
From the above figure, it is clear that the majority of the respondents have opted for the option ‘Yes’ with a percentage of 98% while the remaining respondent has opted for the option ‘Partially’ with a percentage of 2%.

According to such traditional inheritance practice, the youngest son is given the right to inherit his father’s house and the best terrace fields which is cultivated by his parents is also given to him as a share of property inheritance.

The majority of the respondents have agreed that such traditional inheritance is still practice today in village.

Hence, it is clearly evident from the figure above that such traditional inheritance practice are still followed today in the village.

**Figure 4.8 As per the traditional inheritance practice, the gender it favors the most is**

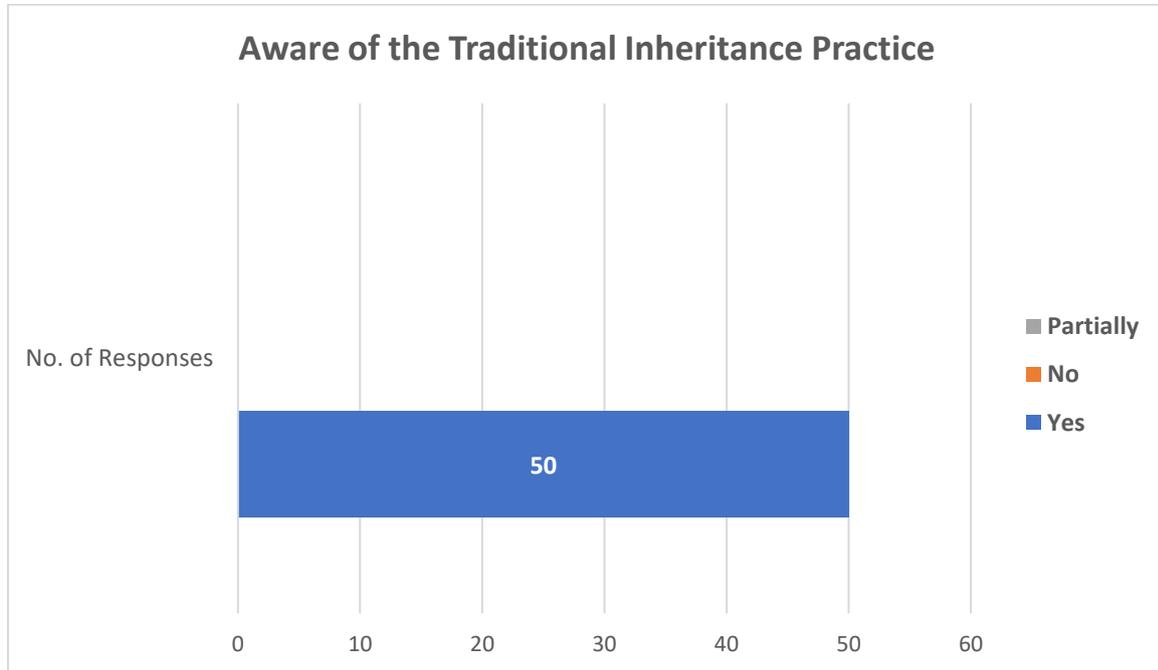


From the above figure, it is clearly evident that as per the traditional inheritance practice, the gender which it favors the most is male members as the total 50 respondents has opted for the option 'Male' with a percentage of 100%. And none have opted for the rest two options – 'Female' and 'Both Male and Female.'

From the responses of all the respondents, it clearly highlights that patriarchy runs strong in the village system.

Hence, it is clear from the above figure that male members are favored/preferred the most as per the traditional inheritance practice.

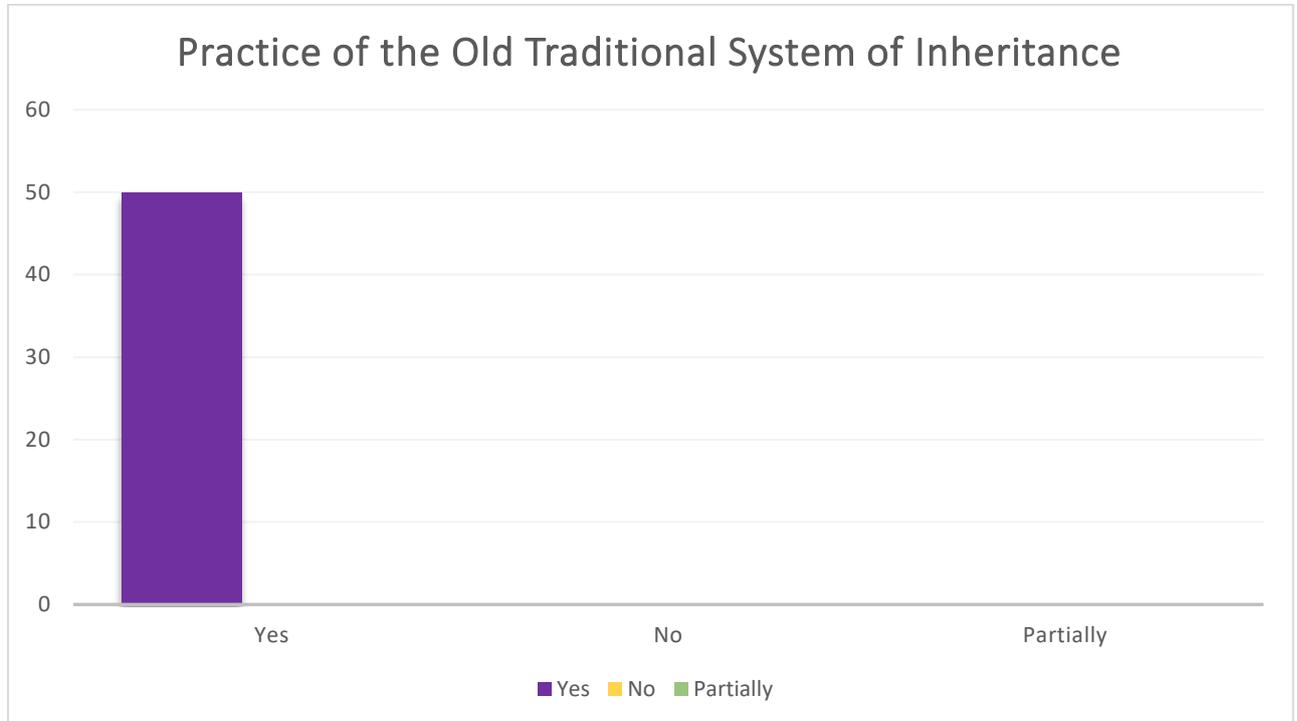
**Figure 4.9 Aware of the traditional inheritance practice in the village**



From the above figure, it is clearly evident that all the 50 respondents are all aware of the traditional inheritance practice in the village as all of the respondents have opted for the option 'Yes' with a percentage of 100%. And none of the respondents has opted for the remaining options – 'No' and 'Partially.'

Hence, from the figure above, it is clear that all the total 50 respondents are well aware of the traditional inheritance practice in the village.

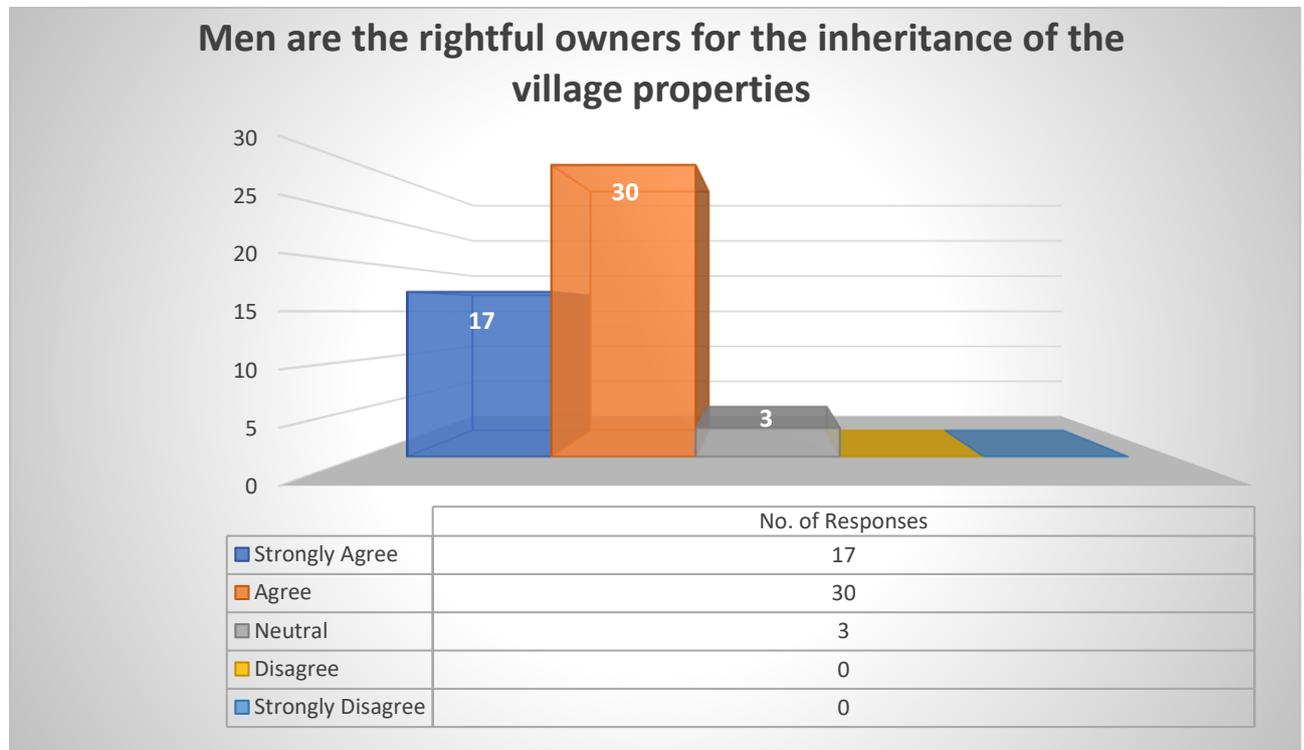
**Figure 4.10 Whether the villagers still practice the old traditional system of inheritance**



From the above figure, it is clearly evident that the old traditional system of inheritance is still practiced in the village today because all the 50 respondents have all opted for the option ‘Yes’ with a percentage of 100%. And none has opted for the other two options.

Hence, it is clear from the above figure that the villagers still do practice the old traditional system of inheritance.

**Figure 4.11 Whether the men in the village are the rightful owners for the inheritance of the village properties**

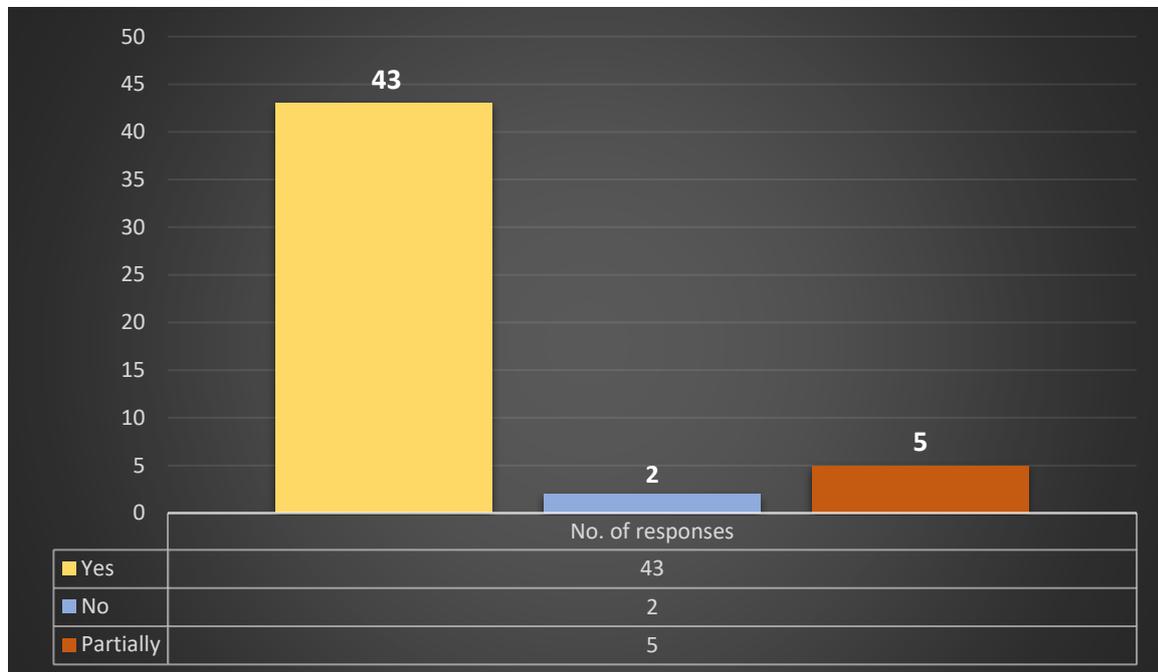


From the above figure, it is clearly evident that men are the rightful owners for the inheritance of the village properties as the majority of the respondents has ‘Strongly Agree’ and ‘Agree’ with a percentage of both 34% and 60% each. While only a few has opted for the option ‘Neutral’ with a percentage of 6%.

From the responses of the respondents, we can see that the patriarchal system has a strong impact on the ownership for the inheritance of the village properties.

Hence, from the figure above, it is clear that men are the rightful owners for the inheritance of the village properties.

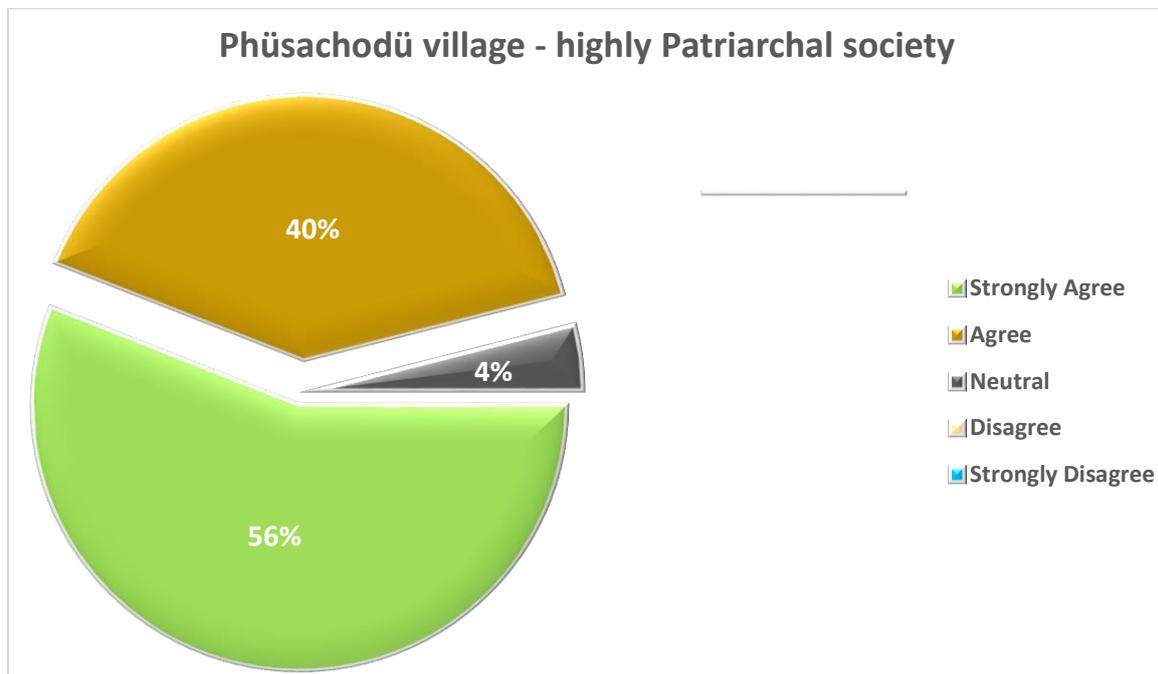
**Figure 4.12 Whether the Phüsachodü men are economically independent than women in the village**



From the above figure, it is clearly evident that the Phüsachodü men are economically independent than women in the village because the majority of the respondents has responded ‘Yes’ with a percentage of 86%. While some few respondents have opted for the options – ‘No’ and ‘Partially’ with a percentage of 4% and 10% respectively.

Hence, from the figure above, we can see that the Phüsachodü men are economically independent than women in the village.

**Figure 4.13 Phüsachodü village is a highly Patriarchal society**



From the above figure, it is clearly evident that Phüsachodü village is a highly patriarchal society as the majority of the respondents have 'Strongly Agree' and 'Agree' with a percentage of 56% and 40%. While only some few has opted for the option 'Neutral' with a percentage of 4%. And none of the respondents has 'Disagree' or 'Strongly Disagree.'

From the responses of the respondents, we can observe that Phüsachodü village is a highly patriarchal society. This is because Phüsachodü village is a male dominated society where male members take control of almost all the activities in the village and at the same time the village functions according to the decision made by the male elders in the village.

Hence, from the figure above, it is clear that Phüsachodü village is a highly patriarchal society.

**Figure 4.14 Whether property rights are given to female members in Phüsachodü village**



From the above figure, it is clearly evident that property rights are ‘Partially’ given to female members in Phüsachodü village because the majority of the respondents has opted for the option ‘Partially’ with a percentage of 66%. While the remaining few of the respondents have opted for the options – ‘No’ and ‘Yes’ with a percentage of 24% and 10%.

From the responses of the respondents, we can see that property rights are ‘Partially’ given to female members in Phüsachodü village this maybe because of the patriarchy system and the customary law in the village. As according to the customary law, the property rights are given to male members only and rarely to women.

Hence, from the figure above, it is clear that the property rights are partially given to female members in Phüsachodü village.

**Figure 4.15 Phüsachodü women are treated equally at par with men in the village**

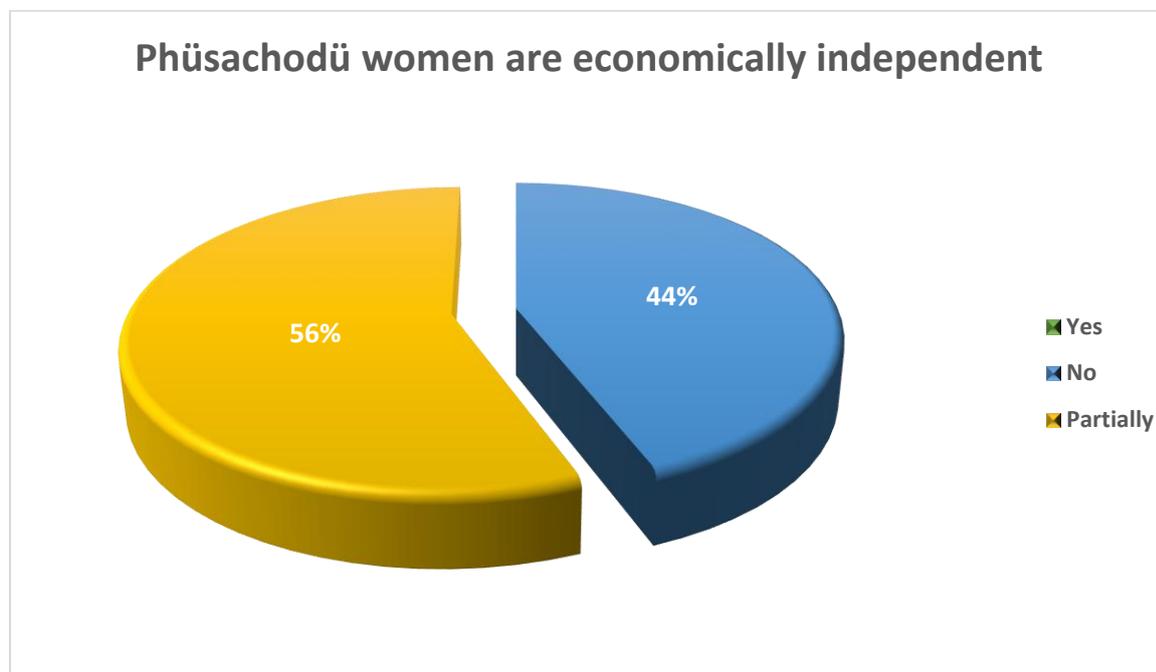


From the above figure, it is evident that Phüsachodü women are not treated at par with men in the village as the majority of the respondents have opted for the option ‘Neutral’ with a percentage of 62%. While some respondents have opted for the options – ‘Disagree’ with a percentage of 18%, ‘Agree’ with a percentage of 14% and ‘Strongly Agree’ with a percentage of 6%.

For the statement whether women are treated equally at par with men in the village or not, to this statement the majority of the respondents have opted for the option ‘Neutral’ with a percentage of 62%. The main reason behind the answers of the respondents maybe because of the patriarchal society, its patriarchal mindset and the attention given to the male members than women (due to the patriarchal system) may lead to such responses from the respondents.

Hence, it is clear from the figure above that the women in Phüsachodü village are impartially or neutrally treated at par with men when it comes to the notion of ‘equality/equally’.

**Figure 4.16 Whether the Phüsachodü women are economically independent**

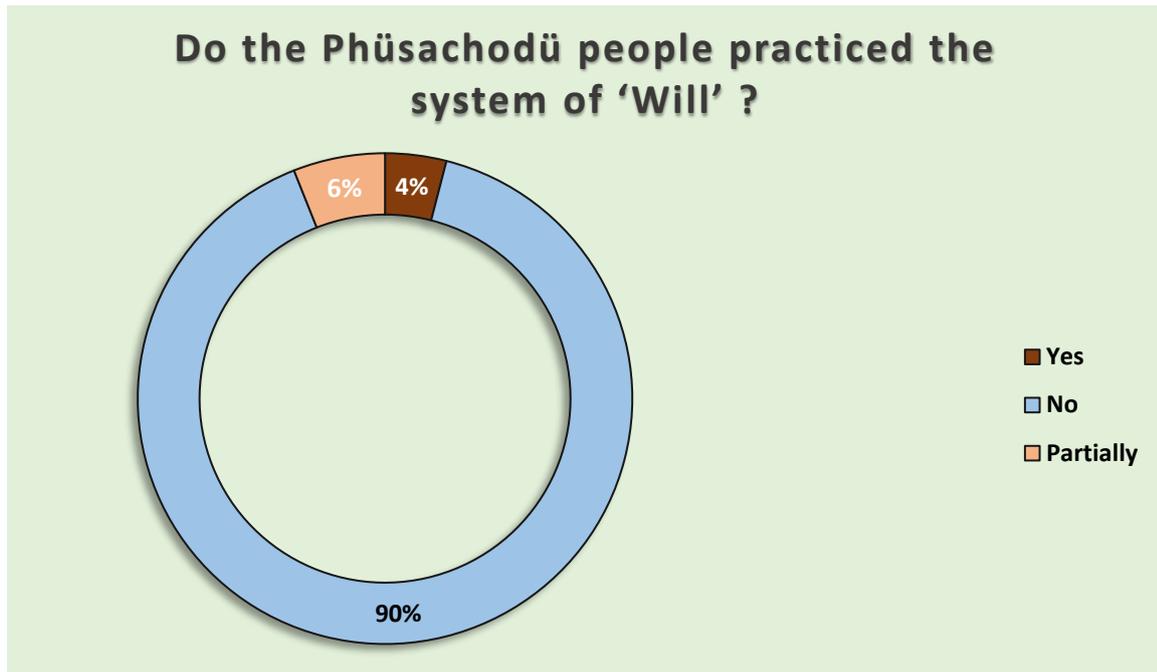


From the above figure, it is clearly evident that the majority of the respondents have opted for the option 'Partially' with a percentage of 56% while the remaining respondents have opted for the option 'No' with a percentage of 44% to the statement whether the Phüsachodü women are economically independent or not. And none have opted for the direct option 'Yes.'

As from the responses of the respondents, we can see that there are two sides of opinion; one being - Phüsachodü women are moderately independent when it comes to the 'economic' aspects while the other opinion being stated that – Phüsachodü women are not economically independent. This maybe because of the effect of the patriarchal system in the village.

Hence, from the figure above, it is clear that the Phüsachodü women are partially independent when it comes to the 'economic' aspects.

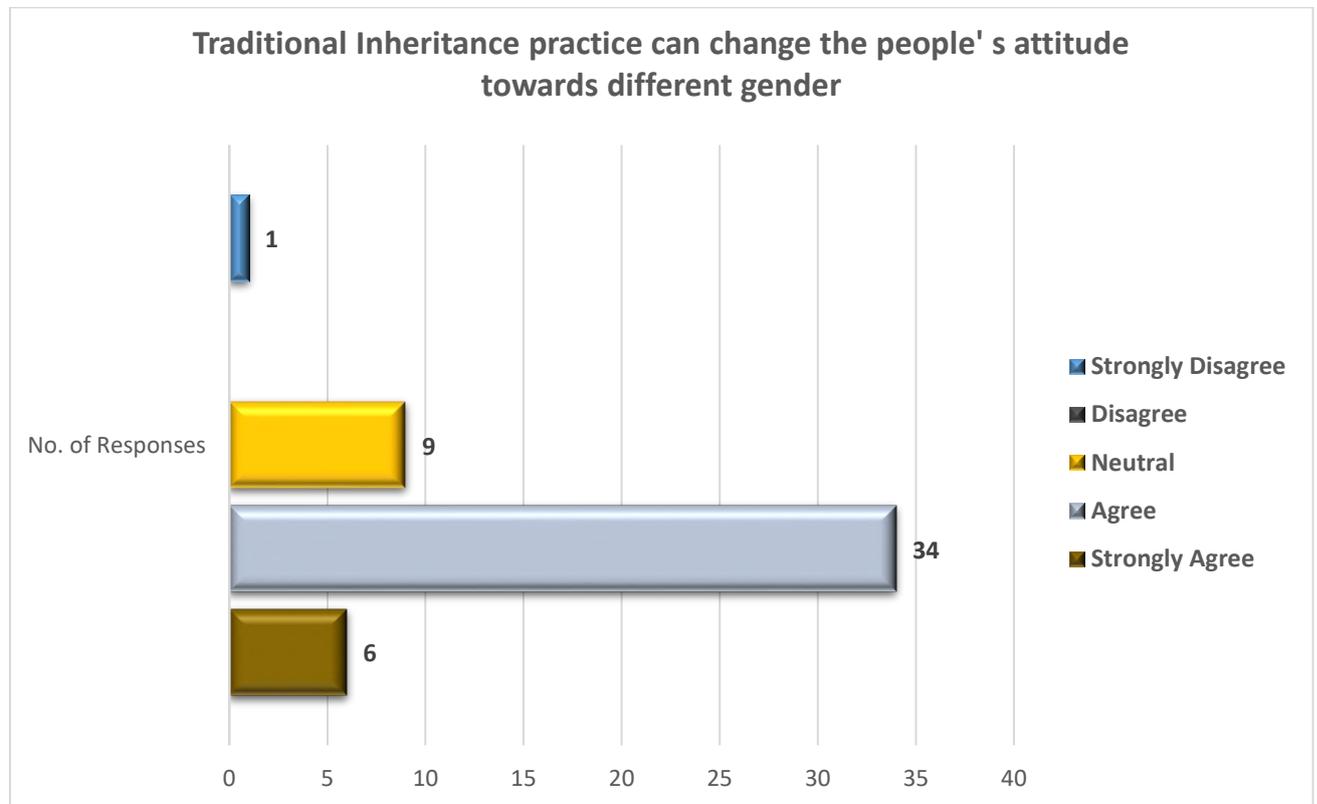
**Figure 4.17 Whether the Phüsachodü people practiced the system of ‘Will’**



From the above figure, it is clearly evident that the people of Phüsachodü village does not practice the system of ‘Will’ as the majority of the respondents have opted for the option ‘No’ with a percentage of 90%. While only a few has opted for options – ‘Yes’ with a percentage of 4% and ‘Partially’ with a percentage of 6%.

Hence, from the responses of the respondents, it is clear that Phüsachodü village does not practice the system of ‘Will’ (the new trends of inheritance practice).

**Figure 4.18 Due to the patriarchal outlook, the traditional inheritance practice can change the people’s attitude towards different gender**



From the above figure, it is clearly evident that the majority of the respondents agreed with the statement that due to the patriarchal outlook, the traditional inheritance practice can change the people’s attitude towards different gender. As the majority has opted for the option ‘Agree’ with a percentage of 68%. While some few has opted for options – ‘Strongly Agree’ with a percentage of 2%, ‘Neutral’ with a percentage of 18% and ‘Strongly Disagree’ with a percentage of 12%.

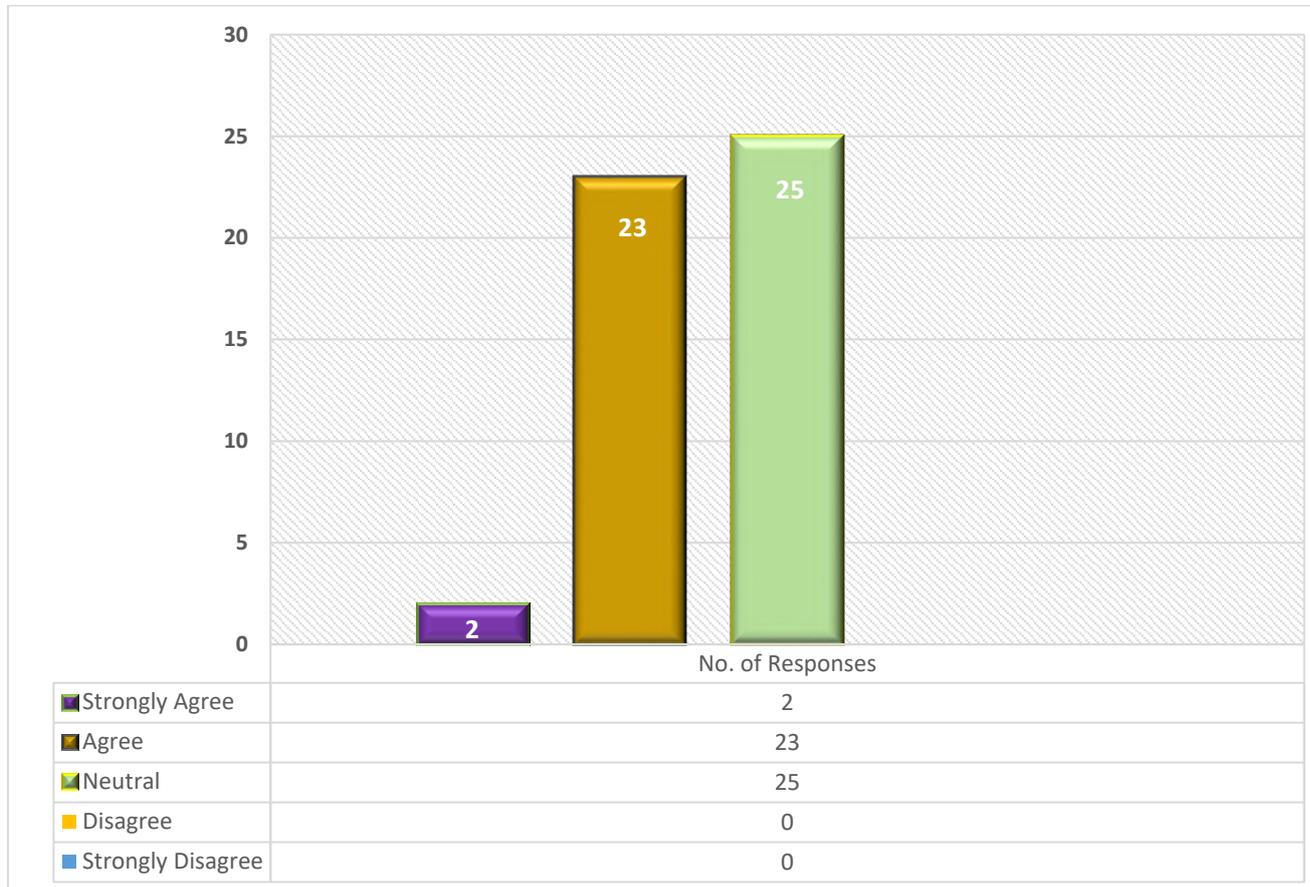
As per the responses of the respondents, we can see that the respondents have different views with regard to the statement. Though there is different opinion with regard to the statement the majority of the respondents have agreed with the statement that due to the patriarchal outlook, the traditional inheritance practice can change the people’s attitude towards different gender.

‘... the social construction of gender is actually a system of power that not only divides men and women as masculine and feminine but typically also places men and masculinity above women and femininity and operates to value more highly those institutions and practices that

are male dominated and/or representative of masculine traits and styles.’ (Peterson and Runyan, op. cit. (1993), p. 18.)

Hence, from the figure above, it is clear that due to the patriarchal outlook, the traditional inheritance practice can change the people’s attitude towards different gender.

**Figure 4.19 Should the traditional inheritance practice still be continued in this 21<sup>st</sup> century**



From the above figure, it is clearly evident that the majority of the respondents has opted for the option ‘Neutral’ with a percentage of 50% for the statement – whether the traditional inheritance practice should still be continued in this 21<sup>st</sup> century. While some few has ‘Agree’ as well as ‘Strongly Agree’ with a percentage of 46% and 4% respectively.

As per the responses of the respondents, the majority of the respondents are with the opinion that the practice of the traditional inheritance practice in this 21<sup>st</sup> century should be neutral. While the remaining few has agreed with the statement that it should still be practice in this 21<sup>st</sup> century.

Hence, from the figure above, it is clear that there is neutrality in the opinions of the majority of the respondents with regard to the statement whether the traditional inheritance practice should still be continued in this 21<sup>st</sup> century.

**Figure 4.20 Statement - ‘Traditional practices need to be preserved in order to safeguard and keep our cultural identity alive’**



From the above figure, it is clearly evident that the majority of the respondents have agreed with the statement - ‘Traditional practices need to be preserved in order to safeguard and keep our cultural identity alive’ as it got the highest number of responses with a percentage of 78% as compared to other options. While some few respondents opted for the options – ‘Strongly Agree’ with a percentage of 12% and ‘Neutral’ with a percentage of 10%.

Though the traditional practices may have some drawbacks yet still it is a tradition which makes one indigenous/tribe different and vibrant from one another thereby making one group unique and marked its identity from the other. This maybe the reason why the majority of the respondents have agreed with the statement - ‘Traditional practices need to be preserved in order to safeguard and keep our cultural identity alive.’

Hence, it is clear from the figure above that the ‘Traditional practices’ should be preserved in order to safeguard and keep one’s cultural identity alive.

# **FINDINGS AND CONCLUSION**

## **CHAPTER-5**

### **FINDINGS AND CONCLUSION**

Traditional cultural practices represent a community's values and beliefs over many generations. Every social and tribal group in the world has its own set of cultural traditions and beliefs.

This study was conducted to study the traditional inheritance practice of Chakhesang Tribe with special reference to Phüsachodü village, Nagaland. It provides information about the traditional inheritance practice of the Phüsachodü village. It also tries to understand both the genders position in the traditional inheritance practice of this village. It also studies the various changes taking place in the traditional inheritance practice in Phüsachodü Village. Due to the ongoing Covid-19 pandemic situation, google form was used for the collection of data. Quantitative research design was utilized to describe the data obtained, along with a detailed explanation on their answers. Hence, from the study, we can understand the various traditional inheritance practice which are practiced among the Phüsachodü people of Chakhesang tribe, Nagaland.

From the study, it has been found that out of the 50 samples, the age group of the majority of the respondents who took part in the study falls under the age group of 21-30 years of age. Both male and female with an equal percentage of 50% each took part in the study. All the respondents who took part in the study are all Christians and all of them are educated. And the majority of the respondents belong to the occupational category of 'Govt. Service.'

The first objective of the study was to study the traditional inheritance practice of Phüsachodü Village. In a sample of 50 responses, it has been found out that 'land' plays an important role in the traditional inheritance practice among the Phüsachodü people because all of the respondents have stated 'Yes' to the importance of land in the traditional inheritance practice with a percentage of 100%. 94% of the respondents have agreed that properties are distributed among the sons only. The majority of the respondents (72%) have stated that according to the traditional inheritance practice the inheritance of the 'Ancestral Property' is inherited by the sons and they are considered to be the rightful heir for such entitlements. The majority of the

respondents (88%) have responded that in the case of no heir, the village elders decide to pass down the property of the deceased person to the claimant only after a thorough investigation on the claimant's 'patriarchal lineage' the property is handed down to the claimant. All the total 50 respondents have responded that 'Through the Customary Law' the village elders make decision regarding the passing down of property assets to the next heir or next person in the family or among the village members with a percentage of 100%. And traditional practices such as 'Shesüh' is still said to be practiced in the village today as the majority of the respondents (98%) have responded that it is still practice in the village. Another traditional inheritance practice which is followed among the Phüsachodü people is the practice of 'Labü' which is an inheritance of the mother's property by the daughters as all the respondents (100%) have responded that such properties are given to daughters only. 'Kalu' which is an old traditional practice of inheritance is considered to be the oldest form of traditional inheritance practice in the village as per the responses of all the total respondents. The majority of the respondents (98%) have responded that as per the traditional inheritance practice, the youngest son is given the right to inherit his father's house and the best terrace fields which is cultivated by his parents is given to him as a share of property inheritance is still practiced in the village today. All the respondents (100%) have agreed that as per the traditional inheritance practice, the gender which it favors the most is Male members. 100% of the respondents are well aware of the traditional inheritance practice in the village. And from the responses of all the respondents (100%) it is evident that the old traditional system of inheritance is still practiced in the village today. There are two view point with regard to the traditional inheritance practice being rigid or not in the village today as the majority of the respondents (62%) have stated that the traditional inheritance practice is partially rigid as compared with the olden times and the rest of the respondents have agreed that it is still rigid as before. Such opinions may have arisen due to the generation gap or differences between the 'Old' and the 'Young' generations as the younger generation may not be well versed in such old traditional practices.

The second objective of the study was to study the position of men in the traditional inheritance practice of Phüsachodü Village. As out of the 50 samples of responses, 56% of the respondents have responded that the Phüsachodü man in the village structure holds the position of 'Decision Maker' in the village. 60% of the respondents have agreed that men are the rightful owners for the inheritance of the village properties. And 64% of the respondents have agreed that the male members in the village plays a significant role in the traditional inheritance practice. The

majority of the respondents (86%) have also responded that the Phüsachodü men are economically independent than women in the village. The majority of the respondents (96%) have responded that due to the patriarchal society, the Phüsachodü men still dominates over the village activities till today. The majority of the respondents (56%) have strongly agreed that Phüsachodü village is a highly patriarchal society. 86% of the respondents have agreed that changes are seen in the position of men in the village today. Such changes are taking place in the village due to social change in the society as well as the influence of modernity.

The third objective of the study is to find out the place of women in the traditional inheritance practice of Phüsachodü village. From the 50 samples of responses, 84% of the respondents have stated that a Phüsachodü woman occupies a position of 'House keeper' in the village structure. The majority of the respondents (66%) have stated that property rights are 'Partially' given to female members in Phüsachodü village. The majority of the respondents (90%) have point out that the types of property inherited by the Phüsachodü women in the village are shawls/mekhelas and ornaments. 62% of the respondents have responded that Phüsachodü women are not treated at par with men in the village as there is neutrality in the treatment of women being equally at par with men. The majority of the respondents (84%) have stated that Phüsachodü women are not given fair shares of property holdings like the male members in the village, this is due to the patriarchal system as well as the customary law in the village. With regard to the economically independent status of the Phüsachodü women, there are two sides of opinions; as 56% of the respondents states that Phüsachodü women are moderately independent when it comes to the 'economic' aspects while the rest 44% of the respondent's states that – Phüsachodü women are not economically independent.

The fourth objective of the study is to study the various changes taking place in the traditional inheritance practice in Phüsachodü village. Out of the 50 samples of responses, 52% of the respondents have stated that changes are taking place in the traditional inheritance practice due to the impact of the modernity in the society. Out of the various trends of inheritance practice, 90% of the respondents have stated that the people of Phüsachodü village does not practice the system of 'Will.' But they do practice the other trends of inheritance practice such as the 'Gifted Land or Acquired land' as 98% of the respondents have stated that 'Gifted Land or Acquired land' of the new trends of inheritance practice are practiced by the Phüsachodü people in the village. With regard to the inheritance of the 'gifted-land', the majority of the respondents (84%) have stated that the woman's property is inherited by the Girl child. 68% of the respondents have agreed that due to the patriarchal outlook, the traditional inheritance

practice can change the people's attitude towards different gender. The majority of the respondents (78%) have stated that fair share of property holdings/ownership between the gender is still not seen today in Phüsachodü village. 50% of the respondents have stated that the practice of the traditional inheritance practice in this 21<sup>st</sup> century should be neutral. The majority of the respondents (76%) have stated that the 'Customary Law' plays a significant role in the traditional inheritance practice. Though the traditional system of inheritance practice may have its positive and negative drawbacks, 78% of the respondents have agreed that the traditional practices should be preserved in order to safeguard and keep their cultural identity alive.

Thus, in contrast to the other tribes in Nagaland, particularly the Angami Tribe who are considered to be the dominant tribe in Nagaland due to their greater numbers - no landed properties are given to women but landed properties are given to women in the Chakhesang Tribe, even if the properties are temporary, they are given land ownership authority. As an example, in the Phüsachodü village of Chakhesang Tribe the tradition of giving women land ownership is known as 'Shesüh.' Although the terminology for such land ownership may differ from village to village, yet the process is the same.

## SUGGESTIONS

- Give men incentives or encouragement to accept rather than oppose or boycott changes in the society.
- Create awareness among males and females regarding the 'Gender Equality' through various programmes. For children, it must begin from the family at the earliest stages and should be stressed and included in the school curriculum as well.
- By promoting more of the local handlooms or hand weaving works of the women in the village can encourage and give more motivation for the women in the village to come out and work by themselves independently which can lead to a 'self-build independent life' of a woman in the village.
- By promoting investments in manufacturing and open markets particularly for products with special preferences (importance) to female labour content which can boost both revenues and the demand for female employment, in that case it can uplift the economic status of the women in the village as there is still female dependency on male when it comes to 'being economically independent' in the village.
- Organizing an awareness program on the traditional inheritance practice can make the younger generation aware of their unique traditional inheritance practices, their culture and their identity. As this particular village has a unique way of its traditional inheritance practices.
- Inheriting a property is not a regular incident so it is one's own duty to take utmost care to have all the details in place.

## CONCLUSION

As a result, a statistical analysis of 50 members was undertaken to finish the study. The facts and views from the study revealed that the traditional inheritance practices are still practiced by the Phüsachodü village till today. Thereby, holding the legacy for preserving and practicing the traditional practices among the Chakhesang tribe in Nagaland. Changes are seen among the people of Phüsachodü village, this is due to the arrival of Christianity as well as the advancement in the modern society which has led to the changes in the mindset of the people. But at the same time the traditional inheritance practices are still unable to be shaken as it is still running strong in the village as these practices are deeply rooted in the community. And also, despite the impact of education and occupation on people's lives, their lives are still governed to some extent by the old customary rules and traditional practices.

As an outcome of the study, it can be concluded that the traditional inheritance practice among the Phüsachodü people continues to grow even today as the people still values the traditional practices in the village. As this is a continuous process that might happen knowingly or unknowingly because since the ancient times, the value of traditional practices as well as the customary law has been extremely high. With the passage of time and people, many young educated minds have gained the knowledge of both the present modern inheritance practices and the traditional inheritance practices of the past which are still practiced by the people in the community. As a result, they live equally on both sides as 'modernity and tradition' go hand in hand. Traditional practices are still highly important in the lives of the local communities till date because during the olden times these traditional practices as well as the customary law serve as a barrier between the good and evil inhabitants of the community or village in particular that is the reason why it is still valued today by the people in the community. As they play a vital role in maintaining stability, peace, harmony and unity in the village.

Therefore, some traditional practices may have both positive and negative consequences for all the members in the society, as good and bad things always inevitably follow each other. But despite the fact that such traditional practices may have both pros and cons, yet each individual in the society incorporates their cultural heritage into their lives in their own unique way.

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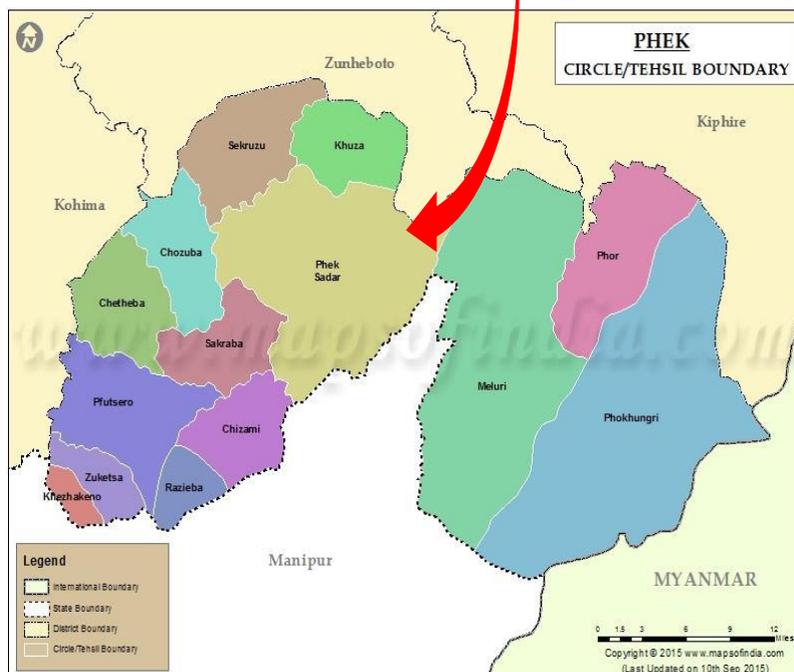
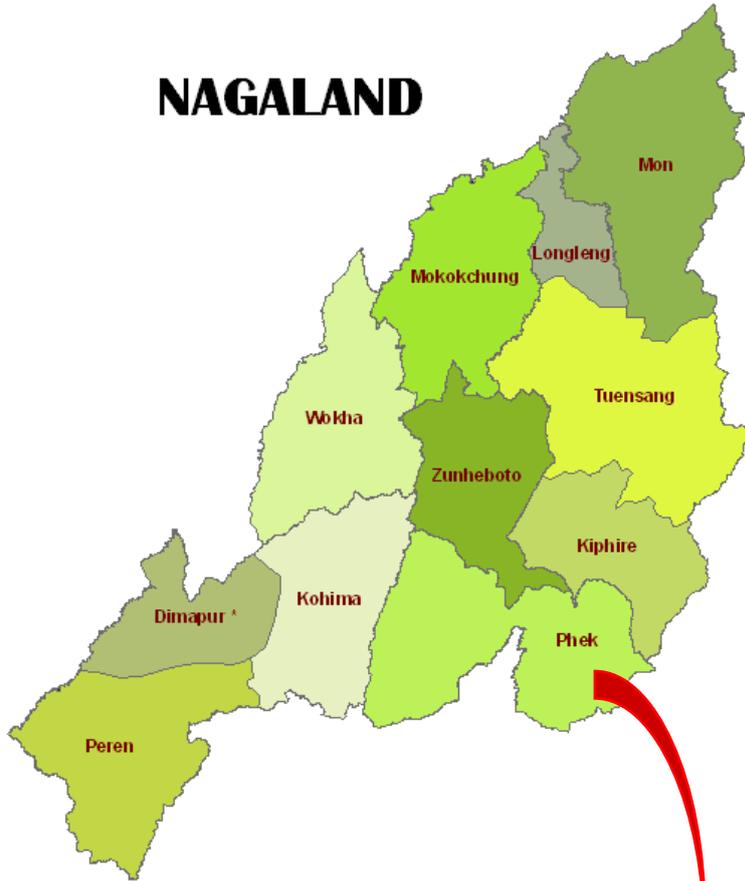
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# GALLERY

## NAGALAND



## CHAKHESANG TRIBE



Chakhesang Men (Sources: Pinterest)



Chakhesang Man drinking his local rice beer (Sources: <https://johangerrits.com/>)



Sources:  
<https://fineartamerica.com/featured/chakhesang-tribe-men-hira->

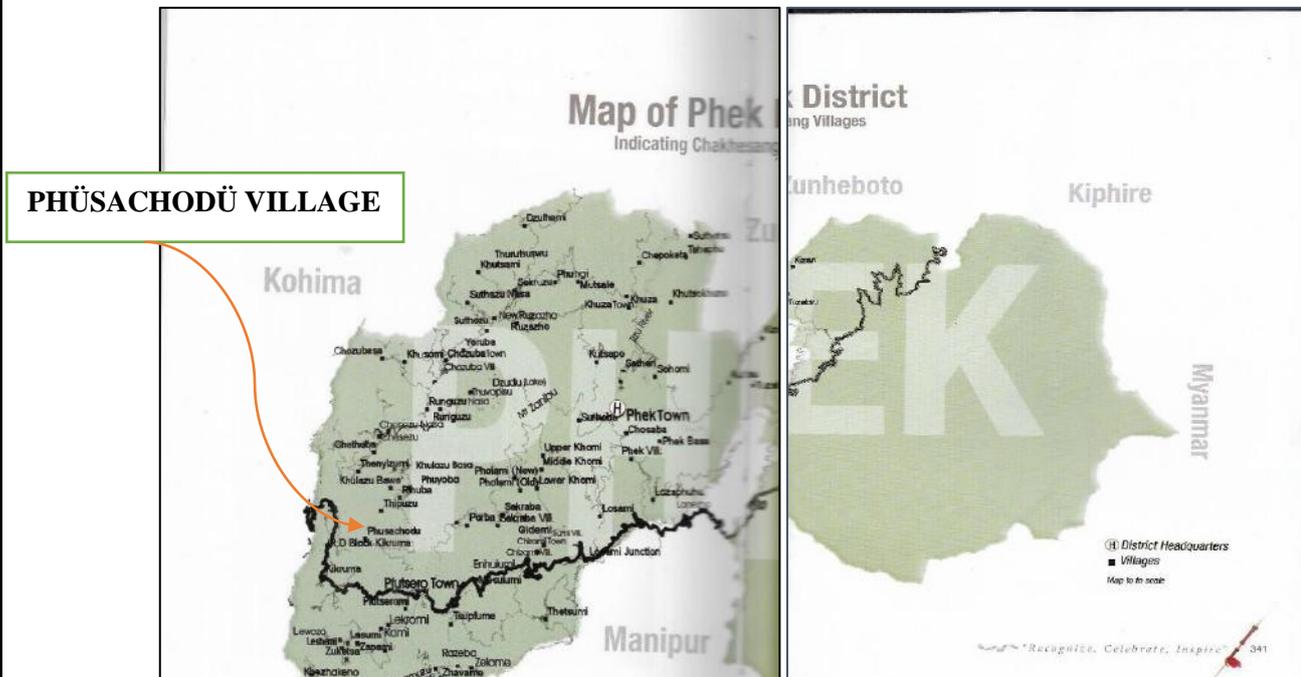


Chakhesang Women Weaving their traditional shawls (Sources: <https://www.sahapedia.org/nettle->)

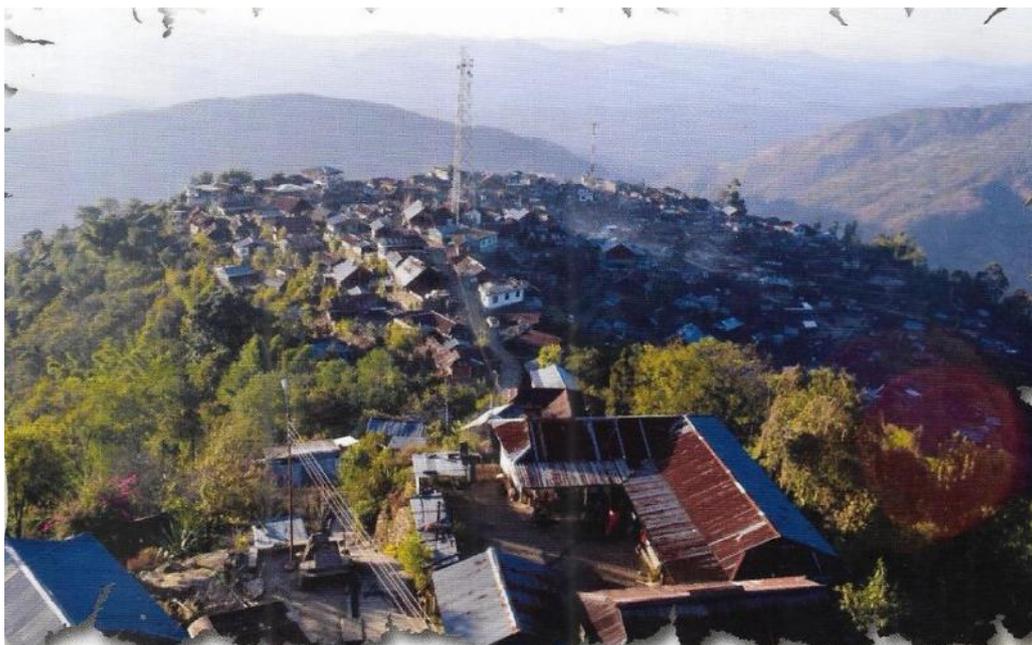


Chakhesang Woman (Sources: <https://pixels.com/featured/chakhesang-tribal-lady-hira-punjabi.html>)

# PHÜSACHODÜ VILLAGE



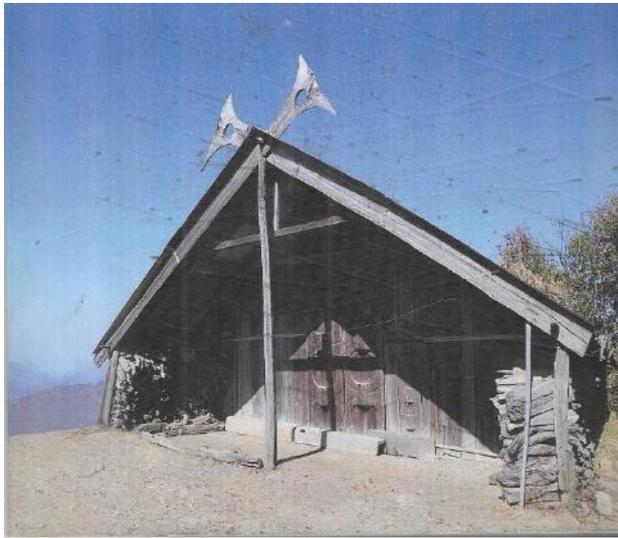
Map of the Villages of Chakhesang Tribe (Sources: Commemorating the Chakhesang 75<sup>th</sup> Anniversary Book)



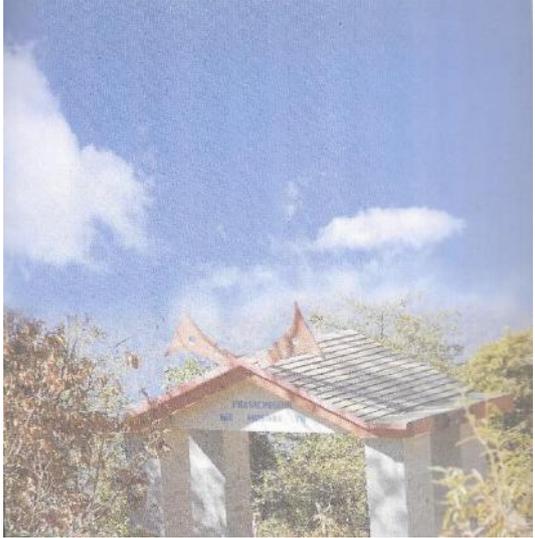
A Glimpse of Phüsachodü Village (Sources: Book - Golden Jubilee of Phüsachodümi Youth Society, 1971-2021)



Aerial View of Phüsachodü Village



Old Traditional House at Phüsachodü Village (Sources: Book – The Venture)



Modern Day Village Gate of Phüsachodü (Sources: Book – The Venture)

# **APPENDIX**

**A Sociological Study on the Traditional Inheritance Practice of  
Chakhesang Tribe with special reference to Phüsachodü Village,  
Nagaland.**

**Questionnaire**

**Personal Profile:**

Name: \_\_\_\_\_

Age: \_\_\_\_\_

Sex: \_\_\_\_\_

Religion: \_\_\_\_\_

Qualification: \_\_\_\_\_

Occupation: \_\_\_\_\_

1. Land is an important property asset in the traditional inheritance practice
  - Yes
  - No
  - Don't Know
  
2. The property assets in Phüsachodü village are distributed among
  - Sons only
  - Clan members
  - Relatives
  - Kinship (relation by blood, marriage or adoption)
  - All the above

3. The rightful owner/heir for the inheritance of ‘ancestral property’ according to the traditional inheritance practice system is
- Son
  - Adopted Son
  - Both the above
4. In case of no heir, the village elders decide to pass down the property of the deceased person to the claimer by tracing the claimer’s
- Clanship
  - Patriarchal lineage
  - Both the above
5. How does the elders in the village make decision regarding the passing down of the property assets to the next heir or the next person in the family or among the village members?
- Through the Customary Law
  - Through the Indian Succession Act,1925
  - None of the above
6. ‘Shesüh’ an old traditional practice of ‘temporal land-ownership’ where paddy fields or a plot of land is given to the woman during her marriage. Is it still practice today in the village?

(\*Shesüh is a temporal land ownership i.e., a particular land is given to her to cultivate till her lifetime but after her death the land is taken back by her father/brothers.)

- Yes
- No
- Partially

7. For the inheritance of the mother’s properties in the name of ‘Labü,’ such properties are given to daughters only

(\*Labü - A basket woven from bamboo splits containing the mother’s ornaments, mekheldas/traditional attire)

- Yes

- No
- Don't know

8. "Kalu" is considered to be one of the oldest forms of traditional inheritance practice in the village

(\*Kalu – Inheritance of Ancestral property/Ancestral property)

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

9. As per the traditional practice of inheritance, the youngest son is given the right to inherit his father's house and the best terrace fields which is cultivated by his parents is given to him as a share of property inheritance – is such system of inheritance still practiced today in Phüsachodü village

- Yes
- No
- partially

10. According to the traditional inheritance practice, the gender which it favors the most is

- Male
- Female
- Both male and female

11. Are you aware of the traditional inheritance practice in the village?

- Yes
- No
- Partially

12. Do the villagers still practice the old traditional system of inheritance?

- Yes
- No

- Partially

13. Is the practice still rigid today in the village as compare to the olden times/days?

- Yes
- No
- Partially

14. What position does a man holds in the village structure of Phüsachodü village?

- Decision maker
- Head of the family
- Bread earner
- Leader
- Option 1,2 & 3
- All the above

15. Men are the rightful owners of inheritance of the village properties

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16. Male members play a significant role in the traditional inheritance practice in Phüsachodü village

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

17. The Phüsachodü men are economically independent than women in the village

- Yes

- No
- Partially

18. As a patriarchal society, the Phüsachodü men still dominates the village activities till today

- Yes
- No
- Partially

19. Phüsachodü Village is a highly Patriarchal society

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

20. At this present-day modern society, there are changes seen in the position of men in the village

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

21. A Phüsachodü woman in the village structure occupies a position of

- Caregiver
- House keeper
- Peace maker
- All the above

22. Property rights is given to the female members in Phüsachodü village

- Yes
- No
- Partially

23. What type of property does the women inherit in Phüsachodü Village?

- Plot of land/fields
- Shawls/Mekhelas and ornaments
- Household articles – pots, cups, weaving implements, rice, baskets, etc.
- All the above

24. Phüsachodü women are treated equally at par with men in the village

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

25. Phüsachodü women are given fair share of property holdings like the male members in the village

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

26. Are the Phüsachodü women economically independent

- Yes
- No
- Partially

27. In the modern society, there are certain changes in the traditional inheritance practice

- Strongly Agree
- Agree
- Neutral
- Disagree

- Strongly Disagree

28. Do the Phüsachodü people practiced the system of 'Will' (defined under the Indian Succession Act, 1925)

- Yes
- No
- Partially

29. The new trend - 'Gifted land or Acquired land' property is practiced among the people in Phüsachodü village

(\*Gifted land/Acquired land – those land which are gifted to the daughters by their parents where the parents buy the land property with their own savings)

- Yes
- No
- Partially

30. In the case of 'gifted-land', the woman's property can be inherited by

- Girl child
- Sisters
- Son
- Both option 1 & 2

31. Due to the patriarchal outlook, the traditional inheritance practice can change the people's attitude towards different gender

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

32. Fair share of property holdings/ownership between the gender is seen today in Phüsachodü village

- Yes

- No
- Partially

33. Do you agree that this system of traditional inheritance practice should still be practiced at this 21st century?

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

34. Do you agree that the 'Customary Law' plays a significant role in the traditional inheritance practice among the Phüsachodü village?

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

35. Do you agree with the statement that such 'traditional practices need to be preserved in order to safeguard and keep our cultural identity alive'?

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

**LAND ALIENATION: THE CASE OF MUTHANGA  
STRUGGLE AND OTHER LAND ISSUES IN WAYANAD DISTRICT**



**By**

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**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM**

**MARCH 2022**



**LAND ALIENATION: THE CASE OF MUTHANGA STRUGGLE AND OTHER  
LAND ISSUES IN WAYANAD DISTRICT**

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in fulfillment of the  
requirements for the award of the degree of **Master of Arts in Sociology**

By

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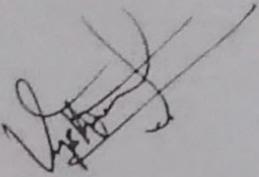
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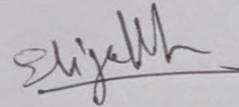
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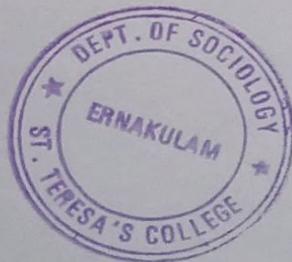
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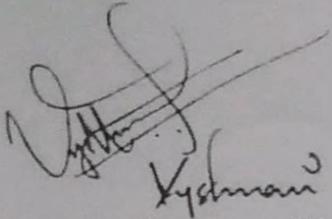
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**MARCH 2022**



## CERTIFICATE

I certify that the thesis entitled "LAND ALIENATION THE CASE OF MUTHANGA STRUGGLE AND OTHER LAND ISSUES IN WAYANAD DISTRICT" is a record of bonafide research work carried out by NISHA T. B, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.



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Ernakulam

March 2022

## DECLARATION

I, NISHA.T. B hereby declare that the thesis entitled "LAND ALIENATION: THE CASE OF MUTHANGA STRUGGLE AND OTHER LAND ISSUES IN WAYANAD DISTRICT" is a bonafide record of independent research work carried out by me under the supervision and guidance of MISS.VYSHNAVI SIVADAS further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship, or other similar title.

Place: Ernakulam

March 2022

Nisha Nisha

Name and signature of the student

## ACKNOWLEDGEMENT

In this humble endeavor, I have received a great deal of support and guidance from different quarters. First and foremost, I thank God almighty, for bestowing upon me an abundance of grace, wisdom, and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt. Elizabeth Abraham, head of the department of sociology, and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Miss.Vyshnavi Sivadas for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have been conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's College (Autonomous).

I also express my special thanks to M.Geethanandan (Adivasi Gothra Mahasabha), Mary lydiya, Aiswarya and Rajani Leela vinod. Last but not the least I take this opportunity to thank my classmates, friends, and my family for their love and support.

Ernakulam

March 2022

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## CONTENTS

### Acknowledgement

<b>Chapter.No</b>	<b>Chapter Name</b>	<b>Page No.</b>
Chapter 1	Introduction	7-15
Chapter 2	Review of Literature	16-44
Chapter 3	Research Methodology	45-47
Chapter 4	Data Analysis and Interpretation	48-62
Chapter 5	Findings,Suggestion and Conclusion	63-67
	Bibliography	
	Appendix:1 Interview guide	

# CHAPTER 1

## INTRODUCTION

Land alienation is a serious problem facing the Scheduled Tribe. Most of the tribal people live in the forest. About 90 percent of the tribes are dependent on agriculture as well as other allied activities. Land is a tangible asset of the tribal community. They are emotionally attached to land. Many tribals become landless for a variety of reasons. The struggle at Muthanga near Sultan Bathery in Wayanad district was one of the most significant land struggles in Kerala. People from different communities in the scheduled tribe took part in the strike. Even after the Muthanga struggle, land struggles have taken place in various places in the Wayanad district. Tribals today face a variety of socio-economic problems as part of land alienation such as poverty, disadvantages related to education, employment, living conditions, administrative inefficiency, culture etc. Even after the struggles, the response from the state has also created a lot of problems in the financial sector of the tribes. The real issues of Tribes are still unquestioned and can be seen as a denial of legal and constitutional protection. This study seeks to find out the impact of the Muthanga struggle and each subsequent struggle in Wayanad, especially in the tribal community as well as the extent to which the government provides legal protection.(Dr:Harsheena V.A,vol.No.10,2014)

The muthanga agitation led by the Adivasis of Kerala is an important chapter in the history of Kerala. Kerala has witnessed many social reform movements in the society during the period of democratization. Most of these struggles were for the attainment of social justice in all spheres of life, including the right to life, the fundamental rights to education, and the right to resources such as land. The Kerala model of development is the result of these socio-political movements. Such social movements across the country have played a major role in unifying our country, which is diverse in culture, language and many other things. The farmers of our constitution are well aware of this fact and they are eager to ensure this right to all the common people, especially the lower caste, the socially backward and minorities. Thus, our constitution gives space to every common man who ensures democracy. Part of it is the rights of the Adivasis or Adivasis of India to recognize the rights of the native, the right to resources, the rights to forest land and the rights to self-government. The Adivasis of India have achieved these rights through constant struggles against all other cultures and political systems, including colonialism. The protection of rights of tribals is in essence protection of forests and protection of natural resources. They are the guardians of nature.

Although our constitution guarantees these rights of the Adivasis, Democratic Kerala is well known in many ways for acting in accordance with the great wisdom of our constitution. However, a few decades of fasting have witnessed the struggle of tribals, Dalits, fisherman and plantation workers. The Muthanga struggle is an episode in this chapter, especially an episode of the tribal struggles that have emerged since the 1990s. There are numerous socio-economic studies related to land reforms and socio-economic studies related to land reforms and social-domestic renaissance movements in Kerala. But readings and studies in this later period are very rare. This study analyzes the circumstances that led to the Adivasis leading the Muthanga agitation, the socio-economic situation they face, as well as

how much constitutional and legal protection Adivasis receive and how it is implemented.

Each of these chapters describes the history of land alienation in Kerala, alienation during colonial and post-colonial period, land attention during democratic rule, and the reasons for land alienation in democratic Kerala. The period of the Muthanga struggle is seen as a process of further democratization of our society, especially as a process of understanding more about the fundamental rights of people who depend on resources. Therefore, the study seeks a methodology to understand the new movements that are currently appearing in our political system.

## 1.1 TRIBES

The word Tribe is generally used for a socially cohesive unit associated with a territory, the member of which regards them as politically autonomous (Mitchell, 1979). Often a Tribe possesses a distinct dialect and distinct cultural traits. The imperial Gazetteer of India, 1911 defined tribes as a “collection of families bearing a common name, speaking a common dialect, occupying, or professing to occupy a common territory and is not usually endogamous, though originally it might have been so. According to R.N Mukarjee, “a Tribe is that human group whose members have common interest, territory, language, social law and economic occupation”. Raymond Firth defines a Tribe as “a group of people of a cultural order that is normally occupying a common language and in particular having a common set of traditions and institutions and responding to the same government”. George Peter Murdock has stated that it is a social group in which there are many clans, nomadic bands, villages or other such groups which usually have a definite geographical area, a separate language, a singular and distinct culture and a common political organization or at least a feeling of common determination against strangers.

*Scheduled Tribes* in India are generally considered to be ‘*Adivasis*’, meaning indigenous peoples or original inhabitants of the country. Tribe refers to a group of people, who together form small or large communities in conversational societies. Their identity is generally defined by common culture, shared locality, special customs and common language and rules. In small Tribes people mostly share means of livelihood also especially in cases where the forest dwellers are dependent on the land and its produce for survival. In many cases the survival methods become a strong binding factor among tribal communities because most of their problems are related to having enough land to cultivate and get the best yield from it.

Most of the Tribes are agricultural laborers and agriculture is their major means of livelihood. They cultivate rice, ragi, pulses, tapioca, ginger, cardamom, pepper and other consumable products as conditions permit. Collection of minor forest produce is the next important occupation practiced by them. Certain tribal communities barter or sell forest produce to the non-tribals. They are experts in felling trees and collection of timber, bamboo, seeds etc. Hunting and gathering of animals are also a principal occupation among the tribal and is practiced by *Malavedan*, *Kurichiyans*, *Malapandaram* communities, etc. Netting, angling and catching fish by various methods are the main occupations during certain seasons among the tribal communities. Basket and mat making are very common among *Koragans*, *Malavettuvans*, *Mannan* and *Mavilans*.

Psychologically, the Scheduled Tribes often experience passive indifference that may take

the form of exclusion from educational opportunities, social conditions. Discrimination among women, occupational differentiation and emphasis on status hierarchical social ordering that characterize the predominant mainstream culture are generally absent among the tribal groups. Although Scheduled Tribes are a minority, they constitute about 8.2% of the total population, are an integral part of India's social fabric and have the second largest concentration after that of the African continent (Dr. Haseena V.A, 2014).

## 1.2 TRIBES IN INDIA

India's tribal community is very vast. Every Indian state has its share of tribal population. Examples of Indian Tribes are Bhils of Rajasthan, Andhra Pradesh, Rajasthan, Gujarat etc. Gonds of Chhattisgarh, Gujjars of Himachal Pradesh, Gonds of Jharkhand, Madhya Pradesh, Khasis of Meghalaya, and Banjaras (Lambadi) of Andhra Pradesh, Karnataka, Rajasthan etc. Madhya Pradesh's Bastar district has the biggest number of Scheduled Tribes in India. The Ministry of Tribal Affairs oversees the welfare and development of the Scheduled Tribes of the country. The smallest tribal communities of India have been divided in to account their historical ethnic and socio-cultural relations. Three principal or main territorial zones are the North-Eastern zone, the Central zones and the Southern zone. The ministry has introduced many schemes to lift the tribals out of the morass of poverty and illiteracy, but these schemes have not always produced the desired result because of the indifference and corruption among the officials in charge of executing these programs, lack of sensitization among Adivasis about their rights, and exploitation of Adivasis by greedy profit-mongers. According to Jain and Sharma (2018) "Gujarat's economy utilizes the historically low socio-economic positions of Adivasis for capitalist accumulation, such that the community's poverty and disadvantaged position is reproduced intergenerationally, instead of being interrupted by their employment in the growth centers of these states". According to the authors, even when tribals try to come from their remote hamlets to cities and try working in construction, textile, or other industries, they are still exploited by being given lesser wages and subjected to what is known as 'surplus extraction and super-exploitation' in Marxian language.

## 1.3 TRIBES IN KERALA

Tribals in Kerala (Adivasis of Kerala) are the indigenous population found in the southern Indian state of Kerala. Kerala, through one of the smaller states of India, is home to several tribal communities. The Scheduled Tribe population of Kerala is 4,84,839 persons constituting 1.45 percent of the total population of the state (3.338 crore) as per the 2011 census (Economic review, 2016). Most of the *tribal* people of Kerala live in the forests of the western Ghats, bordering Karnataka and Tamil Nadu. Wayanad district has the highest number of tribal populations in Kerala (1,51,44), followed by Idukki (55,815), Palakkad (48,972), Kasaragod (48,857) and Kannur districts (41,371). The *Paniya* (Paniyar) are the largest of the 35 major tribes. The main tribal communities are in the Taluks of North Wayanad, Mannaarkad, South Wayanad, Devikulam and Thodupuzha(Wikipedia).

The tribal communities of Kerala not only differ from the non-tribals but also from one another. But they have some uniform characteristics as well. Some of the main characteristics common to all Scheduled Tribes in this state are-

a) Tribal origin

b) Primitive way of life

c) General backwardness in socio-economic status.

Ananda Krishna Iyer has published 'The Travancore Tribes and Castes' in three volumes. He concentrated his study on the hill tribes which were fast deteriorating. In the first volume (1937) he discussed seven hill tribes namely the Kanikkaran, the Malakkurumbans, the Malapandaram, the Malapulaya, the Malavedan, the Malayarayan. The second and the third volumes (1961) deal with the accounts of the Tribes of Travancore. In a later study (1961) he described the hill Tribes of Kerala as pre-Dravidian. He also undertook the ethnographic survey of the hill and jungle tribes of Kochi and published its result in four volumes. The first volume 'Cochin Tribes and caste' (1909) includes description of the Tribes like Kadar, the Malayan, the Nayadi, the Ulladan, Paniyan and others. A. Ayyappan made several systematic studies on the various Tribes of Kerala, 'Nayadis of Malabar' (1937) and 'Erula of Kerala' (1944) are the important studies. Later he conducted a subsequent study on the Irulas in 1965 and the results were published which gives an insight into the socio-economic changes that took place in the Irula community. A.D Luis (1962) made a detailed study of all the 48 Tribes of Kerala. He has discussed their mode of living, occupation, diet, region, taboos, marriage, and rituals. He provides an insight into the changing patterns of tribal social life in the context of the socio-economic conditions of the state. P.R.G Mathur (1971) traces the socio-linguistic evolution of the Tribes of Kerala. In addition to giving some valuable statistical information, the author describes some of the important problems faced by the tribal communities like land alienation, bonded labor, indebtedness, status of tribal women etc. This book also mentions briefly some of the recent political developments among the tribals like the formation of tribal organizations and the influence of Naxalite movement on them etc.

### 1.3.1 PRIMITIVE TRIBES OF KERALA

Tribal people who are food-gathers, with a diminishing population and very low literacy rate can be called the primitive Tribes. *Cholanaikkans, Kurumbas, Kattunaikkans, Kadar and Korakas* are the 5 primitive tribal groups in Kerala. They constitute nearly 5% of the tribal population in the state. Cholanaikkans can be said as the most primitive of them and found only in the Malappuram District only a handful of families are living in the Manchery Hills. Cholanaikkans are mainly seen in the Wayanad district and some in Malappuram and Kozhikode districts. Kadar population is found in Thrissur and Palakkad districts. Kurumbas live in the Attappady block of Palakkad district. The Koraga habitat is in the plain areas of the Kasaragod district.

### 1.3.2 AREA WISE TRIBAL COMMUNITIES IN KERALA

<b>Kasaragod-</b> <i>Korakas, Maradi</i>
<b>Wayanad-</b> <i>Paniyar, Kurichiyar, Urali, Kattunaikkar, Adiyar, Kadar,</i>

<i>Kanduvadiyar, Mullu Kurumar, Thachanadan, Kanaladi</i>
<b>Attappadi-</b> <i>Irular, Kurumbar, Mudukar</i>
<b>Nilambur-</b> <i>Cholanaikkan, Aranadan, Kadar, Paniyar</i>
<b>Parambikulam-</b> <i>Kadar, Malasar, Malamalasar</i>
<b>Idukki-</b> <i>Malapandaram, Malappulayan, Malayarayar, Urali, Muthuvan, Mannan</i>
<i>Nedumangad Knikkar, Malandar</i>

([https://en.m.wikipedia.org/wiki/Tribals\\_in\\_Kerala](https://en.m.wikipedia.org/wiki/Tribals_in_Kerala))

## 1.4 TRIBES IN WAYANAD

Wayanad, the panoramic hill of Malabar in Northern Kerala, situated above the sea level ranges between 700 meters to 2100 meters, is a homeland of various tribal communities. They can be prominently classified into *Paniya, Adiya, Kattunaikkans, Kurichiyans, Kurumas, Ooralis, Oorali kuruma* etc (wikipedia).

### 1.4.1 THE PANIYA

A vast majority of Tribes in Kerala state hail from the *Paniya Tribes* sect. Paniyas inhabit the region of Wayanad and the neighboring parts of Kannur and Malappuram. Paniyas were once sold along with plantations with landlords. They were also employed as the professional coffee farmers by upper castes. The name Paniyan means ‘workers’ as they were supposed to have been the workers of non-Tribes. Monogamy appears to be the general rule among the Paniyas. Paniyan Tribes live together in colonies; their settlement comprises rows of small huts constructed with bamboo with thatched roofs. The Paniyan Tribes of Wayanad districts speak the Paniyan language, which is a complexion of Malayalam and Kannada but some of the words are independent. They choose their life partners from their Tribes only. The Paniyan marriage is

usually arranged by the parents of the bride and groom. The priest is called *Chemmi*. During the marriage ceremony as part of the ritual 16 coins and new dresses are given to the bride. Monogamy is common practice among them. Widow marriage is allowed. They do not practice pre-puberty marriage. The Paniya Tribes have a lot of religious practices. They worshiped banyan trees, *Kali*, *Kattu bhagavathi* with great reverence. They also believe in spirits (Anil, 2014). They hesitate to cut such trees since they believe that they will fall sick.

#### **1.4.2 THE ADIYA**

The *Adiya* are known as 'Ravulavaru Traditionally. The Adiyas like the Paniya is one of the slave sects Kerala. The nuclear Adiya Tribes family the husband is the head of the house. The bride price is given to the parents of the bride by the groom. Divorce, widow marriage etc. are permitted. Polygamy is also practiced. No punitive measure (like ostracizing of the sex offender, as one can see among Kurichiyans) is prevalent among the Adiyas. For sex offences they are allowed to undergo purificatory ceremony known as '*Kalachu veypu*' to join their community back. Head of the community is called *Commikkaran* or *Peruman*. The Adiya community is divided in 20 classes, that is, *Mandu* (Anil, 2014).

#### **1.4.3 THE KATTUNAYIKKA**

The *Kattunayikkan* community is found in Wayanad, Kozhikode, and Malappuram districts. They are also known as Cholanaikkans, in the interior forests of Nilambur area of Malappuram, Kattunayikkan Tribes in Wayanad and Pathinaikkans in the plains of Malappuram districts. As their name denotes, the Kattunaikkans were the king of the jungle regions engaged in the collection and gathering in the forest. They are known as *Thaen Kurumar* since they collect honey from the forest. They have all the physical features of the hill tribes. Their language is a mixture of all Dravidian languages. They worship animals, birds, trees, hillocks and snakes. They are firm believers in black magic and sorcery. They also worship their ancestors, along with worshipping Hindu deities. (Kumar Reddy, 2014)

#### **1.4.4 THE KURICHIYANS**

The *Kurichiyans* are an agricultural tribal community. Up to some decades ago untouchability had been fairly and widely practiced by these Tribes. They have clean food

habitats and keep their houses, premises and dress always clean. They are Matrilineal and live in joint families, under the control of their chieftain called '*Pittan*'. The members of the extended family work together and put their earnings in the same purse. The kurichiya prefer cross-cousin marriage to any other marriage alliance. They do not practice polyandry. Their social control mechanism was most efficient, offenders being excommunicated.

#### **1.4.5 THE URALI KURUMAS**

*Urali kuruma*, the most versatile and colorful tribal people, is one of the rarest artisan Tribes in Kerala. They are mostly found in the Wayanad region. Urali kuruma is one of the subdivisions of '*Kurumba*' and the two others being '*Mulla*' and '*Jen kuruma*' tribals.

#### **1.5 DIVERSITIES IN TRIBAL COMMUNITIES**

All the different Tribes are diverse communities having different language, cultural heritage and socio-political institutions. They are neither integrated into mainstream society nor unified as a common nationality. Therefore, pre-colonial to post-colonial period the approach of divide and rule was followed by the dominant political system. The present study narrates the process of unification of tribal communities as Adivasis asserting their rights for representation in the political sphere.

#### **1.6 LAND ALIENATION AND TRIBES IN KERALA**

Land alienation is a serious problem faced by the Scheduled Tribes. Most of the tribal people live in the forest. About 90 percent of the tribals are dependent on agriculture as well as other allied activities. Land is a tangible asset of the tribal community. They are emotionally attached to their land. Many tribals become landless due to a variety of reasons. The struggle at Muthanga near Sultan Bathery in Wayanad district was one of the most significant land struggles in Kerala. People from different communities in the Scheduled Tribe took part in the strike. Even after the Muthanga struggle, land struggles have taken place in various places in the Wayanad district. Tribals today face a variety of socio-economic problems as part of land alienation. Poverty, disadvantages in education, employment, living conditions, administrative inefficiency, cultural exploitation are some of them. Even after the

struggles, the response from the state has also created a lot of problems in the financial sector of the Tribes. The real issues of Tribe are still unquestioned and can be seen as denial of legal and constitutional protection. The present study seeks to find out the impact of the Muthanga struggle and each subsequent struggle in Wayanad, especially in the tribal community as well as the extent to which the government provides legal protection.(Dr.Haseena,2014)

## **1.7 STATEMENT OF THE PROBLEM**

The problem of land alienation is a much deeply connected phenomenon full of contradictions related to the existing socio-economic order. “We do not know where the tribals, who had been living in this settlement till about five years ago, have gone. They have been driven out of their land”. This is the condition of Kerala tribals. Alienation means in the form of sale, mortgage, encroachment, and other types of transfer like benami transfer. Alienation of land is a serious problem faced by the Kerala Tribes. The number of landless tribals has increased during the last decade and several reasons can be attributed to this phenomenon. Alienation is inherent in exploitative relations of production and its nature varies with that of exploitation. Hence, it also differs among societies based on slavery and serfdom connected phenomenon full of contradictions related to the existing socio-economic order. The topic under study is “The struggle faced by the Adivasis in Sultan Bathery and Mananthavady Taluk in Wayanad District. The Researcher focuses on the present condition of the Adiya and Paniya community and analysis of socio-economic background. The researcher also analyzes how well constitutional and legal protections of tribals are implemented in Kerala.

The Muthanga struggle led by Adivasis of Kerala is a significant chapter in the history of Kerala. The history of democratization of Kerala society has witnessed several social reform movements during the colonial period. Most of these struggles were to achieve social justice in all walks of life including rights to live, fundamental rights, rights for education, and right over resources like land. Such social movements that took place throughout the nation had a prominent role in uniting our country with diversity in culture, language, region and in several other factors. Makers of our constitution have very well recognized this factor and they were keen to ensure this right to all common people, especially the down-trodden people, socially backward people, minorities and the like. Thus, our constitution ensures democracy and the rights of the indigenous people generally known as Adivasis of India, including their right over

resources, right over forest land and right to autonomy. The protection of rights of tribals is in essence protection of forests and protection of natural resources. They are the guardians of nature. There are several socio-economic studies related to land reforms and social renaissance movements of Kerala. But readings and studies of this later period are very rare; here in this study the Socio-economic reasons that led to the Muthanga struggle's Genesis, and the results are analyzed (<https://www.wayanad.com/pages/tribes-in-wayanad>)

## **1.8 OBJECTIVES OF THE STUDY**

- 1) To analyze the causes behind Adivasi land struggles in Kerala after 2000.
- 2) To understand the impact of land alienation on the socio-economic situation of tribals.
- 3) To understand how well constitutional and legal protections of tribals are Implemented in Kerala

## CHAPTER 2

### REVIEW OF LITERATURE

A tribe is a group of people, who together formed small or large communities in conversational societies. Their identity is generally defined by common culture, shared locality, special customs and common language and rules. In small tribes like the one we are discussing here, people mostly share means of livelihood also, especially in cases where the forest Dwellers are dependent on the land and its produce for survival. In many cases the survival methods become a strong binding factor among tribal communities because most of their problems are related to having enough land to cultivate and get the best yield from it. Most of the Tribes are Agricultural Laborers and agriculture is their major means of livelihood. The implementations and tools used by them are very crude. They cultivate Rice, Ragi, Pulses, Tapioca, Ginger, Cardamom, Pepper and other consumable products as conditions permit. Collection of minor forest produce is the next important occupation practiced by them. Certain tribal communities barter or sell forest produce to the non-tribals. They are experts in felling trees and collection of timber, bamboo seeds etc. Hunting and gathering of animals are also a principal occupation among the tribal and is practiced by Malavedan, Kurichiyans, Malapandaram etc. Netting, angling and catching fish by various methods are the main occupations during certain seasons among the tribal communities, Basket and mat making are very common among Koragans, Malavettuvans, Mannan and Mavilans.

Land alienation is slowly leading to the expulsion of tribals from society. It seriously affects many of their fundamental rights and traditional way of life. 90% of the Adivasis are still lagging behind in social progress due to lack of land of their own. It prevents them from growing in society. There are more than 40 Adivasis communities in many districts of Kerala and most of them are landless people. Landlessness is low in Travancore and cochin. Most of them are landless and most of them are landless tribes (Wayanad, Palakkad) (Brijoy,2013). As part of the land grabbing by the migrant peasants, the Adivasis were reduced to the land

of Hindus, Christians, Muslims, exploiters and landless slaves. Migration of people living in the Attappady plains started in the 1950s. In 25 years, 20% in the district. Tribal families also became landless (Brijoy,2013).

One crucial factor that has led to this change is man's encroachment into forest land. "Forests are dynamic living systems. They are continually changing. Humans have had, and will continue to have, a change of hand in that change. Humans introduce the greatest amount of known variability" (Cook, 2012). One major casualty of civilized man's encroachment into forest has been the tribals, who were the original inhabitants of that land. Their lives and sources of income remain threatened because of this infringement. The tribals in India may not be totally isolated and disadvantaged like those who inhabit the forests in Amazon. On the other hand, geographical isolation might have, at least in some cases, helped foster interesting cultural ramifications and art forms. However, the result of geographic isolation has been, for most Tribal communities, highly negative. This is mainly because sources of income are very limited in such isolated pockets. Further, whenever tribals have come into contact with the more developed world, they have been continuously exploited by the developed class and denied access to education and related advantages. This exploitation started from the time the British consolidated their power in India but has continued after independence as well. "Under the increasing pressure of population, many outsiders also started settling in tribal regions. With their money power, they offered credit facilities at the doorstep. Initially, it provided relief to Tribals but gradually their system became exploitative" (Mondal, n.d).

The word 'Tribe' is generally used for a 'socially cohesive unit', as associated with a territory. The members regard them as politically autonomous ("mitchell,1979;232). Often a tribe possesses a distinct dialect and distinct cultural traits. The empirical Gazetteer of India, 1911, defines a tribe as a "collection of families bearing a common name, speaking a common dialect and professing to occupy a common territory and is not usually endogamous, though originally it might have been so". According to R.N Mukarjee, "A tribe is that human group whose members have common interest, territory, language, social law and economic occupation'.

Kerala, one of the smaller states of India is home to several tribal communities “The scheduled Tribe population of Kerala is 4,84,839 persons constituting 1.45percent of the total population of the state (3.338 crore) as per 2011 census” (Economic review, 2016). Kurichiya, Paniya, Malayarayar, Urali, Urali Kuruma, Cholanaikkan, mythical, mannan, Irular, etc. Are some of the many districts of Kerala, Wayanad has the largest tribal population, and Paniyas are the largest tribal group. Besides Wayanad, Palakkad, Kasaragod, Malappuram, and Idukki are the other districts in which tribal populations are mainly found. Raymond Firth defines a tribe as “A group of people of a cultural order that is normally occupying a common language and in particular having a commonest of traditions and institutions and responding to the same government... George Peter Murdock has stated that is a social group in which there are many clans, nomadic bands villages or other such groups which usually have a definite geographical area, a separate language, a singular and distinct culture and their a common political organization or at least a feeling of common determination against strangers.

Ananda Krishna Iyer has published “The Travancore Tribes and castes ‘in three volumes, Iyer concentrated his study on the hill tribes which were fast doing out or were deteriorated. In the first volume (1937) he discussed seven hill tribes, namely the Kanikkaran, the Malakkurumbans, the Malapandaram, Malapulaya, the Malavedan, the Malayarayan. The second and the third volumes (1961) deal with the accounts of the tribes of Travancore. In latest study (1961) he described the hill tribes of Kerala as Pre-Dravidian. Iyer also undertook the ethnographic survey of the hill and jungle tribes of Kochi and published its result in four volumes. The first volume of his work ‘Cochin tribes and caste’ (1909) includes description of the tribes like Kadar, the Malayan, the Nayadi, the Ulladan, Paniyan and others. A. Ayyappan made several systematic studies on the various tribes of Kerala, ‘Nayadis of Malabar’(1937) and ‘Erula of Kerala’ (1944) are the important studies. Later he conducted a subsequent study on the Irulas in 1965 and the results were published which gives an insight into the socio-economic changes that took place in the Irula community. A. D Luis (1962) made a detailed study of all the 48 tribes of Kerala. He has discussed their mode of living, occupation, diet, region, taboos, marriage and rituals. He provides an insight into the changing patterns of tribal social life in the context of the socio-economic conditions of the state as a whole. P.R. G Mathur (1971) traces the socio-linguistic evolution of the tribes of Kerala. In addition to giving some valuable statistical information, the author describes some of the important problems facing the tribal people like

land alienation, bonded labor, indebtedness, status of tribal women etc. This book also mentions briefly some of the recent political developments among the tribals like the formation of tribal organizations and the influence of the Naxalite movement on them etc.

Paniyan tribes are the major tribal community of Kerala. They reside in hilly and forest areas of Kerala and Karnataka. The word Paniyan means workers in the regional language Malayalam. Ancient period Paniyan tribes are amongst those tribal people who have worked as bounded laborers by the landlords. Majority of Paniya tribes live in the northern part of the Western Ghat. The main occupation of these tribes is in the field of land owners. They worked as slaves in the ancient period. Most of the people of this community engaged with agricultural works but some of them engaged in Tea and coffee estates and constructional works. Paniyan tribes together in colonies, their settlement comprises rows of small huts constructed with bamboo with hatched roots. Paniyan tribes of Wayanad districts speak the Paniyan language, it is a complexion of Malayalam and Kannada but some of the words are independent. They choose their life partners from their tribes only. The Paniyan marriage is usually arranged by the parents of Bride and groom. The priest is called Chemmi, During the marriage ceremony as part of the ritual 16 coins and new dresses are given to the bride. Monogamy is common practice among them. The Paniya tribes have a lot of religious practices. They worship Banyan trees, Kali, Kattu bhagavathi with great reverence. They also believe in spirits (Anil.2014).

The Adiya tribe is also one of the slave tribes in Wayanad. These tribes are known as 'Ravular' traditionally. The word Adiya means slave in local language Malayalam. Gadhika is a kind of traditional dance performed by them. They choose their life partners from tribes only and as per customs Bride price is given to the parents of the bride by groom on the occasion of their marriage. Polygamy and divorce are practiced among them. If the woman commits any mistakes (sex offenders), they have to undergo a purification ceremony called Kalachu veypu to join the family back. Head of the community is called chommikkaran or peruman. Adiya community is divided in 20 classes i.e. Mandu (Anil.2014).

In India, the mainstream globalization model has neglected the inclusive growth of the economy and has largely concentrated on promotion of gross domestic products, thus creating unhealthy consequences. Its impact has been displaced in large numbers by developmental

projects which have ignored effective rehabilitation. The neo-liberal movement has not only deprived them of their identity but also their livelihood rights, pushing them into abject poverty; the impact of globalization on tribal life is also evident in the state of Kerala. The problem of alienation cannot be calculated through analyzing the amount of land lost and in the similar way the benefit of resettlement should not be proclaimed by looking at the amount of land gained through the process. The displacement and resettlement are highly affected socio-economic and political living grounds of each community. 'ooru kootam' as a core system itself governance developed by and for "Tribal communities have importance in asserting the socio-political and cultural identities and rights of every tribal community" (Rajesh, et. al, 2019).

These colonies were formed as part of the old zamindar system. The tribal people would come for a walk in the plantations or fields and settle down in some corner of the land owned by zamindar. They would work for the landlords and settle down there. They have no owners of the land they stayed on. It would be a tiny piece of land where three or more families stayed in a small shed. They had no land to cultivate or keep their animals, says M Geethanadhan, state coordinator, Adivasi Gotta Mahasabha (AGMs). According to AGMs data, there are around 2,000 colonies in Wayanad which are settled in private lands without proper documents. "Migration of people from the low land to Wayanad, construction of dams and reservoirs by the government, deforestation etc. were some of the reasons that these tribal communities, especially Paniya, Adiya and Kattunaikkan of the district, remained landless".

Even in the state of Kerala none of the developments has touched the tribals, despite the fact that Kerala is one of the few remaining places in the world where communism continues to survive, albeit in a slightly different way than Karl Marx had originally envisioned the Idea (Jaffe & Doshi, 2017) and communist and socialist are still believed to be working for empowering the marginalized and uplifting the downtrodden (Anil, 2019). As Amartya Sen (1999) pointed out, development is not something that can be seen in isolation, which means that just a few percentages of the population becoming immensely successful cannot be viewed as an index of development. For a country to be considered developed, the capabilities of all its people need to be tapped and problems addressed, especially those of marginalized communities who do not have proper access to education and employment opportunities. The requirements of different communities may vary, but at some level all these remain interconnected.

In India the well-being and progress of the various tribal communities is the responsibility of the ministry of tribal affairs. The ministry has consistently introduced different programmes for the welfare of the tribal populations. Debar commission (1968-61), the national commission for Scheduled Tribes set up under the leadership of Sri. V.N Debar, was instrumental in pointing out the inequalities among tribal communities. “The Debar Commission observed four different layers among Scheduled tribes at the base of which they found a group of tribes”, an extremely underdeveloped stage and at the top most level amongst the tribes, a layer that can very well afford to forgo any further help. We feel that this lowest layer needs the utmost consideration at the hands of the Government” (Bharian et. al, 2004).

Though the various schemes introduced by the authorities for the upliftment of tribals have not been uniformly successful, some changes are gradually seeping into tribal Communities and tribes are getting the rights to speak for themselves. In 2012, the National Advisors council (NAA) recommended that “the free prior and informed consent (FPIC) of attached Adivasis communities be obtained before the government acquires any land for development projects, or decides on a rehabilitation package” (Gopalakrishnan, 2013). This is a landmark milestone because before this amendment was recommended to the Panchayat (Extension to Scheduled Areas) Act, 1996 (PESA),” constitution with Adivasis was considered sufficient for such matters, and the result was that their interests. And opinions were, in essence, rarely taken into consideration, though activist groups have been presently demanding it. Mitra & Singh (n. D) point out that “the literacy rates for scheduled tribes in India have also improved substantially from 1991 (29.60%) for both males (13.83% to 40.65%) and females (3.16% to 18.19%) respectively. Through the general trend is higher among men in tribal communities as it is in the case of most mainstream communities as well, the authors point out that “tribal society in general is categorized by lack of discrimination Against women, and tribal women participate in all spheres of economic and social lives”. There is also regional variation to women’s education among tribals and the “dropout rate among tribal girls in classes I-VIII is the lowest in the states of Himachal Pradesh in northern India, followed by Kerala in south India and Nagaland in Northeastern India”.

Though changes are indeed taking place in tribal communities, much more is required to integrate them fully with the mainstream population. In most cases, tribals live in

underdeveloped and isolated forest areas and are forced to subsist on whatever they obtain from the surrounding, infertile land. Many of the schemes meant for tribal welfare are generating the desired results because of bureaucratic corruption, in difference of those in charge of implementing programs for tribal development, exploitation of the Adivasis themselves about their rights. Eswarappa (2017) in his study about the development of Adivasis raises “policy questions pertinent to both the policy makers and practitioners on the efficiency of policies related to vulnerable groups”. According to him, “prevailing factional politics and a painting on the part of the governing agency are preventing the marginalized groups from adequately benefiting from the development inventions”.

Laws which are applicable to the rest of the county cannot always be implemented in tribal communities all of a sudden without understanding their culture. Sometimes authorities are unknowingly” slapping POCSO (Protection of children from sexual offences) Act on the men from Paniya, Kattunaikkan community for following the traditional marriage system of the Adivasi community. Twenty boys were arrested in 2015 under the POCSO Act from Wayanad. Ironically the person who headed the district child welfare committee which arrested the tribal boys was very tenient to the rape accused from his own tribe. Both the issues of unwed mothers and misuse of POCSO act happen because with the advent of ‘civilized modernity the tribal Hamlet lost the traditional system of tribal chieftains having a say in the affairs of the socio-economic administration of the hamlets (Kuvalyamala, 2019).

Besides these, there are other schemes like Tribal girl’s child endowment scheme and various healthcare schemes that include programs for maternal healthcare, financial help for traditional tribal heaters, and special schemes for helping sickle -cell anemia patients, since this genetic disorder is prevalent in many tribal communities of Kerala (Ibid). All those are bringing about a steady through slow progress in the tribal standard of living. This topic is derived from the thesis prepared by a student on a similar topic, the tribes, the autonomous people of the land who are believed to be the earliest settlers in the Indian peninsula. “They are called Adivasis, meaning forest settlers (R.V.Varma, the Indian tribes (1990). According to the Oxford English dictionary the word” Tribe's" derived from the Latin term ‘tribus’ which was applied to the early people of Rome. The term, however , has gone through a lot of changes. It meant a political unit consisting of a number of clans.

G. S Ghurey (1943) has examined the status of the tribals in the total Indian structure. In his later work he deals with the problem of integration of the tribes in the light of the latest political and constitutional issues (1957). A.A.D Luis has made a detailed study of all the 48 tribes of Kerala (1962). He has discussed their mode of living, occupation, religions, taboos, marriage and rituals. Julnes (1994) determined in a Nationwide survey of tribal leadership that a major obstacle in generating economic development is that many governments become plowed by neopolism, high turnover and incompetence, and are unable or unwilling to create internal economic momentum. While tribes can change many aspects of their reservation governments, other difficulties have resulted from decades of federal mismanagement and are unlikely to change soon. In 1872 E.T Dalton compiled data about the geographical setting, physical traits, economic, social and religious life of the Lepchas and Limpus of Sikkim and Darjeeling. W. Geookes (1894) describes the culture of tribes like the Gujars, the Tharas, and the Khasas, thus bringing out their reciprocal interactions among ecology, economy and social life. Iravati karve has made a number of studies on the tribes of Maharashtra and she has given a clear picture of the geographical distribution, demographic setting and contemporary tribal situation in Maharashtra (1969)

## **HISTORY OF LAND ALIENATION IN KERALA**

The aborigines, literally the real inhabitants of the earth, or aboriginal population, are the largest Ethnic minority at the bottom of Kerala society which includes the tribal population of the state. About 3.5 lakh people from 35 different communities make up more than one percent of the total tribal population in Kerala. Kerala is generally known for its progressive implementation of the total population of the state. Land Reform won the honor of protecting the basic rights of the tribals When the Land Reforms Act gave ownership to lakhs of tenants and landless people in the state. The aborigines were excluded from Forested highlands of Kerala since ancient times. The post-colonial government created a 'tribal' slot to include them in the constitution. Their identity as Adivasis and hence their closeness to Space was evident in their struggles for the restoration of land and forest rights. The struggle of the Adivasis was not to gain new ownership of the land, but to reclaim the lost ownership of their land.

## **2.1 LAND ALIENATION DURING COLONIAL PERIOD AND POST COLONIAL DEVELOPMENT PROJECT**

### **2.1.1 COLONIAL PERIOD**

British colonial rule saw a planned attack on self-sufficiency. In blatant violation of tribal laws, the forest and land in the homeland of the Adivasis were brought under their control. Introduction to the alien concept of private property. Establishment of the zamindari system, where landlords were to collect land. In addition to forest laws, lease income from farmers also contributed to the looting. As well as the resources of the tribal motherland and its commercialization. Forests were the abode and breadwinner of the Adivasis. The tribal community suffered When the British declared forests as state property. Forests were declared reserved. Problems arose when the tribals were not allowed to relocate and cultivate. The Adivasi community also sought to collect forest resources such as honey, fruits, food and timber. They began to establish an autonomy. They had no private property. Everyone had a common property. There is a sense of community, not a sense of individuality. The British brought their own laws and policies. Policies It shattered tribal lives. It shattered the social and economic system of the tribes. They interfered in the peaceful existence of the tribal community. The self-government system was destroyed by the British. They did not recognize the autonomy of the tribal communities. The chiefs lost many of their administrative powers and obeyed the rules Formed by the British. In the early days of British rule, the tribes had to pay their dues Tax in the form of natural or forest resources. But then it turned into money. As a result, they were exploited by landlords and moneylenders. Gradual tribes with landless and agricultural laborer's Adivasi who went to distant places in search of the work endured a lot of hardship. They were recruited and barred at very low wages from returning to their homes. The establishment of plantations affected the tribal community The policies of British rule drove the tribals out of their homeland as marginalized.

### **2.1.2 INDIAN FOREST ACT ANDTRIBES**

The Indian Forest Act of 1927 was enacted to protect and protect the forests of India. The Act provides for various provisions for the protection of such forests in a scheme submitted to a State Government for the formation of any forest or wasteland owned by the Government or owned by

the Government as reserved forest. The right to land within the forest is not recognized by the forest laws. The Forest Act of 1980 made the situation worse. In many states, the decision to issue a title before the law was taken as a result of intense struggles and hardships of the Adivasis. The British were the first to restrict the free use of forests by tribes by enacting the Forest Act of 1894. They retained the responsibility of these forests from the local rulers. British colonial policy continued in the form of domestic colonialism in independent India, where natural resource segregation extended the plundering of tribal lands and forests. It is an unfortunate fact that legally the Government of India is due to the colonial base of the Government of India. Unregistered titles are not given in writing to the Sub-Registrar's Office. The government is deliberately taking over the land and resources that the tribals have enjoyed as public property for ages. Only private land was approved by the British Government. In Britain, by the grace of the king, all forests belonged to the king or princes. It does not realize that the forest is the habitat of millions of Adivasis and that they have destroyed the forest system to sustain the life of the Adivasis. After the tribal land was legally confiscated, the government generously agreed to give some back as a measure of grace. Thus, forest laws came into force in many parts of India. As a result, tribal interaction with the state's instruments, the forest department, has not been smooth. The Forest Act of 1868 of the Colonial Central Government initiated the process of forest acquisition by the government. The Central Government's Forest Conservation Act of 1980 was another important legislative tool that made it illegal for tribals to stay in the forest. Until then, the Adivasis who had been moving inland should be physically evicted from the forests. Today the Adivasis are the lowest strata of the class community in Kerala. As the poorest of the poor in the state, even their extraordinary knowledge of biodiversity and medicinal plants is today being pirated and patented. The Government of Kerala is still pursuing British policies. They do not change the rules. These British laws are detrimental to the Adivasis of Kerala (C.R. Bijoy, 2021)

### **2.1.3 SOCIAL FORESTRY AND EXPANSION OF PLANTATION**

Forests are important natural resources and play a major role in ecological balance. Kerala was blessed with rich forests. Evergreen forests were an important feature of Kerala. 75% of the total geographical area of Kerala is densely forested. The process of social afforestation also began with colonial rule. The British made policies for capital accumulation. They considered

the forest as a commercial source. Through their policies, they have transformed traditional forests into community forests. Community afforestation is the conservation and protection of forests. In the pre-colonial period, the economic status of the so-called forest dwellers was uncertain. However, they seem to have enjoyed in many ways the boundaries of the forests and their surrounding areas, which are directly dependent on the forest habitat. Community afforestation involves complete social transformation through activities related to afforestation. These events went beyond mere tree planting rituals to establish plantations in Kerala in the first half of the nineteenth century. The gardens began with two colonial perspectives. First, it was started as part of a colonial strategy to protect the forest in a scientific way. Second, the colonial rulers wanted to expand agriculture in more areas and maximize income. The plantations were mainly divided into tree plantations and agricultural plantations. The British planted mahogany, teak and cinchona in different parts of Malabar. The availability of land and the scarcity of timber motivated them to start gardening. The demand for timber increased in the 1840s, and its availability was limited, and with the advent of the railway system the industrial demand for timber doubled. The timber from Malabar was exported to England. Teak planting in Malabar was started mainly for the marine industry, railways, mines and public works. The government leased the land for the plantations without interest for a long time. Nilambur Valley has been selected as the state for teak plantations. In 1830 small and large plantations were started in the nominal and Darjeeling areas under the East India Company. With the defeat of Tipu Sultan, the company became a producer of natural resources in Malabar, Mysore and Kodagu. The British established tea and coffee plantations in the traditional tribal habitat. For this reason, the Adivasis were subjected to mass evictions. Their shifting cultivation was stopped. They had no right to cultivate the forest. The Adivasis were alienated from the forest. The plantation industry in Kerala originated through the predecessor of Harrison Malayalam Limited. They leased the fertile lands of Kochi, Travancore and Malabar from the kings. Then came the plantations of coffee, tea, and rubber. They still own over one lakh acres of revenue land in Kerala which started two centuries ago. The history of land grabbing began in 1921 with the registration of new companies such as Malayalam Plantation ITD (UK) and Harrison & Crossfield ETD (UK) under the English East India Company Act of 1908. Another example is the takeover of Kannan Devan Hills by Tata. (C.R. Bijoy, 2003)

## 2.1.4 POST COLONIAL DEVELOPMENT PROJECT

- a) Migration
- b) Development and Displacement
- c) Deforestation

Kerala has been inhabited by people since time immemorial, but the reasons for these migrations varied from ancient times, with inter-local migration and local migration occurring. There was also migration to Kerala from other countries. During the pre-Malabar modern period, there were many small settlements in different parts of the country. But in the first half of the twentieth century there was a massive migration to the dense forests of Malabar. Within Kerala. The most important internal migration from Travancore to Malabar took place in the 1920s. There were several reasons for this migration process. This is the movement of the people of Kerala from one rural area to another. It was an agrarian migration. The availability of cheap land in Malabar has been attracting farmers since 1920. During the period 1945-1970 the flow was at its full potential. Almost all migrations are generally from underdeveloped areas to developed areas, agricultural areas or non-agricultural communities. But the situation in Malabar is very different from other migrations. Here a group of people migrated to the underdeveloped area, where wildlife and diseases awaited them. They wanted to improve their condition and had to work against nature. The settlers destroyed the tribal way of life. In his book "Africa in Kerala", According to Shri. K Pandor, in 1976, a sub-committee was formed to look into the forcible seizure of tribal land. The settlers took over the tribal lands and enslaved them. Gradually they became migrant land workers. The strongest migration to Wayanad took place during the colonial period. The plan was to house World War II soldiers. For this, 33,802 acres of tribal land was acquired in South Wayanad, Sultan Bathery, Ambalavayal and Nenmeni villages. Large-scale migration from Central and South Kerala also took place in Wayanad. Immigrants encroached on a large number of Adivasis and forest lands for cash crop cultivation. Organized immigration took place in the 1960s. It was in the context of private afforestation and land reform. The settlers alienated the land and livelihood of the Adivasis, which led to changes in their livelihoods, employment, living standards and starvation.

The process of nation-building itself marginalized the Adivasis in their own habitat. More than 10 million Adivasis have been displaced during the so-called forest-based eco-initiatives into development projects, mines, industries, dams, national parks, wildlife sanctuaries and ecotourism areas. Tribal migration is taking place through industrialization and urbanization, and the name of national development is the main source of livelihood loss for the tribals. The fact that the primary source of modern development is the affluent tribal motherland is the reason for their brutal migration. This is not only destroying vital habitats, but also threatening the very survival of the Adivasis. Incidentally, the state has become the greatest enemy of the Adivasis. 20% or 135 lakh tribals are victims of development. About 9% or 20 lakh Adivasis have been displaced at least once. Other statistics on evictions show that 8 lakh people are being evicted through 119 Central and State Government schemes, of which 50 per cent are tribals. About 90 percent of the county's coal mines are in tribal areas. The mines have displaced more than 21 lakh people in the last 40 years, of which 14 lakhs are tribals. It is estimated that the dams alone have displaced 21 million people in the last 40 years, of which 40% are tribal. The Government of India report of 1987 estimates that out of a total population of 185 lakhs, 85 lakhs are Adivasis who have been displaced at least once. As of 1991, more than 2% of India's population was displaced by development projects, of which 7.5 million were tribals. About 50 per cent of them are tribals. Despite being a very small minority of only 8% of India, the government does not even have a rehabilitation policy. The draft rules were released in 1994 by the Ministry of Water Resources and the Ministry of Rural Government. Only 10.15% of these Adivasis have been rehabilitated and 30% have been rehabilitated non-Adivasis. It is estimated that in the near future another 10 lakh tribals will be resettled through development projects including wildlife sanctuaries and national parks. Adivasis are being relocated from their homeland for various development programs being implemented in Kerala. During the last decades of the nineteenth century, the East India Company intensified deforestation in Kerala. It shattered tribal lives. They were the ones who collected the food. They depended on forest resources for their daily lives. Deforestation and destruction of food stocks for the timber industry. The British established teak plantations in Wayanad and Nilambur. Deforestation also took place for the needs of the railways. In Kerala, several projects are under consideration, including the Athirappilly project. Tribal project using the power of the Gram Sabha. The large-scale plantations implemented by the East India Company destroyed the traditional habitats of the community.

## **2.2 LAND ALIENATION DURING DEMOCRATIC RULE**

Even after the belated framing of the rules, the successive government failed to implement the 1975 Act. On the other hand, encroaching on the tribal lands continued with due political patronage. The 1975 Act categorically states that all transactions of Adivasi lands during the period between 1960 and 1982 are illegal and invalid. It also says that all such lands are to be returned to the original tribal owners. The Act further restricted transfer of tribal land to non-tribals from 1982 onwards without prior consent of the authorities. The Implemented Act stated that it would apply only to those cases of land alienation where the tribe had records to prove their prior ownership of their respective land. The tribal population never knew that they should have possessed land records from the government for the land they inhabited for generations. The vast majority of the tribes never had records of ownership given by the government officials, even though they were enjoying the possession of their ancestral land from time immemorial. The position of the government in general only helped the powerful encroachers to occupy tribal lands. After the implementation of the act several applications were received in their original forms. Moving the bill in the assembly, the then state Revenue Minister said that encroachers had snatched the land from the tribals adopting fraudulent methods, apart from providing them dry fish, tobacco, and paltry amounts of money in return. He declared: 'Whatever may be the methods adopted, this government considers all such land transactions as thefts and we are determined to return the stolen property to their rightful owners'. The Act could get the mandatory assent of the president of India in November of the same year. However, no action was taken on the part of the state government to implement the Act, even though it was a period of emergency. In the meantime, encroachment of the tribal land continued during this period. The encroachment on the tribal land had become more regular during the period between 1950s and 70s. The non-tribals from the plains went to the tribal areas and snatched the tribal land using different methods. These encroachers had a different perspective of the concepts of land ownership, which was unknown to the Adivasis.(C.R.Bijoy,2003)

Finally, the state government formulated the necessary rules to implement the 1975 Act, after eleven years of its passing, in 1986 with retrospective effect from January 1<sup>st</sup> 1982. However, by 1982, massive encroachment was already done by non-tribals in the predominant tribal belt of Attappady in the Palakkad district and the tribal dominated Wayanad district. Even after the

belated framing of the rules, the successive government failed to implement the 1975 Act. On the other hand, encroaching on the tribal lands continued with due political patronage. The 1975 Categorically states that all transactions of Adivasis lands during the period between 1960 and 1982 are illegal and invalid. It also says that all such lands are to be returned to the original tribal owners. The Act further restricted transfer of tribal land to non-tribals from 1982 onwards without prior consent of the authorities. The Implemented Act stated that it would apply only to those cases of land alienation where the tribe had records to prove their prior ownership of their respective land. The tribal population never knew that they should have possessed land records from the government for the land they inhabited for generations. The vast majority of the tribals never had records of ownership given by the government officials, even though they were enjoying the possession of their ancestral land from time immemorial. The position of the government in general only helped the powerful encroachers to occupy tribal lands. After the implementation of the act, several applications were received by the state governments, but no action was taken by the successive UDF-LDF government to restore the alienated tribal land to the original owners. The tribal sub plan of 1995 says that the government has received 8641 applications for the restorations of the alienated tribal lands, but only 563 applications have been disposed of and land has been restored only in one or two cases. It was in this background that Dronellar Tampico tribal of Manadhavadi in Wayanad moved a public interest litigation in 1988 before the Kerala High court. The High Court in its order of 1993 asked the government, however, the court granted further extension to implement the act till April 1996. Still the government refused to implement the act and carry out the court orders even during the extended period. Though our constitution guarantees these rights of the tribals, democratic Kerala has failed to act in accordance with the great wisdom of our constitution in many ways. Kerala has several progressive laws including land reforms to end land ownership. But lacks policies and programs to preserve the right of traditional resource dependent people like Tribal, Fisher folks Dalits and minorities groups. However, the last few decades have witnessed the struggle of tribals, Dalits, Fisher folk and plantation laborers. The Muthanga struggle is an episode of this chapter, especially of Adivasis struggles that have surfaced since 1990. Since Independence, the Governments in both the center and the states have launched a series of welfare programs for the uplift of the Tribal people. The constitution of India accorded them special legislation for bringing them on a par with the modernized sector of the society. Indeed the constitution has

included a separate schedule for this purpose. The major constitutional provisions include reservation of seats in the union and state bureaucracies and in the educational institutions run or assisted by the state. The various Tribal welfare programs instituted to improve the lot of these people and have their counterparts in other states. Many of them are financed by the union government. Indian Adivasis were apparently there before Aryans and Dravidians occupied the lands, though it is difficult to assess the exact time of the origin of most tribes as their recorded history about them nor are there any well-known records from equations to understand anything about their lifestyle. In technical terms Article 342 of the Indian constitution relates to a special provision in respect of “scheduled Tribe” which are defined as the “tribe or Tribal communities or parts of or groups within tribal communities which the president of India may specify by public notification”. The tribal groups are presumed to form the oldest ethnological sector of the national population. The term” Adivasis” (Adi-original: vasi- inhabitants) has recently become current to designate these groups. The tribes are: hunters, forest lands cultivators and minor forest. Product collectors lived in isolation with nature hence divided into a large number of sub tribes, all mutually inclusive and the common features of all these tribes are (1975).

### **2.3 REASON FOR LAND ALIENATION IN DEMOCRATIC KERALA**

Alienation of land is a serious problem faced by the scheduled tribes. Land is the mainstay of the tribes and more than 90 percent of them are dependent on agriculture and allied activities. Hence, land is the only tangible asset of a tribal community, and they are emotionally attached to it. The number of landless tribals has increased during the last decade and several reasons can be attributed to this phenomenon. Scheduled Tribes largely depend upon non-tribals to meet their credit requirements. The socio-economic survey of tribals reveals that tribals alienate their lands mainly for meeting their domestic expenses and for clearing their past debts. The main causes of land alienation and landlessness among the tribals are poor economic conditions, drinking habit, indebtedness, urbanization, industrialization, lack of land records, administrative inefficiency, delay in getting, Judgment, oral mortgage of lands in the hands of non-tribals, non-possession of Judgment, interest not shown by tribal pleaders or not taking interest due to heavy bribe, fear from police and court establishing marriage with tribal women and sharecropping. Land alienation has given birth to several allied problems among the tribals, that is, increased poverty among the tribals, decreased the occasion of employment, migration of tribals, exploitation of

tribal laborers, exploitation of tribal women, created tension between tribals and non-tribals, increased the distance between the rich and the poor tribals, developed extremism and naxalism in tribal areas, brought law and order problem in tribal areas, directly or indirectly. In post-independent Kerala, large-scale alienation of tribal lands took place mainly due to the immigration of plainsmen to the hill areas, displacement for projects etc.(C.R.Bijoy,2003.vol.38)

## **2.4 LAND REFORM AND LAND ALIENATION OF TRIBALS**

The historic Kerala Land Reforms Act 1963, with its “land to the tiller” policy unfortunately turned out to be a nightmare for the tribals. Under the new law, the occupiers of the land (settler farmers) became the owners and the original owners (the tribals) became landless and were reduced to the status of agricultural laborers. This resulted in the total derailment of their lives. After the enactment of Kerala Land Reform Act, the non-tribal communities who invaded Attappady and Wayanad behaved ruthlessly towards the Adivasis who were the real owners of the land. They exploited the Adivasis more unscrupulously than their former rivals, the British or landlords. The new masters and the Government bypassed the Dalit and Adivasi laborers by focusing on giving land rights to tenants only. In fact, it was the apathetic attitude displayed by successive governments that made the issue more complicated. Thus, the Adivasi issue in Kerala presents a dismal picture. As the Government remained indifferent, the Adivasis have from time to time tried to assert their land rights but were brutally crushed by the state violence as at Cheengeri (1995) and Panavally (1997), Muthanga and Chengara. The celebrated Kerala model of development has not made much change for the socio-economic life of the marginalized sections of Kerala. According to Chathukulam and John, tribals have been largely left out of the gains of the vaunted Kerala model of development (2006). According to Kunjaman (2002) systematic marginalization of the subaltern sections has been a blot on the Kerala model. In the implementation of land reforms, the fundamental programme for which Kerala is well known, the legitimate claim of the Dalits, the traditional tillers of the soil, to cultivable land was never recognized. Among the few states that have achieved Land Reforms in India, Kerala has been rated very high. However, it is equally true that Kerala did not achieve complete success in land reforms. Land alienation started in the 1950s. In the meantime, the tribals acknowledge the fact that mobilization without any individual interest and ideological aspect can successfully address their real unrest in front of others. Therefore, when analyzing the recent history of tribal unrest in

the last 100 years, over one million acres of land are believed to have been grabbed from Kerala's tribal population. Their long agitation to regain the forests and lands where Their ancestors have lived for generations intensified after the starvation deaths of 32 tribals last year. And the struggle is just about beginning to pay off in a scheme that could benefit hundreds of tribal families; the Kerala government is giving away surplus land to landless tribals. Four hundred tribals in Idukki, Kerala's largest district, have been promised between one and five acres of land per family. But that is just the beginning. For in the last 100 years, over a million acres of land are believed to have been grabbed from Kerala's tribal population. The government believes the free land will enable the tribals to sustain themselves instead of relying on state support. However, to benefit its nearly 50,000 landless tribal families, Kerala needs over 100,000 acres of surplus land -- which it says it doesn't have (Dr. Haseena V.A, 2014).

## **ADIVASIS LAND ALIENATION AND LAWS IN KERALA**

Our constitution provides several rights to the Adivasis. The constitution took into consideration that there existed clearly vulnerable groups who were subjected to systematic exploitation. The establishment of an egalitarian social order with equity for all sections of the society, free from any form of discrimination what's ever, on the grounds of religion, race, sex or place of birth was the stated goal for our nation. Therefore, equity for weaker sections of society was the moving spirit of the constitution. Considering the existence of iniquitous forces embedded in the socio-economic and political system, specific safeguards in the favor of some communities were included in the constitution to hold officials responsible to act in their favor in specific terms. Members of the Schedule Caste and Scheduled Tribes are two such categories. A clear policy of positive discrimination was to be perusal. Wherever necessary specific provisions were to be made in the constitution. Many of the social rights of Tribals, Dalits and other Indigenous people are embraced in our constitution as a part of fundamental rights. Though the state of Kerala is considered as a progressive state, the fundamental rights of the resource-dependent communities have never been addressed by the political society.

## **2.2.1 PROVISIONS IN ARTICLE 341 & 342**

Articles 341 and 342 of the constitution provides for the classification of certain sections of the people as STs and SCs for the specific purpose of providing special provisions and safeguarded them. This clearly is based on categorical recognition of a historical fact that these sections are subject to the worst kinds of deprivation, that they need to be protected and promoted and that it was the responsibility of the state to undertake the task. It was also a fact that the Adivasi were distinct and they resent changes being imposed upon them. Under article 341, the President of India has been given the responsibility to specify through public notification in consultation with the Governor of respective states and Union Territories the castes, races or tribes or parts of a group within castes, races or tribes. Such notified castes or tribes or parts then for the purpose of the constitution, would be deemed to be a scheduled caste or tribe as the case may be for connected state or union territories. Once such a list has been promulgated, any changes can be made only by the parliament according to clause (2) of article 341 and 342. In addition, article 342 defines tribe as an endogamous group with an ethnic identity who have retained their traditional cultural identity. They have a distinctive language, a dialect of their own. They are economically backward and live in seclusion governed by their own social norms. They have a self-contained economy. The ST and SC list that was notified was amended through acts of parliament in 1956 and 1976. Even though these changes were made as per provisions in the law, non-Adivasis have been included in the list. The state is duty bound to enlist the Indigenous people to give them constitutional protection but ever after the controversies related to the listing of Schedule Tribes of Veda still remain unsettled. (C.R. Bijoy, 2008, Vol.51, No. 12)

## **2.2.2 FIFTH & SIXTH SCHEDULE**

Article 244(1) provides for the fifth schedule which may be made applicable to any state other than those areas in North East India, where a separate schedule namely the sixth schedule applies. According to para 4 of schedule, each state having scheduled areas should constitute a tribal Advisory council, consisting of more than 20 members whom  $\frac{3}{4}$  should be tribal MLAs for the state. TAC can also be established in states having STs even though they may not have scheduled as per Amendment introduced in 1976. In addition to 8 states having scheduled areas.2

other states without scheduled areas namely West Bengal and Tamil Nadu have established TACs. The duty of TACs is to advise on matters pertaining to the welfare and advancement of STs in the state. The TACs are expected to meet at least twice a year. The fifth schedule envisaged the self-rule of Adivasis. Under the fifth schedule the Governors of the state were given unlimited powers. The governor may by public notification direct that any particular act of the parliament of the state shall not apply to the fifth schedule areas or amend a law enacted by the parliament. The governor is also empowered to frame new laws and make regulations in consultation with the TACs. The schedule was ensuring that tribal areas brought under it function as a sub-system with the scope to promote the self-governing of communities and evolving this system as dictated by the social and economic situation with the well-being of Adivasis as prime consideration. In 1972 a review of the application of the fifth schedule was made. In 1976 the constitution was amended empowering the president to extend the schedule areas. The resolution of the parliament on the occasion of the amendment envisaged that in order to intensify 'tribal development' all areas which are currently not classified as scheduled areas but having more than 50% of ST concentration could be brought under it. Extension of present schedule areas bringing all other tribal areas under the fifth schedule and were the tribal areas where the tribal areas are presently fragmented., to recognize these areas so to make them compact. This process of extension ground to a halt in 1978 itself leaving the state of West Bengal, Tamil Nadu, Karnataka and Kerala untouched and vast areas in other states left uncovered(C. R. Bijoy, 2008).

### **2.2.3 SIXTH SCHEDULE**

Article 244 (2) of the constitution provides for the sixth schedule which applies for the administration of the Tribal areas of Assam, Meghalaya, Tripura and Mizoram. Para 20 of the scheme provides a list of tribal areas covered by this schedule in three parts. There shall be a district council for each autonomous district consisting of not more than 30 members of whom not more than 4 persons shall be nominated by the Governor and the rest shall be elected from There are different STs in the autonomous district. The Governor may by public notification divide areas into autonomous regions and they shall separate regional councils for each area. The ADC, a regional council, may make rules for approval of the governor regarding formation of subordinates, local council and conduct of their functions and on matters of administration of the district council and regional council are empowered to make laws and regulations. Further, this

tribal group has been vehemently demanding the inclusion of tribal areas under the fifth schedule since 1994.(C.R Bijoy, 2008)

#### **2.2.4 DECENTRALIZATION IN KERALA V/S PESA 1996**

Kerala is considered as the first state in the Indian union, where decentralization through Panchayati raj is implemented. But the specific form of Panchayati Raj governance in the tribal areas has not yet been properly addressed in Kerala. A radical transformation in the governance especially at the village level in the scheduled areas was affected in 1996 with the enactment of the Provision of Panchayats (Extension to the Scheduled Areas) Act. It came into effect on 24/12/1996. The community at village level managing its affairs in accordance with its customs and traditions is now fundamental in the governance of scheduled areas. The competence of Gram Sabha has been acknowledged in safeguarding and preserving the community resource, which in the context of scheduled areas covers all-natural resources including land, water, and forests and minerals. Through the PESA Act 1996 the primary unit of the gram Sabha envisaged in the act is incorporated in the Forest Right Act. The PESA act has not yet been applied in Kerala. Since the Nilpusamaram was launched by the tribals in 2014 the state government of Kerala submitted a proposal before the central government to implement the act.(C.R.Bijoy,2003)

#### **2.2.5 NEGATION OF INTERNATIONAL COVENANT**

Further the democratic governments kept silent over the constitutional safeguards in Kerala. Political parties were lenient in protecting the rights of migrants and also new political parties representing them. Hence democratic government kept silent over the provisions of article 244 of constitution, and overlooked the Debar commission that recommended the restoration of alienated land of Tribes. In administrative reforms they never contained the spirit of ILO Convention and the UN Draft Declaration on the Rights of Indigenous people (convention 107: Convention concerning the protection and integration of Indigenous and other Tribal and Semi-Tribal populations in independent countries, convention 167: concerning Indigenous and Tribal peoples in independent countries). The Government of Kerala neither invoked the provisions of the Kerala Private Forest Act of 1971 for assigning or conferring forest land/forest rights of Adivasis. Instead, the govt of Kerala repealed the only law to restore the alienated land

of tribes -the Kerala schedule tribes (restriction on transfer of land restoration of alienated land) Act and enacted another law to bestow alternate land for tribes during the year 1999. The provisions of this act was also not implemented. The lots that were enacted for Tribals uphold the basic principles of the International Covenants. By not implementing the laws ensuring the protection of Tribals, the government of Kerala is violating the International Covenants.(C.R.Bijoy,2003)

## **2.2.6 FAILURE OF LAND REFORM**

Until Independence and the formation of the state Kerala, the Adivasi who lived in the Malabar area did not receive much attention from the authorities. Among the other reasons, the powerful non-Dalit, non- Adivasis who controlled the plantations in this area were successfully in bargaining with colonial administration for better provision to maintain their legal and economic status, suppressing the needs of the local population. With the entry of the East India Company and creation of a huge number of cash crop plantations, Adivasis, especially those belonging to the Paniya, Adiya, and Kattunaikka communities, were completely evicted from these forest areas of Malabar. With the steady growth in timber business and massive deforestation for decades, a good majority of the Adivasi community became tenants in paddy fields of cash crop plantations. The Paniya and Adiya community suffered the most through slavery and constant displacement since they never owned land and had to work for the settlers. The emerging issue of a large number of landless Adivasis from the northern part of the state, especially from Palakkad, Wayanad, and Kannur and desperate for their rehabilitation has to be seen in the light of experience.

## **2.2.7 IMPLEMENTATION OF LAND REFORM ACT OF KERALA**

The tenancy reform act passed in 1970, specifically meant for providing land to landless, it benefited a few but a large majority were allotted only a few cents in the so-called colonies designed for them. Even with the creation of the One lakh colony, quite a few Dalit-Adivasis and fish workers were still left out systematic marginalization that has only become aggravated in current times. Whether from a class perspective or from a community identity perspective, it is the failure of a democratic state. A good majority of the Dalits and Adivasis remain fully landless. There is an increasing number of people living in colonies. It is reported that a total

number of 36,000 Dalit and Adivasi families are residing in colonies. Lakhs more are landless. Adivasis have lost their traditional forest abodes since the colonial invasion. The forest department systematically converted the Adivasis into habitats called colonies. Expansion of plantations and post-colonial development like construction of huge dams /irrigation projects also pushed the Adivasis into colonies. Further, the social forester's organized migration from low lands did the same thing to these resource-dependent communities. Though the safeguards like Tribal autonomy are clearly ensured in the constitution, the democratic society in Kerala, including our legislature, is more lenient to the casteist approach, putting the tribals into caste-colon.

## **GENESIS OF MUTHANGA STRUGGLES**

Movements for the Restoration of Unauthorized Land and Forest Rights The 1990s were an important period for the tribal communities in Kerala. Under the leadership of community groups and non-governmental organizations, a number of organizations launched a rights campaign for the tribes. In Wayanad, a group of NGOs and social activists called "South Indian Adivasi Sangam" was started during that period C. K Janu was the chairperson of that sankamam. Several questions of tribes in south India including tribal autonomy and restoration of alienated land were raised in that collective In 1970, legislation was passed in Kerala relating to land reform. There was no legislation to protect the autonomy of the adivasis and their land. The Dhobar Commission, appointed by the Central Government in 1960, recommended the restoration of unclaimed tribal land. In view of the Central directive, the Kerala Legislative Assembly unanimously passed a law for the restoration of unclaimed tribal lands from 1960 onwards. This Act is known as the Kerala Scheduled Tribes (Control over Transfer and Restoration of Tribal Land) Act, 1975 (KST Act for short, 1975). Rules were framed in the year 1986. Through the tribes were not aware of the act, more than 8,000 applications were registered by them. It was assessed that based on the act the government of Kerala was bound to restore more than 10,000 hectares of the land. Opposition parties have stated they will not run in the by-elections, but will seek redressal of their grievances. Kerala High Court directs law enforcement Meanwhile, tribal organizations and civil rights groups began agitation to reclaim

the unclaimed tribal land. The controversy continued throughout that decade. Ruling and opposition leaders took part in the agitation, regardless of party affiliation. But the central government rejected the proposal. Towards the end of the decade, the Left-led government of Kerala repealed the 1975 Act and introduced another amendment in the Assembly. The Kerala Legislative Assembly unanimously approved the bill. CPM member Smt. Gauri Amma disagreed with the bill. The Kerala High Court then declared the bill unconstitutional. However, the Kerala government approved the bill in the same year. The case has been pending for over a decade. The Supreme Court partially approved the 1999 Amendment Act of the Government of Kerala. Provision was made to provide alternative land to the adivasis who had lost their traditional habitat and agricultural land. But till date the government of Kerala had not made any concerted effort either for restoring the land or for giving alternate land. Tribals all over India have a long history of freedom struggle. They fought against the Aryans and the colonial rulers to protect their land and autonomy. The constitutional provisions regarding tribal autonomy are the result of their defensive struggle. In Kerala too, the community along with Pazhassi Raja fought against the British Raj. Although there is no recorded history, many tribes such as Paniya, Muthuvan, Mannan and Mala Arayar resisted the alien forces to protect their communal rights. Many communities like the Nairs in the nineteenth century. Ezhava and Pulia started consolidating civil society in Kerala. But it was not easy for the tribal communities to unite as one common nationality as they were isolated in the forest and divided into different communities. Therefore, they were not considered as a pressure group in Kerala politics. They were not represented in the legislature. But in the 1980s, tribal organizations and members of civil society began to speak out on behalf of the adivasis. Tribal rights since the early 1990s have been addressed by tribal organizations for land reform and criticized by social activists. Constitutional protection, including legal protection for the protection of land and culture and the restoration of unclaimed land, were two important questions that arose in the early 1990s. In the early 90s, a movement for the restoration of tribal alienated land emerged throughout Kerala. At the beginning of that decade, C.K. Janu rose to become a tribal leader. Many struggles took place in Kerala under the leadership of CK. Janu, Ambukkuthi, Kolikampally, Panavalli, and Chingeri struggles. The main feature of the 18 struggles was the participation of women.

### **2.3.1 LAND STRUGGLE AND RESTORATION**

During that decade, many tribal organizations and civil society groups came forward to restore the unclaimed tribal land. Immediately after the 'Adivasi Sangam', C.K. Janu emerged as the youth leader of the adivasis. Before becoming active in organizing tribals, she was involved in a literacy campaign with the support of some NGOs, but by the end of 1992 she was organizing tribal women and started several land grabbing movements in Wayanad district. In 1993, he entered the reserved forest land at Ambukuthi near Mananthavady. Hundreds of landless tribals took part in the agitation. The agitation was started by a platform called 'Adivasi Vikasana Pravarthana Samithi'. The adivasis were imprisoned and cases were filed against them. Soon they started another land grab movement in Kolukkumalai. In 1994, C.K. Janu organized the adivasis and carried out a satyagraha agitation for the adivasis on the Chinkeri farm. She was arrested and jailed for several days. In 1995, they started another Grab Movement in the Panavally surplus land. Meanwhile, a state-wide forum called 'Adivasi Coordinating Committee' was organized to restore unclaimed tribal land. The agitation came to a standstill after 1999 when the issue of restoration of unclaimed land came up for consideration by the Supreme Court. Another phase of land struggle started in Kannur district in the same decade. The community built in Kannur district was attacked by landowners and evicted from their habitat. The people's movement was organized until the adivasis were rehabilitated. Kannur district was not considered a tribal district. With C.K. Janu and activist M. Geethanandan were also present. Soon another broad platform called 'Adivasi Dalit Samara Samiti' was organized. The strike committee expanded the strike across Kerala. In 1999, a cultural meeting was held in Kundala (Idukki) and a hunger strike was held in Thodupuzha to restore the Kundala tribal land. The land restoration agitation at Thoovaipathy in Sholayur in 2000 and the Panavally land protection yajna against the government were some of them. Notable struggles.

### **2.3.2 REFUGEE CAMP**

During the last two years (1990-2000) 157 tribes in Kerala died due to starvation. This is not the first such death in Kerala. Ministers and officials said the cause of death was drinking sewage as usual. On August 29, 2001, hundreds of adivasis from Kannur and Wayanad came to CK. Janu and M. Geethanandan marched to the state capital, Thiruvananthapuram, and set up refugee camps in front of the CM's residence and secretariat. The movement received considerable

popular support from civil society. The struggle continued for 48 days. During this period hundreds of Adivasis came from different parts of Kerala and joined the struggle. It was a nonviolent struggle. The adivasis staged a satyagraha in front of the CM's residence and secretariat. They built a hut in front of the Secretariat. They sang and danced. They exposed the immoral nature of the state which exposed its sincere indifference to the problems of the state towards the tribal issues. While the dying adivasis were holding a refugee camp called the "Kutil Kettal Samaram", the Kerala government spent crores of rupees to try to stop the Oman tourist festival. who was arrested by the police, CK Janu. Police and authorities made several attempts to demolish the hut built by the adivasis. Finally, 48 days later, on October 16, 2001, the government was forced to end the strike.

The state of Kerala, agreed to the following :

- ➡ Resettle all landless tribes in Kerala
- ➡ Financial support mechanisms will be provided for resettled tribes
- ➡ Adivasi "ooru kuttam " shall be taken into confidence
- ➡ Considering the preponderance of Adivasis, the government of Kerala will place a request Before the union government invoked the provisions of the Private Forest Act, 1971 to divert vested Forest For the assignment to the landless.
- ➡ Tribal habitation will be bought under the Vth schedule of the constitution.
- ➡ Resettlement of tribals will be implemented in a Mission Mode.

During the 48 days of the agitation, various tribal communities gathered around the federal platform of the Adivasi Gothra Mahasabha. On March 2, the Antony government issued leases to 243 families in Marayoor (2.50 in Kundala, 160 families (5 acres), 60 families in Chavassery-Kannur (1 acre 10 cents) and 740 plots in Chinnakanal-Idukki. Opposition parties, such as the IM opposed the project from outside. The main slogan was: A tribal court was also held at Mananthavady to symbolically prosecute the bureaucratic behavior of the forest department. A statewide campaign was launched to establish land rights and launch a land grab movement. Adivasis and government of Kerala compelled the AGMS to launch another phase of land agitation, thus leading to Muthanga struggle

### **2.3.3 MUTHANGA STRUGGLE**

It is yet to be ascertained what happened in Muthanga as part of the restoration of tribal self-government. The Muthanga agitation and its aftermath were reported in popular journals and newspapers in early 2003 for three consecutive months. No one has done further investigation to find out the exact details of what happened in Muthanga. The decades 2000-2001 witnessed the mass participation of the adivasis in restoring their lost land and rehabilitating the adivasis. The constant struggles for land restoration have led to numerous land grab moves since the beginning of that decade. The adivasis challenged the immorality of the 'state' in the mass movements of the adivasis, especially in the refugee camp in front of the Secretariat. The result was the upliftment of thousands of adivasis across Kerala, which culminated in an agreement, which the State promised to rehabilitate all landless tribals in Kerala with effect from 1.1.2002. A Tribal Resettlement and Development Mission (TRDM) was formed and rehabilitation was envisaged as part of the Tribal Sub Plan of Kerala. In essence it was the political manifestation of a social movement. The rehabilitation program was started and the concept of "gram sabha" or "village community" was revived in the community. Achieving the visibility of the adivasis provoked the ruling class. They refused to recognize the constitutional rights of 22 adivasis. This prompted the adivasis to return to their traditional exile center, Muthanga. Tribal groups led by the Adivasi Gothra Mahasabha started the agitation. They made preparations for rehabilitation in various parts of Kerala. On January 2, 2003, hundreds of Adivasis gathered at Thiruvannur Colony in Wayanad district. About 2000 people gathered. The people are from different panchayats like Thirunelli, Mananthavady, Panamaram, Nadavayal, Noolpuzha, Kottathara, Pulpally and Mullankolli: Most of them are from different forest areas of Wayanad Wildlife Sanctuary. On the morning of January 3, 2003, people entered the Muthanga Range of the Wayanad Wildlife Sanctuary. Although considered a wildlife sanctuary, the Muthanga Range was completely deforested. Biodiversity in this range has been completely wiped out for the birch eucalyptus garden. The forest department itself has completely destroyed the environment. Officials have turned the wildlife sanctuary into a tourist destination. The masses of the tribes were rapidly uniting with their homeland. About 800 families lived in three separate settlements at Muthanga: Ambukuthi, Thakara Padi and Ponkuzhi. Although the adivasis came to Muthanga from different panchayats in Wayanad, they organized into 28 gram sabhas (villages) and started farming and environmental rehabilitation. The influx of tribals into the Muthanga range itself was a major

blow to the commercial and corporate interests of the ruling class. The Muthanga range was enlisted for eco-tourism by the Forest and Industry Department of Kerala in the First Global Investment Meet 2001. The right assertion of Tribal provoked the politicians. Immediately after the culmination of GIM-2001, the Government of Kerala took a decision to evict the tribals. On February 17, 2003, a wildfire broke out in the newly established tribal settlements in Muthanga. Acres of dry grassland and eucalyptus orchards were destroyed by the fire. The adivasis alleged that the fire was the result of a conspiracy by the authorities. The adivasis detained some officers and men they suspected of having seen at the scene of the fire. Detention provoked officials and political parties. They mobilized the locals and organized hartals to evict the adivasis. On February 19, 2003, hundreds of policemen, rangers and selected locals entered Muthanga. Police opened fire on the tribals. Their huts were set on fire. Everything in the possession of the adivasis was burnt. Many, including children, were brutally abused. Hundreds of women and children were imprisoned. There was an organized racist attack on the adivasis in Wayanad. In addition, police began arresting tribal activists in all districts. In Muthanga, a tribal named Jogi was shot dead and a policeman was killed. The brutal arrest of Adivasis by the then congress led Government, continued for days, until public opinion surfaced in the civil society against the brutality of the government. Under the hue and cry of the violations of human rights and related issues, the real politics of the muthanga struggle was least discussed. The adivasis entered the Muthanga range to question the legitimate claim to forest land.

The government had agreed to grant the forest land under the provisions of the Westing and Assignment Act. In addition, the activists organized 28 villages in Muthanga and started several environmental rehabilitation projects along with agriculture. It also took over schools for children, health activities, and the anti-alcohol campaign in accordance with the PESA Act. Women's participation in community life, land / farm ownership and maintenance was encouraged. The movement focused mainly on developing the model of self-governance. Adopts the provisions of the PESA Act 1996. The Act recognizes the traditional rights of the Adivasi as 24 Gram Sabha in dealing with the affairs of the community. The adivasis lived peacefully in the forest. But the state has charged hundreds of women, children and the elderly with numerous crimes and jailed them for months. Twelve cases were registered against the tribals at a cost of crores of rupees and a charge sheet was prepared against them. More than 20 people involved in the case have died. A decade later, in 2004, following the peaceful struggle of the adivasis, the

Government of Kerala announced a rehabilitation package for the adivasis. The government began to answer Pesa's question. Subsequently, the Forest Rights of the Adivasis were approved by Parliament in the form of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

This chapter deals with the methodology used by the researcher for the study 'Land alienation: The case of Muthanga and other Adivasi land struggles'. In this chapter, the researcher briefly presents the operational definitions, research questions, research design, research setting, universe, sampling method, sources of data collection, and tools of data collection.

#### **3.1 OPERATIONAL DEFINITION**

The major concepts involved in the study are explained

**3.1.1** TRIBE- A Tribe is an indigenous group of people who follow their common language, customs, beliefs system, norms and values.

**3.1.2** PANIYA TRIBE- The Paniya, also known as Paniyans, are an ethnic group of India. The Paniya tribe inhabits Malappuram, Wayanad, Kannur and Kozhikode Districts in Kerala. In Wayanad, the largest population of Scheduled Tribes is that of the Paniya tribe. “Paniya language” is a Dravidian language which is a mixture of Malayalam, Tamil and Tulu. Majority of them face social disadvantage and are landless.

**3.1.3** ADIYA TRIBE- The Adiyas are also known as “Ravulayar”. They live in the districts of Kannur and Wayanad in Kerala. The Adiya community also used the ‘Ravula’ language. They are agricultural workers, so they also believe in agriculture. Every year their annual festival is held in Valliyoor kavu in Mananthavady to trade services with landlords.

**3.1.4** LAND ALIENATION- Land alienation refers to the losing of land of a person (here indigenous people) to government, encroachers and settlers.

**3.1.5** CULTURE- It is a collection of different traits or attributes such as language, pattern of behavior, ethnicity etc, which defines a particular community.

### **3.2 RESEARCH QUESTION**

- 1) What are the reasons behind the post-2000s Adivasi land struggles in Wayanad?
- 2) What is the socio-economic background of the Adivasi land struggle in Wayanad after the 2000s?
- 3) How well are constitutional and legal protection of tribals implemented in Kerala?

### **3.3 RESEARCH DESIGN**

The researcher has undertaken a Qualitative approach for this study and the research design used in this study is explanatory in nature. The purpose of explanatory study is to identify the causes and effects of Adivasi land struggles in Wayanad after the 2000s.

### **3.4 RESEARCH SETTING**

The study is conducted in the district of Wayanad in the north-eastern part of Kerala. Wayanad is a hilly district situated in the western Ghats bordering Kerala and its altitude ranges from 700 meters to 2100 meters. Many tribes live in the forests of Wayanad and the district has the highest tribal population in Kerala. Adiya and Paniya live in Wayanad though they are found in other districts like Kozhikode and Malappuram, Kannur. The Paniyas and Adiya who were interviewed for this study are living in the 2 areas of Sulthan Bathery and Manathavadi.

### **3.5 UNIVERSE OF THE STUDY**

Adiya and Paniya tribes of Wayanad District form the universe of the study of which 13 people were selected by Snowball sampling method from the 2 areas Sulthan Bathery and Manathavadi in Wayanad District. Snowball sampling is used to identify more participants from the first respondent who is interviewed. convenience sampling technique used for the study. Convenience sampling technique used to assess respondents' availability and willingness.

### **3.6 SOURCES OF DATA COLLECTION**

The sources of data collection are primary and secondary data. The researcher used

primary and secondary sources with equal importance. The primary data was collected by using the method of personal interviews with the participants in this study. The secondary data collection was carried out using articles, journals, newspapers, magazines etc.

### **3.7 TOOLS OF DATA COLLECTION**

The researcher used a semi-structured interview guide for collecting data from leaders and participants of the Adivasi land struggles. This is because the researcher felt that interviews can lead to more accurate and reliable information from the respondents. The guide was formulated on the basis of pilot study and personal observation. Telephonic interviews and its recordings were also used for data analysis.

**3.7.1 Data Analysis-** After the interviews, the responses were transcribed and thematically analyzed after coding.

### **3.8 LIMITATIONS OF THE STUDY**

Even Though data collection was planned to be carried out with participants of the Muthanga struggle, the researcher faced difficulty in that. The data collection was done with participants of Muthanga Day of Remembrance commemorated in 2022. Most of the questions in the interview guide were not covered due to their busy schedule.

### **3.9 ETHICAL CONSIDERATION**

- Information about the purpose of the research was provided to the participants.
- The participants' informed consent was taken before conducting the interviews. They were informed about the outline of the study and their convenient time was considered for scheduling the interview. They were free to ask questions regarding the study.
- The participants were ensured that confidentiality would be maintained and their information would be used only for the study.

## **CHAPTER 4**

### **DATA ANALYSIS AND INTERPRETATION**

This chapter deals with Data collection and Interpretation. The study is aimed at Land Alienation: The case of Muthanga struggle and other land issues in Wayanad District. To evaluate the reason behind the post-2000s Land struggles in Wayanad District, the socio-economic background of the Adivasis land struggle in Wayanad after the 2000s, and how well constitutional and legal protection of Tribals are implemented in Kerala.

#### **4.1 PARTICIPANTS IN MUTHANGA STRUGGLE**

##### **CASE:1**

Sivan s/o Jogi

It was formed by a resident of Puthiyidam colony of Payyampally village. I belong to the Adiya Tribal community. Currently I am residing at Chaligatha colony of Paiyampalli village, Mananthavady Taluk. I was fifty years old when I went to Muthanga with my father, Jogi. Puthiyidam is a Tribal colony in Payyampally village. There are 12 small traditional types of huts made in mud and bamboo. More than twenty families were residing in 12 huts. All the families are landless. The 20 cents of land where more than 20 families resided was owned by one old Tribal chieftain (Moopan). My father Jogi was an agricultural laborer. Paddy fields were owned by landlords of upper caste Hindus and few Christian families. My father was an aspiring agricultural activist; but he was not occupying any land. So he joined the tribal movement, namely AGMS. On 2nd January 2003 my father along with other 13 landless Tribal families entered the Muthanga forest land, erected huts in the Thankrapadi area. We did a lot of work inside the forest. Everything was decided by the Oorusabha, a collective of village-level families; issues relating to land and landlessness of the Tribal were decided in the meeting. Almost all the people participated in the struggle and were well aware of the causes. They are fighting. My father is actively involved in all the activities. On 19th February 19 a very huge contingent of police and forest officials entered Muthanga. They opened fire on the tribal people. Several people were brutally assaulted. My father Jogi, was blown to my family. Government did not give any compensation for the loss of my father. The revenue department of Kerala gave an appointment for my sister Seetha in the Kerala service. Later and during the year 2015, I was

given one acre of agriculture land in Kallady, Mananthavady Taluk. The land is inhabitable and uncultivable. It is assigned by the revenue department. My petitions for charging my plot to a cultivable area has not yet been considered by the government:-Hence even after 7 years I could not enter into the rehabilitation land. I raise my income for sustenance through agriculture on leased land and through other skilled work. I was not charged with any of the cases related to the Muthanga incident. I am married and have two children. My wife and her father had also participated in the Muthanga struggle.

### **CASE:2**

Kulian Chaligatha

I belong to the Adiya community of Wayanad District. I joined the land movement led by C.K Janu After the ‘Kudilkettal Samaram’ of 2001. We are landless Adivasis of Wayanad. I know the value of the land where I work for the settlers. When the movement led by the Janu and the offer of agriculture land to the landless Adivasis, I was attracted to Janu’s land movement. So I along with more than 20 landless families went to Muthanga. After 45 days of peaceful living we have progressed very much, transforming the land to cultivable land. But on 19th february,2003 Police and forest officials evicted Adivasis from Muthanga. I was cruelly beaten by the police. They were put in jail, charged with several criminal cases. I was hospitalized for several days. My wife and small children were also jailed. Still I am tightening several cases. I lost my health. Still I have to work hard for my sustenance. Even after being released from jail, I participated in several public functions -During 2014, I participated in the ‘ Nilppu Samaram’ organized by the AGMS. Though I was assigned one acre of land near Kallody, Mananthavady Taluk. My family has not entered the land. We can transform the land only if the resettlement scheme is organized by Tribal resettlement development mission.

### **CASE:3**

Babu,kuttimoola

I am a permanent resident of Kuttimoola Tribal settlement. I belong to the Kurichiya community. Members of our community were overing a few areas of agricultural land traditionally. The members of the traditional Kurichiya Tribal settlements have increased for the last decades, Customarily the land and cultivation is governed and controlled by our elders. The

family property-agriculture land - has been maintained by our elders and the young generation for a variety of agriculture. Customarily the landed property should not be fragmented into individual private property. The few acres of the land- nearly 4 acre if given to as per Hindu succession law the land will be fragmented into 10 cents and 20 cents etc. In accordance with the traditional practice, gaining land for the new generation is the ultimate solution for poverty. 8 families participated in the Muthanga struggle . I was arrested and kept in jail for 45 days. Several cases were registered against me and my family members from kuttimoola. After 2015 was assigned 1 acre of agriculture land at Kallady, Mananthavady Taluk. Apart from the social movement led by AGMS, I am active in politics also.

#### **CASE:4**

Bindu/ Suresh

I along with 10 families from our Tribal hamlet called Murrikkaladi,Cheeral, Wayanad District participated in the Muthanga struggle. I belong to Vettakuruma of Wayanad District. Traditionally we were a forest dependent community. Traditional artery was popular among our Tribes. Majority of the members of our habitation are landless families. The meager land where we reside. Currently it is owned by one of the elders of our community. When newly married families multiply, we are compelled to move to places where we can find a dwelling. Hence when we heard about the land movement led by C.K Janu, we immediately joined. On 2nd January 2003 families entered the Muthanga forest. We know that it is a deforested area. We erected tents near by Thakarapadi we were doing agricultural work in newly settled land. On 19th February,2003 our huts were burned; we were arrested many of our community members were beaten, tortured and jai. Children and women also were jailed. My husband Suresh and 5 people were put in jail for 45 days. After being released from jail we continued in the movement. Though more than 16 families participated in the agitation, only 3 families were assigned land near the Irulam Forest area. We feel land is the most important requirement of our community. We are also actively participating in the socio-political movements continued by the AGMS.

**CASE:5**

Ramesh-Shantha

I was an active participant in the Muthanga struggle. My wife, daughter and son also took part in the struggle. The main reason for participating in this struggle is the lack of land. In the colony where we were staying there were 4 thatched houses. 8 married families lived in those 4 houses. Married people, children and the elderly all lived in four houses. The food was cooked in one house. All of them earn their livelihood by cultivating and working in the paddy fields. He was actively involved in understanding the tribal issues before the Muthanga agitation and in the Nilppu samaram before the Secretariat regarding the land issue. The idea of building a hut in Muthanga came up as a result of the Ooru Kootam going to many colonies and understanding their land issue. The struggle begins with ensuring the self-governance of the adivasis. But the struggle to build that had greatly affected the bourgeoisie. But the bourgeoisie smuggled sandalwood from the Muthanga forest, killed wild animals and smuggled meat on a large scale. Their smuggling was severely affected when the adivasis built huts in the Muthanga forest. With the connivance of the bourgeoisie, the police and forest officials unleashed massive violence against the adivasis and their huts in the Muthanga forest. There were three settlements: ponkuzhi, Thakara Padi and muthanga. Apart from the police, there were other atrocities against the adivasis. Women and children have been subjected to various forms of cruelty. They still face mental and physical problems. He is now in a condition where he has to face hearing loss due to being kicked in the ear during police brutality. One acre of land has been acquired in Meppadi as part of the agitation. Government support for cultivation is required.

**CASE:6**

Balan S/O Veruvan

My family and I took part in the struggle. Father, mother, wife, children, sister, husband and children were also involved in the struggle. We lived in Thiruvannur Colony. It was a situation where more than one family had to move into one house. All of them were engaged in agricultural work, so it was difficult to make a living from the meager income available to them. Our lives were full of hunger. All our houses were in a deplorable condition. We did not get a proper education due to problems at home. We were only able to go up to 10th class. No one owns land in our colony so we do not have a place to live. The decision to settle in the

Muthanga forest land was taken as a result of a group of people led by the Gotra Maha Sabha. I'm 26 years old. Muthanga lived in a hut with the aim of securing our self-governance through struggle. But as a result of the then government's intervention, we were subjected to police brutality. It was brutally beaten and tortured by the police. We had nothing to resist in front of them. We were arrested and charged with a number of crimes. My father Died as a result of brutal torturing by the police. I was still unable to go to work due to health problems. The case against us is still pending. Participated in the struggle but did not get land. So home is still a dream for us. I stood as part of the struggle and did not receive any benefits. My sister's daughter has to stay in jail. The amount sanctioned by the court has not yet reached their hands. I am still able to intervene in tribal issues and speak for them, and is able to give his children a good education. My family has got one acre in the Chethalayam forest range as part of rehabilitation. but we have not been able to go and stay there yet. Today our agenda is to give us back our forest land.

#### **CASE:7**

Rajan

I was a member of Gothra Maha Sabha. I have been a resident of Chaligatha Tribal colony, Payyampally work village of Mananthavady Taluk. I belong to the Adiyar Tribal Community. The Chaligatha Tribal settlement is at the bank of the Kabini river, near Kuruva dweep. As the paddyfields nearby the river mainly used for rice cultivation several community members, including men and women depended on agriculture. Land is owned by non-tribal people and we were only laborers and lands. During the post harvest season we usually cultivate vegetables and leave land. Apart from agriculture I do fishing occasionally. occasionally i do work for others. There were 80 families residing in our settlement. 28 families participated in the Muthanga struggle. I, along with my wife and small children entered Muthanga forest land and settled in the nearby Thakaraappady area. We did agriculture work in Muthanga collectively. We aspired to overcome the backwardness due to landlessness and poverty. On 19th february, 2003 police action started in Muthanga. Many huts were burned down. I was arrested and put in jail for 45 days. I was cruelly beaten and charged with several cases. My wife and children also went to jail. The release from jail was a hard time for me to come back to normal life. The trauma of torture and eviction lenterd of family for days there was no work. Local inhabitants ritual isolated tribal

people for participating in the struggle. There was no support from political parties. Gradually I became involved in agriculture work on leased out land. After 2007, the government decided to give a part of land in Aralam Farm Kannur for the land less tribal from wayanad. I also applied. As the offered financial support system was not provided I wrote back to wayanad. Involved again in agriculture and fishing. Occasionally I had to go to Muthanga cases that had been undergoing trials in Courts in Ernakulam. In 20015, some of the cases were transferred to Wayanad. As per the direction of the High court Of Kerala i got one lakh. Compensation for putting my children unlawfully in jail. I started a petty grocery shop inside the settlement. During the land of 2014, Kerala Government: declared a package for muthanga evicties. As I was assigned 1 acre of land in Aralam farm, I was excluded from the muthanga package. I build a better louse in my settlement using the grant provided by Panchayath. During the flood of 2019 and 2020 my house, grossery shop and everything was devastated by flood. Recently, some of the precious lost houses during the flood were rehabilitated. I was excluded from that list as I was a "landowner"as per records. As the COVID pandemic has receded, the grossery shop. No agriculture work has been carried out by anybody in Chaligadha since the 2019 flood.

### **CASE:8**

Balan-Lathath

My wife, me and my 4-year-old children took part in the Muthanga agitation. A family of about 8 people lived in our colony. All are landless. That is what led us to take over the Grand Forest. He was brutally beaten by police during the struggle and has been in jail for 44 days. He was arrested on several charges. My children have also had to go to jail. The court had ordered compensation for the children who had to stay in jail. It's not allowed for my children. As part of his rehabilitation, he was given one acre of land on Aralam Farm but had to return due to lack of financial support. About half of the land is rocky and uninhabitable due to wildlife disturbances. Often the authorities do not properly disburse government funds among the adivasis.

### **CASE:9**

Neethu D/o Velayudan

My family is also part of the Muthanga struggle. I was a very young girl . About half the people in our colony were landless. Everyone works for a living. All those who were part of the struggle today face many health problems because they are all victims of police harassment. 10 families who took part in the struggle have been given one acre of land in Vellarimala as part of rehabilitation. No one has been confirmed there. There has been no financial support from the government to build houses and cultivate the newly allotted land. Therefore, half of them remain in their colony.

### **CASE:10**

Adivasi Leader

My family took part in the Muthanga agitation. I was involved in tribal issues from the very beginning. That is why Muthanga was able to become a part of the agitation. The agitation was started with the aim of adivasi autonomy. My father, mother and siblings were all part of the Muthanga movement. There are about 30 families living in our colony. Having no land of their own, so many families do not have access to housing. Everyone here works for a living. Often there is a situation of starvation. I was subjected to a lot of harassment by the police as part of the Muthanga agitation. I'm still suffering from many health problems. To date, no benefits have been received from the government. However, he continues to collaborate with political parties. The LDF party seems to understand our problems the most. Many parties do not try to understand our real problem. The houses allotted to us are not built properly. The funds allotted for tribal welfare are not properly utilized among the adivasis. Although the land has been allotted as part of the Muthanga agitation, there is no opportunity to go and live there. With no access to water or transportation, it is difficult to move there quickly and for some, half of the land available is not usable. The government does not even investigate this properly.

### **CASE:12**

Ammin

I was part of the Muthanga agitation. The main reason for participating in the Muthanga agitation is that we do not have land of our own. Land was a major problem not only for me but also for the people who make up half of our colony. All are bounded laborers. Most of the people in the colony live on the income from it. They have often been subjected to extreme poverty and

health problems. The Muthanga 'Kudil Ketti' agitation is being led by AGMS. Everyone from our colony, including me, was in attendance. We were ensuring our Self-Rule by tying the knot in the crash of Muthanga. It was a very peaceful life. But due to government intervention, on February 19,2003, there was a brutal police crackdown on our huts. The huts were shot at and the police treated us violently. They participated, beat and tortured us,regardless of whether we were women or children. I had injuries to my legs during the shooting. So far I have not received any medical expenses from the government for those involved in the strike. One acre of land was allotted on Aralam Farm.Many had to return to their own colonies because the land had no financial support from the government. None of this was properly investigated by the government. Withhold funds for Tribal development and do not spend exactly that among the Adivasis. If you want to question that, label me a Maoist. When I go to the Panchayat office in connection with the education of children, I often hear the so-called Maoists.Officials are showing us such bad interventions.The government needs to focus on Tribal development. Proper land distribution should be done.This is because about half of the Adivasis make a living from agriculture. They cannot cultivate because they do not own land. In addition, the necessary financial support must be provided. Political parties see the adivasis only as a vote bank about whether their intervention is not taking place in the Adivasi colonies.

### **CASE:13**

#### **Adivasi Leader**

From what I understand Muthanga was not just an incident. It was also an occasion to mark a period of progress for the adivasis and tribals. It was an event where many tribals in Wayanad faced their emancipation to achieve their dreams. Police brutality during the Muthanga agitation shattered the hopes of the adivasis. Muthanga is a village spread over an area of about 20 square km from Ponkuzhi to Muthanga by a group of more than 20 adivasi tribes. Self-governance, the constitutional right of the adivasis in India, and the right of the self-governing Grama sabha to decide what to do there, declared that we would implement and develop ourselves and set up shops and markets there. As a result of the conspiracy hatched by criminals, goons, forest officials and the police who worked with the villagers and their accomplices, the huts were set on fire and 4,000 tribals were set on fire.The Muthanga Struggle led by C. K Janu was a period of gradual agitation started by Janu almost a decade and a half before that. From the speeches made

at the UN during the 1992nd period, the agitations in Panavally, Chingeri, Ambukuthi and Kolipali spread all over the place during the periods 1996-1997. The struggle for the reclamation of alienated land is going on and the struggle that started in Thiruvananthapuram in Kannur district during 1997-1998 is turning into a struggle to seize the Aralam Farm. When 181 Adivasis Died in a year in 2000 and 2001, a strong political agitation was organized by the Adivasis in the administrative center of Thiruvananthapuram. All sections of Kerala were organized. Kerala was a country where Nairs, Christians and Renaissance people made progress. In this way, every society has established its authority over its resources. Scattered communities reclaim their land and culture. Instead of thinking that they have a right to such a movement, democratic Kerala has seen a history of wielding a sword and firing against this movement. It was a milestone in the history of Kerala and in the history of India for the Adivasis. The autonomy of the adivasis was to be recognized. When all their moves failed, in 2019 there was a massive evacuation here in the presence of thousands of policemen. As a result of that evacuation, the huts of thousands of adivasis were set on fire and their belongings destroyed. Children's textbooks were destroyed.

## **4.2 DISCUSSION**

In order to analyze the cause behind the Muthanga struggle and the socio-Economic impact on the life of Tribals, researchers conducted the field study in Wayanad District during the months of February , March (2022). 13 sample participants in the Muthanga struggle studied by the way of interviewing, recording the testimonies and also collecting data related to the Muthanga struggle. From the participatory investigation it was identified that more than 800 families participated in the Muthanga struggle by the way of erecting huts in the Muthanga Forest range; the data was substantiated by the leaders of the Muthanga struggle like Vinu, M.Geethanandan etc. The participant were from different Panchayath in the Wayanad District like Noolpuzha Panchayath, Nenmeni Panchayath, Sulthan Bathery Nagara Sabha, Pulpally ,Thirunelli Panchayath, Noolpuzha panchayath, Kottathara, Kaniyambetta. Participants from Noolpuzha belong to *Paniya* community, participants from Manadhavadi belong to *Adiya* community, Thirunelli and Pulpally belong to *Vetta Kuruma, Katunaykka, Kurichya* community. It may be observed that a cross-section of different communities of Wayanad District participated in the struggle.

A set of questions were formulated and the feedback taken from sample participants from different Panchayats. 11 Participants were selected from Sulthan Bathery Taluk(Nenmeni Panchayath ,and Noolpuzha Panchayath, Cheeral) and Mananthavady Taluk (Thirunelli Panchayat, Chaligatha) almost all the persons selected belong to Paniya community and Adiya community. Interviewed were 1.Sivan s/o Jogi(Paiyampalli Village,Mananthavady Taluk); 2.Kuliyani(Chalikatha,Mananthavadi); 3.Babu (Kutti Moola, Mananthavady Taluk); 4.Suresh-Bindu(Murikkalaadi colony, Sulthan Bathery Taluk); 5.Ramesh- Shandha (Koyalipura colony,Sulthan Bathery); 6.Balan s/o Veruvan (Thiruvannur colony,Sulthan Bathery); 7.Rajan (Chaligatha colony, Mananthavadi); 8.Balan-Latha(Kannamcode colony,Sulthan Bathery); 9.Neethu D/O Velayudan(Bicharam colony,Sulthan Bathery); 10.Ravi(Thiruvannur colony, S.Bathery); 11.Ammi(Chekadi,Mananthavadi) and also interviewed 2 Adivasi leaders.

As mentioned earlier, the issues investigated were the cause behind Adivasis' land struggles that led to the Muthanga struggle and the Socio-Economic impact of the Muthanga struggles. It is also probed how far the constitutional rights were achieved by participating in the Muthanga struggle. The state response to the Adivasis struggle and the policies followed by the government were also investigated. Questions were related to: the causes for the participation in the land struggle, the nature of atrocities met by them, the cases registered against them, and the socio-economic benefits attained, etc., were raised. The data related to the rehabilitation after the Muthanga, the nature of land received after the struggle, the socio-economic change and other social indicators like education,The effects of flood and other natural calamities were also raised in the questionnaire. The questions related to the state response and the policies of the government are also included in the questionnaire.

### **4.3 CAUSES BEHIND THE STRUGGLE**

Through this study the researcher tried to understand what led the Adivasis to land struggle. Koyalipura paniya Tribal colony is located in Sulthan Bathery Taluk. All the members participated in the Muthanga Struggle. They were a landless family in the tribal colony. There were nearly more than 30 Paniya tribal houses in the settlement. The majority of the houses were in dilapidated condition; about fourteen families abandoned the residence in Koyalipura colony and participated in Muthanga. Almost all the families including men and women were dependent

on agriculture labor work in the paddy field. The paddy field is owned by upper caste Hindus. A few of them were experts in timber loading cultivation. During this period especially in the end of 1999s work in the agricultural paddy fields and the other small coffee plantations was meager. Poverty and even hunger were common problems among the tribals. Majority of tribal families depended on the free ration distributed by the government during the June, July, August season. Poverty and landlessness was one of the main reasons for encroaching on Muthanga land. Ramesh said that “the problem of every Paniya family is similar in nature.”

The socio-economic situation of nearly 100 families in Thiruvannur colony was similar to that of Koyalipura colony; majority of them were dependent on agricultural work. Some people do outside labor work. Nearly 100 houses were small and were in a dilapidated condition with no common space for agriculture and other community activities; The majority of the members of the tribal habitation were landless. They aspired to a better life. Hence the tribal families entered Muthanga forest land which is very near and familiar to all the family members in Thiruvannur. The members interviewed from the Nenmeni Panchayats also report similar experiences. The members belong to the Paniya community. There was a landless family Other members from Noolpuzha Panchayath were Ravi (Thiruvannur colony), Neethu (Bicharam Colony). They belong to the Paniya community and are facing similar socio-economic conditions as narrated by Ramesh and Balan. .

#### **4.4 POLICE ATROCITIES AND MUTHANGA CASE**

During the forceful eviction and police action all the family members were cruelly beaten and tortured and their family was scattered. All the members were put in jail. Balan’s father Veruvan was beaten during a police investigation and charged with several crimes. He died due to the police torture during the period of investigation carried out after the Muthanga struggle. Balan have to struggle hard to get out of the trauma due to police torture. There are cases still pending. Kannamcode tribal colony is like a labor camp inhabited by the 8 families Balan and Thangka of kannamcode tribal colony who were jailed for 44 days along with 2 children who were seriously injured. Balan was cruelly tortured during the eviction process. Both were charged with several grievous crimes. They had to fight in the court as their children were jailed. The Kerala High Court had ordered compensation for the children jailed (150 children jailed). But Balan’s family was not given any compensation. Shivan’s father Jogi who was killed in the

police firing during the eviction. Shivan was only 14 years when his father Died. Other members interviewed from Thirunelli Panchayath were faced with several hardships during the Muthanga eviction. They were jailed for several crimes.

#### **4.5 REHABILITATION AND RESETTLEMENT**

AGMS had staged a 'Stand-Up strike' in front of the Thiruvananthapuram secretariat demanding distribution of land to the Adivasis as part of the Muthanga agitation. As part of this, the government agreed to give one acre of land to the Adivasis. Some of the participants were given one acre of land at Aralam Farm (Kannur), Vellarimala and Kallady. No land has been distributed anywhere as part of the rehabilitation for all the people who took part in the strike. Balan says that after 2014 the family was given one acre of agricultural land near the Chethalayam forest range. Though sixteen landless tribals were given land in the area, no resettlement schemes were implemented. Hence Balan has not entered the rehabilitation area. All the families were allotted in different places in Wayanad District. It may be noted that only Vijayan/Thangka of Koyalipura colony (Noolpuzha Panchayath) is currently settled in the newly allotted resettlement land at Vellarimala. Vijayan/Thanka also actively participated like others. The family could be sustained in the newly allotted land at Vellarimala as wife Thanka is employed at a nearby plantation. Though Vijayan is suffering from ill health he has done Cardamom plantation, animal husbandry, etc. Vijayan stated that he could have attained a better life, had he been given financial support for agriculture from the government. Before 2014, Balan-Latha's family applied for a rehabilitation package in Aralam farm, Kannur; they were allotted one acre of land in Aralam Farm. They were compelled to return to their native place as the financial support mechanism offered by the tribal resettlement and development mission was delayed. Neethu's family also faced several hardships during Muthanga agitation. 10 families were allotted one area of land in Vellarimala village. They said that they could not make a permanent settlement in the newly allotted land as no financial support for agriculture and housing was provided by the government. Shivan v/s Jogi and Rajan-at abandoned agricultural labor work due to several reasons. Shivan Jogi had acquired some technical skills and earned a living during such works. Almost all of them were actively involved in agriculture in leased land and did other cultivation including vegetables. Though they were given one acre of land at a kallady in mananthavady, Taluk Shivan could not occupy that land. The land was totally

uninhabitable. Though he applied for a change of the plot it was not considered yet. Other members of Chaligatha settlement were allotted a far away plot in Chundel village (Vythiri Taluk). Though they had tried several times to occupy the land, they had to return to the native hamlet as the land was not suitable for agriculture. During the 2019-2020 flood the majority of the houses in this habitation were devastated by the flood; Rajan had applied for one acres of land in Kannur Aralam farm. He had to return from there. After returning from Aralam Farm alone, he started in small grocery shops during the flood of 1999-2020 everything included newly built houses supported by the Panchayath devastation. Other members interviewed Babu Kuttimoola, Mananthavady, Chandran, Thirunelli; They got one acre of land in Kallady, Mananthavady Taluk. They have transformed their land to farmland though they were not provided any financial support from the government

#### **4.6 CHANGES BROUGHT ABOUT THE MUTHANGA STRUGGLE**

After the Muthanga agitation, many changes took place among the Adivasis. Today, many have become politically conscious and aware of their rights. They cultivate the land they get and thereby find the finances they need. In addition, the children of those who took part in the struggle are educated and many are working. Gained the knowledge to bring their problems before society. Even today, despite the land issues, they have the energy to establish their presence in all areas. Gradually by actively involving in social issues, political parties had to recognize Balan as a grass root level activist. Having gained the people's support, Balan was nominated as a panchayath member during the period from 2016 to 2020. The acceptance by the political party was due to the recognition gained by Adivasi Gothra Mahasabha as a socio-political outfit. The children were educated by hard work and the eldest daughter is in postgraduate study. Sundaran and Gopalan stated that aspiration for land and better education for our children is the political vision gained from the teaching of Adivasi Gothra Mahasabha. Their daughter graduated and passed the teacher training course; Gopalan is placed in employment at Thirunelli Temple and Madhavan and wife Meenakshi work hard to overcome their suffering. They added that every family that participated in the Muthanga struggle had been transformed by the struggles carried out.

#### **4.7 SOCIO-ECONOMIC IMPACT OF THE STRUGGLE**

Qualitative analysis of the data shows that almost all those participants in the muthanga struggle were totally landless. Majority of them were having less than out of land and traditional type of huts. Unemployment and starvation problems were reported among the tribal people. Participants of the struggle were determined to build up a new life in the form of the Constitutionally recognised Grama Sabha. When evicted by police action many of them including womens ,children and old people were cruelly beaten up or tortured. Almost all of them were jailed and charged with grievous crimes. Almost all of them were fully convinced about their rights and felt that they were doing a lawful action. When released from jail they continued in the tribal movement, managed their cases and actively participated in several socio-political programmes. The majority of them aspired to political consciousness and hence participated in parliamentary political elections. Majority of them worked hard to get better wages and earnings either through agriculture in leased land or by migrating to far away places. They realized the value of education and their second generation is focussing on education. In fact, after the experience of muthanga agitation, in the year 2015 , immediately after "Nilpu Samaram " , their second generation launched a student collective called Adishakti Summer School. Having an experience of 7 years, the platform has been registered as an NGO providing support for hundreds of students . A section participated in the muthanga struggle and were allotted agricultural land in several villages. Many of their elders do not make a permanent dwelling in such lands either due to the lack of government support or the land is uninhabitable. Had there been further support including financial support from the government the socio economic life of those evicted from muthanga would have been changed to considerable extent From the foregoing analysis it may be concluded that the Muthanga struggle had a Socio-Political impact on the life and vision of both the participants and the Adivasi community in general. It is reported by the participants that more than 800 families (more than nearly 4000 tribal people) entered the Muthanga forestry in Wayanad District. They could build up a village-level self rule area. Apart from the questions of land, the struggle had transformed almost all the participants in their thought process; they were not near laborers these had been earlier. Their aspiration for land, reorganization of village-level autonomy in accordance with constitutional provisions like tribal autonomy and self rule governments had transformed them as socio-political beings. They are now conscious about their rights, hence even without the support

from the political parties and financial aid from the government they are hard working and have gained a self-sustained economic life. It may be attributed to the political consciousness created by the Adivasi Gothra Mahasabha.

It is supported by many of the persons interviewed that several of the second generation are being educated; they have created their own organization for acquiring better education. Currently many of them have better housing. Several persons interviewed mentioned that their life could have been socially and economically improved had the state implemented their resettlement and development mission of the tribals in its true spirit.

#### **4.8 LACK OF CONSTITUTIONAL COMMITMENT ON THE PART OF THE STATE AND UNRESOLVED PROBLEMS OF THE TRIBES**

Tribals of Kerala have been continuing their struggle for decades. From the evaluation and qualitative analysis of the samples it may be inferred that tribals of Kerala , especially the most backward landless families, have been fighting for their constitutional rights like rights to live, land, forest rights and self-rule. Though Kerala is considered as progressive society upholding socialist values, it lacks the constitutional commitment for inclusive governance for tribals, dalits , fisher-hold, and linguistic minorities like tamil plantation laborers. The democratic state could not assimilate the essence of social-reconstruction movements led by marginalized people during pre-independence and the current movements. Though dozens of progressive legislation regarding land reforms have been implemented , constitutional provisions to protect the land and culture of tribes were not embraced in any law in kerala. Hence the alienation of tribal land is being continued in the democratic kerela.

## CHAPTER 5

### FINDINGS, SUGGESTIONS AND CONCLUSION

#### MAJOR FINDINGS OF THE STUDY

➡ Assessing the socio-economic impact of the Adivasis' land struggle and other issues in implementing the constitutional and legal protection for scheduled tribes, the investigation by researchers revealed that a tribal movement for the restoration of their alienated land had emerged immediately after implementing the land reform laws.

➡ The process of land reform had been concluded by the middle of the decade in the 1980s. The voice for the restoration of alienated land gained momentum in the beginning of 1990. The study shows that the land reforms implemented in Kerala had not considered the tribal land questions.

➡ The legislation passed by the Kerala legislative assembly in 1975 pertains only to land lost or alienated during the Post-independence period due to the encroachment by organized communities from low-lands.

➡ Several historical reasons for the down-trodden conditions of the tribals in Kerala. The process of land alienation continued from the colonial period and the implementation of British forest policy on the vast area of forest land. The establishment of large scale plantations, legislation to control forest land and timber also evicted tribals from their natural abode.

➡ By the end of this decade, tribal movement started raising demands like resettlement of all landless Adivasis to end starvation death, declare Vth schedule area in accordance with the Constitutional provisions, implement PESA Act, 1996 (Provisions of Panchayats -Extension to the Scheduled Areas-Act, 1996) passed by the parliament; repeal the amended Act of 1999 to restore alienated land; assignment of vested forest land as per the Act of Vesting and Assignment Act, 1971 etc; assign all the tribal project land like Suganthagiri, Pookot lake project etc.

➡ In the year 2004, 19000 acres of vested forest land was allotted for tribal resettlement by the Central Government in the year 2006. A resettlement programme was initiated in 7500 acres of land in Aralam Farm during the 2004-2006.

## **RECOMMENDATION AND SUGGESTIONS**

1. There should be comprehensive law in accordance with the constitutional provisions for protecting tribal land to restore their alienated land
2. Agreements committed by the state had to be valued.
3. There should be a law for governing the land and culture of tribals in accordance with the schedule of the constitution.
4. Top priority should be given to central legislation like PESA and the Forest Right Act , 2006.
5. Special cases should be given to aspiring students in education.

## **CONCLUSION**

The Muthanga incident is a new chapter in the democratization process of Kerala society. Contrary to the general description of this process as the Muthanga incident, the episode of the tribal struggles is a reflection of the growing awareness among the marginalized people. To appear in civil society, as some scholars have observed. Struggle is part of the modern history of marginalized people. Through this study the researcher sought to understand the reasons why adivasis have been fighting for land since 2000, how land alienation has affected the socio-economic condition of Adivasis ,and how well constitutional and legal protection of tribals are implemented in kerala.

Through this research, the social,cultural, political, economic, and educational problems faced by Adivasis could be understood. Why are they leading the struggle again. Land is an integral part of their lives. The earth plays a major role in any development that is supposed to work among them. They have a deeper understanding of the pros and cons of the Muthanga struggle in their lives. In each case, they have seized it,despite obstacles we can scarcely imagine.”They are still trying to ensure their self-governance.

Kerala model of development is well known for its social indicators like education, health and other social services. Social scientists have compared such social indicators to that of European and former socialist countries. The reason for the growth of education and health is generally attributed to the land reform implemented in Kerala during the 1970s. It is true that slogans like ‘land to the tiller’ had changed the face of Kerala radically. The process put an end

to landlordism. Both the investigation of the researcher shows that this process had little impact on the life and culture of Adivasis. In fact, the process of land reform and further course of evolving the Kerala model of development had aggregated the landlessness and other social backwardness of tribal people in Kerala.

The objective of the present study is to probe the causes behind the Adivasis movements in Wayanad that led to the Muthanga struggle. Assessing the socio-economic impact of the Adivasis' land struggle and other issues in implementing the constitutional and legal protection for scheduled tribes, the investigation by researchers revealed that a tribal movement for the restoration of their alienated land had emerged immediately after implementing the land reform laws. The process of land reform had been concluded by the middle of the decade in the 1980s. The voice for the restoration of alienated land gained momentum in the beginning of 1990. The study shows that the land reforms implemented in Kerala had not considered the tribal land questions. The Kerala Scheduled Tribes (Restriction on Transfer and Restoration of Alienated Land) Act, 1975 popularly known as KLT Act, 1975 was the only piece of Legislation passed by the Kerala legislative Assembly for the tribal land protections. In fact it was initiated by the Union government. Though the Act of 1975 was passed in the legislative Assembly, no rule was framed for implementing the Act till 1986. When intervention by the Judiciary was initiated, Political parties stood against Adivasis. The movement for the restoration of alienated land was sparked due to the unconstitutional stand of the State of Kerala. Movement continued for a decade and the State of Kerala repealed the Act in 1999. The study also exposes the roots of the socio-economic reasons of land alienation of tribals in Kerala. The legislation passed by the Kerala legislative assembly in 1975 pertains only to land lost or alienated during the Post-independence period due to the encroachment by organized communities from low-lands.

The study shows that there are several historical reasons for the down-trodden conditions of the tribals in Kerala. The process of land alienation continued from the colonial period and the implementation of British forest policy on the vast area of forest land. The establishment of large scale plantations, legislation to control forest land and timber also evicted tribals from their natural abode. The terrible form of slavery based on the caste hierarchy meted out the certain sections of tribals like Paniya, Adiya, Kattunaikka made a sections of them bonded labourers. The process of converting forest land to large scale plantations, construction of big dams and irrigation projects, social forestry displaced Adivasis from their homeland. The traditional rights

of the forest dwellers were not recognised. In short, there are historical reasons for alienating tribals from their homeland.

During the beginning of 1990, the tribal movement led by leaders like C.K Janu raised the issues of tribals comprehensively. By the end of this decade, tribal movement started raising demands like resettlement of all landless Adivasis to end starvation death, declare Vth schedule area in accordance with the Constitutional provisions, implement PESA Act, 1996 (Provisions of Panchayats -Extension to the Scheduled Areas-Act, 1996) passed by the parliament; repeal the amended Act of 1999 to restore alienated land; assignment of vested forest land as per the Act of Vesting and Assignment Act, 1971 etc; assign all the tribal project land like Suganthagiri, Pookot lake project etc. Those demands culminated in a long -drawn peaceful agitation in front of the Secretariat and chief minister's residence in 2001. It resulted in an agreement between AGMs and the Government and a package in the form of a Resettlement and Development Mission (TRDM). It is a part of Tribal development in Kerala. The resettlement program was carried out by the government in 2002, January. The process continued for some months. But the delaying tactics of the administrators prompted the tribals to launch another agitation and led to the process of Muthanga agitation. Land Forest Rights, Constitutional rights for self rule (PESA Act) etc; were raised in the struggle to establish tribal grama sabhas in the forest area in accordance with law. Instead of conducting conciliation process state unleashed terror. Evicted the tribals from their natural abode. Though several forms of atrocities were meted out on them, The socio-political platform called AGMS sustained the movement. AGMS has occasionally participated in electoral politics enlightening the political rights of adivasis since 2004. Several litigation were followed to safe-guard the rights of adivasis including the defense of several cases registered against Muthanga agitators. In the year 2004, 19000 acres of vested forest land was allotted for tribal resettlement by the Central Government in the year 2006. A resettlement programme was initiated in 7500 acres of land in Aralam Farm during the 2004-2006. AGMS led another peaceful struggle in the form of 'Nilpu Samaram' or standing strike in front of the Kerala Secretariat during 2014. Tribals demanded a resettlement package for Muthanga evictees, declaration of Vth scheduled area or schedule area and implementing the PESA Act in Kerala; they demanded to implement forest rights , especially community forest rights, in its true spirit. The standing strike was also divided to assign the vested forest land to landless tribals approved by the supreme court. The standing strike continued for six months. In the end of December, 2014

the government considered many of the demands. A detailed proposal for declaring Vth scheduled was submitted before the union government and orders were issued to implement a package for Muthanga evicters. In short, though the agitation in Muthanga forest was suppressed, the struggle had several impacts. Land distribution was initiated at Kannur Aralam Farm. The process of taking over vested forest for resettlement was also initiated. Discourses regarding tribal autonomy also started in 2014.

### **Scope of Future Study**

The Muthanga land struggle is a milestone in the land struggle of Tribals in Kerala. It is only a part of the re-emergence of a community which has been shattered due to several historical reasons. The cause of events of this moment have a unique maturity when comparing to the tribal movements occurred in other part of India. This piece of research is only an introductory one in nature. Several factors are to be probed further in detail like extent of land alienated; comparative study of the land alienation of tribals in Kerala in relation to other states; the socio-cultural factors that strength in social fabric of the community and its influence in the current struggles. women's role etc.

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**APPENDIX**  
**(INTERVIEW SCHEDULE)**  
**LAND ALIENATION:THE CASE OF MUTHANGA STRUGGLE AND OTHER**  
**LAND ISSUES IN WAYANAD DISTRICT**

Schedule:

Place:

Date:

**1) PERSONAL DATA**

**Name of the respondent:**

**Sex** :

**Age** :

a) To analyze the cause behind Adivasis' land struggle in Kerala after 2000?

1) Did you participate in the muthanga struggle? What is the reason for participating in such a struggle?

2) Have you participated in any land grash struggle since the Muthanga struggle?

Eg:valad, Ambuti, pulpally, chethalayam

3) What is the reason for the whole family to take part in the muthanga struggle and other struggles?

4) Have you or anyone in your family been subjected to Police harassment or Arrested as part of the struggle?

5) Were you aware of the struggle before taking part in it?

6) Has the arrival of tribal leaders had any effect?

7) The case of the Muthanga struggle is still pending in the court and has any benefits been received as part of the case?

8) Did you take part in the stand-off in Thiruvananthapuram as part of the government's decision not to allot land as part of the Muthanga struggle?

9) What is your opinion about the police eviction process in the Thovarimala case?

10) Have you ever received land and have not received a deed?

11) Has there been any positive intervention on the part of the political party before and after the struggle. Why was there a positive intervention?

**b) To understand the impact of land Alienation on the Socio-Economic situation of tribals?**

1) Has land been acquired after the standoff? Where, is it livable?

2) Are the rehabilitated areas exactly habitable? Is transportation, drinking water, town

Etc. available

3) Is it suitable for cultivation?

4) Has rehabilitation affected your life in any other way? Eg: unemployment, water, transportation, etc.

5) How has the forest Right Act affected livelihood?

6) Has the struggle caused a huge loss in the economy? Were there any support from authorities or NGOs?

c) To understand how well constitutional and legal protections of tribals are implemented in

Kerala?

1) The Government had allotted land as part of the struggle and rehabilitation. Did you get it? Are you satisfied with allotted land?

2) Were those arrested during the strike later given government grants or any other kind of benefits?

3) Did the Government fund those who took part in the struggle?

4) The government has also taken steps to evaluate the flood affected land and has the government taken any steps to relocate them?

5) Have you received any other types of benefits so far

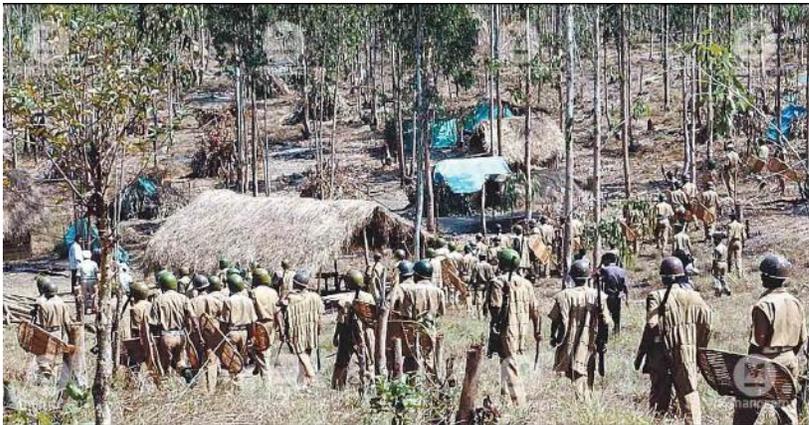
6) What was the Government's response after the struggle?

\*what do you think of the government's response to the land issue?

7) How much Kerala model development is being implemented in the tribal areas?

8) Do Government implemented policies benefit in any way?

## RELATED PHOTOS OF MUTHANGA LAND STRUGGLE





Adivasi Gothra Mahasabha leaders CK Janu, and M. Geethanandan  
After their arrest from the Muthanga agitation site in 2003.

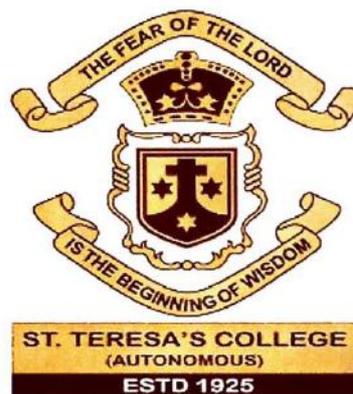






**MORTICIAN'S ENDOWMENT OF FUNERAL RITES IN A  
SOCIO-ECONOMIC POINT OF VIEW**

**SARAH MARIA (Reg.no AM20SOC014)**



**DEPARTMENT OF SOCIOLOGY  
ST. TERESA'S COLLEGE, ERNAKULAM  
MARCH 2022**

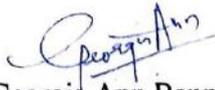


**MORTICIAN'S ENDOWMENT OF FUNERAL RITES IN A  
SOCIO-ECONOMIC POINT OF VIEW**

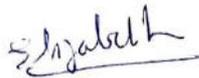
A Qualitative Dissertation submitted to St. Teresa's College as  
partial fulfilment of the requirements of Masters of Arts in  
Sociology.

**Proposed by,  
Sarah Maria  
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Under the supervision of  
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Georgia Ann Benny  
Research Guide



  
Smt. Elizabeth Abraham  
Head of the Department

## CERTIFICATE

This is to clarify that the final year project entitled as --- **Mortician's Endowment of Funeral Rites in a Socio-Economic point of view**, is submitted for the award of the **Masters of Arts in Sociology** from St. Teresa's College, Ernakulam – is a genuine work done by **Sarah Maria** under my guidance and supervision from the college and hereby approved for submission.



Georgia Ann Benny

Assistant Professor

Department of Sociology

St. Teresa's College, Ernakulam

Ernakulam

March 2022

## DECLARATION

I, hereby declare that the project entitled as “**Mortician’s Endowment of Funeral rites in a Socio-economic point of view**” proposed and presented by *Sarah Maria* is a bonafide record of independent research work carried out by me under the supervision and guidance of **Georgia Ann Benny**. I further declare that this thesis in partial fulfilment of Masters of Arts in Sociology is a genuine work carried out under the University for the award of post-Graduation, associateship or other similar title.

Ernakulam  
March 2022

  
Sarah Maria

## ACKNOWLEDGEMENT

In the accomplishment of this venture successfully, many people have bestowed upon us their sincere efforts and guidance upon me.

Primarily, I thank my parents for the whole-hearted support showered upon me for the successful completion of this research. It was indeed a privilege to be entrusted with the responsibility of the curtain raiser to a new area of research under concern to a new subject matter---entitled as 'MORTICIAN'S ENDOWMENT OF FUNERAL RITES IN SOCIO-ECONOMIC POINT OF VIEW'. This dissertation also combined with our personal curiosity, motivation to acknowledge and to know more about these individuals and their invalidated importance in the societies.

Secondly, I would like to thank the backbone of our college, our beloved principal Dr. Lizzy Mathew who never fail to ensure the unending support and affection. I'm conveying my heartfelt gratitude to the Head of the Department of Sociology Smt. Elizabeth Abraham.

Then, I extent my heartfelt gratitude towards Georgia Ann Benny, Assistant Professor of Department of Sociology who is my Research Mentor --- the beacon of support and encouragement. Her timely guidance, instructions showered impressive droppings of ideas for researching more on my subject. Even though I had a vision, I needed a battalion to bring this.

Ernakulam

March 2022



Sarah Maria

## ABSTRACT

Ancient history of Kerala has limited information about the burial diggers and their social state. The Hindu rites of cremation had their origin in Vedic periods as well as though the deceased were sometimes buried without cremation. During the Vedic period, the Indian society was divided into four castes – Brahmins, Kshatriyas, Vaishyas and Shudras and the fifth caste known as Panchamas or Chandalas also known as ‘Outcaste’.

After the arrival of British in Kerala, among the Christians deaths are bewailed with loved lamentations, ware candles, are carried in procession, incense burnt and masses celebrated for the soul, if for that soul, if for that of a rich man for forty days, but for a poor man only one day. Even among the Muslims of Kerala similar burial practices are found.

Burial diggers occupy a low status in the society as they belong to lower castes. They were considered as untouchables. These morticians are often exploited by the upper class without giving them proper remuneration for the work. Burial diggers live a life of fear and stress as they have seen their forefathers dying due to diseases affected from as part of their job. What has changed over the past decades is a change of cultural views towards death. The funeral industry is experiencing changes, that is those changes that are adapting to mega – stylish funerals, organized by event management specializing in funeral services have sprung up in NRI towns.

## CONTENTS

INTRODUCTION .....	
REVIEW OF LITERATURE.....	
RESEARCH METHODOLOGY.....	
CASE STUDIES.....	
FOCUS GROUP ANALYSIS.....	
ANALYSIS AND FINDING.....	
CONCLUSION.....	
SUGGESTION.....	
BIBLIOGRAPHY.....	
APPENDIX.....	

CHAPTER – 1  
INTRODUCTION

# INTRODUCTION

## 1.1 PROLOGUE

Morticians also known as undertakers or Funeral Directors are people who involved in the funeral rites. Morticians are contacted by family members to arrange for the propagation of the body and planning for the funeral.

## 1.2 HISTORY OF MORTICIANS

For as long as human beings have cared for their dead, there have been funeral directors.

The ancient Egyptians were possibly the first society to support full-time Funeral Directors or Embalmer with specialist priests spending up to 70 days preparing deceased royalty and nobility for the afterlife. Wealthy Romans relied on their families to look after their remains, but professional mourners were employed to make a fuss of the deceased's passing.

In medieval Britain, an undertaker was originally anyone who performed an 'undertaking'; there were those who undertook weaving as well as those who undertook funerals. Eventually, however, the funeral undertaker was shortened to undertaker, and other trades abandoned the designation to avoid being associated with the funeral profession.

The first undertakers were woodworkers - furniture makers and carpenters - that had the skills required to make a coffin. In rural areas, if they had a horse and cart, they also provided transport, although with most people dying at home, friends and family often carried the coffin to the local churchyard.

As society became more urban, walking funerals became less practical and funeral transportation more necessary. Over time, moonlighting carpenters moved beyond making the coffin and

transporting the deceased. They took on all the elements we consider to be an integral part of the modern funeral director's role, from care and preparation of the body to organising the funeral service.

It is not clear when the funeral director title was first used, but the British Undertakers' Association became the *National Association of Funeral Directors* back in 1905.

The switch from undertaker to funeral director is possibly a reflection of the increased responsibility involved in 'directing' every aspect of the modern funeral service. These days, we have come to rely on the profession's experience and specialist knowledge to ensure that our loved ones get the final send-off they deserve.

It is also an acknowledgement of the care that is taken behind the scenes by a trade trusted with looking after the body of a loved one, from collection to chapel of rest. Author and academic Brian Parsons says the most important evolution in the funeral director's role has been this care of the deceased.

"In 1900 we were pretty hands-off, people died at home, people stayed at home. Now that has completely changed. Death now happens in the institution, whether it's a nursing home, a hospital or a hospice, and the body doesn't rest at home between the death and the funeral."

"The funeral director is now very much the custodian of the body, preparing the body and allowing access to it. Really that's just because society has changed, the way we care for the living has changed and then the way we care for the dead has changed."

Many of the 3,000 independent funeral directors in Golden Charter's UK-wide network are long-standing, family-run businesses that can trace their roots through their local communities. All provide a modern compassionate and professional service, before, during and after the funeral service.

### 1.3 FUNERAL RITES DURING VEDIC PERIOD

Funeral Ritual According to Pandit includes following ceremonies of giving rice-falls.

1. Having held one's breath (performance pranayama, by taking in a breath slowly through one nostril, holding it and letting it out through the other. The Gayatri Mantra may be said by a brahmans silently to himself to time this correctly; other castes should mentally chant the name of the Lord) and sipped water silently from one's palm (i.e; without saying a mantra out loud)

2. Having taken up water, now, and still holding the water.

3. Beginning with the name and the date (of the ceremony).

4. Apasavyam: (the sacred thread is moved to the right shoulder and left of the body) in the place of death of such and such a person from such and such a gotra.

5. "I will perform the giving of the rice-ball (pindadanam called sava, for the purpose of gratifying the deity presiding over the place of death."

6. The purification of the place (wooden seat or thali where the pinda will be placed) with water (avanejanam), in order to offer worship.

7. Having strewn kusa grass complete with its roots, its points towards the south Holding the pinda in the right hand and placing it on the kusa grass.

8. "I am offering pinda (pinda-danam) called sava (Savanamna), in the particular place of death in the particular family.

9. May whatever I have given come to you.

10. In addition to the pinda, I sprinkle water again, (using dharbal, on the pinda, and offer a strand of wool Curna sutram), chandan (placed with the index finger, the bhrnga—raja flower, a light of sesamum oil, incense of the resin of rala, the fragrant root of utsava, cardamom, an

offering of food consisting of cooked black gram (masa, anna, naivadya) and sacrificial fee daksina- an iron coin. The offerings are made to the pinda with the forefinger of the right hand. A tilak is placed on it, and rice and water are sprinkled over the area (**Indian beliefs and rituals; New Delhi- Usha press**).

#### 1.4 MORTICIANS IDENTITIES

Death was a visible part of everyday life (Lederman 1996. Death was “integrated, through a series of rituals and symbols, into the life of the community” (Lederman 1996:26).

In the field of Anthropology, one main core of subject which is entitled as "The Anthropology of Death and Burial"-- are relevant to our exploration into the topic of death, condition of funeral directors on how they deal with it. The course is explicitly cross-disciplinary and besides anthropology we also explore the topic of death through the lens of Biology, History, Religious studies, Medicine, Law, Philosophy, Sociology, Literature and Art (Jakara.K. Griffin | 2017).

The term mortician is derived from the Roman word mort- (“death”) + mortician. In 1895, the trade magazine. The ‘Embalmers’ monthly put out a call for a new name for the profession in the US to distance itself from the title undertaker, a term that was then perceived to have been tarnished by its association with death.

Funeral Directors are people whom dispose human body and are determined by the social milieu in which one is embedded (Durkheim 2001; Metcalf and Huntington 1991; Turner 1995; Van Gennep 1960).

The definition given by Pine stated that --- undertakers worked to establish standard procedures for embalming and pushed for regulations governing its use and the licensing of its practitioners. The undertakers established associations, published journals, and opened schools dedicated to teaching the skills needed to prepare, display, and dispose of human bodies. These early practitioners also sought to redefine themselves as ‘funeral directors,’ rather than as the decidedly

less professional sounding ‘undertakers.’ In addition to their technical skills, funeral directors differentiated themselves from mere undertakers by developing managerial and counselling skills, and they came to see themselves as providing a service rather than simply selling products (Pine 1975)

## 1.5 THEORETICAL ANALYSIS ABOUT FUNERAL DIRECTORS

The philosophical theories about morticians raise more questions. In theoretical perspective---Morticians, according to Parsons (2003, p. 76), it is the funeral directors who are one of the primary caregivers to the bereaved, and they are employed as their agents –paid experts, while the client simply issues instructions in the capacity of contractor. Following a death, contact is made with the funeral director to make arrangements that primarily – but not exclusively – centre around disposal of the body therefore, funeral director is often linked to the circumstances of death. (Parsons, 2003, pp. 67–68).

From the book of Arnold.M.Rose entitled as ‘Sociology of occupation—the case of the American Funeral Director’--- defines the sociology of occupations, in the core area of the study of social organization, has occasionally benefited from an interactionist approach, particularly under the leadership of Everett C. Hughes.

In another essay, Robert W. Habenstein, a student of Professor Hughes, applies the point of view to the occupation of funeral director. A social process extends in both directions through time.

Habenstein's article illustrates the manner in which a historical analysis of a process provides improved understanding of its current state. It is interesting to note the application in this essay of Max Weber's concept of the "ideal type" - or, as Howard (P.) Becker has called it, "constructive typology"-as a means of furnishing additional insight into the process of professionalization among funeral directors.

## 1.6 SCIENTIFIC STUDY OF MORTICIANS

### ▪ MORTUARY SCIENCE

Mortuary science is the study of deceased bodies, particularly with respect to their burial and the bereavement of their families. The term “mortuary science” is most often used to describe college curriculums that prepare students for work as a funeral director. Of course, mortuary science also involves science. Whether you are strictly an embalmer — the person who prepares the deceased body for burial — or you are a funeral director, you will need to have a variety of practical science skills under your belt. A mortuary science degree will teach you the biology of the human body, how to examine corpses, and how to preserve and prepare the body, either for funeral services or for medical/research purposes. This is a mix of art and science.

Funeral directors are also business managers — they run the daily operations of the funeral home, plan wakes and funerals, and coordinate all the details leading up to those events. They must know how to manage the costs associated with funeral processes, oversee staff, plan the intricate details of the funeral, file important paperwork, and work to ensure each family's needs are met, while remaining compliant with state laws.

## 1.7 CONDITION OF MORTICIANS – AN OVERVIEW WITH SPECIAL REFERENCE TO KERALA

Over the past century the lower ‘impure’ castes in India have brought their funerary rituals in tune with the Brahminical mainstream, a process known as Sanskritization. But a sense of oppressed identity persists, in which both cosmopolitanism and particularism are played out. Day-to-day funerals are complex politicized performances in which values in Indian society are condensed, manipulated and polarized. Funerals convey multifarious ways of negotiating the

public and the private, the local and the global. In this paper I examine the funeral of Amma, the female eldest (Karnavar) of a wealthy business family belonging to the ritually low Ezhava caste of Kerala. The context of Amma's personal history highlights how Ezhavas, and particularly women, have resisted caste-discrimination, availing themselves of educational opportunities and achieving personal agency. I argue that in Amma's funeral contending ritual modes—anti-casteism, modern consumerism and matrilineal revivalism—neutralize the awesome ritual implications of Sanskritization. The revival of matrilineal ritual seems to reinstate women symbolically as keepers of male migrants' foreign earnings. More generally, if the central problem of life is to cope with or resist oppression, funerary rituals will exhibit a rich repertoire of tradition and innovation that disclose how history is rewritten as a project for the future (**reference from the book 'Mortality- promoting the inter-disciplinary study of death and dying**)

## 1.8 COVID 19 – THE RISKS FOR FUNERAL DIRECTORS

The COVID-19 pandemic has already caused more than a 100 000 deceased worldwide, causing funeral directors to become overburdened. Consequently, some funeral homes are obliged to keep the deceased in refrigerated trucks until it is possible to bury or cremate them, or bodies are refused because of a shortage of capacity. Yet, to our knowledge, there are no studies currently being conducted on how this affects funeral directors. This is not surprising, as this group has seldom been studied in the past. This is unfortunate, firstly, because this group has been essential on every day of this crisis and secondly because there is cause for health concerns based on the few studies that have been conducted in the past. In this article, we wish to address the possible physical and mental health risks to funeral industry workers based on these few studies worldwide.

Firstly, there is a risk to physical health. Previous studies have shown that funeral directors run the risk of becoming infected when embalming a corpse. Often, they do not know the specific cause of someone's death (e.g; due to professional secrecy) and at times they

do not know the guidelines for treating corpses or follow them strictly. These dangers are especially important with regard to COVID-19, as the virus seems to be very contagious and can survive in dead bodies. Moreover, the guidelines have only recently been introduced and are still evolving.

Secondly, there is also a risk to mental health for funeral directors. Previous studies have shown that traumatic stress events, the number of funerals, the high demands of the job and overexposure to death during their work can all lead to a negative impact on funeral directors' mental health. Furthermore, funeral directors consider it an important aspect of their work to give the best possible emotional and practical support to family members of the deceased.

The COVID-19 crisis is challenging in all these areas. The unusually high death rate during this crisis leads to an overexposure to death and funerals. In combination with the difficult working context due to strict security measures, it will substantially increase the demands of the job.

Finally, there is the constant fear of being infected themselves.

Just as saving people is an essential task, so is burying and cremating people who could not be saved essential. There are different approaches to this crisis around the world, but we all wish to give proper respect to our dead and appropriate support to grieving relatives.

One day, this crisis will end. Hence; It is our duty to be prepared to give the proper care, not only to our healthcare workers but also to funeral directors who have taken care of our deceased relatives, with risk for their own lives. More studies are necessary on funeral directors, and policymakers should take initiatives to support this often forgotten but essential group of caregivers.

## 1.9 CHANGING TRENDS IN FUNERAL RITES

In a society where commodification is the name of the consumerist game, human relations, family moments, community occasions and everything else come with a price tag. Apparently, even death (Rhea Almeida, Homegrown site; Folo-mojo)

From community to commercial: funerals in central Kerala have seen a gradual change in the last few years, turning a solemn grieving process to a professionally organised event.

Sanjay George Mathew, owner of the event company Coco-Nadu Event Management in Tiruvalla, describes how until a few years ago, “There are always new trends emerging like this, and the same thing is now happening with funerals,” he says.

Mathew continues to note the changes that have emerged in these ceremonies, talking about how transporting the body from the home to the church used to be done in an ambulance, but now the chosen vehicle is a cooled glass case. Black or dark coloured flowers have been replaced with white decorations, some funerals now have themes and matching outfits for the loved ones of the deceased, and sorrow, prayers, and condolence messages are now orchestrated by event management professionals. As it happens with any new tradition, these evolving funerals have garnered mixed reactions. While some commend the power of technology to help connect families across the globe during tough times, others dislike the ostentatious ‘show’ that these otherwise solemn events have turned into. Saniyil – businessman confides that he’s often heard family members criticising the fact that their intimate moments of pain or suffering are being broadcasted for the world to see.

Mathew's counter opines that -- received criticism for cashing in or commercialising someone's death, he maintained that he runs a business and works for money, just like everyone else, and he caters to a growing demand.

In a society where commodification is the name of the consumerist game, human relations, family moments, community occasions and everything else come with a price tag. Apparently, even death.

What has changed over the past decades is a change in a change in the cultural views towards death. The funeral industry is experiencing changes that are re-shaping the death rituals and methods of body disposal. Kerala society is slowly adopting to mega stylish funerals methods of body disposal. Kerala society is slowly adopting to mega stylish funerals organized by event management companies to service this rising demand, several event management companies specializing in funeral services are sprung up in NRI towns.

## JUSTIFICATION

From the ancient time onwards, it is the morticians who retrieves the deceased persons and does all the funeral duties but researches on morticians is an untapped area. Though they work as a menial laborer and prepares bodies of the deceased for burial or cremation they are not given enough recognition in society. Mortician cremates the body of the dead whom he has no personal connection. though they do many useful things to society they were not even mentioned in the historical books and records written by a famous Historians. Morticians are just like decomposers who satisfy the world effectively by removing all forms of wasteful content. Through this research, I'm trying to bring them into the limelight of society.

## CONTEMPORARY RELEVANCE

It is relevant to know that life history and present state of morticians in-order to have a clear image of their social, political, economic and cultural conditions. Today funerals are becoming as stylish as the jumbo weddings. To serve this demand several event management companies sprung up in NRI towns. Now a days; a death is an occasion for a family re-union as well as an opportunity to show off. So, we are also studying about the changes and trends brought in the rites and rituals. As Morticians belongs to an unorganized group where their problems were never addressed in public. So, it is essential to have a detailed understanding whether the policies by government is enough for the upliftment of this group.

CHAPTER – 2  
REVIEW OF LITERATURE

## REVIEW OF LITERATURE

A news article by Mitali Parekh on [dnaindia.com] titled ‘Documenting Vedic Funeral – How the funeral rites practice changes across the globe’ – is based on the thesis – The Survival of Hindu Cremation Myths and Rituals by Aditi Samarth, a humanities professor from U.S.A. Aditi Samarth wanted to study how Diaspora communities retain their traditions through rituals and ceremonies in the final rites of passage. Samarth found the Bernese funeral procession rambunctious with music and dance; whereas the cremation among Morticians Hindus was found to be closely following the Vedic Model. In America funerals were governed by city and state laws and held in funeral homes with distilled rituals.

Another news video titled ‘Life of women working in Shanthi-Kavadam in Trivandrum’—was uploaded in Asianet News Channel on 12<sup>th</sup> November 2012. As part of the show “Sthree”-- the six women workers in Shanthi-Kavadam, an electric crematorium in Trivandrum is introduced to us. The news video speaks about the societies stigma of women restricted to certain types of jobs like crematorium which at first appearance looks like a park or as garden.

When the crematorium was renewed as Shanthi-Kavadam; seven women were appointed. They got the job through the unit of Kudumbashree [women organization]. They work in shift with a time duration from 1pm – 11pm and from 12pm – 6pm. The working group of women includes --- Sheela, Latha, Vimala, Revathi, Ramani, Chandiri and Sajitha. They speak about how people looked upon them as impure. As a woman they go through pain by seeing death, but these women are compelled to suppress their emotions for money.

These women do the final rites at Kochi crematorium – an article updated on February 8<sup>th</sup>,2018 in express. This article reveals about Celina, 52-year-old lady who works as a mortician. This article portrait Celina – as an unusual figure working as a mortician. According to her, cremation centers are now virtually her courtyards. Celina moves on her daily life in working as mortician to prepare for the final rites. Celina has been following this routine for the last 11 years.

Celina undergoes through strenuous childhood and traumatic marital lives. She lost her husband at a very young age. So, in order to keep her family sustained, she took up this job. She receives an amount of rupees 1500 as a mortician where she has to pay back to the Municipality fee as rupees 405. Though she admits the very fact of physical disabilities faced while working as a mortician, she was able to sustain her family needs with this job. She receives family support for doing this job. Thus, she beams with pride when people identify her as the lady of crematoriums. Thus, we can conclude that, each job has its own dignity. And it is important for the society to remove all those stereotypes regarding the menial jobs.

An online newspaper, the News Minute 2016, in an article titled ‘I am used to dead bodies’ reported the pathetic life conditions of two women Baby and Celina who were working as morticians. According to this article, their poor economic and family conditions forced them to choose the job of morticians. The article says that working in this field are facing exploitation and they only receive small amount as remuneration for their work. The Hindu Business Line 2018 in an article ‘Death Inc’ reported the changes that are taking place in the system of Indian funeral rites. The report says that for many a Hindu, it is the final wish to die in Varanasi or be cremated at one of its Ghats. In earlier period, the Pandits did all kinds of Poojas to make sure that people are satisfied, but now it becomes a business which helps to earn a

lot of money. As a result of these changes, new websites such as kashimoksham.com are emerged to connect better with clients. In the article 'India's Guardians of death' --- published in the Diplomat on December 14 2017, reported the mindset of society towards the under-takers. The report says that the cremation undertakers perform a sacred function but are considered as untouchables. Even in the twenty first century, these undertakers are considered as untouchables and are not allowed to touch the upper caste people.

Travancore State Manual written by V. Nagam Aiya was a publication of the erstwhile Travancore kingdom, written and published under the statutory command of the King of Travancore. The other book named as Malabar Manual written by the Government of Madras, and originally published in 2 volumes. It is a guide to the Malabar district under the Presidency of Madras in British India, compiled during Logan's Tenure as Collector of Malabar. Not much information was found specifically about the works of grave undertakers but they were mentioned under the lower castes of Kerala. People were mainly divided into 5 castes, Brahmins, Kshatriyas, Vaishyas, Shudras and Panchamas or Chandalas or outcaste as untouchables. Morticians were treated as Untouchables or Chandalas.

'Meet Ramesh Korapathu at Ivor Madham, who lives for souls – we salute' was the title embarked on an article published on October 9<sup>th</sup>, 2015 by an online newspaper TV News. Ramesh Korapathu has been doing a work of a cremator for twenty years. This article is on the theme of him revealing how he even cremates dead bodies of those who have no relatives or address. He is not bothered about the societal stigmas prevalent towards morticians. He does the funeral rites and posthumous works according to the Hindu religious practice. He is like a guard of the souls. He has cremated legendries like Lohithadas, O.V. Vijayan, Oduvil Unnikrishnan and many more. He has not undertaken this

job not because of financial instabilities, but he considers it as his destiny. He has completed Post Graduation in History and Economics. He quoted that “I like burning dead bodies as well as deaths, otherwise I think it is possible for me to work for many years”. Initially, he was being rejected by his family for committing in working as a mortician, but with a gradual pace of time, he was being accepted by his family members.

Lastly, in my study, I am going to make a deep analysis on morticians with regards to the theoretical study of Jonathan Barret.

**CHAPTER- 3**  
**RESEARCH METHODOLOGY**

## RESEARCH METHODOLOGY

### TITLE OF STUDY:-

Mortician's endowment of funeral rites in a socio- economic point of view.

### SIGNIFICANCE OF DEALING THE PROBLEMS FACED BY MORTICIANS:-

Being a mortician is not an easy job. Dealing frequently with death and tragedy is the toughest thing about being the mortician; especially during the covid19 pandemic. As they belong to the secluded group their sufferings were never addressed in public. Thus, it is important to have detailed understanding on whether the policies implemented by the government is enough for the upliftment of this group.

### OBJECTIVES:-

- To study the socio-psychological and economic conditions of the respondents.
- To examine the changing trends in relation to the performance of funeral rites.
- To understand the role of law-making bodies for the upliftment for the respondents.

## DEFINITION OF CONCEPTS

Mortician:-

Mortician also known as Embalmer or Funeral Director; is a person who involve in the funeral rites. He prepares bodies of the deceased for burial or cremations.

## FIELD OF STUDY

- Universe – Morticians in Kerala Society.
- Sampling size – The population size is limited to 10 morticians.
- Sampling strategy – Sampling strategy employed in this study is convenient sampling.

## DATA COLLECTION METHODS USED IN RESEARCH

✚ Primary data collection method.

- I'm conducting my research through telephonic interview schedule with help of questionnaires that focus primarily on the objectives of the research. Case study method will also be applied to my research for detailed understanding.

✚ Secondary Data Collection Method.

- My data collection is wheeled through data sources collected from newspaper, historical books, magazines and social media.

## TOOLS AND METHODS OF DATA COLLECTION

- Telephonic Interview Schedules.
- Case Study Methods.

**CHAPTER - 4**  
**CASE STUDIES**

## CASE STUDIES

### CASE-STUDY 1

#### RAMANI

Ramani is a 63-years old woman who works in the Shanthikavadam crematorium, Thiruvananthapuram as an assistant cremator and cleaner. She is married and has three children. Her husband is suffering from cardio-vascular disease and he is unable to go for work. Earlier, he also did some petty jobs but now, Ramani is the only bread-winner of the house.

Mrs. Ramani has two daughters, and all of them are married. She has a son who does not have permanent job, but has assisting his mother in daily expenses. Ramani said that her family went through a financial crisis as she has to spend major portion of her income for her husband's treatment and for their daughter's marriage. When asked about the job satisfaction, she said- I enjoy doing this job but the salary is insufficient.

Ramani got this job through Kudumbashree until 13-years ago. She has mentioned about the hostility shown by her family and relatives initially to the job at the crematorium and later how it turned to sanction.

Ramani works in the first shift with two others, they clean the floor after the cremation rituals are done and they also assist Udayan (cremator) for the cremation work. Most of the records in the crematorium are handled by Ramani and she does it with all the enthusiasm.

And she is the one who took the initiative to send a request to the corporation to allot pension for the crematorium workers. But all her fears are about her increasing age and the financial insecurities amidst this pandemic.

## CASE-STUDY 2

### VIMALA

Vimala is a worker in the Shanthikavadam – a public crematorium in Thiruvananthapuram. And this 64 – year old woman is the present association secretary of the crematorium. Vimala is a spinster and she lives with her relatives. She is a seventh standard drop-out; as her parents could not afford her studies. She lost her mother at a very young age and her father left her after his second marriage.

As per co-worker's remarks – Vimala is a secluded person though, she is the one who is always stay bold, courageous and responsible. At first, when asked her questions – she was reluctant to answer but co-operate with me. She has mentioned that during the initial days of joining the work, she was confused as there was no one was there to guide them and to give a brief about the functioning of their job. But gradually with a pace of time, they understood the pattern and the functioning of their job.

For the past 15 years of her experience, she has been the one who took up the initiative to inform to their concern authorities (Trivandrum cooperation authorities) about their grievances and their needs with respect to their job. Even during this pandemic, they have directly written a grievance letter to Chief Minister of Kerala to increase their wage.

Vimala co-ordinates and supervise other women co-workers. The task coordinating other members seems so easy for her as all other fellow works respect her orders. She has been suffering from some age-associated diseases like arthritis and cataract. When I had a conversation with her, I understood that, she enjoys her life at its fullest while being single and gives a satisfied remarks about job satisfaction and income satisfaction amidst this pandemic.

## CASE-STUDY 3

### UDAYAN

Udayan who is 46-years old is the main cremator in the Shanthikavadam and he has been working there for the last 5 years. Before taking up this job, he has done several other jobs. From the childhood itself he had a service-oriented mind.

During the school days he was a member of scouts and guides and he was awarded as a best volunteer for his selfless services. Udayan mentioned that, he could not work to his full potential while doing other jobs because he always desired to do some humanitarian jobs.

He also made a remark that, he has always recognized a stigmatized approach against the morticians and towards their work; and when he took up this job as his profession --- he has faced many stigmatized inequalities and attitudes from the society. Later on, he himself observed the positive approach toward them.

This recognition gave him satisfaction and motivation to indulge more into this dignified job. Udayan shared with us the story of the Legendary king Harichandra as per the Hindu Mythology who had to work in the cremation ground due to his selfless commitment and truthfulness towards mankind.

He is receiving a good amount as salary for his work, which is enough to secure his family in a better life. He is the only earning member of his family, and his family includes his wife and children.

Even though the crematorium authorities for years are not taking special care of the worker's health; but he is of the opinion that his health is in good condition.

When we critically evaluates his statement; this itself shows how the male workers are gaining all privileges and how much they are ignorant about other co-female worker's health.

But the situation has immensely changed during this pandemic, where the concern authorities from the co-operation are given emotional financial support to the women workers without showing wage-based gender biases.

Udayan was the one who provided a detailed description about the functioning and the importance of huge crematoriums in city like Trivandrum. He said about the life in cities, and how pollution and population congestion affect the lives of people in Trivandrum. This in turn made the Trivandrum co-operation to lay down the foundation of Shanthikavadam crematorium.

## CASE-STUDY 4

### SAJITHA

Sajitha is 45-years old woman working in the Santhikavadam, Thiruvananthapuram. She is the youngest amongst all the workers and she came as a replacement for a woman who left the job. Sajitha discontinued her studies after failing in tenth class. Later, she was forced to work as a tailor due to the economic crisis.

At a very young age, she got married to an auto-rikshaw driver. Her husband's income was insufficient to satisfy their household needs. Her family, included her husband's diseased mother and their three children. So, when kudumbashree offered her a job in the public crematorium she accepted.

During the first days of the job, she was unsatisfied. As a new-comer she didn't receives a warm welcome from other co-workers who were working for many years.

Gradually, she got along with them and now she is a helping hand for the aged workers. Sajitha takes care of the first aid in the shanthikavadam in case of medical emergency during this pandemic. Now she needs financial support as her elder daughter is studying abroad. So Sajitha is working overtime to make money for it.

Her daughter holds a stigmatized approach towards this job and considers her job as inferior, where the daughter has promised her mother that, when she starts earning, she will not allow her mother to do this job.

Amidst, these uncertain times, Sajitha now feel the same, because she opines that the Government of Kerala and the people are not bothered to evaluates how pathetic is their living.

Because the mainstream society and the concerned state authorities are not articulating the necessary laws and policies for these people. And they have to cremate more than 45 dead bodies each day.

Sajitha was satisfied with the job earning 10,000 per month but now she and her co-workers couldn't afford that amount to meet the household needs during this pandemic.

## CASE-STUDY 5

### REVATHY

Revathy is a 64 years old woman working in the Shanthikavadam, Thiruvananthapuram. She belongs to a fishing community in the Valayathura, a fishing port. She is living with her husband who is a fisherman. Earlier, she was fishmonger in the Valayathura fish market and later when she got the job in public crematorium, she stopped selling fish. Now she lives in her own house with her husband and they don't have children.

When she joined the Shanthikavadam, she had to go through a mental trauma as the corpse brought back the memories of their child whom she lost at a very young age. In such a situation, she even thought of leaving the job but due to her husband's support, she continued.

She is a woman with a great willpower and she is considered to be the perfectionist by the co-workers. She also provides some financial assistance for the co-workers' children's education because she loves children.

As a job in Shanthikavadam is in shifts, the rest of the times she worked as a caretaker in the nearby houses. Now as her health conditions are getting worse due to this pandemic, she is about to quit the job in Shanthikavadam and to join a small initiative of processing half cooked chappattis in her neighborhood.

Her positivity towards life is inspiring to us even though she had to go through many difficulties in her life.

## CASE-STUDY 6

### CHANDIRI

Chandiri is 64 years old woman, who is a spinster is the president of their kudumbashree unit. She has been working in the shanthikavadam for more than 13 years. She was a menial labor before entering into this job.

She is an independent woman earning her livelihood herself. She has only two brothers and no other relatives, but surprisingly these brothers are ignorant of taking care of her.

Hence, she has molded herself to be independent woman by taking part in this job and is living in a small rented house – meeting all the expenses with the salary she earns from this job. Her life experiences mold her to be self-reliant and as a strong lady.

Her other traumatic life experiences made her to realize the fact of living for oneself and building up less expectations from the society. As she was an unmarried woman, brothers were unwilling to look after her. This realization made her to took up this job, to make herself economically independent.

Before having this job as a mortician, she engaged herself in several other jobs like domestic household labors functioned as a cleaning staff in some government offices. Finally, she entered into this job as a funeral director or as a mortician.

At the beginning, she received an amount of 1,500 per month which was barely sufficient to meet the daily expenses. For the past 6-7 years, they receive an amount of 10,000 as a monthly income.

Even during these uncertainties as any other co-workers in the shanthikavadam, she is not satisfied with this sum amount. Being the president of the kudumbashree unit.

She has presented a memorandum before the Mayor of Thiruvananthapuram corporation before the covid out-burst but the painful fact was that no action has been taken the government. The other major issues which concern them is about the wage and about the occasional leave.

Before the covid19 pandemic, if they take a leave for a day, they do not receives an amount for that day. Therefore, they were forced to work all days in a month without taking sufficient leaves.

The other major crisis was that, they do not receive any allowances or incentives such as pension, PF and so-forth. She is also of the opinion that – there is always an invisible inequality between male workers and female workers, especially regarding tips and bonus they receive from the relatives of the deceased people.

As the main cremator, Udayan has mentioned about the lack of health care facilities provided to the co-workers. But Chandiri is not concerned about her age or health issues, because she is a dedicated woman and gives her fullest effort for proper functioning of her job she is doing.

She is the one who has witnessed the changing approaches and attitudes of societies during the past 14 years. She observed that there is positive acceptance, incorporation and respecting these jobs with more dignified outlook. Though there are many limitations and struggles in this job, she enjoys with utmost pleasant smile.

## CASE-STUDY 7

### LATHA

Latha is the most vibrant woman among the workers who is 48 years old has been working in shanthikavadam for 13 years. Among all the other women and co-workers, it is Latha who is leading an enthusiastic life.

Being an employed woman, she manages her daily domestic chores all alone. She was studious from childhood but, could complete only pre-degree. Later, she was married to auto-rickshaw driver who later manages her. They are happy with what they have.

Before under-taking the job as a cremator, she has done several other inferior labour works. When she expressed her views on health incentives provided for them, she opined that there were governmental initiatives on health only during the spread of contagious diseases like Nipah, which became disastrous disease among Keralites.

Now, during this pandemic, they were given annual leaves and other considerations to maintain their health. Since she is a dedicated woman, she didn't give priority to any sort of precautions initiated by the government against government though she fulfills her all covid19 protocols. The only remedy she follows is to keep her body and environment clean.

She is also an active participant in politics. She contested for the panchayat elections. Initially she received an amount of thousand per month, but now for the past few years, it has been raised to ten thousand per month. But this amount is not sufficient for satisfying their household needs amidst this pandemic times. She is getting full support from her family for doing this job.

The problem faced by the women workers in the shanthikavadam is more or less the same. One of the major problems that she points out is that they did not receive their salary for the past two to three months. She stressed on the inequalities prevailing among women and men in this field.

According to her opinion, men receive a bonus of thousand while women receive a sum of hundred. There is also a move on the part of men restricting women from receiving this amount. She faces all the challenges with a positive approach.

## CASE-STUDY 8

### VINOD

Vinod is a 47 years old man working in the shanthikavadam for the past ten years. He is a native of Thiruvananthapuram. He has three daughters and a wife living with his aged parents. After his completion of pre-degree, he started doing many jobs to sustain his family. He worked as a labor in MHT Company, Chennai.

He is the only income earner in his house. Earlier he had no ambitions to achieve in his life. The death of his brother became a turning point in his life. Because of lack of property and money, he faced a troublesome situation to bury the dead body of his brother. After this incident occurred, he worked hard to earn a property.

In the year 2000, he entered into this job in shanthikavadam as a cremator. He receives initially an amount of fifteen thousand per month and also receives another incentive as a tip and bonus from the MHT Company and from the relatives of the deceased.

He very well supports and coordinates with Udayan who is another co-worker in shanthikavadam. They both are the main cremators of the shanthikavadam. He is the only cremator who bury the bodies with woods in a traditional way as per the demand of the customers.

He is very much passionate about the job, which was once proven by a true incident. Once a fire broke out, he was trapped in the room where he got suffocated from the huge fumes but courageously, he escaped from the incident. Still, he sticks on with the same job due to his strong willpower.

Due to his strong passion, he didn't bother about the societal notions about this job. He deeply understood about the reality of life. He is also concerned about the environmental issues. As he receives this job from his ancestors, he does this job wholeheartedly. He wishes to continue this job throughout his life.

## CASE-STUDY 9

### SHEELA

Sheela is a 47 years old woman who became part of the member of shanthikavadam as being a member of kudumbashree unit. She is married woman having three children and her husband who is a daily wage worker. She has been working in shanthikavadam for more than 11 years.

She is the bread winner of her family, because her job is a relief for her family to manage financial assistance. She shared an experience of fire explosion that happened at the cremation centre. But even during those difficult times she faced all challenges with immense courage. She explained about the sewage disposal system.

As a member, she too have experiences which has revealed the stigmatized approach towards these people. Early, her husband shows some uninterest for working her in the crematorium. But later on, he understood the fact that each job has its dignity.

She shared awkward where the relative of the deceased person who gave her bonus with left hand and she as a believer of superstitious practices viewed as kind of negligence. She is a strong lady with huge will-power and determined mind. She also criticized the government for not providing the needful incentives.

## CASE-STUDY 10

### BABY

Baby is the famous cremator in Ernakulam district, Kochi --- who is an icon of women empowerment. She is a 57-years old and has been doing this job for the last 30 years. She is doing the work of a cremator in the church St. Basilica Lady of Our Snow famously known as Manjumatha church located at Pallipuram. She inherited this job from her mother Annakkutty who was also a mortician in Manjumatha church.

It was baby's family members who had done this work as an ancestral job where at the beginning it was her uncle who performed the job and later after the death of her uncle, it was taken by her mother Annakkutty. After the death of her mother, Baby took up this job. Currently, she is the only cremator in that church. She is a widow and now she is living with her sister's children.

For economic independence, baby is still doing this job though this job has many challenges. She is continuously receiving pressure from different facets of society as the natives of that place believed that this is to be a job done by men folks. She has received and is receiving monetary benefits from the church. She receives an amount of thousand for each cremation work.

She does many other church-related works such as cleaning and many other works considered by the society as inferior. She has no other member to support her in doing those works. The members of the church believe that she is receiving good monetary benefits so that she is continuing with this job.

Initially when she took up this job, she faced many challenges from the society because it is a male centric society. Church members are not too considerate about her. Baby being the female worker in the church, because they think that the earning that she makes from the church, is enough for a moderate living. Initially, baby was excluded from the community programs but gradually with the pace of time, society

accepted her as no one else is there to replace her in doing grave digging. Gradually, with the intervention of media, who published about her activities to the outside world, which made her famous in her locality and also in the district of Ernakulam.

Later on, many media persons also approached her to understand her biography which later on created disturbances for her though partially it made her famous. But this continuous intervention of media started defaming her sisters' children with whom she is living at present so baby also considers the continuous intervention of media to be a burden for her in the society. She is a bold woman who is self-reliant.

**CHAPTER- 6**  
**FOCUS GROUP DISCUSSION**

## FOCUS GROUP DISCUSSION

The case studies were held through focus group discussion. The people I met through google meet, immensely contributed their part by explaining their suffrages along with the functioning of their job. For the studies of shanthikavadam, the whole team contributed their part of answering extensively. This helps to understand their situations in an in-depth manner. Major share of workers were women, which gives immense joy to see how much they were empowered financially. One among the co-workers like Sajitha and Vinod both have stated that --- amidst the pandemic they all were severely hit by First wave, Second wave and by Third waves of pandemic like any other common humans.

Amidst these uncertainties, they were supposed to work. Because their job of cremating bodies was necessary during the first wave and second wave of covid 19 pandemic. They have stated that during the second wave of covid they were supposed to bury 45 dead bodies per day. It was a hectic job, because of which they couldn't make use of their recreational time. The covid has break down them emotionally. Still, they strive to be committed to their work.

People of shanthikavadam is of the opinion that there still prevails a lack of implementation and allocation government policies for their upliftment. They have argued that the government authorities of Kerala are ignorant about their pathetic state of social-economic-psychological conditions of morticians in our society.

From the Vedic period onwards we can view through the historical texts describing how people who have done this job were segregated and marginalized from the mainstream of societies. They were generally termed and belong to Shudras from Shudra communities. It is the morticians who retrieves the deceased persons and does all the funeral duties, but they lives and their pathetic societal status is an untapped areas of interest.

Hence, the discriminatory and stigmatized approaches towards them should be removed from the regressive mindset of major share of people. They are to be considered as individuals and their work should also be treated with huge respect. Each one of us should foster inclusion, acceptance, and recognizing them as individuals. Their presence and their job require huge respect and the society should give them proper recognition

**CHAPTER-6**  
**ANALYSIS AND FINDINGS**

## ANALYSIS AND FINDINGS

- Most of the morticians under my case study belongs to the age group 40 to 65 years.
- Out of the ten cases, 7 of them are married and live along with their partners and their children.
- One among of them is a widow and the other two are spinsters.
- Seven of them own their own houses and two of them live in a rented house and one lives with her relatives.
- Most of them do not have even primary education.
- The highest educational qualification attained among the members is pre-degree.
- All of them belong to a poor economic background and most of them took up this job to attain a financial stability.
- Some of them are the only source of income in their families.
- The present social status of the workers has been affected by this pandemic.
- Each day, they have to deal with 45 dead bodies during the second wave of the covid pandemic and is so hectic for them.
- Compared to pre-covid times, they are not even receiving the needful annual leaves for maintaining their health.

- The government officials and the society which is not giving them appropriate recognition for their work.
- When compared to the male morticians, women are facing more mental pressure and depression.
- The social status of the workers has improved a lot when compared to the initial status which was low.
- Financial independence gives a woman more respect in the society.
- Most of them had done many petty jobs like tailoring, plumbing, household labors, etc, before taking up this job.
- From the historical period, cremation works were reserved for men especially belonging to a lower section of society but now the pattern has been changed which has included female workers.
- They have good working conditions compared to earlier days.
- They have access to all basic requirements such as restrooms, break times and other required things needed for a crematorium worker.
- During the initial days, they had no access to technological advancements but now the records have been computerized.

- Each cremator has to work for three to four hours daily.
- They also engage in other part time jobs after their work.
- Along with the salary, they also receive an extra payment and bonus from the relatives bringing the dead bodies to cremate.
- But the women workers receive less than what the male workers receive which clearly depicts the gender inequalities and discriminations existing in such workplaces.
- The workers are provided with provisions for re-creation facilities.
- The workers are provided with uniform. But they are not provided with any other extra requirements according to their needs.
- Many of the workers indulge themselves in part time jobs for increasing their standard of living
- This is because very few workers are the only income source in their houses. Amidst these uncertain times, if they need to meet their incurring heavy expenses, they need to incorporate other labor-works.
- During these pandemic times, the annual amount of 10,000 seems not enough to lead a healthy life.
- The pandemic had brought a significant amount of insecurities among these workers with regards to their payments.

- It is not sufficient to meet their daily chores.
- From the Vedic period onwards, people used to treat this job as an inferior one which is supposed to be done by the lower section of the individuals.
- This pattern can be seen among these workers because most of them are belonging to the lower section of the society.
- From my case study, it is found that most people don't seem to get an interest to pursue this field of a career.
- This itself vividly shows how stigmatized these jobs are still prevailing in this society.
- From my study, it is very clear that there lies a huge gender discrimination prevailing in jobs like these.
- Majority of the male population are receiving comparatively higher income and bonus than the female workers.
- During this pandemic, we can observe that many people have been affected by financial crises which made their lives still stand.

- Likewise, these people also suffered a lot during the first wave by cremating more than 45 dead bodies daily without even considering their health conditions.
- These people are not recognized by the government, and therefore, there is a lack of proper implementations in the planned programs with regard to the working conditions of the morticians in and around the crematorium.
- The women morticians are receiving a sum of ten thousand rupees while the male cremators in the shanthikavadam earns an amount of fifteen thousand monthly.
- Some of them have inherited the job from their ancestors whereas others voluntarily joined for this job.
- Difference was seen in the pre-cremation rituals based on religion, caste and regions.
- All of them work in the unorganized sector so that they have no works security.
- Even though the work is challenging, workers have incorporated themselves to work with more enthusiastic approach.
- They have to work all the day because there is no provision for holidays, entertainment and leisure which is completely absent in their lives.

- The women workers in the Shanthikavadam coordinated by the Kudumbashree unit and the male workers are recruited by the Chennai based MHT Company.
- There is no pension scheme for those who retire from the cremation works.
- The salary that they are earning is not sufficient for taking loans or other financial assistance.
- Debts are one of the reasons for the workers to stick on to this job.
- They do not believe in superstitions; they are more empirical.
- They believe that we should only fear the alive beings and not the dead bodies.
- The under-takers are concerned about the environment. They give much priority to cleanliness and are eco-friendly in nature, as they claim.
- Most of the cremators first faced rejection from their family members when they joined for this job.
- Gradually, their notion of considering these jobs as inferior one was later accepted with huge respect.

- The only query, these individuals raised is about--- the inadequate government policies for the upliftment of the cremators.
- They have submitted a letter directly to the Chief Minister of Kerala, but didn't receive rightful response or no response.
- The state government and the concerned medias are ignorant to recognize, to include, to respect these people and their suffrage faced during these difficult times.
- The media journals fail to acknowledge their issues and worries to the outside world.
- There are no adequate government policies for the upliftment for the cremators.
- The cremators are not aware as much about the policies and programs which benefit them.
- Most of the cremators are not bothered about their health. They are unaware and do not bother about their usage of safety measures like wearing masks, gloves, etc, while cremating.
- But now, because of this pandemic, they are cautious about their health.

- The cremators in the organization do not face any sort of sexual harassment from the male workers.
- During the period of spreading contagious diseases like Nipah virus, it becomes a threatful situation for the cremators.
- There are two types of cremating methods, the first is of using wood, which has been used since Vedic age onwards.
- The new method is of electorial crematorium using electricity.
- In short, when we go through the historical texts, it is clear that there still lies a huge demarcation between male and female workers.

CHAPTER-7  
CONCLUSION

## CONCLUSION

Throughout history, one of the biggest taboos that we, as a society have faced, is that the concept of death. Even in India, death is seen as tragedy and all those associated with it are seen as unclean and impure. While for the family, this is temporary, for the people who handle the bodies daily, it was a permanent stigma, making them 'untouchables' during the Vedic period. In modern era, the stigmatized approach has been removed to a huge extent but these people are more often ignored by the mainstream societies and the concern authorities.

Within the cultural context of India, it seems that individuals rarely acknowledge the morticians. Morticians spend much of their working hours with the dead. Society fails to acknowledge much of the psychological distress they experience. Stress is an inevitable component of life, and comes in variety of shapes and forms, with varying prominence, due to organizational focus shifting to enhance well-being and focus on increasing productivity among workers.

Another inevitable acute stressor in our lives is death. Death is the only certainty of life, brings with it the idea of loss, grief, anger, depression and so on all of which irreversibly alter us. This research paper aims to therefore understand these repercussions on a specific population of individuals, morticians, a large chunk of whose everyday stress itself is the handling of death, loss and grief. But at the same time morticians face social stigma.

It is thus important that we study not only the presence, but also the intensity of such stigma as well as understand if and what sort of coping mechanisms are employed by the workers. This will better help to map how the support systems required for them to thrive and succeed at their jobs.

CHAPTER – 8  
SUGGESTIONS

## SUGGESTIONS

I, hereby put forward some suggestions to improve the lives of morticians. They are mentioned as follows

### 1. Improving and considering the mental health

As they are constantly involved in the burial activities, they have a chance of falling into mental depression. Hence the NGOs along with Government should provide them medical assistance and should provide them with healthier working conditions along with support them financially.

### 2. Removal of social stigma

Each job has its own dignity. Whether it is sewage cleaning, domestic labours, plumber or even whether it is a mortician job. The above stated jobs are often seems to hesitate to provide the needful respect and recognition. Thus, these jobs should also be considered with equal standard. Therefore, such stereotypes should be changed and we should understand the very fact of being considered and included to the so-called “standards of job”.

### 3. Proper waste management

The workers are untrained and unaware in handling with hazardous wastes. They are discarding wastes into landfills, ponds thus potentially contaminating ground water and soil. Thus, they should be trained for the proper waste disposal system. Because the pandemic has brought a new awareness to maintain a hygiene lives to stay healthy.

### 4. Participation of NGOs

Active participation of NGO Agencies is necessary. Should enact some awareness programmes on health, cleanliness, ensuring better living conditions for the morticians. NGOs should actively conduct awareness classes for maintaining proper health amidst this pandemic.

## 5. Implementation of Government policies

Government should take the initiation to implement programmes and measures to ensure the betterment of morticians or funeral directors. Government along with NGOs should cordially join in the process of directors. Government should bring-forth favourable policies that must accelerate

- a) Subsidized loan facilities
- b) Need for the salary expansion amidst this pandemic.
- c) Pension schemes to increase the social and economic status of workers in the cremation centres.

## 6. Protection of female workers in the cremation centres

The concerned authorities of the organization must make sure that the female cremators are treated well.

## 7. Functions to be performed by the concern authorities of the cremation centre.

The concerned authorities of the organization should assure job security especially to female funeral directors. Organization should also grant maternal leaves. The organization should forefront child care facilities to minimum truck load of work for the female cremators. It should envision certain provisions to provide them with medical allowances. They should also be given training in electrical crematorium.

## 8. Counselling practices

To ensure informed decisions and procedures within the crematorium and also among the workers.

## 9. Both government and organizations should identify all the awareness strategies for morticians. They should monitor whether cremators are provided basic infrastructural facilities.

10. Morticians must be permitted with pension schemes by the concerned authorities of the organization they are working with.
11. As the work of morticians is a service to the society, which should be redefined by providing the proper recognition by the society.
12. Attempts has to be made to redefine their work by shifting its emphasis from body handling to providing important and necessary service for the living.
13. Amidst this pandemic their salary should be increased in order to cope up with the difficult situations.
14. Morticians should practice role professionalism to overcome social stigmas.

In conclusion, society should change their dimensions of considering morticians as untouchable, irrelevant excluded groups, because they too are humans with same emotions and dignity.

CHAPTER - 9  
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CHAPTER-10  
APPENDIX

## APPENDIX

Online Interview Schedule for collection of data from crematorium

- + Name
- + Gender
- + Age
- + Working hours
- + Nature of residence (rented home/ own home/ residing with cousin relatives)?
- + How did you come across this job, whether by lineage, or whether through any other organization?
- + Have you taken any special training before joining this job?
- + How many years have you been in this profession?
- + Is your job permanent?
- + Whether have you all engaged to any substitutive part-time jobs?
- + Did you all receive any incentives or pension as part of this job from government or any other organizations?
- + Will the customers provide you any additional money for your work?

- # Are your basic needs satisfied through the salary you receive from your job?
- # Are you a member of any organization or association? If any mention the organizations name?
- # What was your family's response on taking up this job in the crematorium?
- # Have you ever gone through discrimination from the society for performing this job?
- # During this pandemic period, have you faced any health issues due to the hectic workload?
- # Does the constant sight of dead bodies and mourners create any mental anxieties and stress in you?
- # Are you facing any emotional and psychological illness?
- # Do you feel contentment in doing this job?
- # Which all types of cremation methods have been used in the crematorium (whether it is an electric cremation or wood or grave digging)?
- # Do you cremate the dead bodies of people from different religious and cultural backgrounds?
- # Are your children interested in taking up the job after them?
- # Are you getting necessary basic amenities like food, sanitation facilities, clean drinking water in the workplace amidst this pandemic time?

- # Have you faced any sort of abuse or maltreatment in the workplace?
- # Does any governmental officials or other organizational authorities come for inspections in your workplace?
- # Do you follow the traditional funeral rites while cremating the bodies?
- # Have you noticed any changing trend in the funeral rites?
- # Are you keeping the proper record of the cremated bodies and their causes of deaths using computerized techniques?
- # Do you follow universally approved methods of keeping yourself clean and safe while doing this work?
- # Do you think that the job of a mortician is gender based?
- # Do you have a stigmatized approach if it is impossible for the women section to perform these works?
- # Do the female relatives also accompany the dead bodies to the funeral grounds these days amidst the pandemic time?
- # Does your cremation technique have any bad impact on the environment?

**A STUDY ON THE PUBLIC DISTRIBUTION  
SYSTEM DURING COVID-19 PANDEMIC  
WITH SPECIAL REFERENCE TO RURAL  
AREA**



By

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MARCH 2022



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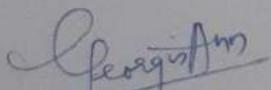
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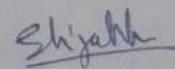
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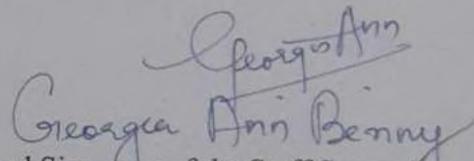


  
**Elizabeth Abraham**  
Name and Signature of the  
Head of the Department

**MARCH 2022**

## CERTIFICATE

I certify that the thesis entitled “ **A STUDY ON THE PUBLIC DISTRIBUTION SYSTEM DURING COVID-19 PANDEMIC WITH SPECIAL REFERENCE TO RURAL AREA**” is a record of bonafide research work carried out by **SREELAKSHMI V S** under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology.

  
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March 2022

## ACKNOWLEDGEMENT

In this humble endeavour I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Dr. Sr. Vinitha CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

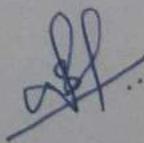
I take this opportunity to express my gratitude to Smt Elizabeth Abraham, Head of the Department of Sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Smt Georgia Anna Benny for her constant guidance and inspiration without which the work not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's College (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam  
March 2022



Sreelakshmi V S

## DECLARATION

I, **SREELAKSHMI V S** hereby declare that the thesis entitled "**A STUDY ON THE PUBLIC DISTRIBUTION SYSTEM DURING COVID-19 PANDEMIC WITH SPECIAL REFERENCE TO RURAL AREA**" is a bonafide record of independent research work carried out by me under the supervision and guidance of **GEORGIA ANNA BENNY**. I further declare that this thesis has not been previously submitted for the award of my degree, diploma, associateship or other similar title.

ERNAKULAM  
MARCH 2022



SREELAKSHMI V S

# CONTENTS

## CHAPTER

INTRODUCTION.....	1-19
REVIEW OF LITERATURE.....	20-33
METHODOLOGY.....	34-36
DATA ANALYSIS AND INTERPRETATION.....	37-65
FINDINGS AND CONCLUSION.....	66-68

## BIBLIOGRAPHY

## APPENDIX

## LIST OF TABLES

TABLE NO.	TOPIC	PAGE NO.
4.1	TABLE SHOWING THE AGE OF THE RESPONDENTS	37
4.2	TABLE SHOWING THE FAMILY INCOME OF THE RESPONDENTS	42
4.3	TABLE SHOWING THE NUMBER OF HOUSEHOLD MEMBERS	44
4.4	TABLE SHOWING THE NUMBER OF YEARS OF RATION CARD POSSESSION	46

## LIST OF FIGURES

FIGURE NO.	TOPIC	PAGE NO.
4.1	GRAPHICAL REPRESENTATION OF SEX OF THE RESPONDENTS	38
4.2	GRAPHICAL REPRESENTATION OF EDUCATION LEVEL OF THE RESPONDENTS	39
4.3	GRAPHICAL REPRESENTATION OF MARITAL STATUS OF THE RESPONDENTS	40
4.4	GRAPHICAL REPRESENTATION OF OCCUPATION OF THE RESPONDENTS	41
4.5	GRAPHICAL REPRESENTATION OF TYPE OF HOUSEHOLD	43
4.6	GRAPHICAL REPRESENTATION OF TYPE OF RATION CARD	45
4.7	GRAPHICAL REPRESENTATION OF EXPENSES INCURRED ON ACQUISITION OF RATION CARD	47
4.8	GRAPHICAL REPRESENTATION OF USAGE OF RATION CARD BY THE RESPONDENTS	48
4.9	GRAPHICAL REPRESENTATION OF POSSESSION OF RATION CARD	49
4.10	GRAPHICAL REPRESENTATION OF ALLOCATION OF COMMODITIES FROM RATION SHOPS	50

4.11	GRAPHICAL REPRESENTATION OF ALLOCATION OF COMMODITIES FROM RATION SHOPS DURING COVID-19 PANDEMIC	52
4.12	GRAPHICAL REPRESENTATION OF PRICING OF COMMODITIES	54
4.13	GRAPHICAL REPRESENTATION OF QUOTA OF COMMODITIES FOR ANY MONTH AWAITED	55
4.14	GRAPHICAL REPRESENTATION OF MISSAPPROPRIATION OF QUOTA FOR A MONTH	56
4.15	GRAPHICAL REPRESENTATION OF IRREGULARITIES IN MAINTENANCE OF RATION CARD	57
4.16	GRAPHICAL REPRESENTATION OF REASONS BY PDS DEALERS FOR NOT GIVING FULL QUOTA	58
4.17	GRAPHICAL REPRESENTATION OF AVAILABILITY OF BENEFITS AND SUBSIDIES FROM RATION SHOPS	59
4.18	GRAPHICAL REPRESENTATION OF FAMILY MEMBERS VISITING RATION SHOPS DURING COVID-19 PANDEMIC	60
4.19	GRAPHICAL REPRESENTATION OF QUALITY OF FOOD GRAINS	61
4.20	GRAPHICAL REPRESENTATION OF ATTITUDE OF THE PDS DEALER	62
4.21	GRAPHICAL REPRESENTATION OF INFORMATION SHARED BY THE PDS DEALER REGARDING THE POLICIES AND SCHEMES BY THE GOVERNMENT	63

4.22	GRAPHICAL REPRESENTATION OF SATISFATION ON THE FUNCTIONING OF THE PDS OUTLET	64
4.23	GRAPHICAL REPRESENTATION ON RATING OF OVERALL FUNCTIONING OF THE PDS OUTLET	65

# **INTRODUCTION**

## INTRODUCTION

One of the main physiological needs of human being irrespective of their class and status is food. The basic requirement like clothing, shelter and access to food is mandatory for every person in the society. Thus food is considered as the basic requirement for the existence of human beings and every individual owns a fundamental right to be free from hunger. Thus, Food Security is determined as a basic element that eliminates poverty through the assurance of food grains available to households both financially and physically while economic growth is the most important factor to achieve the sustainable development by reducing the poverty and through attainment of self sufficiency in food. Food security and economic growth interact with each other in a mutually reinforcing process over the course of development.

According to World Bank 1986, the term Food Security defined as “access by all people at all times to sufficient food for an active and healthy life”

World Food Summit (1996), defined Food Security as “When all the people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary need and food preferences for an active and healthy life”.

### **Food Security**

Food security ensures when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security has three important and closely related components, which are availability of food, access to food, and absorption of food. Food security is thus, a multidimensional concept and extends beyond the production, availability and demand for food. Ensuring food security is the basic goal of social justice, apart from development of adequate human resources.

Components of Food Security:

1. Production and procurement.
2. Storage
3. Distribution.

All these functions are performed through the PDS (Public Distribution System). PDS is operated under the joint responsibility of the Central and the State governments. The Central government, through Food Corporation of India (FCI), has assumed the responsibility for procurement, storage, transportation and bulk allocation of food grains to the State governments. The operational responsibility including allocation within State, identification of eligible families, issue of ration Cards and supervision of the functioning of Fair Price Shops (FPSs) etc., rests with the State governments.

India accounts for 16.7 per cent of the world's food consumers. India's size in terms of food consumers is many times larger than the average size of the rest of the countries, except China. Improving food security ought to be an issue of great importance for a country like India where one-third of the population is estimated to be absolutely poor and one-half of children malnourished in one way or another. According to World Food Programme that rise of prices 87 per cent for food grains, 58 per cent for dairy products, and 46 per cent for rice created a crisis situation which threatens to plunge more than 100 million people on every continent into hunger is called 'silent tsunami'. A number of countries have been facing riots for food. According to CNN-IBN report in 2009, even farmers are the producers of food grains but are selling their wives into flesh trade to survive a few more days of living with that two-meal a day life. Hunger, and malnourishment that accompanies it prevents poor people from escaping poverty because it diminishes their ability to learn, work, and care for themselves and their family members.

Food insecurity exists when people are undernourished as a result of the physical unavailability of food, their lack of social or economic access to adequate food, and inadequate food utilization. However according to FAO, food insecurity exists when all people, at all times, do not have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and nutritious and preferences for an active and healthy life. In other words food insecurity has limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways. Hunger is potential consequences of food security and, is defined as an uneasy or painful sensation caused by lack of food. The food insecurity is may occurs of two types, transitory and chronic. The transitory food insecurity may occur due to natural clematises and

anthropogenic factors such as flood, drought, earthquake, war, riots, erosion of income sources, price rise and so on. The chronic (hidden) food insecurity refers to a situation in which people consistently consume diets inadequate in calories generally by women, children (particularly scheduled tribes, and scheduled castes) in rural masses, and referred to as Chronic Energy Deficiency (CED). If an adult man takes caloric intake less than 1890 calories in a day for long time, he may be a victim of chronic food insecurity. Food insecurity is responsible for poor health. In the study conducted by Ayres and McCalla in 1996, have concluded in their study, that nearly 75 per cent of poor and undernourished people live in rural areas where food itself is produced.

### **History of Public Distribution System**

PDS was introduced after 2nd World War due to severe food shortages in the country. Initially, the subsidy was common to all. In 1990's, PDS was restructured to include hilly and inaccessible areas. Finally, the scheme was moved with a targeted approach and is known as Targeted PDS (TPDS). Under Essential Commodities act 2001, Public distribution system order was passed. It governs rules regarding identification of beneficiaries and commodities to be included for PDS. Department of rural Development through BPL survey decides criteria for inclusion or exclusion of beneficiaries. Finally, individual states identify the beneficiary households. Central govt. allocates food grains as per list prepared by NITI Aayog (erstwhile Planning Commission) based on families of BPL category to each state. Enactment of Food security Act, 2013 has done away with the need for BPL based identification.

PDS in India Public Distribution System is considered as principal instrument in the hands of Government for providing safety net to the poor and the downtrodden. The system serves triple objectives namely protecting the poor, enhancing the nutritional status and generates a moderate influence on market prices. The focus and coverage of PDS have changed widely over the years. Initially during world war civilian consumption was restricted so as to divert food items to meet the food requirement of defence forces. Subsequently frequent occurrence of drought throughout the country made the planners to think on food shortages. In order to overcome this shortage ration system was came in to existence. FPS was opened to distribute the items of

mass consumption in urban areas. Thereafter, it was extended to rural areas. From the year 1992 Revamped PDS was introduced in those areas where Drought Prone Area Programme and Dessert Development Programme were in operation. Under this system people were allowed to purchase essential items from the FPS at relatively much lower subsidized rates. After, the Chief Ministers Conference held in July 1996, a revised scheme known as Targeted PDS was introduced countrywide with a network of 4.74 lakh FPS. Under this system two-tier subsidized pricing system by classifying the cardholders is followed. Cardholders are classified as Above Poverty Line (APL) and Below Poverty Line (BPL). The BPL families are entitled to receive the essential commodities at a price, which is very closer to the economic cost. BPL families are identified based on the methodology Page no.169 given by Lakdawala Exert Group on estimates of poverty. The TPDS was further liberalized in December 2000, and was renamed as Antyodaya Anna Scheme. Under this scheme the poor was further classified as the 'Poorest Among the Poor' and other living 'BPL'.

### **Categories of Public Distribution System in India**

There have been monumental changes in the current Public Distribution System since its inception.

#### **Revamped Public Distribution System (RPDS)**

The Revamped Public Distribution System (RPDS) was launched in June, 1992 with a view to strengthen and streamline the PDS as well as to improve its reach in the far-flung, hilly, remote and inaccessible areas where a substantial section of the poor live. It covered 1775 blocks wherein area specific programs such as the Drought Prone Area 1 Paddy Procurement Centers (PPCs) operated by the PACS 2 Odisha State Co-operative Marketing Federation 3 National Agricultural Co-Operative Marketing Federation 5 Programme (DPAP), Integrated Tribal Development Projects (ITDP), Desert Development Programme (DDP) and certain Designated Hill Areas (DHA) identified in consultation with State Governments for special focus, with respect to improvement of the PDS infrastructure. Food grains for distribution in RPDS areas were issued to the States at 50 paise below the Central Issue Price. The scale of issue was up to 20 kg per card. The RPDS included area approach for ensuring effective reach of the PDS commodities, their delivery by State Governments at the doorstep of

FPSs in the identified areas, additional ration cards to the left out families, infrastructure requirements like additional Fair Price Shops, storage capacity etc. and additional commodities such as tea, salt, pulses, soap etc. for distribution through PDS outlets.

#### Targeted Public Distribution System (TPDS)

In June 1997, the Government of India launched the Targeted Public Distribution System (TPDS) with focus on the poor. Under the TPDS, States are required to formulate and implement foolproof arrangements for identification of the poor for delivery of food grains and for its distribution in a transparent and accountable manner at the FPS level. The scheme, when introduced, was intended to benefit about 6 crore poor families for whom a quantity of about 72 lakh tons of food grains was earmarked annually. The allocation of food grains to the States/UTs was made on the basis of average consumption in the past i.e. average annual off-take of food grains under the PDS during the past ten years at the time of introduction of TPDS. The quantum of food grains in excess of the requirement of BPL families was provided to the State as 'transitory allocation' for which a quantum of 103 lakh tons of food grains was earmarked annually. Over and above the TPDS allocation, additional allocation to States was also given. The transitory allocation was intended for continuation of benefit of subsidized food grains to the population. Above the Poverty Line (APL) as any sudden withdrawal of benefits existing under PDS from them was not considered desirable. The 6 transitory allocation was issued at prices, which were subsidized but were higher than the prices for the BPL quota of food grains.

#### PDS for General BPL

The BPL survey of the government is based on certain indicators to assess the economic status of the households. In this context, the identified BPL family is issued a ration card by the department of food supplies and consumer welfare to avail the essential items on monthly basis. Besides, the government also creates space of different subsidized policy to the beneficiaries within the same scheme by looking into the matters of vulnerability on different aspects.

### PDS for APL

The families found above the poverty line through the BPL survey are the APL families. When an APL family is issued a ration card by the department of foods supplies and consumer welfare, by that time the family becomes a beneficiary under the APL scheme. Usually, the subsidized prices for the essential items under the scheme are almost same with the prices of other schemes except the food grains prices.

### Antyodaya Anna Yojana (AAY)

AAY is a step in the direction of making TPDS aim at reducing hunger among the poorest segments of the BPL population. A National Sample Survey Exercise points towards the fact that about 5 % of the total population in the country sleeps without two square meals a day. This section of the population can be called as “hungry”. In order to make TPDS more focused and targeted towards this category of population, the “Antyodaya Anna Yojana” (AAY) was launched in December, 2000 for one crore poorest of the poor families. AAY has been expanded multiple times thus increasing its overage to 2.5 crore households. AAY contemplates providing poorest of the poor families food grains at a highly subsidized rate of Rs.2/per kg for wheat and Rs. 3/per kg for rice. The States/UTs are required to bear the distribution cost, including margin to dealers and retailers as well as the transportation cost. Thus, the entire food subsidy is being passed on to the consumers under the scheme.

### Annapurna Yojana

The beneficiary under the scheme is not a family rather an individual. An individual being a helpless, destitute, widow, divorced or same tune of plight is considered a beneficiary under the scheme and gets free of food grains of a certain quantity.

## **Goals of PDS**

The goal of PDS does not restrict itself with the distribution of rationed articles. Making available adequate quantities of essential articles at all times, in places accessible to all, at prices affordable to all and protection of the weaker section of the population from the vicious spiral of rising prices is the broad spectrum of PDS.

The goals of PDS are:

- Make goods available to consumers, especially the disadvantaged / vulnerable sections.
- Check and prevent hoarding and black marketing in essential commodities.
- Rectify the existing imbalances between the supply and demand for consumer goods. Ensure social justice in distribution of basic necessities of life.
- Even out fluctuations in prices and availability of mass consumption goods.
- Support poverty-alleviation programmes, particularly, rural employment programmes, (SGRY/SGSY/IRDP/ Mid day Meal Scheme.

## **PDS under Five Year Plans**

The real aim of First-Five year plan was essentially guided by the consideration of price stability for consumers in the urban areas.

This trend continued in the Second- Five year plan which emphasized on building food reserve to moderate prices fluctuations and to meet emergencies.

The Third-Five year plan recognized some of the factors inhibiting the implementation of the food policy specially storage and warehousing facilities etc.

The Fourth-Five year plan continued the trend and further got caught up in ideology of cooperatives replacing Fair Price Shops (FPS) instead of emphasizing the need for making food grains available to all the poor at affordable prices.

The Fifth-Five year plan used PDS as an instrument to discourage speculative activities in the area of trading and minimizing any sizeable subsidy burden on the

public exchequer. On July 1, 1979 the Union Government inaugurated the production-cum-distribution system.

The Sixth-Five year plan (1980-85) made a general reference to the need for the PDS to play a major role in ensuring supplies of essential commodities to consumers at reasonable prices. It promised that the PDS would be so developed that it would remain a stable and permanent feature of the strategy to control prices and to achieve equitable distribution.

The Seventh-Five year plan recognized the PDS as a permanent feature of the strategy to control prices, reduce fluctuations and achieve an equitable distribution of goods (Planning Commission, 1985).

The Eighth-Five year plan focused to make PDS more efficient by proper targeting and exclusion of non-poor segments of the population (Planning Commission, 1992).

The Ninth-Five year plan (1997-2000) aimed at achieving various objectives such as maintaining supplies in PDS, monitoring the prices of commodities of common consumption, enforcing various control orders under Essential Commodities Act, 1955 and strengthening the consumer movement in the country.

The Tenth-Five year plan (2002-07) emphasized on introducing two-tier price scheme under public distribution system which will weed out bogus cards in circulation. The objective therefore, should be to reduce the subsidy burden of the Government without affecting the interests of the poor and downtrodden. It aimed at strengthening of price monitoring cell for supervision, scrutiny and reporting of the prices & trend analysis of price situation; monitoring cell for public distribution system for close monitoring of the functioning of the public distribution system & prevention of malpractices; analytical laboratory for improving quality control measures & analysis of food articles and assistance to voluntary consumer organization for consumer education and protection. Since then, the Indian government has been using the public distribution system as a deliberate policy instrument to overcome chronic food shortages apart from using it for stabilizing food prices and consumption in view of fluctuating food production in the country.

## **PDS Management**

Management structure of the PDS in India includes policy formulation, fixing of objectives, strategy for procurement and distribution of foodgrains and other essential commodities. The operational details of PDS differ from state to state. Though the policy of setting up Fair Price Shops owes its initiation to national food policy, its implementation remains the direct responsibility of the State Governments. The centre plays a prominent role in procurement, interstate movement of cereals and in determining the support prices which is the basic factor influencing the PDS issue price in the state. In order to operate the PDS effectively, the central government also issue from time to time guidelines to the states, regarding the operational details of the PDS. Of course, the central guidelines have been taken into account, but the decisions have been those of the state government. These include the commodities to be brought under PDS, ration scales, number, location and licensing of FPS, the terms and conditions for the FPS authorisation and methods of supplying, checking, remunerating FPS dealers etc. Setting up of an effective delivery system, granting fair and equitable access at a low administrative cost and in accordance with the needs of the local population at various places depends upon a large number of administrative and organisational details and many subsidiary policy decisions. Apart from the decisions taken at the state level, these decisions also taken at the district, block, at FPS level and play their part in determining the availability cost and benefits of access to the PDS.

## **National Food Security Act (NFSA)**

### **National Food Security Act, 2013**

As passed by the Parliament, Government has notified the National Food Security Act, 2013 on 10th September, 2013 with the objective to provide for food and nutritional security in human life cycle approach, by ensuring access to adequate quantity of quality food at affordable prices to people to live a life with dignity.

The Act provides for coverage of upto 75% of the rural population and upto 50% of the urban population for receiving subsidized food grains under Targeted Public Distribution System (TPDS), thus covering about two-thirds of the population. The eligible persons will be entitled to receive 5 Kgs of food grains per person per month at subsidized prices of Rs. 3/2/1 per Kg for rice/wheat/coarse grains. The existing Antyodaya Anna Yojana (AAY) households, which constitute the poorest of the poor, will continue to receive 35 Kgs of foodgrains per household per month.

The Act also has a special focus on the nutritional support to women and children. Besides meal to pregnant women and lactating mothers during pregnancy and six months after the child birth, such women will also be entitled to receive maternity benefit of not less than Rs. 6,000. Children upto 14 years of age will be entitled to nutritious meals as per the prescribed nutritional standards. In case of non-supply of entitled foodgrains or meals, the beneficiaries will receive food security allowance. The Act also contains provisions for setting up of grievance redressal mechanism at the District and State levels. Separate provisions have also been made in the Act for ensuring transparency and accountability.

### **Salient features of the National Food Security Act, 2013**

- Coverage and entitlement under Targeted Public Distribution System (TPDS) : Upto 75% of the rural population and 50% of the urban population will be covered under TPDS, with uniform entitlement of 5 kg per person per month. However, since Antyodaya Anna Yojana (AAY) households constitute poorest of the poor, and are presently entitled to 35 kg per household per month, entitlement of existing AAY households will be protected at 35 kg per household per month.

- State-wise coverage : Corresponding to the all India coverage of 75% and 50% in the rural and urban areas, State-wise coverage will be determined by the Central Government. Planning Commission has determined the State-wise coverage by using the NSS Household Consumption Survey data for 2011-12 and also provided the State-wise "inclusion ratios".
- Subsidised prices under TPDS and their revision : Foodgrains under TPDS will be made available at subsidised prices of Rs. 3/2/1 per kg for rice, wheat and coarse grains for a period of three years from the date of commencement of the Act. Thereafter prices will be suitably linked to Minimum Support Price (MSP). In case, any State's allocation under the Act is lower than their current allocation, it will be protected upto the level of average offtake during last three years, at prices to be determined by the Central Government. Existing prices for APL households i.e. Rs. 6.10 per kg for wheat and Rs 8.30 per kg for rice has been determined as issue prices for the additional allocation to protect the average offtake during last three years.
- Identification of Households : Within the coverage under TPDS determined for each State, the work of identification of eligible households is to be done by States/UTs.
- Nutritional Support to women and children : Pregnant women and lactating mothers and children in the age group of 6 months to 14 years will be entitled to meals as per prescribed nutritional norms under Integrated Child Development Services (ICDS) and Mid-Day Meal (MDM) schemes. Higher nutritional norms have been prescribed for malnourished children upto 6 years of age.
- Maternity Benefit : Pregnant women and lactating mothers will also be entitled to receive maternity benefit of not less than Rs. 6,000.
- Women Empowerment : Eldest woman of the household of age 18 years or above to be the head of the household for the purpose of issuing of ration cards.
- Grievance Redressal Mechanism : Grievance redressal mechanism at the District and State levels. States will have the flexibility to use the existing machinery or set up separate mechanism.
- Cost of intra-State transportation & handling of foodgrains and FPS Dealers' margin : Central Government will provide assistance to States in meeting the expenditure incurred by them on transportation of foodgrains within the State, its handling and FPS dealers' margin as per norms to be devised for this purpose.

- Transparency and Accountability : Provisions have been made for disclosure of records relating to PDS, social audits and setting up of Vigilance Committees in order to ensure transparency and accountability.
- Food Security Allowance : Provision for food security allowance to entitled beneficiaries in case of non-supply of entitled foodgrains or meals.
- Penalty : Provision for penalty on public servant or authority, to be imposed by the State Food Commission, in case of failure to comply with the relief recommended by the District Grievance Redressal Officer.

## **COVID 19 Pandemic**

COVID-19 is not only a global pandemic and public health crisis; it has also severely affected the global economy and financial markets. Significant reductions in income, a rise in unemployment, and disruptions in the transportation, service, and manufacturing industries are among the consequences of the disease mitigation measures that have been implemented in many countries. It has become clear that most governments in the world underestimated the risks of rapid COVID-19 spread and were mostly reactive in their crisis response. As disease outbreaks are not likely to disappear in the near future, proactive international actions are required to not only save lives but also protect economic prosperity.

### **Covid-19 and the Economy**

On March 11, 2020, the World Health Organization (WHO) characterized COVID-19 as a pandemic, pointing to over 3 million cases and 207,973 deaths in 213 countries and territories. The infection has not only become a public health crisis but has also affected the global economy. Significant economic impact has already occurred across the globe due to reduced productivity, loss of life, business closures, trade disruption, and decimation of the tourism industry. COVID-19 may be that a “wake-up” call for global leaders to intensify cooperation on epidemic preparedness and provide the necessary financing for international collective action. There has been ample information on the expected economic and health costs of infectious disease outbreaks but the world has failed to adequately invest in preventive and preparedness measures to mitigate the risks of large epidemics.

With globalization, urbanization, and environmental change, infectious disease outbreaks and epidemics have become global threats requiring a collective response. Although the majority of developed countries, predominantly European and North American, have strong real-time surveillance and health systems to manage infectious disease spread, improvements in public health capacity in low-income and high-risk countries—including human and animal surveillance, workforce preparedness, and strengthening laboratory resources—need to be supported by using national resources supplemented with international donor funding. International collective action among governments, non-government organizations, and private companies has been advocated in building and financing technological platforms to accelerate the research on and development response to new pathogens with epidemic potential .

In the case of COVID-19, such cooperation is critical, especially for the development and production of a vaccine. The Coalition for Epidemic Preparedness Innovations (CEPI), a global partnership launched in 2017, has tracked global efforts in COVID-19 vaccine development activity and is advocating for strong international cooperation to ensure that vaccine, when developed, will be manufactured in sufficient quantities and that equitable access will be provided to all nations regardless of ability to pay. Furthermore, affected countries may benefit from exchanging technological innovations in contact tracing, such as health Quick Response (QR) codes, to manage the outbreak more effectively. However, there are important privacy implications that need to be considered. In the case of COVID-19, the collective response and adoption of preventive measures to stop the global spread were implemented too late, after COVID-19 had already penetrated other regions through international travel.

The global COVID-19 pandemic has overwhelmed India's health infrastructure and disrupted the economy. Additionally, recent data on malnutrition paints a worrying picture. India has one of the highest proportions of undernourished children in the world, in terms of both stunting and wasting. Moreover, the National Family Health Survey 2015-16 and 2019-20 rounds show that there is either a stagnation or worsening of several malnutrition indicators in several states. (The NFHS-5 data pertain to the situation before the onset of the COVID-19 pandemic.)

Studies have shown that households continued consuming less food several months after the nationwide lockdown in 2020, than before it. A survey by the Centre for

Sustainable Employment at Azim Premji University found that over 75 per cent of the households were eating less during the lockdown than before it. There was a slight recovery post-lockdown, but 60 per cent of the households still reported eating less than before the lockdown. Moreover, disadvantaged households have been disproportionately affected. For example, almost half of the informal workers in a survey said that they were eating less than before.

In this context, PDS can be all the more important to help vulnerable families tide over the pandemic-induced food insecurity.

### **PRADHAN MANTRI GARIB KALYAN YOJANA**

In 2016, the Govt. of India launched Pradhan Mantri Garib Kalyan Yojana as a part of the Taxation Laws Act 2016 (second amendment). The initial objective of the PM Garib Kalyan Yojana scheme was to ensure tax evaders declare unaccounted money and avoid penalty and criminal prosecution. Through this scheme, the govt. intended to use the deposited black money for welfare of the poor people. The scheme was valid from December 2016 to March 2017.

In 2020, the govt. extended the scheme to include relief packages during the pandemic. The aim was to support livelihood of poor during COVID-related lockdowns.

### **PM Garib Kalyan Anna Yojana**

This is the worlds' largest food security scheme launched by the Government of India to combat COVID-induced economic disruptions. The scheme aims to ensure food safety (of the poor) by providing food items including 5 kg rice/wheat per individual and 1 kg gram per family every month for free.

All beneficiaries of the targeted public distribution system (TPDS) for Antyodaya Anna Yojana (AAY) and priority household (PHH) ration cardholders are eligible for food grains under this scheme.

Key features of the scheme include the following:

- 66% of India's population was covered under this scheme
- Each one of them received double of their current entitlement.
- This additional was free of cost.
- To ensure availability of protein, 1 kg of pulses were provided to families (as per regional preferences)
- As the pandemic spread through the country, the Government of India announced the Pradhan Mantri Garib Kalyan Anna Yojana, providing 5 kgs of rice or wheat and 1 kg of pulses to eligible people free-of-cost, in addition to the regular entitlement of quota of foodgrains. The scheme was initially meant to be implemented from April 2020 to June 2020 but was later extended till November 2020. In April 2021, as the second wave of infections spread, the Government of India again announced 5 kgs of free foodgrains per person per month for the months of May and June. This was further extended till November 2021.

But, as systemic issues such as the significant exclusion errors of eligible beneficiaries persist, vulnerable families are likely to struggle to cope with the economic effects of the pandemic.

## **KERALA**

Kerala is one of the smallest states of India. The state stretches along the Malabar coast on the western side of the Indian peninsula, is sandwiched between the hills of the Western Ghats on its eastern edge, the Arabian sea on the western edge and is bordered by the states of Karnataka and Tamil Nadu.

### **PUBLIC DISTRIBUTION SYSTEM IN KERALA**

The **Civil Supplies Department** discharges the important responsibilities of Public Distribution, enforcement of markets discipline and promotion of consumer awareness and protection of their interest. In the 60s and 70s it won many accolades for the pioneering achievements in the implementation of Universal Rationing System. The Department of Civil Supplies functions under the Department of Food, Civil Supplies and Consumer Affairs of the Government of Kerala. The Commissioner of Civil Supplies is the Principal Head of the Department and Principal Advisor to the Minister in charge of Food & Civil Supplies. The Director of Civil Supplies is the administrative head of the Department of Civil Supplies. He exercises the statutory functions entrusted with him under the Kerala Rationing Order 1966, PDS (Control) Order, 2001 and other control orders issued by the Government of Kerala under the Essential Commodities Act.

The Civil Supplies Department discharges the important responsibilities of Public Distribution enforcement of markets discipline and promotion of consumer awareness and protection of their interests. The Public Distribution System came into existence in the state with effect from 01/07/1965. The state which has very high deficit in the production of food grains, the PDS has great relevance and importance. Keeping in view the importance and need of promotion of consumer awareness and protection of human rights, Government have formed a separate wing in the food, Civil supplies and Consumer Affairs Department in the secretariat to attend the subject, Consumer Affairs. Similarly a Consumer Affairs Cell has been formed in the Commissionerate of Civil Supplies also.

The functions carried out by the Department can be broadly divided into the following three categories.

1) Control of Rationing and marketing of essential commodities

In the state, which was very high deficit in the production of food grains, the PDS has great relevance and importance. Timely lifting of commodities allocated from central pool and ensuring distribution of the same through more than 14000 ration shops and ensuring timely lifting and distribution of the same is a major function of the Department. The Department keeps vigil to discourage and prevent hoardings and black marketing of essential commodities.

2) Consumer Affairs

Keeping in view the importance and need for promotion of consumer awareness and protection of their rights, Government of Kerala formed a separate wing in the Food Civil Supplies and Consumer Affairs Department in the secretariate to attend to the subject, Consumer Affairs. This wing works under the Additional Secretary to Government with supporting staff. Accordingly a Consumer Affairs Cell has been formed in the Commissionerate of Civil Supplies also.

3) Consumer Dispute Redressal Commission (CDRC) and Fora (CDRFs)

As per the Consumer Protection Act 1986, Government of Kerala set up the State Consumer Dispute Redressal Commission and the Consumer Dispute Redressal Fora at three regional places. On 03/10/1991, separate fora were established for all the 14 districts. Now the State Consumer Dispute Redressal Commission, which is the state level apex body and 14 district fora were functioning in full fledged manner.

4) Distribution of Kerosene

Distribution of kerosene is governed by the Kerala Kerosene Control Order, 1968 promulgated by the State Government under the essential Commodities act, 1955. As per this order, sufficient number of Kerosene Wholesale Dealers (KWDs) are appointed by the District Collector concerned and these KWDs lift the stock of kerosene allotted to them every month by the Departmental Officers from respective companies, IOC, BPC, IBP and HPC and make it available for distribution to the

ARDs who in turn lift the stock allotted to them and distributed to the card holders. The scale of distribution is 0.5 liters per month for electrified houses and 4 liters per month for non- electrified houses for lighting purposes. 2532 kl Kerosene is issued as for fishing purposes minimum deposit of Rs 2500 at their order.

The Civil supplies department is mainly concerned with the implementation of schemes connected with distribution of Rice, Wheat, Sugar and Kerosene. The state follows Targeted Public Distribution System (TPDS). The stock of PDS items allotted by the Central Government is distributed on the basis of family Ration Cards. The families are categorized as Below Poverty Line (BPL) and Above Poverty Line (APL).

The consumers are categorized as follows

Ration card color	Beneficiaries	Benefits
Yellow card	Most economically backward section of society and Antyodaya Anna Yojana beneficiaries	35 kg food grains per month free of cost, 1 kg sugar at the rate of Rs.21 and 500 mil liter kerosene at the rate Rs.33 per liter.
Pink card	Priority or Below Poverty Line (BPL)	4 kg rice, 1 kg wheat per head per month at the rate of Rs.2/kg, 500millilitre kerosene at the rate of Rs.33 per liter.
Blue card	Non Priority Subsidy or Above Poverty Line(APL)	2 kg rice per head per month at the rate of Rs.4/kg, 3 kg wheat flour per month at the rate of Rs.17/kg.
White card	Non Priority	4 kg rice per card at the rate of Rs.11 per kg, 3 kg wheat flour per card at the rate of Rs. 17/kg.

Due to the Covid 19 Pandemic hit the Public Distribution System in Kerala provided Special kit to all ration card holders which was actually a relief to everyone.

# **REVIEW OF LITERATURE**

## REVIEW OF LITERATURE

This chapter mainly consist of the secondary data collected in order to understand the role, relevance and effectiveness of Public Distribution System in India as well as Kerala in specific.

Bhat and Bhat (2012) conducted a study on the functioning of the Public Distribution System in Kashmir. It is referred to as the 'Kashmir Model' of Food Security Programme which was implemented, where in grains are obtained from the framers at higher price than the market price and provide them in a subsidized rate to the consumers. After accomplishing self- sufficiency in food production, the main challenge of the PDS was translating this macro level food security programme into a micro level, so that households in states which couldn't produce enough food to feed its population and depended on imports could avail of the surplus in states which produced more than what was necessary to feed their population. In their study they have concluded that, the PDS in Kashmir region is not functioning properly as per the expectation of the general public and also mentioned about the lack of vigilance from the side of the State Government on the PDS outlet owners which is resulting in to black marketing and mal practices.

Arora (2013) examined the functioning of food subsidies in India and analyzes the reasons behind the failure of the Public Distribution System in many parts of the country. She argues that the two major objectives for initiating this food security program were to provide nutritional support to the poor through subsidized and cheap food grains and maintain price stability. It has failed to reach the poor in most of the states other than the southern states like Andhra Pradesh, Tamil Nadu, and Kerala, where it has been partially successful. To improve the functioning of the system it is imperative to improve outreach and proper vigilance to be provided to reach to the inner areas of the North eastern states of the country.

In his study, Ghuman (2013) focuses on the organisation and operation of the Punjab Public Distribution System (PDS). They promoted the Public Distribution System as a helpful policy tool for supplying essential items to individuals living in poverty. Punjab contributes significantly to national wheat and rice output. According to their research, over 76 percent of food grains in Punjab were diverted to the open market, with another 13 percent going to APL families. Only 10% of the grains were delivered to the BPL recipients. Their research also detailed the fundamental flaws and flaws in the PDS's operation in Punjab.

Bora (1992) described the growth of Maharashtra's food administration. For food regulation and administration, the Bombay model was followed throughout India. Even in the most dire food crises, the British government pursued a laissez-faire pricing strategy. Until World War II, the distribution of available food grains and other important goods was entrusted to market forces, even in times of scarcity. This sparked a culture of stockpiling, profiteering, and speculating, much to the detriment of farmers and consumers, while the government was also exporting food grains at the same time. Rationing should be started immediately, according to the 1943 food grains policy. Ration stores have been established in Pune, Ahamdabad, Solapur, and Hubli, based on the Bombay model.

In Maharashtra, India, Sawant (2013) evaluated the impact of PDS on social security and poverty alleviation. They discovered that PDS was not reaching the poor and needy, therefore it was modified to Targeted PDS with the goal of ensuring food security for the most vulnerable members of society. They agree that the current state of PDS, such as low quality of good supply, weight reduction, leakages of PDS items to the open market, non-availability of commodities, and so on, has contributed to the scheme's collapse. They propose a timely supply of high-quality items, the development of accessible public facilities, the consolidation of families into a single fair-price shop, and an effective and systematic complaint-redressing process for the poor.

Kumar (2012) stated in his study that corruption at both the micro and macro levels has caused the Public Distribution System to collapse. "Consumer Clubs," a Government of India initiative launched in 2006-07 with the goal of educating youngsters about consumer rights and protecting and disseminating information about the government's different schemes. Several clubs in rural, elementary, and upper primary schools have served as watchdogs to ensure that the PDS system is functioning properly in their areas. The clubs were discovered to serve a vital role in preventing corruption and maintaining food security, but they were made non-functional owing to a lack of financial assistance.

In 32 communities, Srinivas and Thaha (2004) discussed the Alternative Public Distribution System (APDS) using the Community Grain Fund. Local Production, Local Storage, and Local Distribution are the goals of the APDS program. The gains this effort produced on food and nutrition security, fodder and fuelwood security, livelihood, and ecological security were astounding in a rain-fed semi-arid location like Zaheerabad in Andhra Pradesh's Medak district. But, more than any of these already outstanding indications, the fact that each of the 32 rural communities was governed and administered by Dalit women was a tremendous political statement made by the women of DDS sanghams.

George (1996) investigated the Indian food subsidy. According to their research, the food subsidy has two components: one for the consumer and the other for the expense of carrying buffer stock. The Food Corporation of India is responsible for procuring and issuing food grains on behalf of the Indian government (FCI). The difference between these two prices is frequently insufficient to cover the Corporation's handling costs, thus the government reimburses the FCI for the difference between the economic cost and the issue price as a consumer subsidy.

George (1999) looked at the PDS in Kerala, where it was used by 97 percent of the population. The study looked into Kerala's previous agriculture output, food availability, procurement and distribution performance, and the factors that influenced it in order to better understand the food grain system. The state shared just a minor percentage of food grain output. Because of the substantial price differential between the free market and the ration price, the quality of food grains offered through ration stores is limited. Rice was purchased in significant quantities by low-income populations. Consumer costs were significantly greater than producer expenses in the absence of restrictions. Kerala was unable to fund its own PDS due to the economic viability of its fair pricing stores.

Food subsidies, according to Grover (1998), are a formidable weapon in the government's arsenal for controlling the economy. The government's subsidy has been gradually raised over time. However, the PDS Working Group of the Eighth Plan suggested a significant cut in food grain subsidies. The Dalgi Committee (1979) also stressed the importance of social aims being subsidised. Grover's research focused on the micro level, namely the state of Haryana, Hissar, and Karnal districts. Both ration stores and cardholders were included in the PDS research. PDS's effect on the weaker sections has been noted.

Puri (2012) conducted a study of 12 randomly chosen villages in the Indian state of Chhattisgarh and discovered that the vast majority of PDS recipients are content with the way their ration stores operate and are adamantly opposed to cash transfers. Due to the lack of banks in rural India, he discovered that currency transmission was a serious challenge. The majority of respondents said that dal and cooking oil should be included in the list of products offered, in addition to the commodities in the PDS. They also advised for reducing the amount of wheat served and substituting rice in its place. It was also proposed that food grains be allocated according to the number of persons rather than the entire family.

With reference to the state of Andhra Pradesh, Tarozzi (2002) examined the Indian Public Distribution System as a provider of food security. According to him, Andhra Pradesh already had a focused and somewhat major distribution system in place before the implementation of the Targeted Public Distribution System. Andhra Pradesh began implementing the "2 Rupees per Kilogram" scheme in 1983. The recipients were given a special ration card, and their eligibility was determined by a means test.

Singh (2011) has been pointed out some of the drawbacks in the PDS-

- Lack of effective contribution towards household food security,
- Urban biased and pro-rich to its ineffectiveness in reaching the poor,
- PDS is not cost effective,
- Storage losses are very high, and
- Per capita transfer of income is very small in amount.

George (2006) focuses on a major issue proper nutrition in India. The author claims that, despite the fact that agriculture is India's primary business, the right to food bill is still languishing in the Indian parliament. In India, due to effective politicians, the right to education takes precedence, but for some reason, they have yet to provide the right to food.

In a research conducted in Maharashtra by Chandanshiv (2013), it was discovered that problems like as leakage and benefits given to the non-poor are caused by the removal of qualified recipients from the PDS list. They also stated that PDS may be rendered universal if it incorporates additional commodities like millets, grains, pulses and edible oils. They also defended the idea that PDS alone cannot meet people's food needs and argued that the poor should have access to all of the advantages of programmes like PDS. They also listed concerns arising from cash transfers, such as unfair exclusion, unjustifiable inclusion, administrative loss, and probable leakages, as examples. They suggested that currency might be used to purchase non-food items such as whiskey, undermining the basic base.

Jha (2013) investigated the weaknesses in the Public Distribution System and discussed the different ramifications of the National Food Security Act of 2011, with a particular focus on challenges of finance for guaranteeing universal food security. It has been suggested that a 'common issue price' may be a solution to limit commodity leakages and misappropriation; however, given the scale of food instability and hunger in India, food subsidies and universal grain distribution are insufficient for the population. They pushed for a system that is free of corruption, efficient, and responsible, with improved infrastructure, structural changes, the addition of additional outlets, service monitoring, and decentralisation of distribution and grievance resolution systems.

Jha also did a comparison analysis of the Public Distribution System in 2013 based on characteristics such as food subsidies, income transfers, and low participation.

Primary data was acquired from 500 homes in each of three Indian states: Andhra Pradesh, Rajasthan, and Maharashtra. According to the report, the programme is not adequately targeted, and both the poor and the non-poor benefit from the subsidies. A better network of Fair Price Shops, a bigger PDS price margin compared to the market price, appropriate supply, effective procurement, storage, and distribution, and a focus on livelihood growth prospects in rural regions may all help to assure food security.

Svedberg (2012) weighed in on the benefits and drawbacks of replacing the present PDS with a targeted and differentiated cash distribution plan. He said that such a system may help more than two-thirds of households and expand the PDS' reach into more impoverished areas. He raised worry that supplying poor households with unconditional cash will diminish labour supply while considerably increasing nutritious consumption. He also stated that an increase in the poor's income would result in inflation. To combat the usage of ghost cards, he proposed a targeted and differentiated all-India cash transfer programme based on biometric UID cards.

Based on data from the 50th wave of the National Sample Survey, Household Consumption Survey, Dutta and his colleagues. (2011) analysed the public distribution of food in two states, Andhra Pradesh and Maharashtra. The article concludes that there is a problem with commodity utilisation, population targeting, income transfer magnitude, and food subsidy cost effectiveness. In Andhra Pradesh, a substantially bigger number of individuals use PDS than in Maharashtra, and coverage is 30 percent higher. In order to enhance the system, it is necessary to research success stories and adopt best practises based on regional inequalities.

Khera (2011) examined the efficacy of India's public distribution system as a food security intervention, as well as the hurdles to its usage and effects on service consumers. She discovered that usage is quite poor, and wheat is frequently acquired on the open market at a higher price rather than using the commodities given by the 17 PDS. Her finding proposes two ideas, one based on supply and the other on demand. In the first case, the purchase is motivated by demand factors such as high transaction prices, easy availability of coarse grains, and so on. Supply-driven quantity restrictions, as well as income levels, might be the second factor. She attempts to prove that BPL households purchase PDS.

Khera (2011) also discovered that respondents got between 84 and 88 percent of their entire monthly allowance. She further argued that the PDS food grain subsidy alone is about equivalent to a week's NREGA salary every month for those living below the poverty line. Except in Bihar, where the PDS is still in bad health, a huge majority of respondents chose in-kind food transfers to cash transfers, according to her research. From a universal PDS in Tamil Nadu that delivers grains, dals, and edible oil with little leakages to a targeted PDS in Bihar where much of the grain does not even reach the rural poor, each surveyed PDS has its own distinct peculiarities.

By comparing numbers from the 61st round of the NSSO, Khara (2011) approximated the proportion of grain diverted from the Public Distribution System to the free market. She divided Indian states into three groups based on monthly per capita grain purchases and diversion: "functioning," "reviving," and "languishing." In the first category, there are seven states with a proven track record of PDS operation. There are five revival stages that have proved to boost PDS function dramatically. Eight states are included in the last group, where PDS is not doing properly. In her study, she focuses on potential methods for improving reviving states. Her study provides compelling evidence that PDS is non-functional in many areas.

Using data from the National Rural Employment Guarantee Scheme, Khosla (2011) tried to quantify the impact of caste reservation regulations on the provision of public goods and services in gramme Panchayats in Andhra Pradesh (NREGS). His results revealed that the operation of Panchayati Raj institutions is very context-dependent and is influenced by a variety of socio-political variables. This article indicates that despite not having a stake in NREGS, the advanced caste remained a significant role in power-based politics. He believes that his research will be valuable in a number of parallel areas of Panchayati Raj institutions, where scholars will strive to understand how caste-based reservations interact with politics, bureaucracy, and gender reservations.

Ray et al. (2011) looked at India's food security issues during the previous few decades and how the PDS works with various macro policies. Their research also aims to identify the demographic segments that are entitled to food security in general. They also examine the availability, storage, and purchase of food grains, as well as the performance of the PDS, identify system flaws, and devise solutions to eliminate anomalies and improve the distribution mechanism. They said that focusing on people as part of the PDS has failed to tackle the hunger problem. The failure of the goal of providing food security to the poor has been caused by the exclusion of actual recipients.

Khera (2008) looked at the Government of India's 1997 criteria for identifying low-income families. She discovered that the criteria are consistent and unchanging across the country. She gathered data from 400 randomly selected homes in eight Rajasthan villages and discovered that one-third of the BPL recipients were incorrectly included, while 44% of the eligible households were left out. She questioned the practise of using similar standards across the country while ignoring the variance of geographic and socioeconomic characteristics. She rationalised the omission of eligible homes from the BPL list by claiming that the State Government is attempting to meet the poverty objectives established by the Census Bureau. She also argues that there is a link between the two.

Tritah (2003) looked at the impact of food subsidies on food security and poverty. PDS was discovered to have a poor track record of reaching the intended audience. There is also conditional access to the PDS, with just a small portion of the population benefiting from it. Food subsidies leak out of the system and aren't used to their full potential. The study proposes a new poverty measure that would incorporate the food content of poverty lines and demonstrate that, in comparison to this poverty line, PDS has benefited the targeted group.

Ramaswamy and colleagues. (2002) investigated state institutions' inefficiencies in controlling food prices and administering the public distribution system, which had repercussions for product quality, supply chain, and recipient status. The research presents methodologies for evaluating demand shifts from PDS to open market based on commodity quality. Demand shifts will not occur as long as the market price of food grains stays greater than the price of subsidised grains, according to the findings of the study. When the open market price is comparable to the price of subsidised goods, the quality of the product becomes the deciding factor. In order to optimise procurement, the state must coordinate both the price and the quality of the grains.

Mooij (2001) investigated why the Public Distribution System in undivided Bihar failed (Now Bihar and Jharkhand). Political participation in financial misallocation, licence distribution, and card distribution resulted in a system of widespread anarchy and entrenched corruption, the origins of which are difficult to address. The open involvement of the mafia, rangdars, and the willful blindness of officials is a key factor in the disempowerment of impoverished and marginalised families who are entitled to services. It demands that the state's political and socioeconomic conditions be urgently improved in order to ensure that the benefits reach the intended populace.

The historical and political evolution of PDS in India was studied by Mooij (1998). The article discusses the early public distribution programme, which began in 1939, and the many phases it went through until the 1991 implementation of the Structural Adjustment Program (SAP). Following WWII, the British government in India implemented food grain rationing in Bombay and then in other cities. The second Food Grain Policy Committee (1947), formed after independence, attempted to modernise the system. Since 1957, the Food Grain Enquiry Committee has aided the growth of PDS by importing low-cost wheat from the United States, lowering commodity prices. The 1964 Food Grain Prices Committee advocated establishing the Food Corporation of India which still continues to function.

Balakrishnan et al. (1997) studied the effect of the quality of products provided under public distribution system on consumer switches between open market and PDS. The increase in the issue price increases the cost of PDS grain and forces the customers to switch to the open market however the effect is not always direct. Open market was found to be principle source of supply and PDS did not cover most of the households and failed to satisfy the demand. They suggested increasing the coverage of PDS to maximum households as well as improving the quality of the products so as to compete with the open market as this would help in providing food security for all.

Ahluwalia (1993) evaluated the Indian Public Distribution System's coverage and performance. His main concerns are that leakages into the free market are eating into the scheme's profits, that the program's main target, the vulnerable sections of society, is frequently left out, and that there is a disparity in rural versus urban outreach, all of which have contributed to the scheme's failure. He suggests that in the future, when determining central food grain allocation, the scheme should pay more attention to state poverty levels. The laws and procedures governing ration card procurement and use should be made more user-friendly. Rather than employing a larger number of low-quality grains, a few key locally produced grains should be included so as to reduce costs, satisfy needs and improve the general well being of the targeted population

In Kerala, Koshy (1991) studied stock diversion at sale locations. They said that even in a high-performing state like Kerala, grain has been diverted to the open market in large quantities. They propose that Fair Price store owners raise as much as the beneficiaries desire at a certain selling point. There should be improved means for beneficiaries to receive their monthly allotment without running out of supplies. They suggested that focusing the PDS on the poorest people will have better social and economic impact. It has been expected that enhancing the fair pricing shop's economic sustainability will lessen the need for malpractices.

One of the primary concerns to be addressed, according to Prahadeeswaran M. & colleagues. (2005), is the low offtake of commodities, as compared to the high cost of production and procurement. Despite a decrease in the area under food grain crops in India, yearly output increase for the two main staple grains was 3.59 percent in the 1980s and 2.28 percent in the 1990s, which was higher than the population growth rate of 1.9 percent (Economic Survey, 2003). The overall allotment of rice and wheat in 2008-09 was 26.26 lakh tonnes, although the recorded offtake was just 20.19 lakh tonnes (Department of Food and Public Distribution, Annual Report 2008- 09).

Cyriac and his colleague (2008) both the researcher had studied PDS system in Kerala. They come to the conclusion that, today the PDS in Kerala is redundant for the majority of the population, and since the subsidies come at such an enormous cost, it is definitely the need of the hour to reform and restructure the system. They are also suggesting some reforms to the PDS. That is there is a need to explore the possibility of introducing innovative ideas such as smart cards, food credit/debit cards, food stamps and decentralized procurement in order to eliminate hunger and make food available to the poor wherever they may be in a cost-effective manner.

Shunmughan and Sengottuvel (2010) find that rural people are the primary stakeholders in the Public Distribution System (PDS). India is the world's second most populous country, with the majority of its citizens living in rural regions. PDS was created as a vital component of the Indian government's economic policy to ensure that food grains are available to the public at reasonable costs and to improve food security for the poor. Establishing effective consumer groups in PDS may aid in the protection of the rural population from exploitation and, as a result, may aid in rural development.

A comparative study of India and China was conducted by Zhou and Gandhi (2005). According to their research, India and China both have a public food distribution system that provides subsidised food to its citizens, but the coverage is different. In China, the system favoured urban residents, but in India, everyone had access to government-subsidized food. However, the lack of targeting in their PDS subsidises individuals who are not poor unnecessarily, leading to the rising food subsidy. Though change has been sluggish and incremental, India has begun to pay greater attention to the poor's interests, and the PDS has become a significant instrument of the government's economic policy for improving food security for the poor.

Lang (2012) cited certain government measures aimed at modernising and computerising the PDS. There has been an effort to eliminate identifying mistakes and leakages from the PDS. The digitization of customer records and the computerization of delivery systems are at the forefront of these initiatives. With the use of information and communication technology, the Department of Food and Public Distribution has started a TPDS computerization initiative to make the system more transparent, efficient, effective, and responsible.

Ruth (2011) gave a talk about food security and India's Targeted Public Distribution System (TPDS). In his study, he stated that current yearly food supply is sufficient to feed the world's 6.9 billion people. However, even in the twenty-first century, access to and distribution of food such that people do not have to die of hunger remains elusive, making food security one of the primary worldwide concerns. Food is provided in emergencies by the Food and Agriculture Organization (FAO), the World Food Programme (WFP), and other United Nations organisations; the World Food Convention (WFC); and other Non-Governmental Organizations (NGOs).

# **METHODOLOGY**

## **METHODOLOGY**

This chapter deals with the methodology used by the researcher to study the role played by Public Distribution System during Covid-19 Pandemic with special reference to Rural area. This includes the research design and tools used for data collection.

### **STATEMENT OF THE PROBLEM:**

PDS in India Public Distribution System is considered as a principal instrument in the hands of government for providing safety net to the poor and the downtrodden. The system serves triple objectives namely protecting the poor, enhancing the nutritional status and generates a moderate influence on market prices. The focus and coverage of PDS have changed widely over the years. The Public Distribution System has evolved over time as its importance has also changed. In Kerala, ration cards are widely acknowledged as identity cards and are merely kept and renewed as a means of identification.

But, during the Pandemic period these PDS outlets played a vital role in eradicating poverty in rural area. Most of the population in the rural area are self employed or daily waged workers for whom these benefits and subsidies from the PDS outlet are a big relief. However, the poor lifting of food grains stock by state food corporation against the allocation acts by the Central Government as an important constraint in the successful implementation of PDS . It has been observed that on account of shortage of resources, there is considerably delay in lifting of food grains on the part of state agencies and fair price shops dealers. The consumers are not given the arrears of the previous month which in turn makes room for diversion and defeating the very purpose of the scheme.

This study explores these issues in depth and attempts to identify the prevalent food consumption patterns across socio-demographic groups in the rural area of Kerala while linking them to questions of food security, malnutrition and the economic status of different categories of households.

**GENERAL OBJECTIVE:**

To study about the Public Distribution System(PDS) during Covid-19 Pandemic.

**SPECIFIC OBJECTIVE:**

1. To study the benefits derived out of Public Distribution System during Covid-19 Pandemic
2. To study the problems relating to the implementations of the Public Distribution System
3. To find out whether the beneficiaries have any suggestions to the improvement of the Public Distribution System.

**DEFINITION OF CONCEPTS:**

- Public Distribution System :

The Public Distribution System came into existence in the state with effect from 01/07/1965. The state which has very high deficit in the production of food grains, the PDS has great relevance and importance. The Public Distribution System studied are from Cherai area of Ernakulam District of Kerala.

- Covid-19 Pandemic :

Covid-19 has affected day to day life and is slowing down the global economy. This pandemic has affected thousands of peoples. It has rapidly affected our day to day life, businesses, disrupted the world trade and movements. In this project Covid 19 an infectious disease caused by SARS-CoV-2 Virus is been analyzed from the point of Public Distribution System and its role played during this pandemic in rural area.

**RESEARCH DESIGN:**

The research design used in this study is descriptive in nature. A descriptive research design is a type of research design which is widely used to obtain information which systematically explain the phenomenon or population. The descriptive research design helps to understand the different factors that lead to the understanding of the importance of ration shops especially during the covid-19 pandemic which generated a hope for living in the minds of individuals.

**VARIABLES:****Dependent Variable:**

Public Distribution System

**Independent Variable:**

Age

Sex

Educational Level

Marital Status

Occupation

Income

Number of Household

Type of Household

**UNIVERSE:**

The universe of this study mainly comprises of the beneficiaries of Public Distribution System Outlets of Cherai Panchayat of Ernakulam District of Kerala.

**SAMPLING METHOD:**

Simple random sampling method is used in this study. The Cherai Panchayat mainly consist of 2 Public Distribution System Outlets. The data about the beneficiaries was directly collected from the PDS dealers and using simple random sampling method the respondents was randomly selected.

The sample consist of 50 beneficiaries for the study.

**TOOLS OF DATA COLLECTION:**

The tool used in this study is pre structured Questionnaire, which was used to collect data from the respondents through telephonic interview.

**ANALYSIS OF DATA**

The collected data was analyzed and interpreted .

# **DATA ANALYSIS AND INTERPRETATION**

## DATA ANALYSIS AND INTERPRETATION

This chapter deals with the Data analysis and interpretations. This study is aimed to analyse the effectiveness of Public Distribution System in rural area during Covid 19 pandemic.

Table 4.1

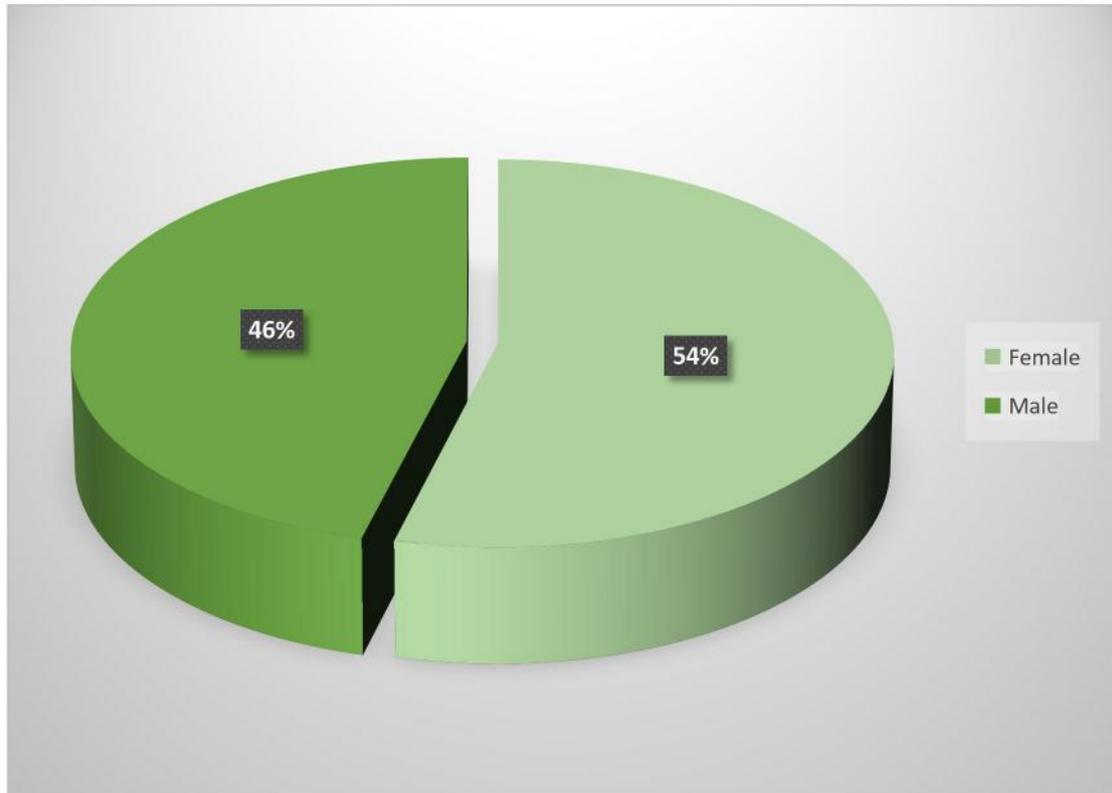
TABLE SHOWING THE AGE OF THE RESPONDENTS

Age	No. of Respondents	Percentage
30-39	8	16
40-49	11	22
50-59	20	40
60-69	7	14
70-79	4	8
Total	50	100

The table 4.1 shows the age group of the respondents of this study. And it's evident that most of the respondents fell in the age group of 50 to 59 (40 percentage), followed by the age group of 40 to 49 with (22 percentage) and then by the age group of 30 to 39 with (16 percentage) and age group of 60 to 69 with (14 percentage) and last the age group of 70 to 79 with (8 percentage).

Figure 4.1

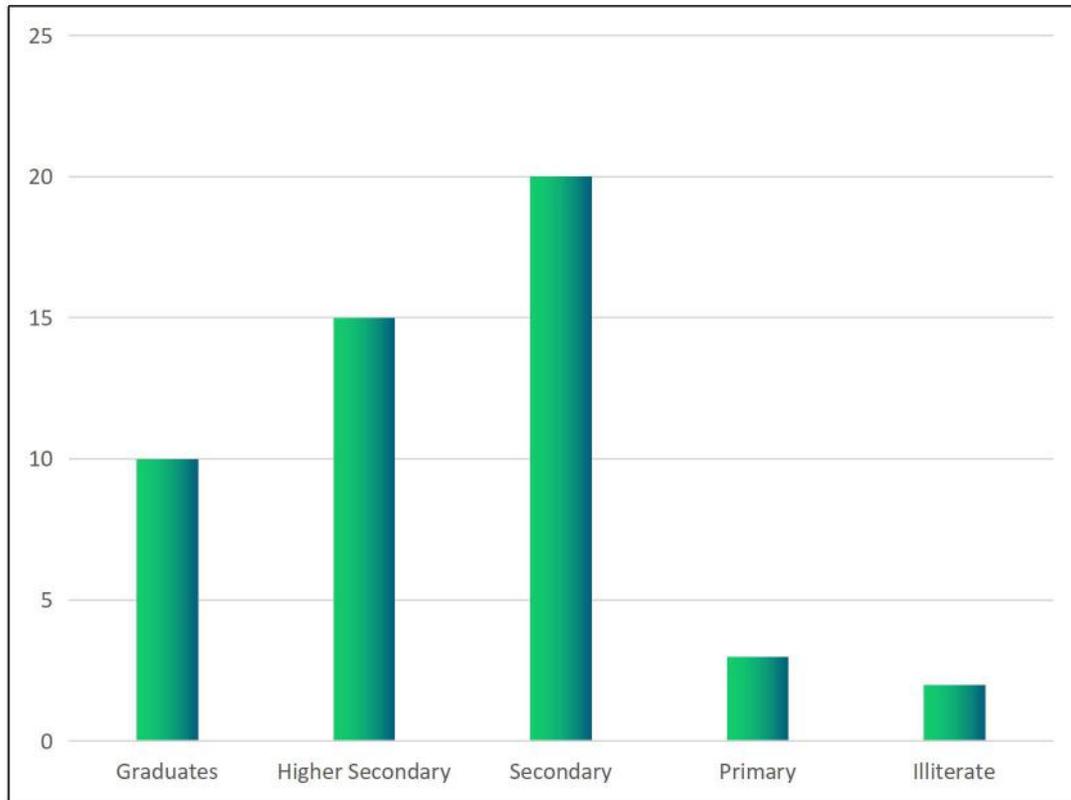
GRAPHICAL REPRESENTATION OF SEX OF THE RESPONDENTS



The figure 4.1 depicts the graphical representation of the sex of the respondent of the study. The majority of the respondents are female with 54% and 46% of the respondents are Male.

Figure 4.2

GRAPHICAL REPRESENTATION OF EDUCATION LEVEL OF THE RESPONDENTS



The figure 4.2 depicts the educational qualification of the respondents. Majority of the respondents have secondary level education 40% , 30% have higher secondary level education and 20% of them are Graduates. 6% of the respondents had primary level of education and 4% of the respondents were illiterate.

Figure 4.3

GRAPHICAL REPRESENTATION OF MARITAL STATUS OF THE RESPONDENTS

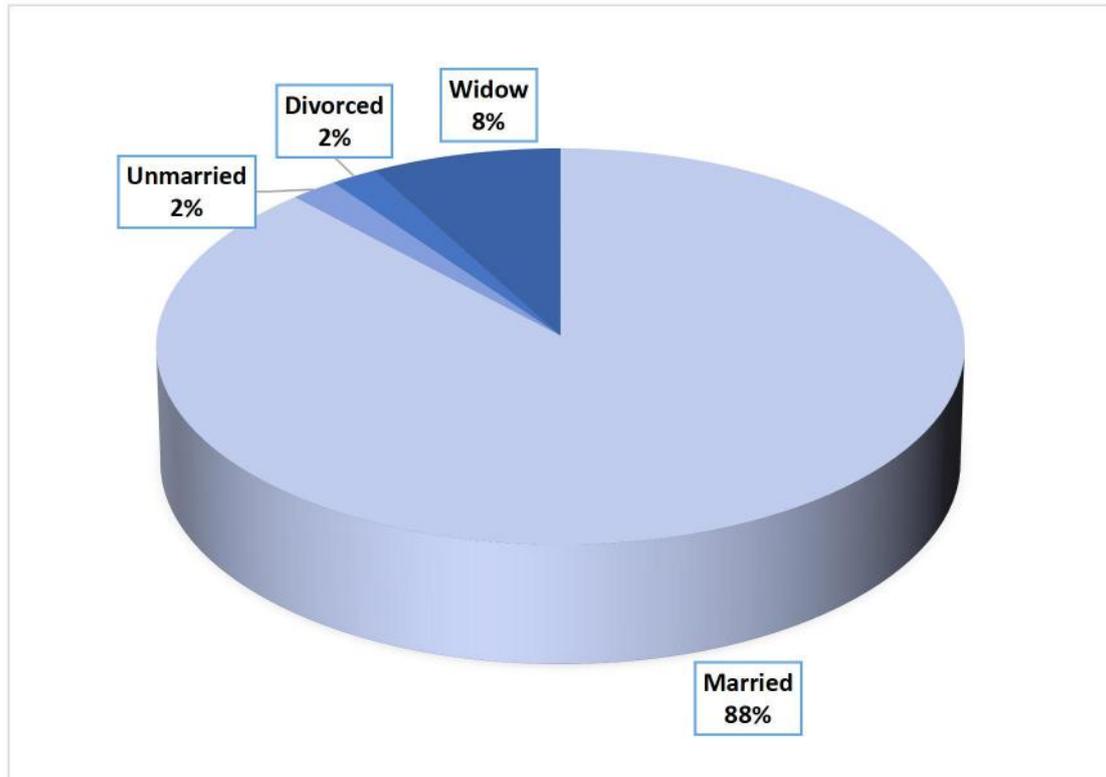


Figure 4.3 shows the graphical representation of the Marital Status of the respondents. The figure highlights that most of the respondents are married with 88 percentage. Then the remaining 2 percentage are unmarried, 2 percentage are divorced and 8 percentage of the respondents are widows.

Figure 4.4

GRAPHICAL REPRESENTATION OF OCCUPATION OF THE RESPONDENTS

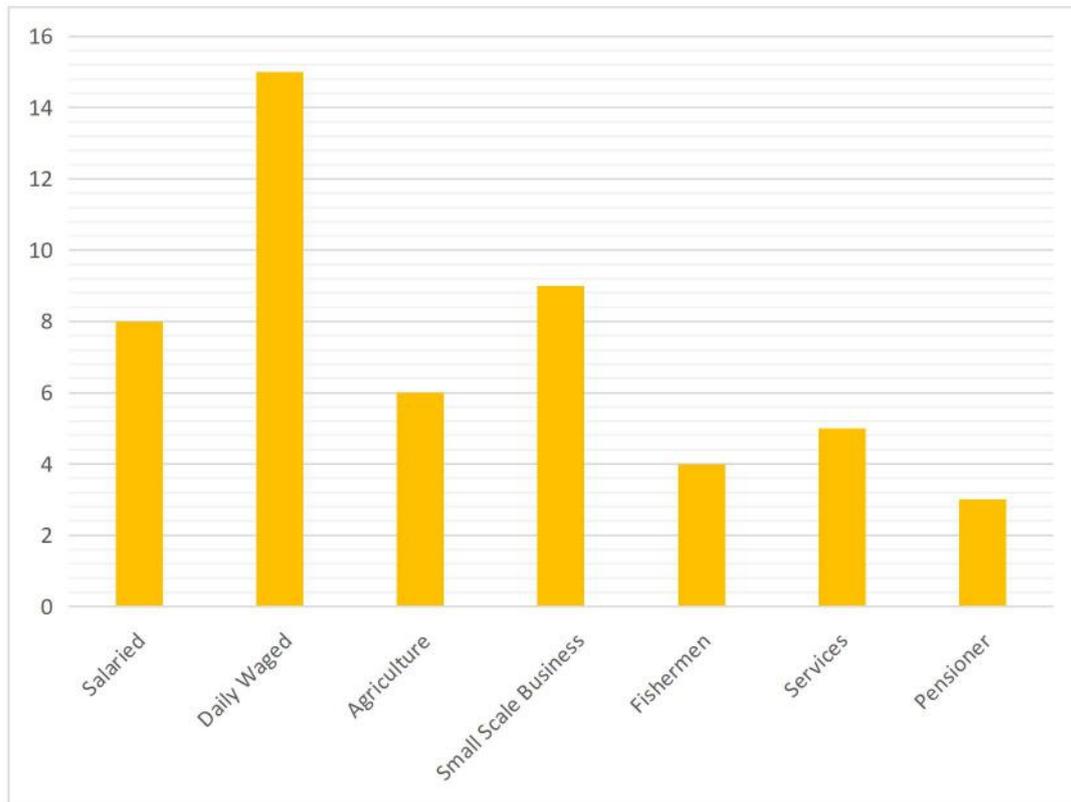


Figure 4.4 shows the occupation of the respondents. From the figure it is clear that most of the respondents are Daily Waged workers, followed by Small scale business entrepreneurs. Some of the respondents are Salaried employees, Agricultural workers. Some of the respondents are from the fishermen community. Some of them involve in the service sector and pensioners. Thus from the table it is evident that most of the respondents are Daily Waged Workers but there is diversification of occupation also to be seen.

Table 4.2

TABLE SHOWING THE FAMILY INCOME OF THE RESPONDENTS

Family Income [Monthly]	No. of the Respondents	Percentage of the Respondents
Below 4000	2	4
4000-6000	7	14
6000-8000	13	26
8000-10,000	16	32
Above 10,000	12	24
Total	50	100

Table 4.2 represents the Family Income of the respondents. 4% of the respondents have monthly family income below 4000 who are mostly daily waged workers and housemaids, pensioners. 14% of the respondents are in the category of monthly income of 4000-6000, who are mainly agricultural workers and fishermen community. 26% of the respondents have a family monthly income of 6000-8000 rupees. 32% of the respondents had a family monthly income of 8000-10000 who are basically engaged in small scale businesses and respondents in the service sector. 24% of the respondents had family income above 10,000 who are basically salaried and self employed.

Figure 4.5

GRAPHICAL REPRESENTATION OF TYPE OF HOUSEHOLD

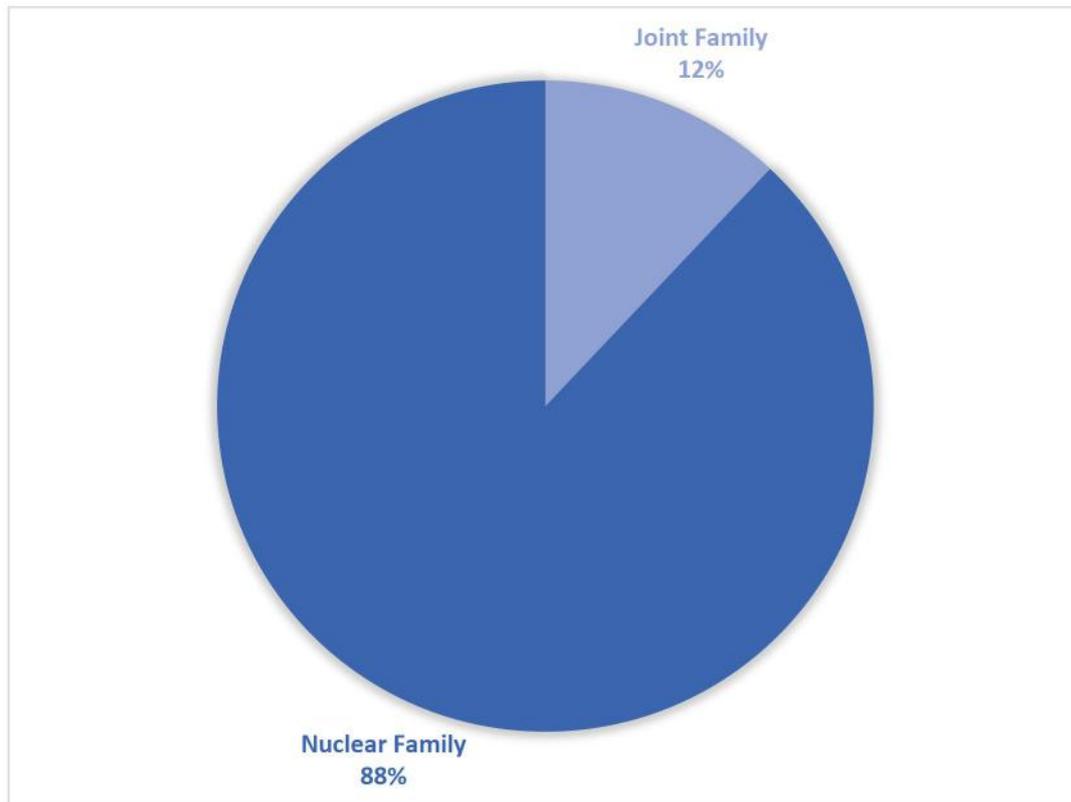


Figure 4.5 shows the type of households. From the data above it clear that most of the households are Nuclear family consisting of father, mother and children (88%). Only 12% of the respondents live in Joint Family System of Household consisting of grandparents and other cousins. Even the study is been conducted in rural area where mostly joint family system is followed compared to urban area, from the data collected shows there is a highest proportion of nuclear family present in this rural area.

Table 4.3

TABLE SHOWING THE NUMBER OF HOUSEHOLD MEMBERS

Household Members	Frequency	Percentage
1-4	44	88
5-6	4	8
7-10	2	4
Total	50	100

Table 4.3 represents the Number of Household members. 88% of the respondents belong to 1-4 category which is basically nuclear family consisting of father, mother and two children. 8% of the respondents had 5-6 members in their family. 4% of the respondents had 7-10 members. These two categories follow Joint family system in this area of study.

Figure 4.6

GRAPHICAL REPRESENTATION OF TYPE OF RATION CARD

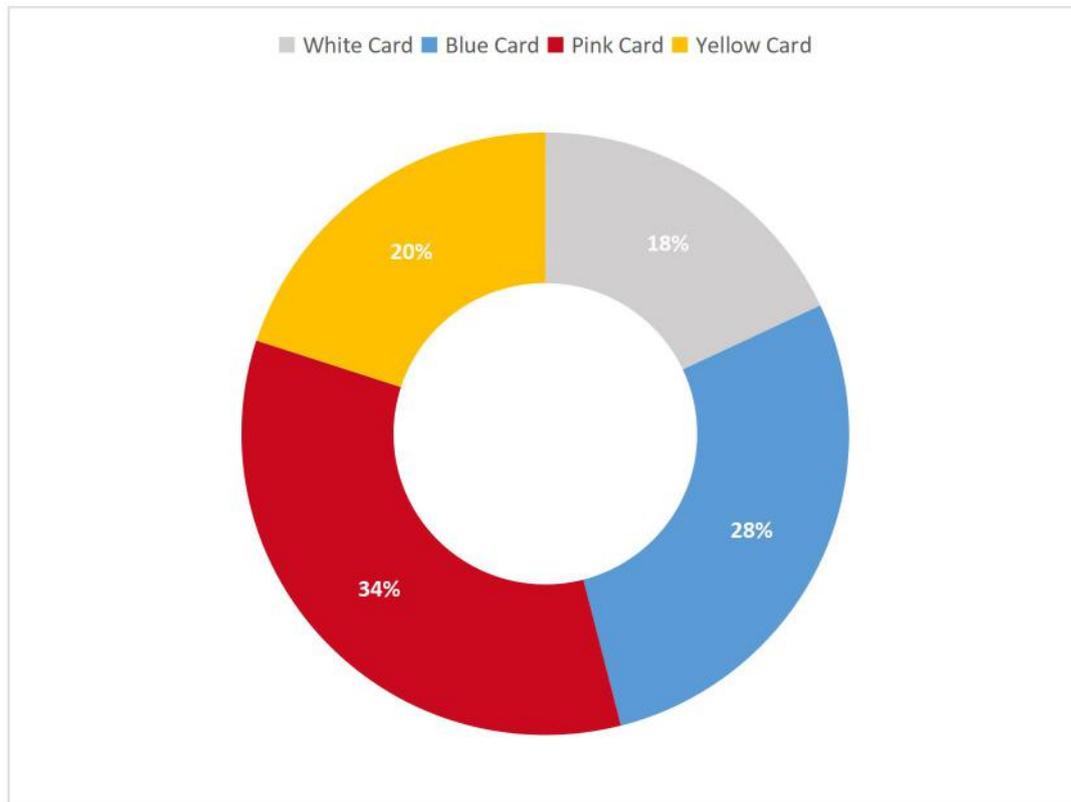


Figure 4.6 represents the Type of Ration Card of the respondents. 18% of the respondents belong to the Non Priority Non Subsidy category thus holding White Ration Card. 28% of the respondents belong to the Non Priority Subsidy category and holds Blue Ration Card. 34% of the respondents belongs to the Priority Household holding Pink Ration Card. 20% of the respondents are included in the Antyodaya Anna Yojana who holds the Yellow Ration Card. Thus from this it is clear that most of the respondents belong to the Priority household category due to their income and occupation level, who avail most of the subsidies and benefit from the Government of Kerala.

Table 4.4

TABLE SHOWING THE NUMBER OF YEARS OF RATION CARD POSSESSION

Years of Possession	Frequency	Percentage
0-5 years	9	18
5-10 years	13	26
10 -15 years	15	30
15-20 years	10	20
Above 20 years	3	6
Total	50	100

Table 4.4 represents the data on years of possession of ration card. 18% of the respondents had the possession of ration card for 0-5 years. 26% of the respondents possess their ration card for 5-10 years. 30% of the respondents had been possessing their ration card for 10-15 years. 20% of the respondents had been possessing their ration card for 15-20 years and 6% of the respondents had been possessing their ration card for above 20 years.

Thus from the above data it is clear that most of the respondents had been possessing their ration card since 15 to 20 years and had been availing its benefits.

Figure 4.7

GRAPHICAL REPRESENTATION OF EXPENSES INCURRED ON AQUISITION OF RATION CARD

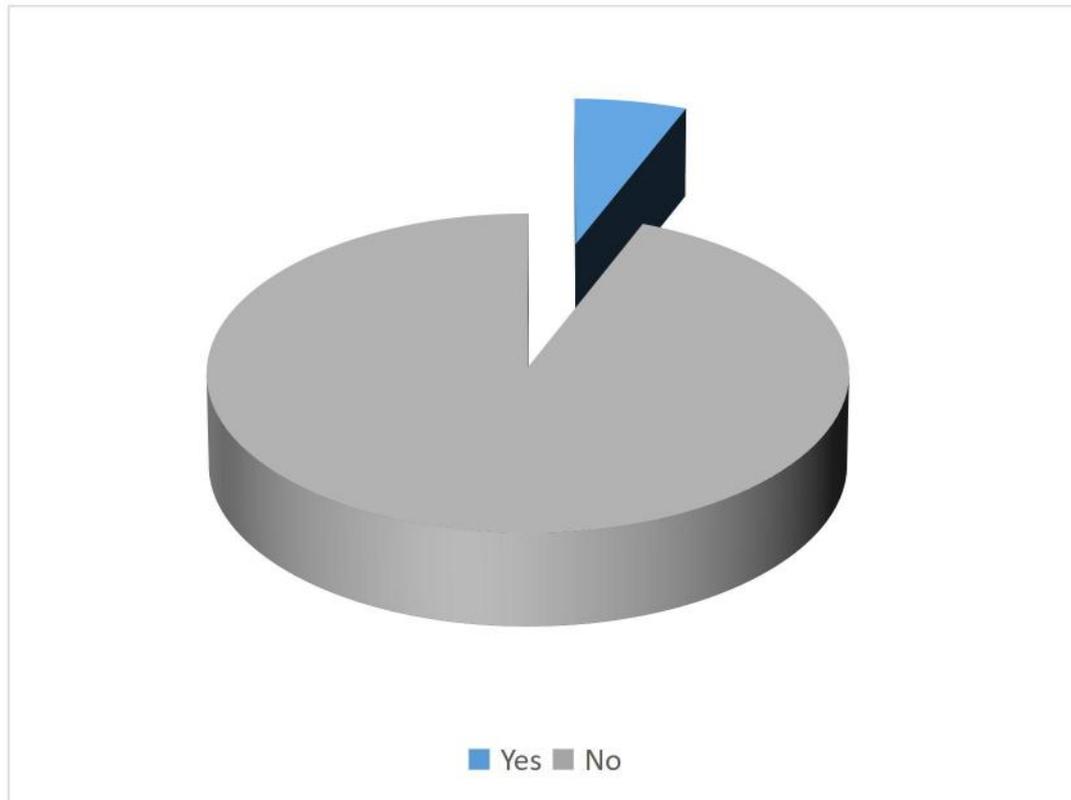


Figure 4.7 show the graphical representation on the expenses incurred by the respondents for acquisition of ration card. 94% of the respondents had not incurred any expenses while acquiring their ration card. But 6% of the respondents had incurred different expenses while the process of acquisition of their ration card.

Figure 4.8

GRAPHICAL REPRESENTATION OF USAGE OF RATION CARD BY THE RESPONDENTS

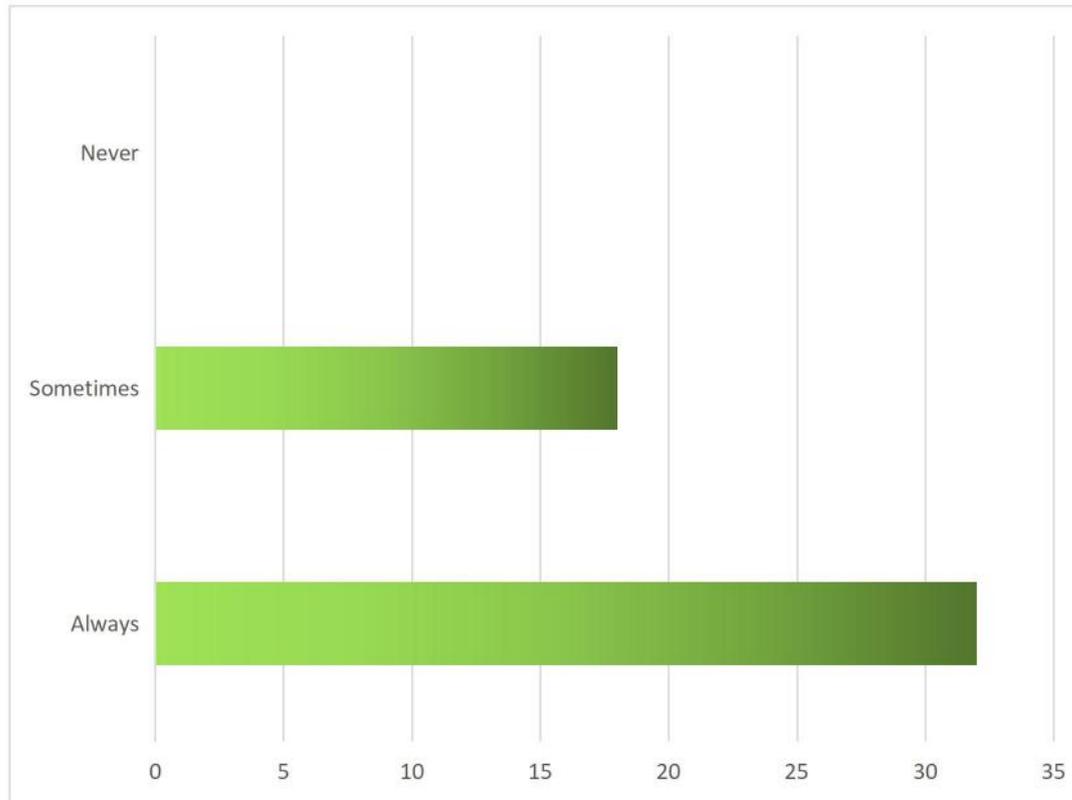


Figure 4.8 shows the graphical representation on the usage of ration card by the respondents. 64% of the respondents had been using their ration card very often and avails almost all the subsidies and benefits on their ration card. 36% of the respondents had been using their ration sometimes like for buying kerosene, availing special kit during Covid-19 pandemic period.

Figure 4.9

GRAPHICAL REPRESENTATION OF POSSESSION OF RATION CARD

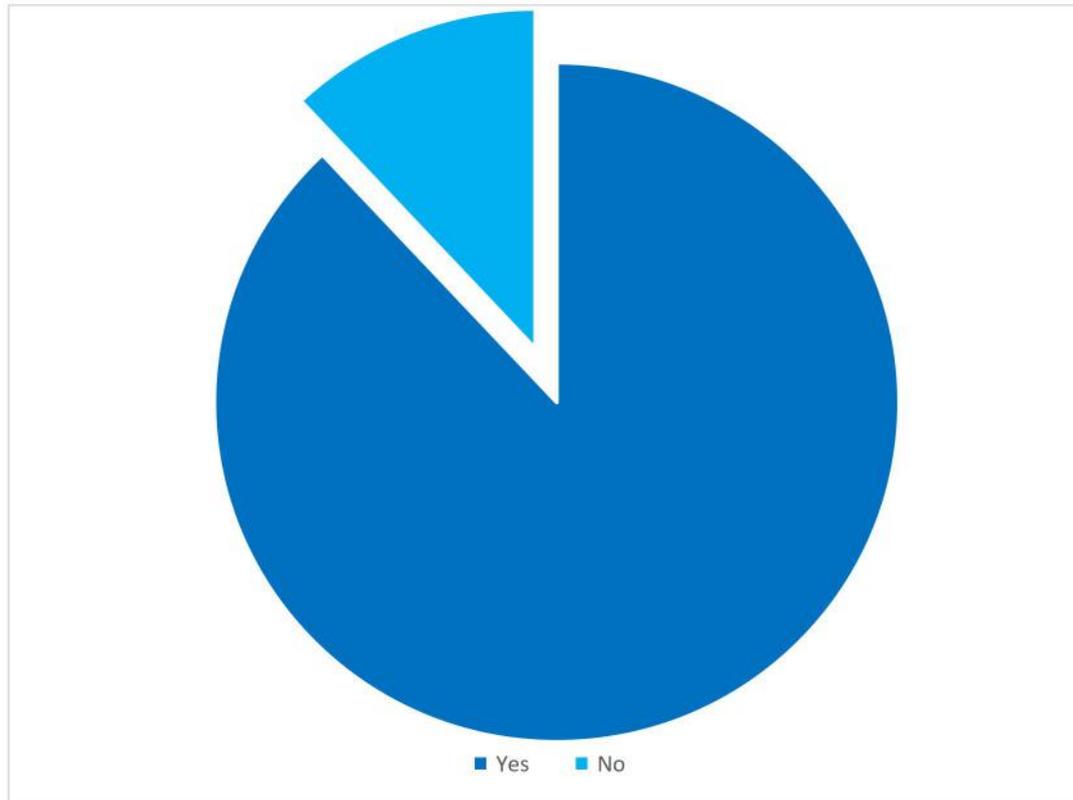


Figure 4.9 shows the graphical representation on possession of ration card. 88% of the respondents possess their ration card with themselves. But 12% of the respondents don't possess their ration card with themselves and are in possession of some relatives or friends who often use the ration card to avail the benefits and acquire the subsidies.

Figure 4.10

GRAPHICAL REPRESENTATION OF ALLOCATION OF COMMODITIES FROM RATION SHOPS

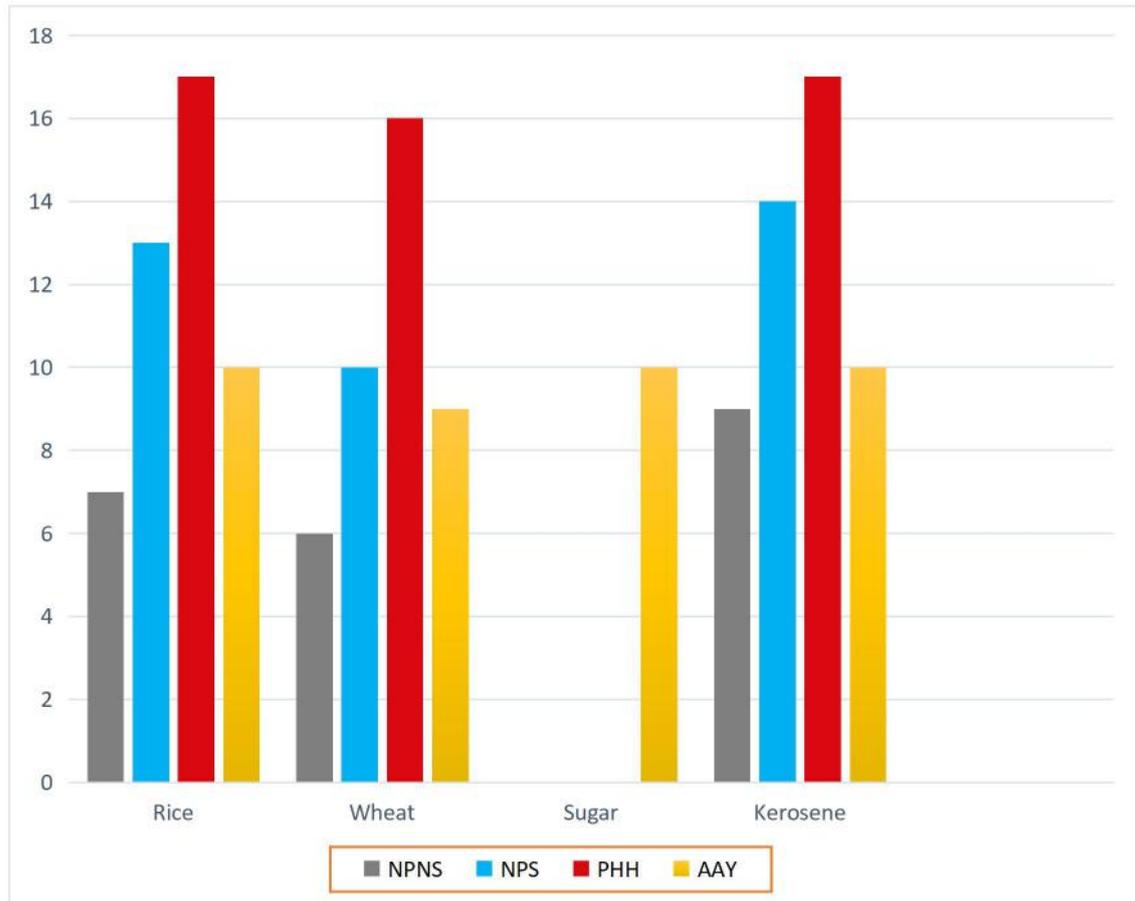


Figure 4.10 shows the graphical representation of commodities allocated and availed by the respondents.

The **NPNS (White)** cardholders, 9 out of 50 respondents (18%)

14% (7) of the respondents bought rice, 10% (5) of the respondents bought wheat, there is no allowance of sugar for non priority category and 18% (9) of the respondents bought kerosene.

The **NPS (Blue)** cardholders, 14 out of 50 respondents (28%)

Rice was bought by 26% (13) of the respondents. Wheat was bought by 20% (10) of the respondents, sugar was not allotted to blue card holders and Kerosene was bought by 28% (14) of the respondents.

The **PHH(Pink)** cardholders, 17 out of 50 respondents(34%)

Rice was bought by 34%(17) of the respondents. Wheat was bought by 32%(16) of the respondents, sugar was not allowed to pink cardholders and Kerosene was bought by 34%(17) of the respondents.

The **AAJ(Yellow)** cardholders, 10 out of 50 respondents(20%)

Rice was bought by 20%(10) of the respondents. Wheat was bought by 18%(9) of the respondents. Sugar was bought by all 20%(10) of the respondents. Kerosene was bought by every 20%(10) of the respondents.

Thus it is clear that irrespective of the card type all the respondents availed almost all the subsidies and benefits from the Ration shop.

Figure 4.11

GRAPHICAL REPRESENTATION OF ALLOCATION OF COMMODITIES  
FROM RATION SHOPS DURING COVID-19 PANDEMIC

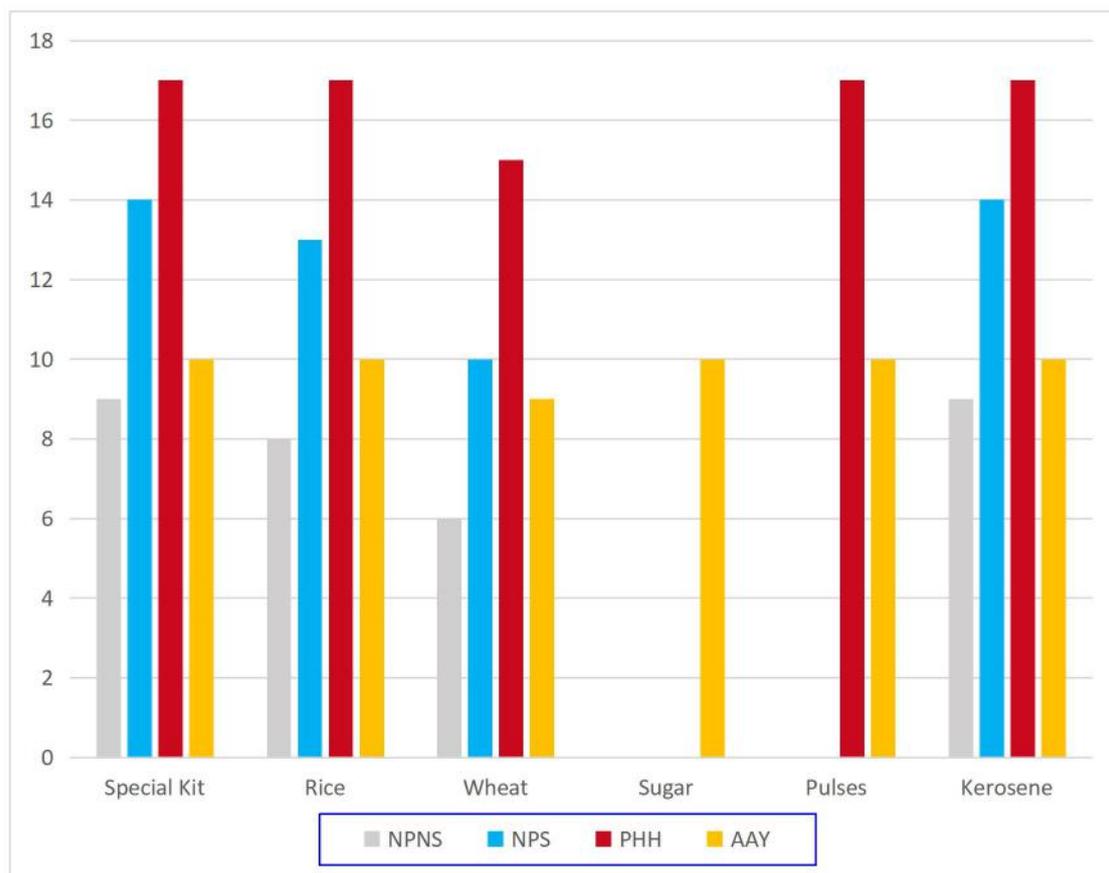


Figure 4.11 shows the graphical representation about the different commodities provided through ration shops during Covid 19 pandemic according to the respondents card type. Special kit which was provided exclusively by the Kerala State Government during Covid 19 pandemic period was availed by all the respondents irrespective of their card type.

The **NPNS(White)** cardholders 18% of the respondents,

Rice was bought by 16%(8) of the respondents. Wheat was bought by 12%(6) of the respondents. Sugar and Pulses was not allotted to this cardholders. Kerosene was bought by all the 18%(9) of the respondents.

The **NPS(Blue)** cardholders 28% of the respondents,  
Rice was bought by 26%(13) the respondents. Wheat was bought by 20%(10) of the respondents. Sugar and Pulses was not allotted to this card type. Kerosene was bought by all the respondents 28%(14).

The **PHH(Pink)** cardholders 34% of the respondents,  
Rice was bought by all the 34%(17) of the respondents. Wheat was bought 30%(15) of the respondents. Sugar was not allotted to this cardholders. Pulses were allotted to this category during Covid-19 and all the 34% of the respondents brought their subsidy. Kerosene was bought by all the respondents.

The **AAJ(Yellow)** cardholders 20%(10) of the respondents,  
Rice was bought by all the cardholders. 18% (9) of the respondents bought Wheat. Sugar as well as pulses were bought by all the 20% of the respondents. Kerosene was also bought by all the 20% of the respondents.

Figure 4.12

GRAPHICAL REPRESENTATION OF PRICING OF COMMODITIES

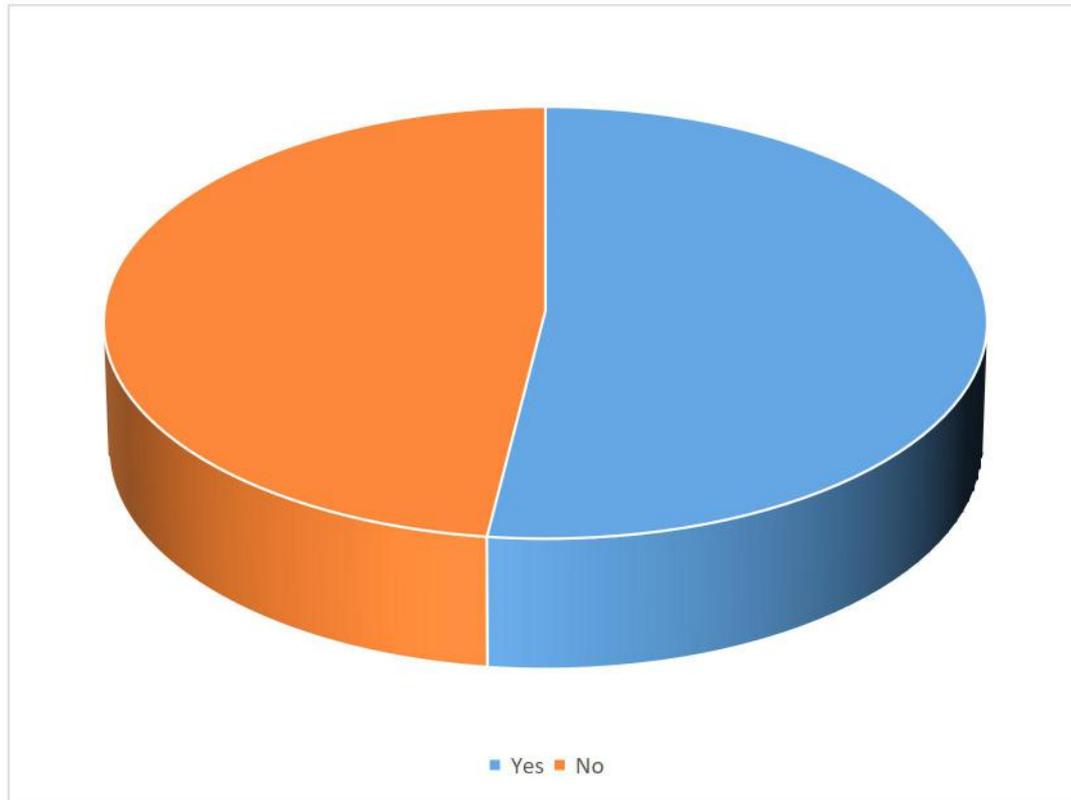


Figure 4.12 shows the graphical representation where the respondents have to pay more or pay less during the Covid 19 pandemic period. 52% of the respondents says they have to pay more during and after the Covid 19 pandemic period. Respondents belonging to the non- priority category as well as NPS had to pay more for commodities after the occurrence of Covid-19 pandemic. 48% of the respondents said they where needed to pay less now compared to previous times which basically included the Priority Category.

Figure 4.13

GRAPHICAL REPRESENTATION OF QUOTA OF COMMODITIES FOR ANY MONTH AWAITED

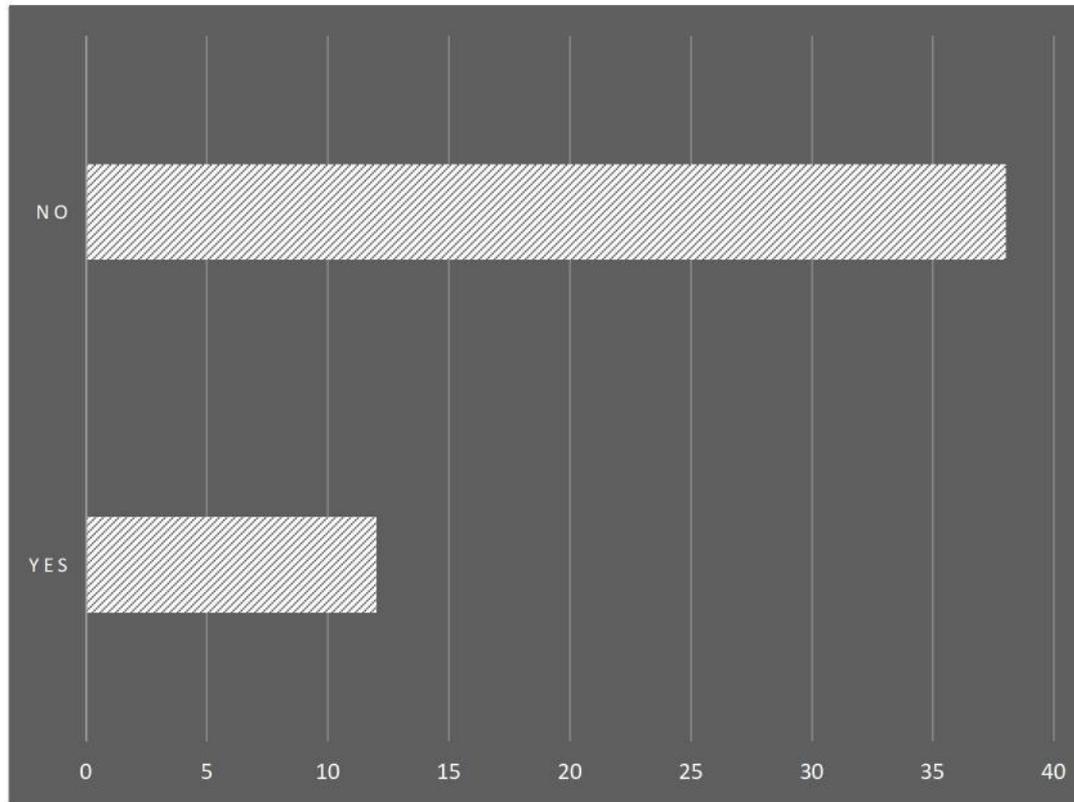


Figure 4.13 shows the graphical representation of any quota for the month awaited for the respondents by the PDS dealers. 76% of the respondents conveyed that their quotas are provided accordingly. 24% of the respondents conveyed that they still awaits their quota for previous month. The main reasons told by the dealer are unavailability of commodities at that time, storage issues etc..

Figure 4.14

GRAPHICAL REPRESENTATION OF MISSAPPROPRIATION OF QUOTA FOR A MONTH

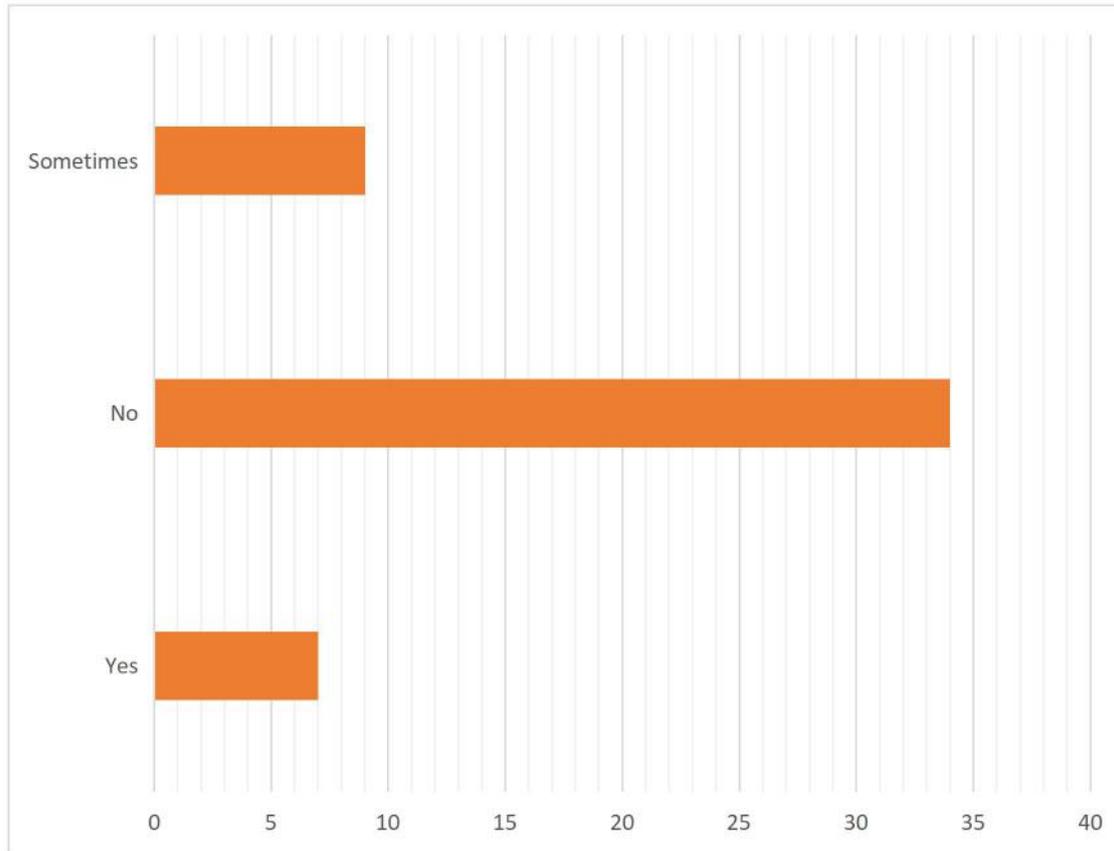


Figure 4.14 is the graphical representation on respondents responses to any instances of any appropriation made by the Ration Shop owners. 68% of the total respondents said they haven't noticed any such instances of appropriation made by the Ration shop owner. 18% of the total respondents have sometime noticed such instances. 14% of the total respondents have noticed such appropriations made by the PDS dealers.

Figure 4.15

GRAPHICAL REPRESENTATION OF IRREGULARITIES IN MAINTENANCE OF RATION CARD

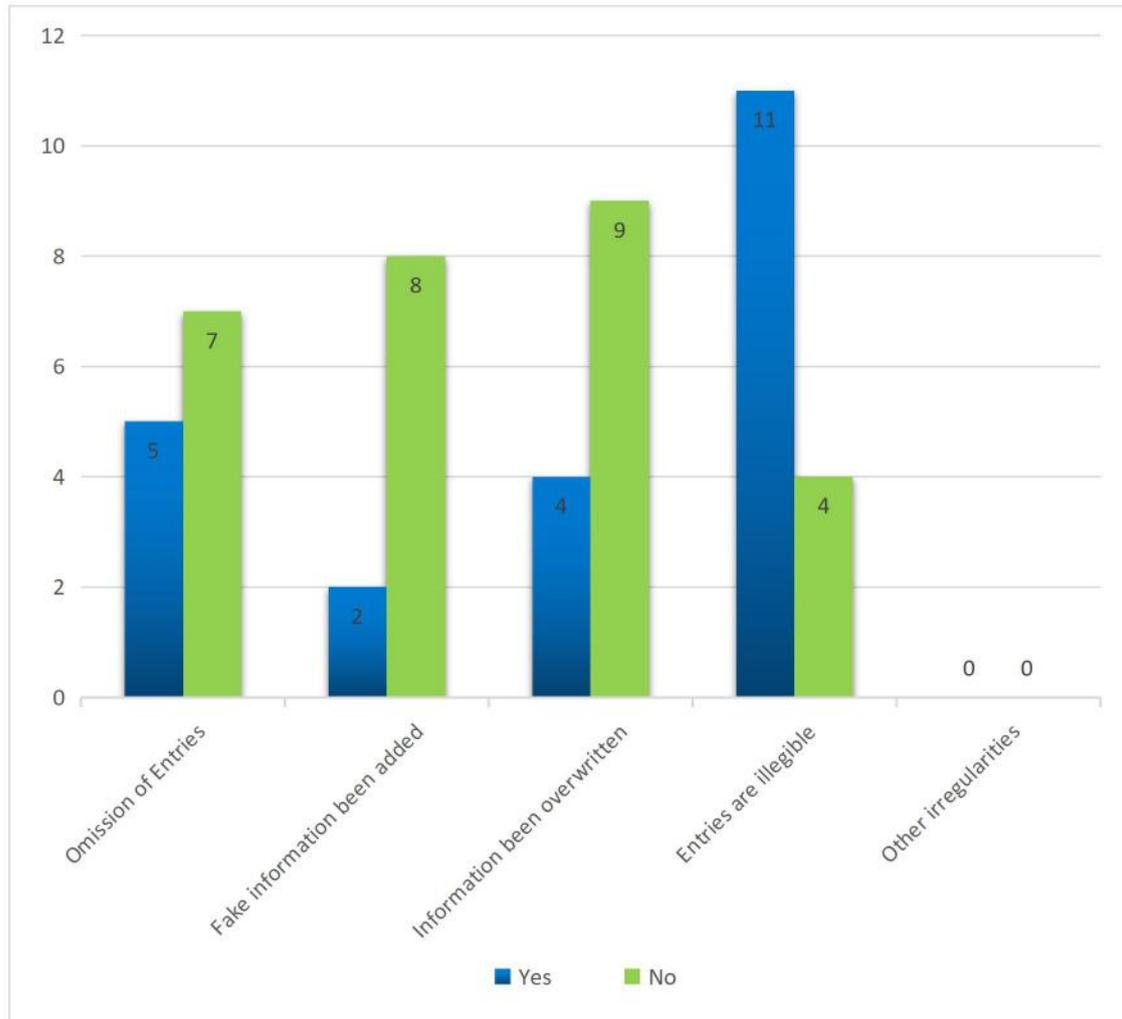


Figure 4.15 displays the graphical representation of the irregularities found out by the respondents during the maintenance of the Ration Card. Most of the respondents highlighted the option Entries are illegible and difficult to understand. This is one of the main issues faced by majority of the customers. Some of the respondents have noticed omission of entries made by the dealers, few have noticed fake information been added. Few of the respondents have noticed information been overwritten by the dealers.

Figure 4.16

GRAPHICAL REPRESENTATION OF REASONS BY PDS DEALERS FOR NOT GIVING FULL QUOTA

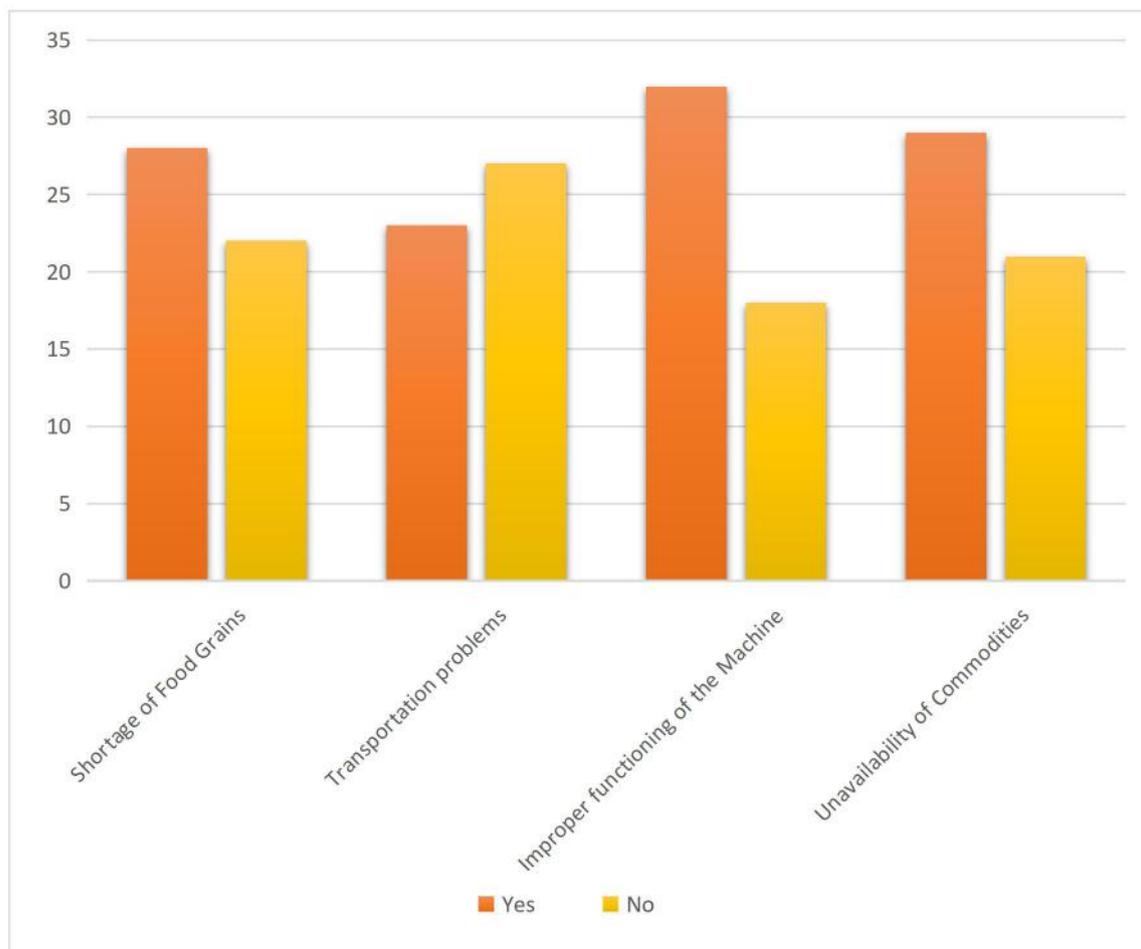


Figure 4.16 shows the graphical representation about the reason behind not providing full quota of ration by the Ration Shop Owners. Most of the respondents supported the statement 'Improper functioning of the Machine' reason told by the Ration shop owners which act as a hindrance for acquiring full quota ration for a month. The other reasons highlighted by the respondents are Unavailability of Commodities at the time of delivery, Shortage of food grains and Transportation issues that delays the arrival of the commodities which in turn affects the distribution via Ration Shops.

Figure 4.17

GRAPHICAL REPRESENTATION OF AVAILABILITY OF BENEFITS AND  
SUBSIDIES FROM RATION SHOPS

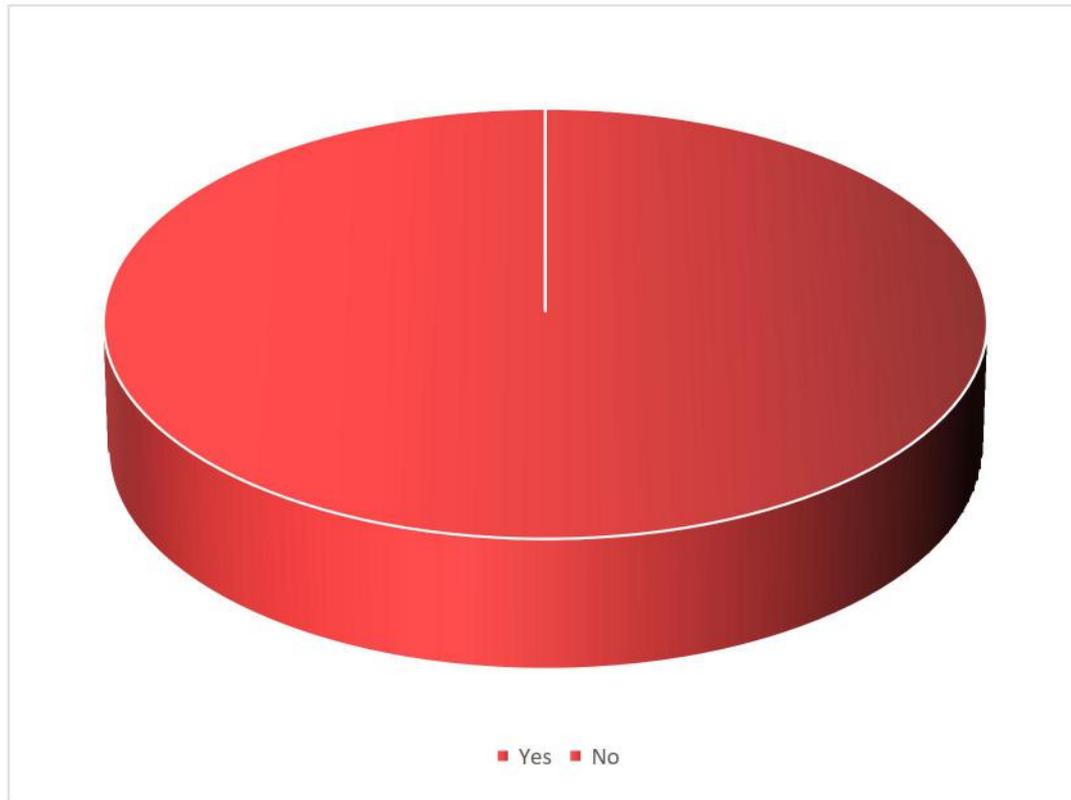


Figure 4.17 shows the graphical representation about the respondents ability to avail benefits and support measures provided by the Government via Ration Shops or PDS outlet. All the respondents (100%) where able to avail all the benefits and support measures which was provided by the Central as well as the State Governments during Covid 19 pandemic periods from the Ration Shops. It shows the effective functioning of the Public Distirbution System in the area.

Figure 4.18

GRAPHICAL REPRESENTATION OF FAMILY MEMBERS VISITING RATION SHOPS DURING COVID-19 PANDEMIC

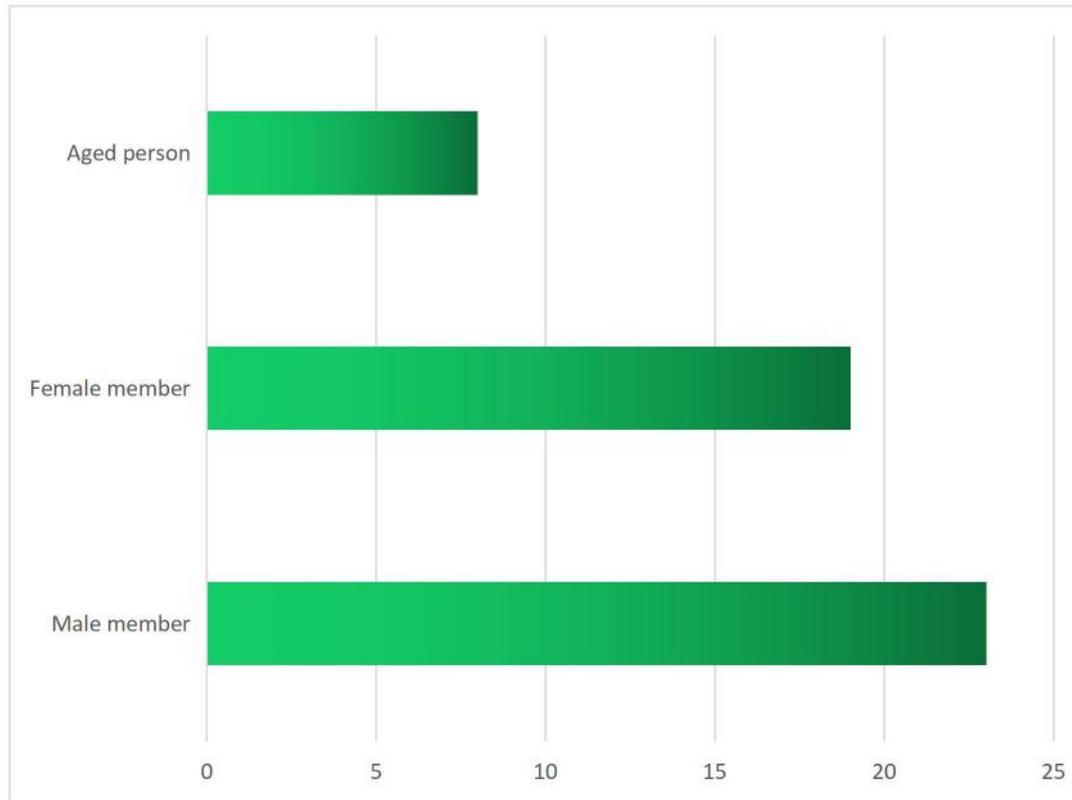


Figure 4.18 shows the graphical representation about the respondents frequent visit to the ration shops during the Covid 19 pandemic period. Here the male members of the family usually shopped during the Covid period (46%), followed by female members (38%) and aged persons 16%. Thus most of the male members from the family of the respondents visited Ration shops during Covid 19 pandemic period.

Figure 4.19

GRAPHICAL REPRESENTATION OF QUALITY OF FOOD GRAINS

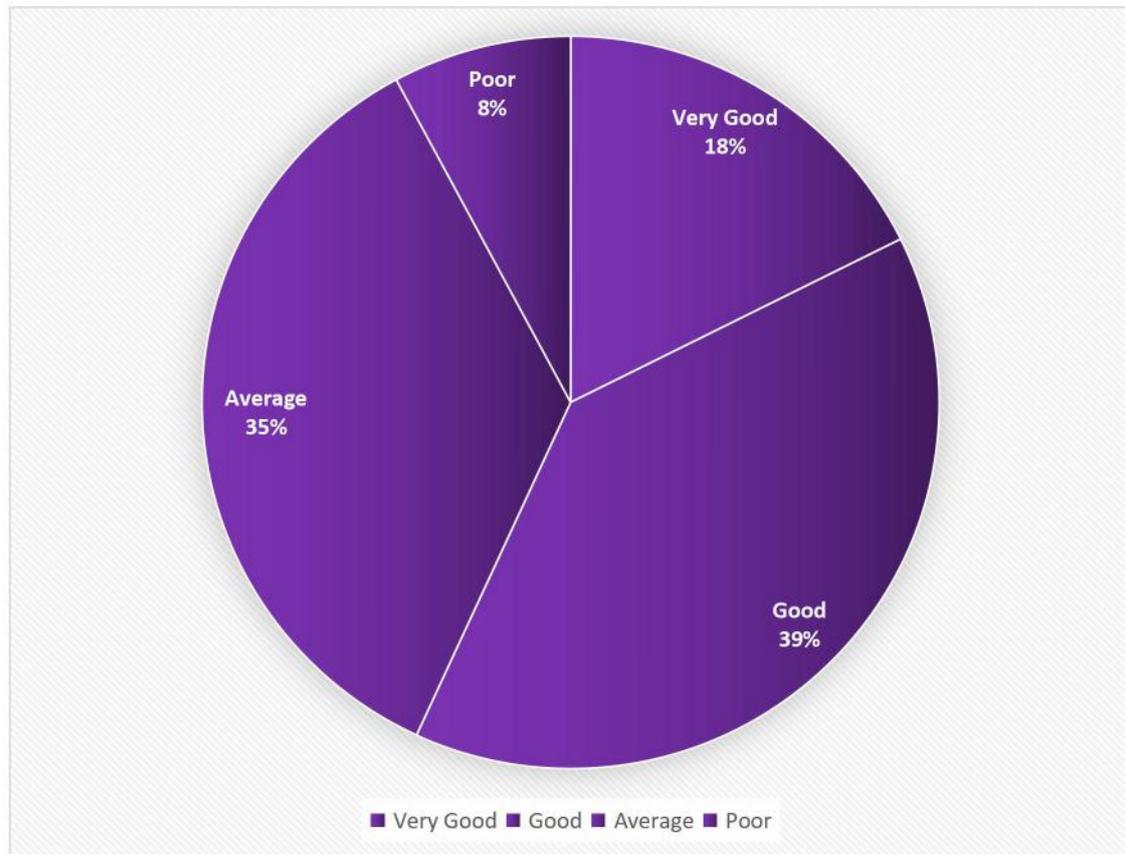


Figure 4.19 shows the graphical representation on the Quality of the grains received from the PDS outlet. 18% of the total respondents rated the Quality of the grains provided by the Ration shops as very good. 39% of the total respondents rated the quality of the grains as good and 35% of the respondents rated the quality of the grains and commodities provided to them as average, 8% of the respondents showed the quality of the grains as poor and unhealthy.

Figure 4.20

GRAPHICAL REPRESENTATION OF ATTITUDE OF THE PDS DEALER

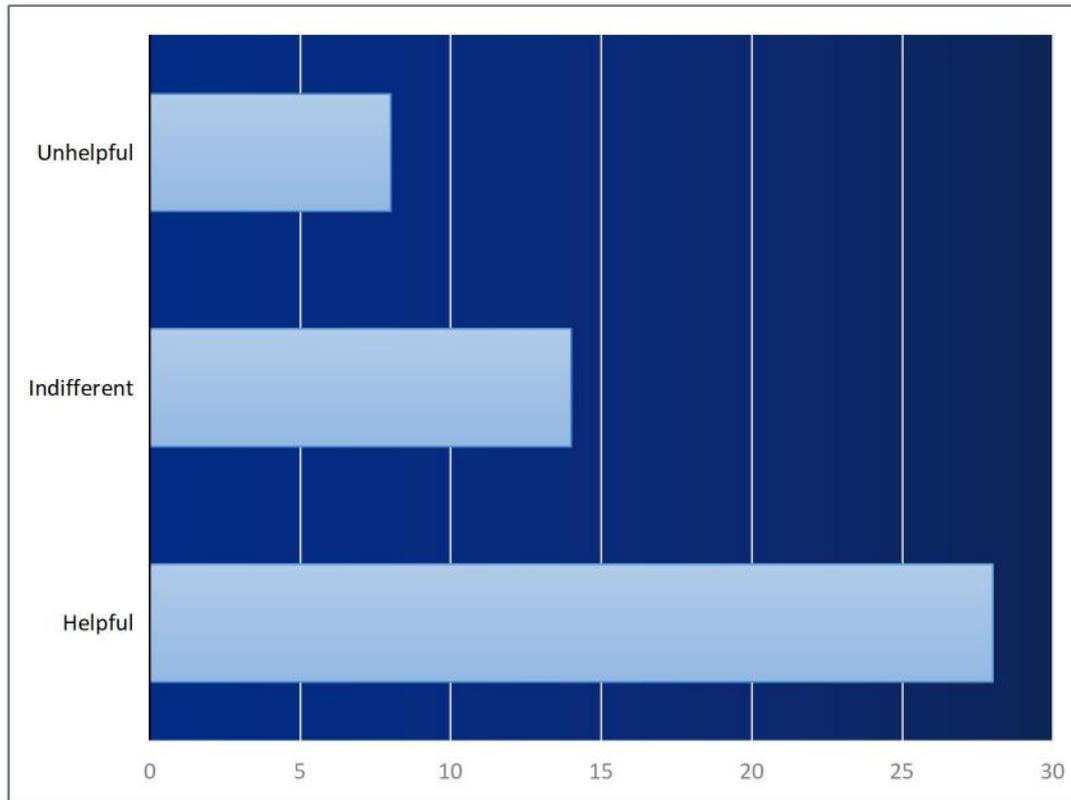


Figure 4.20 provides the graphical representation of the attitude of the PDS dealer rated accordingly by the respondents. 56% of the respondents described the attitude shown by the PDS dealers as helpful, the Ration shop owners provided them with adequate information regarding the subsidies and benefits. 28% of the respondents described the attitude of the PDS dealer as indifferent and 16% of the total respondents described the attitude of the PDS dealer as unhelpful and disappointing.

Figure 4.21

GRAPHICAL REPRESENTATION OF INFORMATION SHARED BY THE PDS DEALER REGARDING THE POLICIES AND SCHEMES BY THE GOVERNMENT

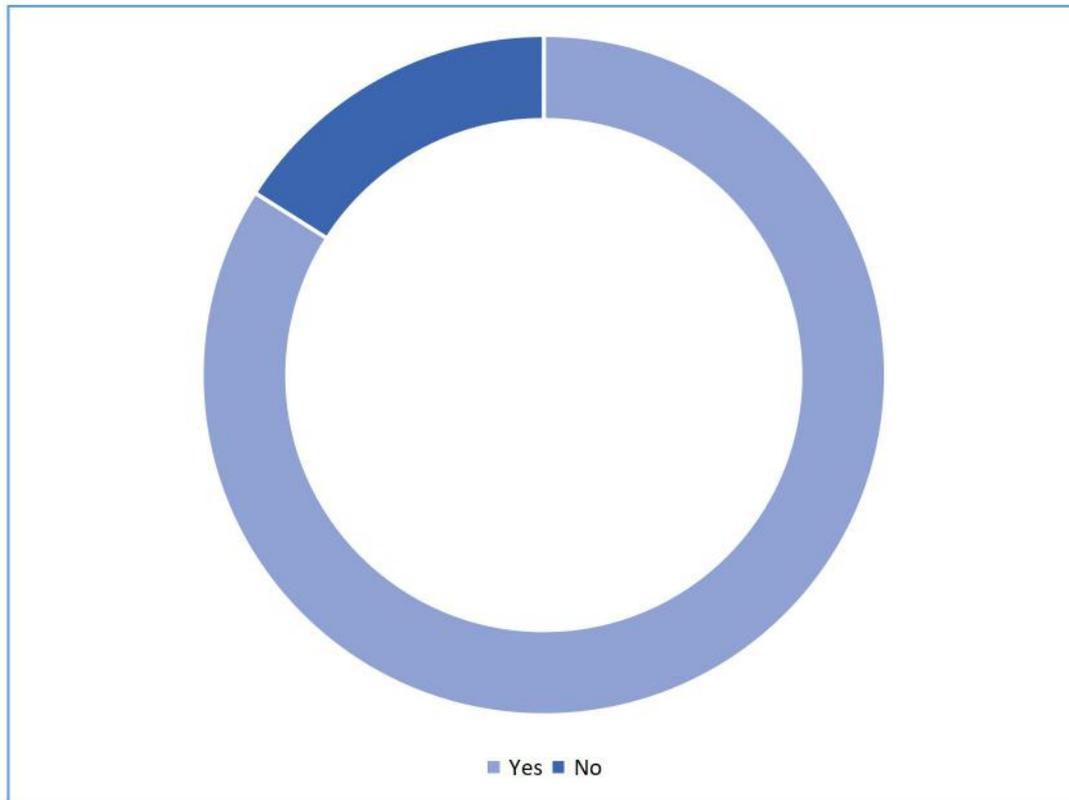


Figure 4.21 shows the graphical representation on the PDS dealer approach in providing sufficient information regarding new policies, plans and changes made by the Government. 84% of the respondents supported this statement, their Ration Shop owners in regular intervals provided them with sufficient information regarding new benefits and policy changes by the Government which helped them in getting maximum benefit and support from the PDS outlets. Whereas, 16% of the respondents showed their regret towards their PDS dealers as they are not provided with sufficient information regarding the new policies and plan which in turn make them lose their subsidies and benefits derived out from these PDS Outlets.

Figure 4.22

GRAPHICAL REPRESENTATION OF SATISFATION ON THE FUNCTIONING OF THE PDS OUTLET

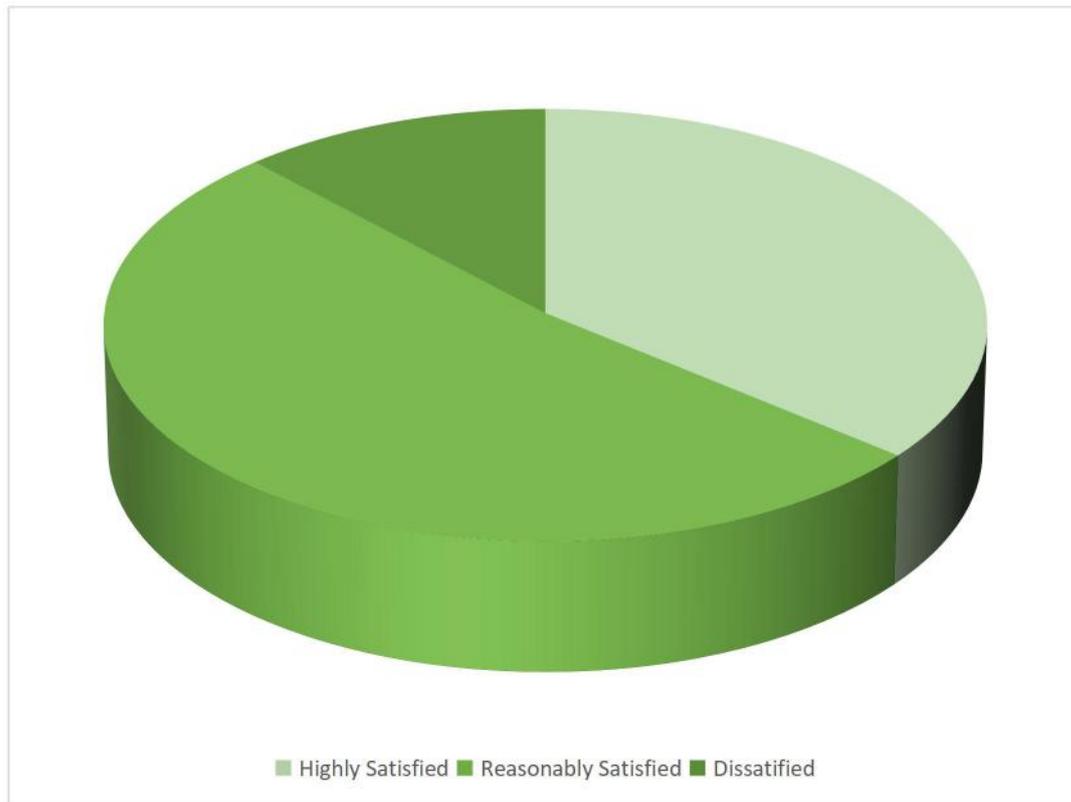


Figure 4.22 shows the level of satisfaction on the functioning of the PDS outlet. 36% of the population are highly satisfied with the functioning of the PDS outlet. 52% of the respondents are reasonably satisfied with the overall functioning of the PDS outlet, and 12% of the respondents showed their dissatisfaction towards the functioning of the PDS outlet in their locality.

Figure 4.23

GRAPHICAL REPRESENTATION ON RATING OF OVERALL FUNCTIONING OF THE PDS OUTLET

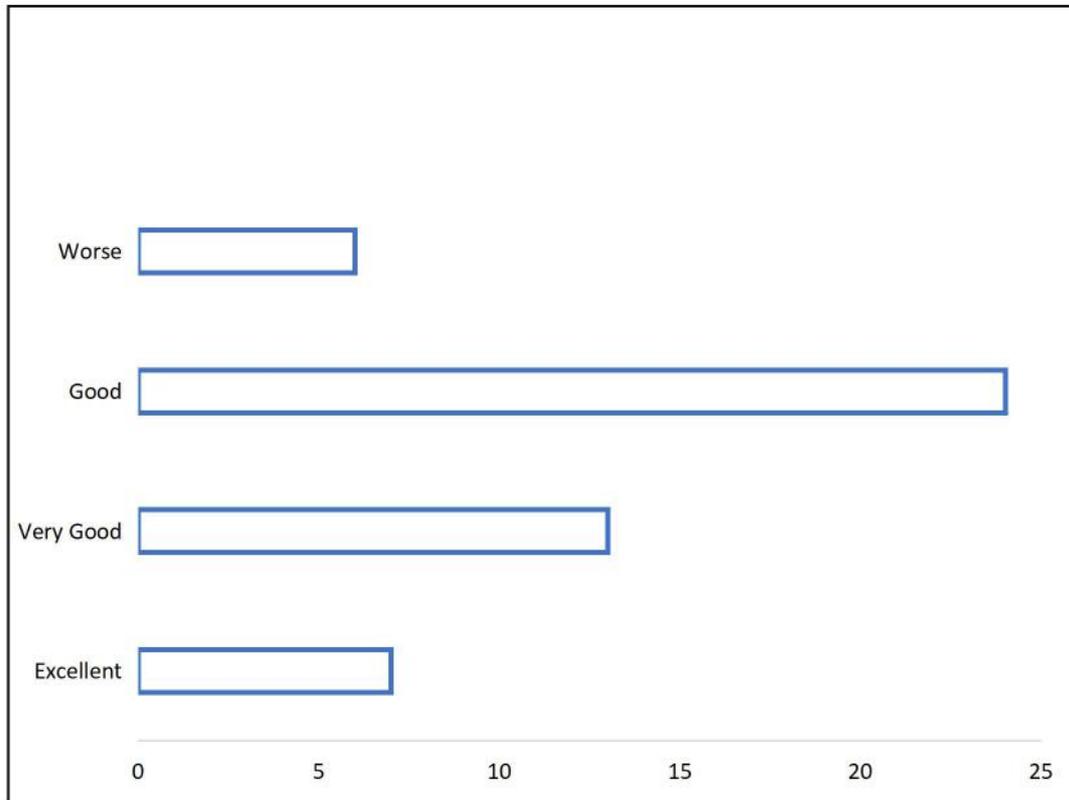


Figure 4.23 shows the ratings given by the respondents on the overall functioning of the Public Distribution System Outlets in Cherai village. 48% of the respondents rated the functioning of the PDS outlet as good, 26% of the respondents rated the functioning of the PDS outlet as Very good and 14% of the respondents rated the functioning of the PDS outlet as Excellent. 12% of the respondents rated the functioning of PDS outlet as worse. Thus from this it is clear that most of the respondents rated the functioning of the PDS outlet as good in their locality.

**FINDINGS, SUGGESTION AND  
CONCLUSION**

## FINDINGS AND SUGGESTIONS

The Public Distribution System (PDS) evolved as a system of management of scarcity and for distribution of food grains at affordable prices. Over the years, PDS has become an important part of Government's policy for management of food economy in the country. PDS is supplemental in nature and is not intended to make available the entire requirement of any of the commodities distributed under it to a household or a section of the society. PDS is operated under the joint responsibility of the Central and the State Governments. The Central Government, through Food Corporation of India (FCI), has assumed the responsibility for procurement, storage, transportation and bulk allocation of food grains to the State Governments. The operational responsibility including allocation within State, identification of eligible families, issue of Ration Cards and supervision of the functioning of Fair Price Shops (FPSs) etc., rest with the State Governments. Under the PDS, presently the commodities namely wheat, rice, sugar and kerosene are being allocated to the States/UTs for distribution.

The Government of Kerala (GoK) has been fast implementing the provisions of the National Food Security Act (NFSA), 2013 and identifying the eligible households. In Kerala, the renewal of existing ration cards coincided with the statutory provisions of the NFSA.

The first objective of the study was to find out the benefits derived out of Public Distribution System during Covid 19 pandemic. In the sample of 50 respondents, the majority of the respondents (40%) belong to the middle age group. 54% of the respondents were female and 46% of the respondents were male. Majority of the respondents (40%) had secondary level educational qualification. 30% of the respondents belong to the daily waged category and 18% of the respondents engaged in small scale business. As this study was conducted in rural area the family income of the respondents (32%) were between 8000-10000. The majority of the respondents (88%) were nuclear family and 12% of the respondents followed joint family system.

The second objective was to study the problems related to the implementation of public distribution system. The majority of the respondents had PHH Pink ration card (34%) followed by NPS blue ration cardholders (28%), AAY yellow cardholders (20%) and NPNS White cardholders (18%). 64% of the respondents always use their ration card to avail the benefits from the ration shops. 88% of the respondents are in possession of their ration card.

The 52% of the respondents said they had to pay more for the commodities during and after Covid 19 pandemic. Majority of the respondents 76% conveyed that their quotas are provided accordingly. This shows the effective functioning of ration shops in rural area.

The third objective was to find out the suggestions given by beneficiaries.

52% of the respondents are reasonably satisfied with the functioning of the PDS outlet.

46% of the respondents rated the overall functioning of the ration shop as good.

The suggestions are:-

- To be informed about the time and availability of the grains in the ration shop by the distributors.
- The entries must be made legible.
- The technical problems of the machine to be solved in time.
- The consumers are to be provided with proper billing.
- The server related issues to be rectified.
- The effectiveness of the biometric machine should be ensured.
- The government should ensure the proper control and effective distribution of commodities and subsidies.

From the study it was clear that majority of the respondents availed their benefits from the ration shops irrespective of the lockdown and restrictions due to Covid 19 pandemic.

## CONCLUSION

Kerala is a chronically food deficit state with internal production meeting less than one-fifth of its food grain requirements. In Kerala, the agricultural production has historically been geared towards cash crops instead of food crops like rice and wheat. Rationing had always existed in the state though its coverage was expanded in the mid 1960s. In 1960, when there was a general food shortage in India, several states had imposed arbitrary restrictions on the food grain movement. Consequently, the problem of food shortage became more acute in Kerala. The decision to extend the rationing system in Kerala was taken at the Conference of the Chief Ministers of all the states in 1964, whereby it was agreed that the quantity of rice required for issue through the PDS would be made available from the respective central storage depots and that it would not be generally necessary for the state government to procure any quota directly from other states. In other words, the expansion of the PDS in the state was based on a tacit understanding between the centre and the state government with the former taking the responsibility of adequate food availability to meet the state's food requirements. The historical background of expansion of the rationing system in Kerala amply demonstrates the role of the PDS as a system essential for food security in an acute food deficit state. To now consider the system as a mere concession to the poor would be a drastic dilution to this historically well defined role.

The Public Distribution System in Kerala is much more effective and efficient compared to other states. But due to the lower production of food grains (rice, wheat) makes Kerala to depend upon different states and the distribution of these items depends on the transportation and availability of the grains in the Government warehouses.

During the Covid 19 Pandemic scenario the role played by Public distribution System is comment-able and is nationwide appreciated because due to its effective working and poverty alleviation in the State.

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# APPENDIX

## QUESTIONNAIRE

1. Age:

2. Sex: Female  Male

3. Educational Level:

4. Marital Status:

5. Occupation:

6. Family Income:

7. Type of Household:

8. Number of Household Members:

	Female	Male
Children		
Adults		
Aged Persons		

9. Type of Ration Card:

White  Blue  Pink  Yellow

10. How many years of having this Ration Card ?

11. Did you had to pay anyone any amount to obtain your Ration Card or for other associated expenses?

Yes  No

12. Are you using the Ration Card, How Often ?

13. Are you in possession of your Ration Card at this moment or is it with someone else?

Yes  No

14. Can you tell what all commodities you are allotted according to your Ration Card from the PDS Outlet?

Rice

Wheat

Sugar

Pulses

Kerosene

15. After the occurrence of Covid-19 Pandemic, what all commodities are you able to avail from the PDS outlet?

Special Kit

Rice

Wheat

Sugar

Pulses

Kerosene

16. Do you need to pay more or pay less for the commodities now ?

Yes

No

17. Is the quota for any of month still awaited ?

Yes

No

18. Has it ever occurred that your quota for a particular month not given or appropriated by someone else ?

Yes

No

Sometimes

19. Have you ever noticed any irregularities from below in the maintenance of the Ration Card?

	Yes	No
Omission of Entries		
Fake information been added		
Information been overwritten		
Entries are illegible		
Other irregularities		

20. What are the main reasons that the PDS dealer usually say when you are not getting the full quota ?

	Yes	No
Shortage of Food Grains		
Transportation problems		
Improper functioning of the Machine		
Unavailability of Commodities		
No issues		

21. During Covid 19 Pandemic scenario were you been able to avail all the benefits and support measures provided by the Government via Ration Shops?

Yes

No

22. Who is going from your family to purchase commodities from PDS Outlet during Covid 19 pandemic period ?

Male member

Female member

Aged Persons

23. How would you describe the Quality of the grains received ?

Very good

Good

Average

Poor

24. How would you describe the attitude of the PDS dealer?

Helpful

Indifferent

Unhelpful

25. Does the PDS dealer provide you with sufficient information's regarding new policies, plan and changes made by the Government ?

Yes

No

26. Are you satisfied with the functioning of the PDS outlet ?

Highly satisfied

Reasonably satisfied

Dissatisfied

27. How would you rate the overall functioning of the PDS Outlet ?

Excellent

Very good

Good

Worse

28. Do you have any suggestions for the improvement of the PDS ?

# **A STUDY ON WELLNESS INDUSTRY USED AMONG I.T PROFESSIONALS IN KOCHI CITY**



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**MARCH 2022**



# A STUDY ON WELLNESS INDUSTRY USED AMONG I.T PROFESSIONALS IN KOCHI CITY

Thesis submitted to St. Teresa's College (Autonomous), Ernakulam in *fulfillment of the requirements for the award of the degree of Master of Arts in Sociology*

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## CERTIFICATE

I certify that the thesis entitled "A STUDY ON WELLNESS INDUSTRY USED AMONG I.T PROFESSIONALS IN KOCHI CITY" is a record of bonafide research work carried out by **STEENA JOSEPH**, under my guidance and supervision. The thesis is worth submitting in fulfillment of the requirements for the award of the degree of Master of Arts in Sociology

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## DECLARATION

I, **Steena Joseph** hereby declare that the thesis entitled "**A Study on wellness industry used among I.T Professionals in Kochi city**" is a bonafide record of independent research work carried out by me under the supervision and guidance of **Dr. Leela P.U**. I further declare that this thesis has not been previously submitted for the award of any degree, diploma, associateship or other similar title.

ERNAKULAM

MARCH 2022



STEENA JOSEPH

## ACKNOWLEDGEMENT

In this humble endeavor I have received a great deal of support and guidance from different quarters. First and foremost, I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

I am extremely grateful to our Director Rev. Sr. Emeline CSST and Principal Dr. Lizzy Mathew for giving me this opportunity.

I take this opportunity to express my gratitude to Smt.Elizabeth Abraham, head of the department of sociology and to all the members of teaching for their encouragement and guidance in accomplishing the work.

I am grateful to Dr. Leela P.U for her constant guidance and inspiration without which this work would not have been possible.

I would like to express my gratitude to the respondents of the study without whose cooperation this study could not have conducted successfully.

I also wish to acknowledge the help provided by the librarians of St. Teresa's college (Autonomous). Last but not the least I take this opportunity to thank my classmates, friends and my family for their love and support.

Ernakulam

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March 2022

# **CONTENT**

1. Introduction.....	2 - 28
2. Review of literature.....	30 - 42
3. Methodology.....	44 - 47
4. Data analysis and interpretation.....	49 - 66
5. Findings and conclusion.....	68 - 69

Bibliography

Appendix

## **LIST OF TABLES**

Sl no:	Title	Pg no:
4.1	Table showing frequency distribution of the respondents with regard to gender	49
4.2	Table showing the frequency distribution of the respondents with regard to family	52
4.3	Table showing the frequency distribution of the respondents with regard to marital status	52
4.4	Table showing the frequency distribution of the respondents with regard to monthly income	54
4.5	Table showing the frequency distribution of the respondents with regards to wellness industry	54
4.6	The table showing the frequency distribution of the respondents with regard to using different kinds of wellness industry	56
4.7	The table showing the frequency distribution of the respondents with regard to place for accessing wellness industry	56
4.8	The table showing the frequency distribution of the respondents with regard to buying equipments for wellness industry	57
4.9	The table showing the frequency distribution of the respondents with regard using wellness industry	57
4.10	The table showing the frequency distribution of the respondents with regard to using online media for doing wellness industry	58
4.11	The table showing the frequency distribution of the respondents with regard to health insurance or mediclaim policy	58

4.12	The table showing the frequency distribution of the respondents with regard to time preferring being engaging in wellness industry	60
4.13	The table showing the frequency distribution of the respondents with regard to body shaming	60
4.14	The table showing the frequency distribution of the respondents with regard to difficulties in wellness industry	61
4.15	The table showing the frequency distribution of the respondents with regard to whether wellness industry is good or bad	61
4.16	The table showing the frequency distribution of the respondents with regard to print media and social media	62
4.17	The table showing the frequency distribution of the respondents with regard to mental peace	62
4.18	The table showing the frequency distribution of the respondents with regard to medical issues while engaging in wellness industry	63
4.19	The table showing the frequency distribution of the respondents with regard to , wellness industry is costly while it is operated.	63
4.20	The table showing the frequency distribution of the respondents with regard to, is wellness industry helps to remove bad habits	64
4.21	The table showing the frequency distribution of the respondents with regard to satisfaction related to wellness industry	66

## **LIST OF FIGURES**

Sl no:	Title	Pg no:
1	The figure showing the frequency distribution of the respondents with regard to age.	50
2	The figure showing the frequency distribution of the respondents with regard to different specialised sectors in I.T Profession	51
3	The figure showing the frequency distribution of the respondents with regard to education.	53
4	The figure showing the frequency distribution of the respondents with regard to spending time for wellness industry	55
5	The figure showing the frequency distribution of the respondents with regard to main motivation for using wellness industry	59
6	The figure showing the frequency distribution of the respondents with regard to importance of wellness industry	65

# CHAPTER 1

## **INTRODUCTION**

Sociological understanding of health and wellness means, The sociology of health and illness, alternatively the sociology of health and wellness (or simply sociology of health), examines the interaction between society and health. The objective of this topic is to see how social life affects morbidity and mortality rate, and vice versa. This aspect of sociology differs from medical sociology in that this branch of sociology discusses health and illness in relation to social institutions such as family, employment, and school, and also interfaces more extensively with sociology of the body. The sociology of medicine by contrast tends to focus specifically on the patient-practitioner relationship and the role of health professionals in society. The sociology of health and illness covers sociological pathology (causes of disease and illness), reasons for seeking particular types of medical aid, and patient compliance or noncompliance with medical regimes.

Health, or lack of health, was once merely attributed to biological or natural conditions. Sociologists have demonstrated that the spread of diseases is heavily influenced by the socioeconomic status of individuals, ethnic traditions or beliefs, and other cultural factors. Where medical research might gather statistics on a disease, a sociological perspective on an illness would provide insight on what external factors caused the demographics who contracted the disease to become ill.

The Health and Wellness industry encompasses all activities which promote physical and mental wellbeing: from yoga to healthy eating, personal care and beauty, nutrition and weight-loss, meditation, spa retreats, workplace wellness and wellness tourism. The Indian wellness industry flourished by banking on the demand for alternative healing practices like the Ayurveda, yoga, naturopathy, etc., and then slowly expanded to include nutrition, fitness, and preventive healthcare. Wellness is an active process of making choices toward a healthy and fulfilling life. ... Wellness is especially important as we age because regular exercise and proper nutrition can help prevent a variety of ailments including cardiovascular disease, obesity, and fall risk behaviours.

The meaning of health has evolved over time. In keeping with the biomedical perspective, early definitions of health focused on the theme of the body's ability to function; health was

seen as a state of normal function that could be disrupted from time to time by disease. An example of such a definition of health is: "a state characterized by anatomic, physiologic, and psychological integrity; ability to perform personally valued family, work, and community roles; ability to deal with physical, biological, psychological, and social stress". Then in 1948, in a radical departure from previous definitions, the World Health Organization (WHO) proposed a definition that aimed higher: linking health to well-being, in terms of "physical, mental, and social well-being, and not merely the absence of disease and infirmity". Although this definition was welcomed by some as being innovative, it was also criticized for being vague and excessively broad and was not construed as measurable. For a long time, it was set aside as an impractical ideal, with most discussions of health returning to the practicality of the biomedical model.

Just as there was a shift from viewing disease as a state to thinking of it as a process, the same shift happened in definitions of health. Again, the WHO played a leading role when it fostered the development of the health promotion movement in the 1980s. This brought in a new conception of health, not as a state, but in dynamic terms of resiliency, in other words, as "a resource for living". In 1984, WHO revised the definition of health defined it as "the extent to which an individual or group is able to realize aspirations and satisfy needs and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources, as well as physical capacities." Thus, health referred to the ability to maintain homeostasis and recover from adverse events. Mental, intellectual, emotional and social health referred to a person's ability to handle stress, to acquire skills, to maintain relationships, all of which form resources for resiliency and independent living. This opens up many possibilities for health to be taught, strengthened and learned.

Since the late 1970s, the federal Healthy People Program has been a visible component of the United States' approach to improving population health. In each decade, a new version of Healthy People is issued, featuring updated goals and identifying topic areas and quantifiable objectives for health improvement during the succeeding ten years, with assessment at that point of progress or lack thereof. Progress has been limited to many objectives, leading to concerns about the effectiveness of Healthy People in shaping outcomes in the context of a decentralized and uncoordinated US health system. Healthy People 2020 gives more prominence to health promotion and preventive approaches and adds a substantive focus on the importance of addressing social determinants of health. A new expanded digital interface

facilitates use and dissemination rather than bulky printed books as produced in the past. The impact of these changes to Healthy People will be determined in the coming years.

Systematic activities to prevent or cure health problems and promote good health in humans are undertaken by health care providers. Applications with regard to animal health are covered by the veterinary sciences. The term "healthy" is also widely used in the context of many types of non-living organizations and their impacts for the benefit of humans, such as in the sense of healthy communities, healthy cities or healthy environments. In addition to health care interventions and a person's surroundings, a number of other factors are known to influence the health status of individuals. These are referred to as the "determinants of health", which include the individual's background, lifestyle, economic status, social conditions and spirituality; Studies have shown that high levels of stress can affect human health.

In the first decade of the 21st century, the conceptualization of health as an ability opened the door for self-assessments to become the main indicators to judge the performance of efforts aimed at improving human health. It also created the opportunity for every person to feel healthy, even in the presence of multiple chronic diseases or a terminal condition, and for the re-examination of determinants of health (away from the traditional approach that focuses on the reduction of the prevalence of diseases ( hhbc.in )

### Determinants

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In general, the context in which an individual lives is of great importance for both his health status and quality of life. It is increasingly recognized that health is maintained and improved not only through the advancement and application of health science, but also through the efforts and intelligent lifestyle choices of the individual and society. According to the World Health Organization, the main determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviours.

More specifically, key factors that have been found to influence whether people are healthy or unhealthy include the following:

- Income and social status
- Social support networks
- Education and literacy

- Employment/working conditions
- Social environments
- Physical environments
  
- Personal health practices and coping skills
- Healthy child development
- Biology and genetics
- Health care services
- Gender
- Culture

The maintenance and promotion of health is achieved through different combination of physical, mental, and social well-being—a combination sometimes referred to as the "health triangle." The WHO's 1986 Ottawa Charter for Health Promotion further stated that health is not just a state, but also "a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities."

Focusing more on lifestyle issues and their relationships with functional health, data from the Alameda County Study suggested that people can improve their health via exercise, enough sleep, spending time in nature, maintaining a healthy body weight, limiting alcohol use, and avoiding smoking. Health and illness can co-exist, as even people with multiple chronic diseases or terminal illnesses can consider themselves healthy.

The environment is often cited as an important factor influencing the health status of individuals. This includes characteristics of the natural environment, the built environment and the social environment. Factors such as clean water and air, adequate housing, and safe communities and roads all have been found to contribute to good health, especially to the health of infants and children. Some studies have shown that a lack of neighbourhood recreational spaces including natural environment leads to lower levels of personal satisfaction and higher levels of obesity, linked to lower overall health and well-being. It has been demonstrated that increased time spent in natural environments is associated with improved self-reported health, suggesting that the positive health benefits of natural space in urban neighbourhoods should be taken into account in public policy and land use.

Genetics, or inherited traits from parents, also play a role in determining the health status of individuals and populations. This can encompass both the predisposition to certain diseases and health conditions, as well as the habits and behaviours individuals develop through the lifestyle of their families. For example, genetics may play a role in the manner in which people cope with stress, mental, emotional or physical. For example, obesity is a significant problem in the United States that contributes to poor mental health and causes stress in the lives of many people. One difficulty is the issue raised by the debate over the relative strengths of genetics and other factors; interactions between genetics and environment may be of particular importance. (World health organization)

## HISTORY OF WELLNESS

Wellness is a modern word with ancient roots. As a modern concept, wellness has gained currency since the 1950s, 1960s and 1970s, when the writings and leadership of an informal network of physicians and thinkers in the United States largely shaped the way we conceptualize and talk about wellness today.

The origins of wellness, however, are far older—even ancient. Aspects of the wellness concept are firmly rooted in several intellectual, religious and medical movements in the United States and Europe in the 19th century. The tenets of wellness can also be traced to the ancient civilizations of Greece, Rome and Asia, whose historical traditions have indelibly influenced the modern wellness movement.

### Ancient Wellness

3,000-1,500 BC: Ayurveda – originated as an oral tradition, later recorded in the Vedas, four sacred Hindu texts. A holistic system that strives to create harmony between body, mind and spirit, Ayurvedic regimens are tailored to each person’s unique constitution (their nutritional, exercise, social interaction and hygiene needs) – with the goal of maintaining a balance that prevents illness. Yoga and meditation are critical to the tradition, and are, of course, increasingly practiced worldwide.

3,000 – 2,000 BC: Traditional Chinese Medicine (TCM), one of the world's oldest systems of medicine, develops. Influenced by Taoism and Buddhism, TCM applies a holistic perspective to achieving health and wellbeing, by cultivating harmony in one's life. Approaches that evolved out of TCM, such as acupuncture, herbal medicine, qi gong and tai chi, have become core, modern wellness – and even Western medical – approaches.

500 BC: Ancient Greek physician Hippocrates – is possibly the first physician to focus on preventing sickness instead of simply treating disease, and also argued that disease is a product of diet, lifestyle and environmental factors.

50 BC: Ancient Roman medicine emphasized disease prevention, adopting the Greek belief that illness was a product of diet and lifestyle. Ancient Rome's highly developed public health system (with its extensive system of aqueducts, sewers and public baths) helped prevent the spreading of germs and maintained a healthier population. (Global wellness institute)

### WELLNESS AND HEALTH

Both wellbeing and wellness are firmly buried identified with one another. Both are fundamental for the person to carry on with a cheerful and sound life. There are different things we need to take care all through life so as to be sound and fit. There is no option in contrast to wellbeing and wellness, we need to eat well food opportune, does physical exercise day by day, think positive and have persistence and responsibility towards a decent way of life.

Being associated with physical exercises every day plans something incredible for our body and brain. It makes us feel good, helps us to complete tough tasks, makes us pleasant all around and keeps us happy all the time because our body releases a chemical called endorphins while we are involved in physical activities. Regular physical activities also reduces stress, improves sleep, boosts energy levels, reduces symptoms of anxiety and depression, increases our self- esteem, makes us feel proud, improves confidence level and personality etc.

Physical exercise is great for our muscles, heart and lungs. Some more advantages of the physical activities are; it builds our bone strength, saves us from obesity by promoting a healthy weight, saves us from diabetes, helps us to build healthy habits, keeps us away from cancer, healthy food in a timely manner, and we can easily maintain our health and fitness. Being healthy means not only away from diseases but it also means the complete feeling of physical, mental and social well-being. Maintaining health and fitness is not a simple task however; not so tough too. We need to involve ourselves into some daily physical activities together with healthy, fresh and timely food which can only provide us long-term health and fitness benefits. We burn extra and unnecessary calories to our body through physical exercises.

Daily physical exercises keep kids so active and put them on a path of better physical and mental health. Physical activities along with the proper nutrition are really very beneficial to the people of all ages from any background and abilities. Being involved in the daily physical exercises is a good strategy to defeat obesity.

It is found that around one-third of the U.S. Adult citizens are obese and almost 17% of children and adolescents are obese. There are many people suffering from diabetes and other chronic health problems such as heart disease, high blood pressure, cancer, asthma, overweight, etc. We can be fit just by incorporating some physical activities including healthy eating into our daily life for 30 minutes (for adults) and 60 minutes (for children). Regular physical activities help us to get long-term health benefits through:

- Prevention from chronic diseases (heart disease, cancer, and stroke)
- Weight control
- reducing extra fat
- making muscles healthy and stronger
- Promoting strong bone and joint development
- Enhancing overall strength and endurance
- improving sleep and keeping away from sleep disorders

- Relieves stress
- Increases chance of living longer
- Increases energy level and self-esteem
- Reduces potential of being depressed
- Promoting health of heart and lungs

We cannot achieve success in our life without health and fitness. It may harm to a big extent if we ignore our physical and mental fitness. In order to get great results in all the areas of our life, we need a healthy and active body as well as a sound mind. There are only a few people having both physical and mental fitness. This is why because only few people know the real advantages of good health and fitness. The person who is more fit has more energy and patience to tackle problems in life. Health and fitness gives energy which improves confidence level to complete a task. Good health and fitness gives a self-replenishing energy which helps us in achieving the goal with required energy levels. (NCBI)

## Pros and Cons of Nutritional Education Programs

**PROS:**

- Employees can achieve a healthier weight (and reduce healthcare costs)
- Encourages healthy choices and lifestyles
- Can be an effective and low-cost way to offer a wellness program

**CONS:**

- Employees can continue unhealthy nutrition habits regardless of access or education
- Employees resistant to change don't have the support and tools they need to succeed

## SOCIAL ASPECTS AND WELLNESS

Social wellness refers to the relationships we have and how we interact with others. Our relationships can offer support during difficult times. Social wellness involves building healthy, nurturing, and supportive relationships as well as fostering a genuine connection with those around you. Conscious actions are important in learning how to balance your social life with your academic and professional lives. Social wellness also includes balancing the unique needs of romantic relationships with other parts of your life. (Jstor)

## PHYSICAL WELLNESS

Physical wellness alludes to great body wellbeing. It is subject to hereditary and furthermore on social, monetary and environmental components. That implies, one's qualities are somewhat answerable for one's physical wellbeing, yet additionally different conditions: where you live, how perfect or contaminated your water and the air around you is and furthermore how great you're social and clinical framework is. It is likewise the after effect of ordinary exercise, appropriate eating routine and sustenance, and legitimate rest for physical recuperation. An individual who is truly fit will have the option to walk or run without getting short of breath and they will have the option to do the exercises of regular living and not need assistance. How much every individual can do will rely upon their age and whether they are a man or lady.

## MENTAL WELLNESS

Emotional wellness alludes to an individual's passionate and mental prosperity. A condition of enthusiastic and mental prosperity where an individual can utilize their reasoning and passionate (feeling) capacities, work in the public arena, and fulfil the normal needs of regular day to day existence. One approach to consider psychological well-being is by seeing how well an individual capacities. Feeling competent and productive; having the option to deal with typical degrees of stress, have old buddies and family, and lead a free life; and having the option to skip back or recuperate from difficulties, are largely indications of emotional well-being. (Medical news today article)

## DIFFERENT TYPES OF WELLNESS INDUSTRY

### Gymnastics

It is a sport that includes physical exercises requiring balance, strength, flexibility, agility, coordination, and endurance. The movements involved in gymnastics contribute to the development of the arms, legs, shoulders, back, chest, and abdominal muscle groups. Gymnastics evolved from exercises used by the ancient Greeks that included skills for mounting and dismounting a horse, and from circus performance skills.

The most common form of competitive gymnastics is artistic gymnastics, which consists of, for women (WAG), the events floor, vault, uneven bars, and beam; and for men (MAG), the events floor, vault, rings, pommel horse, parallel bars, and horizontal bar. The governing body for gymnastics throughout the world is the Federation International de Gymnastique (FIG). Eight sports are governed by the FIG, which include Gymnastics for All, Men's and Women's Artistic Gymnastics, Rhythmic Gymnastics, Trampoline (including Double Mini-trampoline), Tumbling, Acrobatic, Aerobic and Parkour.<sup>[1]</sup> Disciplines not currently recognized by FIG include Wheel gymnastics, Aesthetic group gymnastics, Men's Rhythmic Gymnastics, Team Gym, and Mallakhamba.

Participants in gymnastics-related sports can include young children, recreational-level athletes, and competitive athletes at varying levels of skill, including world-class athletes.

(Euro team 1996)

### Yoga

It is a group of physical, mental, and spiritual practices or disciplines that originated in ancient India, aimed at controlling ('yoking') and stilling the mind, and recognizing the detached 'witness-consciousness' as untouched by the activities of the mind and mundane suffering. There are a broad variety of yoga schools, practices, and goals in Hinduism, Buddhism, and Jainism, and traditional forms and modern methods of yoga are practiced worldwide.

There are broadly two kinds of theories on the origins of yoga. The linear model argues that yoga has Aryan origins, as reflected in the Vedic textual corpus, and influenced Buddhism; according to Crangle, this model is mainly supported by Hindu scholars. The synthesis model argues that yoga is a synthesis of indigenous, non-Aryan practices with Aryan elements; this model is favoured in western scholarship.

Yoga is first mentioned in the Rig-Veda and also referenced in many Upanishads. The first known formal appearance of the word "yoga", with the same meaning as the modern term, is in the Katha Upanishad, probably composed between the fifth and third century BCE. Yoga continued to develop as a systematic study and practice during the 5th and 6th centuries BCE, in ancient India's ascetic, and Śramaṇa movements. The most comprehensive text on Yoga, Yoga Sutras of Patanjali date to the early centuries CE, while Yoga philosophy came to be marked as one of the six orthodox philosophical schools of Hinduism in the second half of the first millennium. Hatha yoga texts began to emerge between the 9th and 11th century with origins in tantra.

The term "yoga" in the Western world often denotes a modern form of hatha yoga and a posture-based physical fitness, stress-relief and relaxation technique, consisting largely of the asanas, in contrast with traditional yoga, which focuses on meditation and release from worldly attachments. It was introduced by gurus from India, following the success of Vivekananda's adaptation of yoga without asanas in the late 19th and early 20th centuries, who introduced the Yoga Sutras to the west. The Yoga Sutras gained prominence in the 20th century following the success of hatha yoga.

(Denise Lardner Carmody, John Carmody 1996)

### Diet

In nutrition, diet is the sum of food consumed by a person or other organism. The word diet often implies the use of specific intake of nutrition for health or weight-management reasons (with the two often being related). Although humans are omnivores, each culture and each person holds some food preferences or some food taboos. This may be due to personal tastes or ethical reasons. Individual dietary choices may be more or less healthy.

Complete nutrition requires ingestion and absorption of vitamins, minerals, essential amino acids from protein and essential fatty acids from fat-containing food, also food energy in the form of carbohydrate, protein, and fat. Dietary habits and choices play a significant role in the quality of life, health and longevity. A healthy diet can improve and maintain optimal health. In developed countries, affluence enables unconstrained caloric intake and possibly inappropriate food choices.

Health agencies recommend that people maintain a normal weight by limiting consumption of energy-dense foods and sugary drinks, eating plant-based food, limiting consumption of red and processed meat, and limiting alcohol intake.

The Dietary Guidelines for Americans is an evidence-based information source that policy makers and health professionals use to advise the general public about healthy nutrition.

A particular diet may be chosen to promote weight loss or weight gain. Changing a subject's dietary intake, or "going on a diet", can change the energy balance and increase or decrease the amount of fat stored by the body. The terms "healthy diet" and "diet for weight management"(dieting) are often related, as the two promote healthy weight management. If a person is overweight or obese, changing to a diet and lifestyle that allows them to burn more calories than they consume may improve their overall health, possibly preventing diseases that are attributed in part to weight, including heart disease and diabetes. Conversely, if a person is underweight due to illness or malnutrition, they may change their diet to promote weight gain. Intentional changes in weight, though often beneficial, can be potentially harmful to the body if they occur too rapidly. Unintentional rapid weight change can be caused by the body's reaction to some medications, or may be a sign of major medical problems including thyroid issues and cancer among other diseases. (Mann, T; Tomiyama, AJ; Westling, E; Lew, AM; Samuels, B; Chatman, J April 2007 ).

### Zumba

It is the largest branded fitness program in the world, created by Colombian dancer and choreographer Alberto "Beto" Perez and founded in 2001. Zumba aims to help people achieve personal transformations. Zumba is a trademark owned by Zumba Fitness, LLC. Zumba was created in the 1990s by Perez in Cali, Colombia. Perez, an aerobics instructor, forgot to bring his regular music to his aerobics class. He happened to have cassette tapes of Latin dance music—salsa and meringue—and danced to them instead, which Perez later taught as "Rumbacize". In 2001, Perez partnered with Alberto Perlman and Alberto Aghion, to officially launch Zumba and the trio released a series of fitness videos sold via infomercial. Insight Venture Partners and the Raine Group made an investment in 2012. The Company expanded into class instruction and by 2015, according to Perlman, there were 14 million Zumba students in 186 countries.

Though the word "Zumba" has several meanings in e.g. Castilian and Latin American Spanish, it is stated by Zumba Fitness, LLC to be a neologism that was expressly created as a name. The original name was "Rumbacize", a portmanteau of rumba (a Spanish word for "party" and various dances) and Jazzercize. (Garcia, Darlin)

## RECOMMENDATIONS FOR WORKPLACE WELLNESS PROGRAMS

What steps can be taken to improve engagement and employee wellness in the workplace? Worksite wellness programs should shift the focus from weight loss to the promotion of healthy eating. This not only fosters employee health and wellness, but it also encourages a collaborative environment to establish healthy eating habits. The daily stressors and pressures of the office are generally not conducive to eating a well-balanced diet. Many employees just grab a quick lunch and eat at their desks while working. This is counterproductive to both employees and the organization, as energy levels and motivation become depleted without adequate nutrition.

Kitchen areas that enable employees to bring healthy lunches and snacks to work are ideal. In addition, healthy foods can be supplied by the office for easy access and guidance to proper nutrition. This demonstrates organizational responsibility for facilitating a healthier workplace and role modelling for employees to follow. It literally says “put your money where your mouth is” and enhances the quality of corporate wellness programs. Employers should also reinforce the value of eating lunches away from desks to take breaks from work and promote more mindful eating.

A variety of educational initiatives that emphasize the health benefits of sensible eating and exercise regimens are also imperative. Healthy lifestyle programs, as opposed to weight reduction efforts, are necessary components for successful outcomes. A holistic approach to health and well-being is central for achieving long-term organizational wellness. The incorporation of wellness challenges and teamwork activities adds enjoyment and lend support for co-workers. These types of bonding experiences are advantageous for boosting office morale while discouraging body shaming and critiques of fellow colleagues.

(Manika Gupta, Hofstra University President of the Wellness Council of America)

## Emergence of covid-19

The COVID-19 pandemic, also known as the corona virus pandemic, is an ongoing global pandemic of corona virus (COVID-19) caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). The novel virus was first identified in the Chinese city of Wuhan in December 2019; a lockdown in Wuhan and other cities in surrounding Hubei failed to contain the outbreak, and it quickly spread to other parts of mainland China and around the world. The World Health Organization (WHO) declared a Public Health Emergency of International Concern on 30 January 2020, and a pandemic on 11 March 2020. Multiple variants of the virus have emerged and become dominant in many countries since 2021, with the Alpha, Beta, and Delta variants being the most virulent. As of 18 October 2021, more than 240 million cases and 4.9 million deaths have been confirmed, making it one of the deadliest pandemics in history.

COVID-19 symptoms range from none to life-threatening. Severe illness is more likely in elderly patients and those with certain underlying medical conditions. Transmission of COVID-19 occurs when people breathe in air contaminated by droplets and small airborne particles. The risk of breathing these in is highest when people are in close proximity, but the virus can transmit over longer distances, particularly indoors and in poorly ventilated areas. Transmission can also occur, rarely, via contaminated surfaces or fluids. People remain contagious for up to 20 days, and can spread the virus even if they do not develop symptoms.

Several vaccines have been approved and distributed in various countries, which have initiated mass vaccination campaigns since December 2020. Other recommended preventive measures include social distancing, wearing face masks in public, ventilation and air-filtering, covering one's mouth when sneezing or coughing, hand washing, disinfecting surfaces, and quarantining people who have been exposed or are symptomatic. Treatments focus on addressing symptoms, but work is underway to develop medications that inhibit the virus. Authorities worldwide have responded by implementing travel restrictions, lockdowns, business closures, workplace hazard controls, testing protocols, and systems for tracing contacts of the infected.

The pandemic has resulted in severe social and economic disruption around the world, including the largest global recession since the Great Depression in the 1930s.<sup>[7]</sup> It has led to widespread supply shortages exacerbated by panic buying, agricultural disruption, food shortages, and decreased emissions of pollutants. Numerous educational institutions and public areas have been partially or fully closed, and many events have been cancelled or postponed. Misinformation has circulated through social media and mass media, and political tensions have been exacerbated. The pandemic has raised issues of racial and geographic discrimination, health equity, and the balance between public health imperatives and individual rights.

### Prevention

Preventive measures to reduce the chances of infection include getting vaccinated, staying at home, wearing a mask in public, avoiding crowded places, keeping distance from others, ventilating indoor spaces, managing potential exposure durations,<sup>[148]</sup> washing hands with soap and water often and for at least twenty seconds, practising good respiratory hygiene, and avoiding touching the eyes, nose, or mouth with unwashed hands.<sup>[149][150]</sup>

Those diagnosed with COVID-19 or who believe they may be infected are advised by the CDC to stay home except to get medical care, call ahead before visiting a healthcare provider, wear a face mask before entering the healthcare provider's office and when in any room or vehicle with another person, cover coughs and sneezes with a tissue, regularly wash hands with soap and water and avoid sharing personal household items.

### Treatment

There is no specific, effective treatment or cure for corona virus disease 2019 (COVID-19), the disease caused by the SARS-CoV-2 virus.<sup>[167][168]</sup> Thus, the cornerstone of management of COVID-19 is supportive care, which includes treatment to relieve symptoms, fluid therapy, oxygen support and prone positioning as needed, and medications or devices to support other affected vital organs.<sup>1</sup>

Most cases of COVID-19 are mild. In these, supportive care includes medication such as paracetamol or NSAIDs to relieve symptoms (fever,<sup>[170]</sup> body aches, cough), adequate intake of oral fluids and rest.<sup>[168][171]</sup> Good personal hygiene and a healthy diet are also recommended.<sup>[172]</sup> The US Centres for Disease Control and Prevention (CDC) recommend that those who suspect they are carrying the virus isolate themselves at home and wear a face mask.<sup>[173]</sup>

People with more severe cases may need treatment in hospital. In those with low oxygen levels, use of the glucocorticoid dexamethasone is strongly recommended, as it can reduce the risk of death.<sup>[174]</sup> Noninvasive ventilation and, ultimately, admission to an intensive care unit for mechanical ventilation may be required to support breathing.<sup>[175]</sup> Extracorporeal membrane oxygenation (ECMO) has been used to address the issue of respiratory failure, but its benefits are still under consideration. (frontiersin.org)

### Impact of COVID-19 on the wellness Industry

The wellness Industry particularly brick-and-mortar gyms were among the hardest hit at the onset of Covid-19. Gyms and fitness studios were the first businesses to undergo forced shutdowns in the United States from the threat of Corona virus spread as these are high-touch businesses. Although the long-term impacts are not known, short term impacts surely have been catastrophic to many. There has been a massive crisis of unemployment of gyms and studio owners, professional trainers and supporting staff. Owners found it difficult to pay bank loans, rents, electricity bills and salaries of employees. Many boutique gyms actually run on small margins and so the Pandemic posed a huge challenge on its very existence. The brick-and-mortar gyms that contribute the highest share to the US fitness industry, estimated to be worth close to nearly \$100 billion, have their own health failing today at least in some segments As uncertainty of the virus prevails, there will be a continuous need for the fitness industry to shape itself with the changing times and many big names have already started doing so, that is by going creative and digital..!! The digital transformation seems to be the best exercise to stay relevant and at the least afloat. As ‘work from home’ has become the new normal for any other establishment, virtual access or ‘workout from home’ made gyms and studios not lose their consistency. It is undoubtedly much more alarming for the smaller players with less or no budget to go virtual or invest in digital advertising or creating a digital platform. However, hundreds of big and small fitness businesses joined in with Omnify’s

‘Zoom Integration’ to enable booking of live classes thereby supporting gyms and studios through live streaming of their services. Virtual classes have become the order of the day keeping the pulse of the fitness industry going. The upward trend for accessing digital content versus the attendance in physical gyms was kind of inevitable given the Covid-19 backdrop. But the question that yet looms large is- For how long? Is this change altogether decisive of the fate of gyms and studios? Also, which kinds of fitness classes look more promising online? Most of the virtual bookings have been of yoga which barely needs any equipment than a mat. So yoga has become even more popular and expected to be a promising deal. Gym training in virtual reality has also upped the scale but workouts with heavy equipment are certainly missed. (tandfonline.com)

#### Fitness industry in India during pandemic situation (covid-19)

Fitness in India: With the corona virus pandemic confining people within the bounds of their homes on and off since March last year, the fitness industry also saw a major slump. Gyms and other fitness centres were seen to be one of the places where the virus would spread quickly, likely due to shared machines, towels, a lot of shared space, and the heavy breathing that came along with fitness, and so, the avenues to go out and exercise were shut off, at least for some time. While this was enough for fitness lovers to take up exercising from home, others started becoming conscious about their health when the lockdown kept on extending for months last year and they had no option but to take up fitness at home.

According to a report by mobile data and analytics provider App Annie, 2020 saw about 71,000 new fitness and health apps being launched, which was a 13% increase over 2019. Moreover, according to an article published on the World Economic Forum website, there was a 46% increase in downloads of health and fitness apps across the world between Q1 and Q2 of 2020, with India witnessing the highest increase in the downloads – of a whopping 156%. This, the report said, meant that there were 58 million new active users in the country. For instance, Indian health and fitness app HealthifyMe alone witnessed an increase of 5 million users during the pandemic, accounting for nearly a quarter of its user base of 21 million

During the period of lockdown, not only did fitness apps see a surge in traffic, but video streaming platform YouTube also got flooded with tutorials and guides on exercising at home, be it for beginners or experts. Now, though the second wave of the pandemic has also

come and gone and fitness institutions are beginning to open up again in several cities, it seems like just like the trend of remote working, fitness at home is also here to stay.

Talking to Financial Express Online, fitness equipment retailer Grand Slam Fitness Director Prateek Sood said, “From the rise of commercial gyms and online personal training sessions, the virus outbreak has steadily transformed the fitness industry. The industry is increasingly leveraging digital opportunities for a connected experience with customers. Classes covering everything from Zumba and Hooping to Yoga and Cross fit are being live streamed through digital tools. Home workout apps are witnessing a tremendous upsurge among millions in self isolation, helping them ease anxiety and stress caused by the crisis.”

“Last year we saw a huge demand for home gym equipment from April to September. But this year we are seeing that individuals from Tier 2 cities want to invest in gym business due to increasing health issues. Corona virus taught them that health is wealth and they have started investing in it. The spread of COVID-19 has encouraged brands to drive both a stronger online presence and discover new ways to connect with customers. Looking at the highly loyal and enthusiastic customer base, creativity and adaptability displayed by brands, the fitness industry will bounce back soon.”

Meanwhile, Nutritionist and Lifestyle Consultant Palak Chaturvedi told FE Online, “Home fitness has been in our lives for decades, plus it has taken on a new role since the pandemic closed gyms around the world. Many of us are trying to find ways to exercise effectively within the four walls. Video workouts are more popular than ever. It gives them access to new kinds of workout sessions that they wanted to try. We’re making a lot of investment there because we think that the industry is finding an en route instead. For me, as a researcher at heart, it’s been fascinating to watch the industry transform so rapidly. What the pandemic has done, I think, is that it’s accelerated a trend that was already in the making. It’s pushed the industry forward and forced a lot of change. The concept of remote fitness is here to stay and evolve into something much bigger.”

“While at-home fitness has been an emerging trend for the past decade, the pandemic has sky-rocketed at-home fitness and placed it front and centre. Since gyms are one of the most high risk environments for the spread of COVID-19, they were one of the first places to shut doors as soon as the pandemic hit India. India had the largest lockdown in the world—from March 25 to May 2020, 1.3 billion people were instructed to stay inside. This has again repeated itself in subsequent waves and lockdowns. That’s a lot of people who, quite

suddenly, found themselves at home, seeking physical & mental wellness. As a matter of fact, between Q1 and Q2 2020, health and fitness app downloads in India grew by 156% – The highest in the world. That translates to 58 million new active users—almost the entire population of Italy,” said Raunaq Singh Anand, Co-Founder of FitTech brand Flexnest.

Talking about the trend that was seen among people during this time, Head of Physiotherapy and Sports Medicine at Nanavati Max Super Speciality Hospital, Dr Ali Irani said, “In these last 15 months, the pandemic has taught us to do exercises at home. Our exercises have changed from gym and heavy weights to breathing exercises, Pranayam and Yogic exercises. Many have opted for Online Yoga; many have also chosen Online Pilates classes. So all the exercises were online.”

He also expected the trend in breathing exercises to continue in an upward graph. “In our experience at the hospital of more than 3,000 COVID positive patients, most of the patients had a vital capacity of less than 1.5 litres, much less than the lungs’ actual capacity of 4.5-5 litres. So, I think with time, we will understand that the most important thing for us are these different types of breathing exercises or Pranayam, which would increase our vital capacity. I believe that people will now also be looking at exercises that would build their immunity, so we are sort of going back to our sciences of naturopathy, ayurveda and unani.”

A similar opinion was also expressed by Palak. “Considering the number of increased cases and the presence of the Delta virus variant in the country, the benefits of home workouts and exercise at home can no longer be further undermined. Keeping one’s fitness journey prepares you by building your immunity from within. Even celebrities and sports personalities have worked out at home. They have made their living rooms into a gym and play/ exercise area. Sports retail brands estimate that fitness gear contributed to almost one-third of their total turnover share for 2020 and nearly 80% of those sales came from enthusiasts wishing to work out indoors.” (Financial express – article)

#### Fitness Industry in India: New tools, gadgets being sought

Palak said, “When the lockdown took effect, home-fitness business took off like wildfire. The rage of Fitness tracking gadgets and pieces of equipment are pretty much selling out. The

Smartphone makers have adapted to come out with prototype devices with built-in technology to get in sync with hardware for increased accuracy. From cardio machines to yoga mats, running and cycling gears keep the cash registers ringing. The download of fitness apps and sales of fitness wearable's have increased as everyone is turning positively to the idea of a simple walk every day to be on the move. Apart from tools, it is also the online services of fitness experts that are making the waves in bringing health a new face within the home."

Amit Khatri, the Co-Founder of smart watch brand Noise, said, "From taking online yoga sessions to setting up a mini gym at home, fitness enthusiasts have become more conscious of their holistic wellness. They seek a health partner in their gadgets that supports them with intelligence on their physical and mental health. This deliberate demand has led to the amplified appetite for fitness gadgets like smart watches which have become an essential gadget for round-the-clock health monitoring. Accordingly, we have witnessed phenomenal growth in the business and shipment for smart watches in the past year. Another gadget that has gained significant attention from fitness enthusiasts is TWS ear buds, which they require for an uninterrupted and prolonged workout session. The demand for fitness gadgets will penetrate further in the coming days. Consumers are becoming more cognizant and intend to buy smart-tech devices equipped with features beyond fundamental functionalities like more insights on health, better battery life, improved aesthetics, and calling features at affordable pricing."

Meanwhile, Raunaq said that Flexnest's smart spin bike has also seen a lot of traction. "Flexnest sold out of their initial lot of 250 smart spin bikes in three weeks as consumers in India are eagerly looking for such solutions that Indian consumers have never seen before. Going forward, just like remote working, At-home fitness is a trend that is here to stay. As the pandemic starts to settle down and people start to step out, a large proportion of the population who have discovered the added convenience of working out from home and invested in connected fitness products will not be returning to the gym," he opined.

Talking about the health aspect, Dr Irani said that the hospital received a team of physiotherapy equipment makers from Jodhpur, and the team was looking to understand the new equipment that were required by the doctors. "We showed them the spirometer, which measures vital capacity. At present, all the spirometers we have are imported, but now, this equipment maker is looking to produce made-in-India spirometers, and so that is the new

gadget or tool that we are looking at, as it would help measure the health of the lung. The way every home now has an oximeter, the next instrument, I believe, would be one that would help in measuring lung capacity.” (Times of India)

#### Fitness at home: What people are seeking for home gyms

Talking about the equipment that people are now looking at for making gyms at home, Palak said, “While home gyms traditionally had heavy equipment, the current trend for lighter fitness activities includes resistance bands, jump ropes, medicine ball, yoga mats, kettle bells, little and heavy dumbbells. Dumbbells come in different sizes, shapes, and materials these days, from plastic-coated to colourful to straight metal. Jumping rope is hands down one of the best ways to get a cardiovascular workout. It increases your heart rate quickly and also works your arms, shoulders, legs, and core. Resistance bands are one of the most versatile pieces of fitness equipment you can buy. You can target your entire body with resistance bands and mimic most machine-based strength moves. A foam roller is a great recovery and mobility tool, as well.”

Her view was mostly reiterated by Grand Slam Fitness’ Sood. “The pandemic has galvanised the development of gym equipment in large quantities and also, new devices to meet the demands of consumers who are early adopters. Working out at home with your own home gym equipment has some serious convenience benefits. There has been a sharp increase in the Home Gym Equipment category like Watt bike, an indoor cycle which is used by many key athletes and celebrities, Motorised Treadmill, “Multi Gym”, and “Gym Equipment” and so on. Many are also opting for equipment which takes up less surface area like dumbbells, stability ball, jump rope, heavy kettle bell, etc.”

Meanwhile, Fitness Talks Founder Pranit Shilimkar guided people on what they can use at home, saying, “Those who understand the balance of all components of fitness and want to set up a home gym do not have to invest a lot into it. For example, yoga mat, foam roller, pair of adjustable dumbbells or a barbell, some plates and at max a bench is more than enough for someone to kick starts their fitness journey which surely is better than nothing.” (bbc.com)

### Remote Fitness: Changes in the industry

Talking about the way the service providers are changing to adapt to the new demands, Sood said, “Amidst the corona virus outbreak, the fitness industry has found itself in a more fortunate position. Some major B2B service providers are coming up with their gyms in smaller cities of India and making their position in the B2C segment due to a lesser impact of Covid in such cities. Companies are also helping people by setting up their own gyms at home keeping the current scenario in mind.”

Palak said, “The fitness industry is shifting from surviving the pandemic and looking for ways to thrive in the next normal, building consumer relationships that will last and grow. The service providers both inside and outside the home will need to reassess their value propositions, articulate their roles in consumers’ fitness routines, and commit to an approach that will win over the right consumers for them. Specifically, the service providers should consider a more hybrid proposition that keeps consumers digitally connected. Makers of in-home tools and equipment can lean into the normalization of DIY fitness and create tools to correctly channelize the available space for maximum benefit. The market is slowly yet surely adapting for the evolution which will gravitate around home fitness.”

She also spoke about the way some of the entities in this space performed. “Last year, HealthifyMe helped people collectively lose two million kilograms in nine months, against the previous year’s one million kilograms. They are not the only ones operating in the tech-driven diet-fitness space that claim to have benefited from 2020’s home-bound, immunity-chasing, fear-ridden India. Fit pass offers access through a single membership to over 4,000 gyms and fitness studios across 17 cities, and also has fitness and diet solutions. From October to December 2020, the business grew by 25-30% compared to the same time in 2019. Internationally, technology became a diet and fitness enabler about 15 years ago, going from calorie recorders to GPS-led fitness trackers, aggregators of studio classes, wearable’s, and now, AR screens that monitor training. All in all, players who have been steadily changing and evolving will ultimately perform far better than those who don’t.”

(nytimes.com)

### New trends in Fitness industry and the changing economics

Describing the new and popular trends, Palak said, “Wearable fitness technology like Fit Bits has become a common device that people use regularly to track their fitness levels and monitor themselves during their workouts. Group workouts have become incredibly popular and are generally conducted amongst a group of familiar people or who have some kind of common ground. High-Intensity workouts have proven to be incredibly beneficial for anyone who wants to partake in this fitness regime that can help get them into shape quickly. No one knows how long this trend will last and companies that can embed their technology into consumer habits and gain share will become highly valuable going forward. Companies that don’t have the resources to grow now may miss the wave. We are likely to see a lot of technology innovations in the fitness and gym industry as well as a great deal of capital coming into the industry to leverage the budding home fitness market.”

Describing the economics of the industry, Sood said, “Studies show that the market for home gym equipment is likely to grow at a CAGR of 9% in revenue from 2019-2025. Digital fitness tools, ranging from at-home connected fitness equipment to tech-smart apparel, offer on-demand workout sessions backed by real-time performance data. These offer flexibility, customisation and convenience. Being low in cost compared to a typical gym membership, users are looking forward to incorporating them into their fitness regimes long after the pandemic subsides.”

Just like the tech and the education industry, the pandemic has caused major changes to take place in the fitness industry. With people’s demands changing, the industry seems to have taken it in a stride and matched the demands with updated, suitable and flexible products. However, while several industry players believe that these innovations are here to stay as people are not likely to return to the rigidity of gymming, the actual impact of reopening of gyms and other fitness institutions would only be clear in due time. (economicstime.com)

### WELLNESS INDUSTRY IN KERALA

Body and mind wellness have always been a prime part of the kerala culture with the existence of yoga, meditation and Ayurveda practices. Moving along with the changing times, lifestyles have also seen a change with new demands that are now looking beyond the

traditional practices by revamping it with modern technologies. Residents of India have seen a dynamic shift in lifestyle in the last few years and as more and more are moving towards healthier lifestyles, demand for wellness and fitness centres/studios has been rapidly growing. Per a report published by Stratview Research on India's Wellness Market 2019, the fitness sector is anticipated to grow aggressively owing to the accessibility technology advancements, ease in internet access and availability of plenty fitness and training programmes. With the mentioned advancements consumers are seen to take great interest in wellness and fitness such as keeping up to date with latest products and services available in order to keep fit. As per a statistical study conducted in 2019, 66.2% of the total female population accounts for participation into wellness and fitness, outpacing the male population. Moreover, fitness and wellness participation when defined by the age group, population aged between 25-34 years were seen to use maximum of the fitness facilities in comparison to other age brackets. In an exciting market like kerala, the growing demand is at variance with services and platforms being offered. While many keralites are seen going to the gym for gaining muscle strength and getting into shape, a fair amount of them are opting for engaging and fun fitness regimes like aerobics, Zumba, gym, yoga, and many more. This growing demand and supply in the fitness industry has grown the fitness culture and attracts not only domestic players but also international players. With the growing disposable income of the youth of this country, the trend of visiting wellness centres has taken a rise with many spending time and money for rejuvenating their body and soul.

According to a report by Deloitte India, the Indian fitness industry crossed the USD 1 billion mark in 2017, growing aggressively from being at a nascent stage to becoming a comprehensive market. This is further expected to moderately grow at a CAGR of 8% over the next seven years. The government too has shown great initiatives to encourage the growth of wellness in its 'Make in India' campaign. As the awareness for health and wellness lifestyle is becoming a major trend in the modern society, the initiation of quantified self-movement has created substantial demand for fitness Apps and wearable's; however the paying apps continue to see a minimal growth. There are many mergers and acquisitions taking place such as Under Armour investing in Jabil Clothing+ and MyFitnessPal and Runtastic being acquired by Adidas. When talking about the fitness tracking marketplace, players like Garmin, Fit bit, Samsung and Apple are seen to shift focus to smart watches to track and record fitness levels, giving rise the gadget-based wearable's whereas smart clothes are yet to be explored. (Times of India)

## Healthcare Scenario of Kerala

Kerala has emerged as the best state in the India in terms of healthcare performance. Kerala's health status is almost on a par with that of developed economies. The state has flourish in increasing life expectancy as well as reducing infant and maternal mortalities. The execution of land reforms improved the standard of living of the rural poor.

The effective execution of the public distribution of food played an important role in improving nutritional status. Kerala's openly funded healthcare system has helped in providing treatment facilities to people. The high literacy rate, especially among the females, also played a major role in improving the health scenario. The Kerala Model of Health is often described as "good health based on social justice and equity".

Despite, better health outcomes on certain sign, the much-signify Kerala model of health has been showing a number of disturbing trends. Although mortality is low, the morbidity (those suffering from chronic/non-communicable diseases) levels in urban and rural Kerala is high in Kerala compared to other Indian States. Thus the inconsistency is that on the one side Kerala stands as the State with all indicators of better health care development in terms of IMR, MMR, birth rate, death rate etc. On the other it outstrips all other Indian States in terms of morbidity especially the chronic illness. Kerala may have the best health indicators but necessarily not have the best public health care institutions. The success of Kerala health indicators is more due to the investment in the social capital rather than only in the public health care, resulting in a more responsible and desegregated primary health care system

The health care system is considered to be the principal factor for attaining the high level of health status in Kerala. From the formation of the state, health care provision was one of the governments' top priorities, and the system was developed in a way that incorporated both western and traditional medicine that was accessible to the people. The health care facilities can be divided into three categories in view of service of care: allopathy (western medicine), ayurveda, and homeopathy, and three categories in view of the ownership: public, private and cooperative sectors. With respect to the allopathy, which comprises 36.9% of total facilities and 94.2% of total beds, the public sector owns 23.3% of the facilities and 39.5% of the beds, while the private sector owns 75.8% of the facilities and 58.3% of the beds. Allopathic facilities of the public sector are systematically organized in rural areas, where 74% of the

population resides, so that each facility with different functional capacities can meet the needs of the people. Each Community Health Centre (CHC) serves roughly 230,000 people, and each Primary Health Centre (PHC) serves a population of approximately 26,000. 11) In addition, there are 5,094 sub-centres of PHCs as grass root institutions with no beds, each of which serves about 4,700 people. Although conclusive evidence does not exist, this ample network that extends to the grass root level must have contributed to less of an urban-rural disparity, which has been a salient feature of Kerala (The Hindu)

### Kerala government to form “physical fitness mission”

Kerala government will form a ‘Physical Fitness Mission’ to improve the health and physical fitness of the people, chief minister Pinarayi Vijayan has said. Addressing a gathering after laying the foundation stone for the sports complex including a synthetic track at the Government Brennen College in Thalassery here on Sunday, he said the mission aims to undertake activities that would improve the physical fitness of the people in all age groups from kindergarten students to senior citizens.

The government wants to groom a healthy generation, and the programme ‘Health through play’ has been launched keeping this objective in mind, he said. Also, we should be able to improve the sporting spirit in more students by setting up sports training facilities in more schools, he added.

The synthetic track and sports complex coming up in Brennen College would boost aspirations of the north Malabar region in the field of sports and games, said the chief minister, adding that the synthetic track would be the first such facility being developed in a college campus using the fund of the Sports Authority of India (SAI). The new project, which is expected to cost Rs 42 crore, would facilitate athletic training with international standards, said the chief minister. Observing that the synthetic track would be a boon to the young athletes at Kannur Sports Division and SAI centre at Thalassery, the chief minister said that nearby schools could also use the facility.

The project will be developed under the funding of the Central government and the Sports Authority of India (SAI), and it is being developed on the 7.5 acre land of the college.

Though the lack of sports infrastructure had been a major obstacle in the sporting sector here, the government gives high priority for it, he said. He also said the existing stadiums and other sports facilities should be improved and also new sports grounds and stadiums has to be developed.

Asserting the government's commitment to the welfare of sports personnel, he said the National Games winners have been given job and the process of finalizing the pending applications is in the final stage. He also said a football stadium of international standard would be come up in Calicut University campus.

Education Minister C Raveendranath presided over the function. Sport and industries minister AC Moideen delivered the keynote address. P K Sreemathi, MP, sports director Sanjay Kumar and SAI regional director G Kishore among others were also present.

(Times of India)

In the life of the professionals wellness industry plays major functions to maintain their personal and professional life, be fit and active. Although many of them were engaging fully. Professionals were more stressed and more depressive, so the role of wellness industry gave relief and also maintained their physical and emotional aspects. Wellness industries give a healthy diet plan, fit and active body without any exhaustion.

This study focused on the I.T professionals that use various wellness industries for the maintaining their body fit and active and also how wellness industry affects the professional life as well as personal life too. And this also focused on how many of them was using different kinds of wellness industry and whether it is helped them or not.

# CHAPTER 2

## **REVIEW OF LITERATURE**

This chapter deals with secondary data that is used by the researcher to study the wellness industry used among I.T Professionals, it includes various articles, books, magazines, periodicals etc...

The WHO definition concerns the authority of the word “complete” in relation to wellbeing. The main issue is that inadvertently adds to the medicalization of society. The necessity for complete health “would leave most of us unhealthy most of the time.” It therefore supports the tendencies of the medical technology and drug industries, in association with professional organizations, to redefine diseases, expanding the scope of the healthcare system. New screening technologies detect abnormalities at levels that might never cause illness and pharmaceutical companies produce drugs for “conditions” not previously defined as health problems. Thresholds for intervention tend to be lowered—for example, with blood pressure, lipids, and sugar. The persistent emphasis on complete physical wellbeing could lead to large groups of people becoming eligible for screening or for expensive interventions even when only one person might benefit, and it might result in higher levels of medical dependency and risk.

The ebb and flow WHO definition of health, formulated in 1948, describes health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” At that time this formulation was groundbreaking because of its breadth and ambition. It conquered the negative meaning of health as nonattendance of ailment and incorporated the physical, mental, and social spaces. Despite the fact that the definition has been censured in the course of over the past 60 years, it has never been adjusted. Analysis is now heightening, and as the population's age and the example of ailments changes the definition may even be counterproductive.

A healthy lifestyle is one which helps to keep and improve people's health and wellbeing. Many governments and non-governmental organizations work at promoting healthy lifestyles. They measure the benefits with critical health numbers, including weight, blood sugar, blood pressure, and blood cholesterol. Healthy living is

a lifelong effect. The ways to being healthy include healthy eating, physical activities, weight management, and stress management.

Today as life gets busier and pushes ahead like a train with no thinking back, individuals regularly overlook what life is and how it must be experienced the manner in which it ought to be. How important it is to stay healthy and do any sort of physical activities has just now merely been in the dreams. Being healthy is not just eating the right food at the proper time, but it also includes keeping your body fit by taking up several healthcare practices which are much more common now. So as to remain healthy and live longer we should quit rationalizing excuses and come to the truth of life.

Health care auxiliaries or practices are measures which are taken up as healthcare alternatives. They establish certain belief systems and practices which are known and fascinating and are not founded on any basic philosophy; the practitioners range from being sincere well-educated professionals and committed to their form of healing. The significant common and important healthcare practices include exercise and body therapies, dance therapies specially Zumba, yoga, and gymnastics etc.

Grisly (1970) states that professional ethics demand complete orientation around the job. In the earlier times occupation and personal life has been considered as separate entities and its practices had no relation other than one supporting the other. But the modern professional demands the emerging up of these two entities. But when this synthesis takes place there are many conflicts as many of the functions in personal life might turn out to be dysfunctional in the occupation life.

Monica Behr (2013) discusses a long list of lifestyle ailments that young urban Indians are being afflicted with. The list is long and frightening – diabetes, heart diseases, obesity, back pain etc. The causes are often the same. Alcohol, tobacco, junk food and a sedentary lifestyle. The low levels of physical activity and exercise also add to the risk of getting such diseases.

Dr. V Mukunda Das Thiruvananthapuram (2009) stressed the need for understanding and imbibing the contours of new work culture, which globalization has ushered in various professional fields. Most of the professionals work for an average of 10 hours for their work at office, except for professors and more often they carry their work to home. They spend even a part of their weekend in completing the pending office work in order to keep up to the desired expectations. Very little people tend to spend more than 5 hours with their family. Working women are playing a dual role in maintaining their family function and fulfilling their sex roles (parsons 1951).

This confrontation of roles is induced by the professional demand. From the functionalist argument (Merton) it is seen that the traditional mother's role has become dysfunctional in the modern professional paradigm. Another phenomena is that elderly are under a role –exist. (Richardson 2006). They are reducing their importance to caretakers of children when the professional spouse is away from home. In other words the elderly teachings about life and work are becoming irrelevant in the modern professional culture. Along with that their position in the family hierarchy also diminishes.

Barman (1960) studied the AAHPER Youth Fitness test battery and administered the test to 78 girls in grade VIII at Mitchell Junior High School. The girls were classified by the Neilsoncozens classification index and composed with national norms. The girls were above the average in sit- ups; standing broad jump, 600 yard run/walk, 50 yard dash and shuttle run but below in the soft ball throw and modified pull- ups. The differences were attributed to their physical education programmes.

Elizabeth (1960) prepared the norms of girls age 12, 13, 14 and 15 on the North Carolina AAHPER Tests. The norms were prepared for each of the five test times, sit – ups, side stepping, standing broad jump, modified push ups and squat thrusts. The sit- ups item provided differentiation on the percentile scale for each age group. The standing broad jump test provided the greatest ranges and the best differentiation of scores on the percentile scale for the age groups The modified pull- ups tests tailed to differentiate the lower end of the distribution for all age groups but did not discriminate above the 20th percentile.

Alston (1965) made a comparison between the performance of girl on the Virginia Physical Fitness test, AAHPERD Youth Physical Fitness test and North Carolina Physical Fitness

Test. He found the correlations between the Virginia and the AAHPERD Test was 0.80. The mean difference gave essentially equivalent result for assessing physical fitness of high school.

Patrick (1972) had constructed to motor fitness test battery for girls in lower elementary grades. The items included in this test were Clarke's strength composite, McCloy's endurance ratio, leg extension and flexion, Well's sit and reach, Dodging run, Base length wire stick balance, and vertical jump. It measured the essential components of motor fitness such as muscular strength, muscular endurance, cardio vascular endurance, flexibility, agility, balance and power.

Beckford (1976) conducted a study to evaluate the physical fitness level of Navajo girls who were 14 to 16 years old. AAHPER Youth Fitness test was administered on the subjects selected from seven schools of the region to measure the physical fitness level. It was also established on the basis of scores obtained from test result from these schools. These norms were compared to national norms found in the manual accompanying the AAHPER Youth Fitness test. The result of this study gave an indication of the overall fitness level of 14, 15 and 16 years of Old Navajo girls of the seven test items. The Navajo norms were below the national norms of 5 items and above on the softball throw and 600 yard run/walk

Sittmann (1981) conducted a study to develop norms for North East Missouri State University students enrolled in the health and physical fitness concept classes. 372 male and 648 female subjects were tested for the sum of 6 skinfolds, predicted % fat, predicted VO<sub>2</sub> max, grip strength, leg strength, back strength, vertical jump distance and vertical jump power. Mean, standard deviations and range for all variables were calculated classification was based on sex. Percentiles in increments of 5 were constructed for each variable in each classification.

. Taddonio (1982) conducted a study to compare the physical fitness of public school students from economically deprived areas with national norms. He also compared the physical fitness to public school students from high poverty area with those from low poverty area. The national norms were developed from 1975 national survey of youth fitness. The AAHPER Youth Fitness test was used as the measures of physical fitness. It was found that there was no difference in the physical fitness of boys and girls represented by 1975 national norms. It was found that also there was no difference in physical fitness of boys or girls high poverty areas and girls from low poverty areas.

Walker (1982) conducted research on 50 blacks and 50 white females 10th grade students were randomly selected and compared on the AAHPERD Youth Fitness test. The black students scored significantly higher ( $P < 0.05$ ) than the white students on leg power ( $M=44.46\%$  and  $31.2\%$  respectively) and speed ( $M=57.8$  &  $30.1\%$  respectively). The white students performed significantly higher than the black students on abdominal strength ( $M=31.5\%$  and  $27.7\%$  respectively). Not other comparison was significant.

Reet Mohinder Singh (1986) prepared physical fitness norms for high school boys of Punjab State. Data were collected on five thousand subjects from various schools in the State. The test administered consisted of eight times i.e., standing broad jump, sit and reach test, agility run, knee bent sit- ups, 50 meters dash, push- up (chairs), cricket ball throw and 600 metres run walk. The percentile norms for physical fitness tests were found to be valid and suitable to assess the physical fitness level of the high school boys of 12 to 15 years of age

. Singh (1988) prepared physical fitness norms for high and higher secondary school boys of Jammu and Kashmir State. Data was collected on 4200 male students belongs to six to eleventh classes of age 13 to 19 years subjects randomly selected and they were administered the AAHPER Youth Fitness Test. Age wise norms were prepared in terms of Percentile scale, Hull Scale and T- Scale (1991) conducted a study on computation of norms for 12 minute run and walk among school boys. Data was collected on 1000 school boys belongs to sixth to tenth classes of age 13 to 15 years subjects were randomly selected and they were administered the Cooper's 12 minutes Run/Walk test. Age wise norms were prepared in terms of Hull scale.

. Joseph James (1990) conducted a survey of physical fitness of Kendriya Vidyalaya boys in Kerala State and the influence of acceleration sprints and hollow sprints on them. AAPHER Youth Physical fitness test was selected to find out their physical fitness levels before and after the treatment of experiment variables. There were no significance differences between the subjects groups on tests of balance upper body endurance and agility. Male students were higher than the female students on all rests expect flexibility. It was felt that social and economic factors and the intensity of habitual physical activity played a significant role in the result of this study.

Raja guru (1990) conducted a survey of physical fitness on school boys are age between eleven and sixteen years in Thanjavur and Pudukottai districts and the influence of selected weight training exercises on them. This study was designed to survey the physical fitness of

high school boy's age ranging from eleven to sixteen years in Thanjavur and Pudukottai districts and the influence of selected weight training exercises on them. After collecting the data from the subjects re-analysed by using t – ratio statistical technique. On the basis of interpretations of data the following conclusions were drawn. The selected weight training exercise had significantly improve the physical fitness level of below average subjects in all six times The selected weight training exercise two hands press high pull up, press behind the neck, triceps press, bench jump, jumping squat and step upon bench had improved the performance in all the physical fitness components namely speed, strength, agility, endurance Abdominal muscular strength and Endurance and cardio respiratory endurance.

. James (1992) conducted a survey of physical fitness of higher secondary school boys age between sixteen and nineteen years at low, medium and high altitudes in Tamil Nadu. For the purpose of this study he has selected 315 school boys studying XI to XII standard from nine schools at low, medium and high altitudes for this survey, the scores made by these subjects at each level of altitudes was compared with other level of altitudes. Physical fitness, emotional, social, spiritual and mental fitness tests were conducted. The data collected at different altitudes analysed by using one way analysis of variance (ANOVA). 1. The medium altitude students of the age 16 to 19 years performance better in pull ups and 50 yards run than low and high altitude students of same age group. 2. The same subjects at high altitude performed well in standing broad jump, 600 yards run walk than the low and medium altitude students. 3. They have done well at low altitude in shuttle run than the other two level of altitude.

Reza.Md.Nasim (2000) “A comparative study of physical fitness between adolescent boys of Bangladesh and India” conducted a study to compare the physical fitness between adolescent boys of Bangladesh and India. Here AAHPERD youth fitness test was chosen by the investigator. In this study the following variables were the criterion to measure physical fitness i) arm and shoulder strength was measured by pull-ups, ii) abdominal strength and endurance were measured by sit-ups, iii) speed and agility were measured by shuttle run, iv) endurance was measured by standing long jump, v) speed was measured by 50 yard dash vi) endurance was measured by 600 yard run walk. In the relation of physical fitness the main difference was computed by employing statistical technique of 't' ratio. From the test result it was found that in respect of physical fitness, adolescence of Bangladesh and India stood as per there was no significant difference as obtained from the results.

. Kumar and Sathe (2003) carried out studies on the relative's effect of health- related fitness on sports proficiently of students of physical education. The subjects for the study were the male students of school of physical education, Devi Ahilya Bai Viswavidyalaya, Indore who had at least participation in inter-collegiate tournament in the year 1995-96. They concluded that a high skilled sports person shows a high correlation with sports performance but the contribution of skill- related fitness and Health related fitness are equal.

Sirijaruwong and Kosa (2006) conducted a study to construct health- related physical fitness norms for students of Rajamangala University of Technology Thanyaburi. AAHPERD Health Related Physical Fitness Test was used and conducted the following tests. Sit and Reach One minute sit-up, 1.5 mile Run/Walk, and body mass index. The data were analyzed by mean, standard deviation, percentile norms was constructed based on percentile scores, and the qualitative grading was used and prepared into five levels, namely excellent, good, moderate, low and poor. It was found that the health- related physical fitness norms for male and female students of Rajamangala University of Technology Thanyaburi by using physical fitness tests: body mass index, sit and reach, one minute sit-up 1.5 mile run/walk were at moderate level. The researcher constructed health- related physical fitness norms for students of Rajamangala University of Technology Thanyaburi according to the objectives.

Bettina F. Piko (2006) the main goal of the present study is to investigate the relationship between youth physical activity, their psychosocial health and well- being, and their life goals. Data were collected among students (n = 1109, age range between 14 and 21 years of age, mean: 16.5 years SD = 1.3 years) enrolled in the secondary schools of the Southern Plain Region (three counties), Hungary. Our findings support previous results that more active students have a better self-perceived health and fitness, lower levels of depressive symptoms and higher levels of life satisfaction. In addition, students who are regularly active prefer less extrinsic values as life goals for their future. However, there are no significant differences by physical activity status in terms of intrinsic values (except for physical health). These findings suggest that physical activity is not pursue beneficial health behaviour only through its functions. In community health programs, a health-related physical education approach should be addressed to improve the psychosocial benefits of physical activity.

. Gill, Deol and Kaur (2010) conducted a comparative study of physical fitness component of rural and urban female students of Punjab University. In the present study an attempt has been made to compare physical fitness components namely speed, strength, endurance,

agility and flexibility between female students belonging rural and urban set-ups. The data was analyzed and compared with the help of statistical procedure in which arithmetic mean, standard deviation (S. D), standard error of mean (SEM), T-test were employed. Rural female students were found to be superior in strength, endurance, speed and agility where urban female students on the other hand, were found to be superior in tasks like flexibility.

. P. Johnson and P.S Raja Marsion Babu (2013) this investigation was purported to evaluate the Physical Fitness Status of Schoolboys adapted by RDT Hockey Academy in the Rayalaseema District of Andhra Pradesh, India. For this reason, 916 schoolboys from thirty-two (32) schools in for (4) different districts adapted by RDT hockey academy in the Rayalaseema Distrcit of Andhra Pradesh, India were considered as subjects. These subjects were in the age group of 11 to 16 years, and they were assessed for their physical fitness status. The fitness parameters were restrained to height, weight, speed, explosive power, flexibility, agility and cardio respiratory endurance using standardized tests and procedures. The data collected were subjected to statistical analysis by means of One way ANOVA, and Bonferroni corrections post hoc test. The confidence interval was fixed at in all cases. The research findings ensure statically considerable age difference on selected variables, and it implies that age differences influence almost all fitness parameters.

Sing, Manjit, et. Al (2014) They study was to determine the comparative analysis of motor fitness components among Sprinters, Throwers and Jumpers. To conclude, it is significant to mention in relation to Motor Fitness Components that insignificant differences occur among Inter- College Sprinters, Throwers and Jumpers on the sub variable Explosive Strength. However, the significant differences occur among Inter- College Sprinters, Throwers and jumpers on the sub variable Agility. Balance, Speed and Flexibility. To conclude, it is significance to mention in relation to Motor fitness Components that insignificant differences occur among Inter University Sprinters, Thrower and Jumpers on the sun variable Agility and Explosive Strength. However, the significant differences occur among Inter-University Sprinters, Throwers and Jumpers on the sub variable Balance, Speed and Flexibility.

. Dharanendrappa. S.N. and C. Betsur, Ningamma (2002) studied “Significance of Emotional Intelligence and Mental Health in Learning Process” Secondary education plays a predominant role in shaping children for the future society. Children with high emotional intelligence and mental health could possess better understanding with their peers and adequate adjustment well in the society. More over it helps the individuals to maximize

potentialities of individuals to the fullest extent. This article deals with the significance of emotional intelligence and mental health in learning process of secondary schools. The techniques are suggested to enhance the emotional intelligence and mental health which are essential for secondary school students for better adjustment and scholastic achievement.

. Ojiha (2002) conducted a study on “Social anxiety and mental health of normal and physically challenged adolescents.” The purpose of the study was to compare social anxiety and mental health of normal and physically challenged adolescents. The sample constituted of 60 subjects (15 orthopedically challenged female and matched control group of normal adolescents) randomly selected from different located in Varanasi. Mental health inventory Jagdish and Srivastava, (1983) was administered to measured mental health. With regard to mental health normal group and orthopedically challenged group showed no significant difference.

Penedo, Frank J (2005). “Exercise and well-being: a review of mental and physical health benefits associated with physical activity”. Purpose of review: This review high lights recent work evaluating the relationship between exercise, physical activity and physical and mental health. Both cross-sectional and longitudinal studies, as well as randomized clinical trials, are included. Special attention is given to physical conditions, including obesity, cancer, cardiovascular disease and sexual dysfunction. Furthermore, studies relating physical activity to depression and other mood states are reviewed. The studies have several implications for clinical practice and research. Most work suggests that exercise and physical activity are associated with better quality of life and health outcomes. Therefore, assessment and promotion of exercise and physical activity may be beneficial in achieving desired benefits across several populations. Several limitations were noted, particularly in research involving randomized clinical trials. These trials tend to involve limited sample sizes with short follow up periods, thus limiting the clinical implications of the benefits associated with physical activity

In 1848 Rudolf Virchow (a German physician) laid the foundation of social medicine (Holtz et al. 2006) by advocating for the relevance and consideration of social factors in human health and disease. While this set a new agenda for medicine, it opened a wide passage for the social sciences involvement in the understanding of human health. The early 1900s marked the beginning in the study of sociological dimension of medicine, especially with the works of Charles McIntire (“The Importance of the Study of Medical Sociology,” published

in 1894), along with other scholarly works of that period including the book by Elizabeth Blackwell (1902) and another by James P. Warbasse (1909), both on medical sociology (Bloom 2002; Hafferty and Castellani 2006, p. 332) .

In the 1950s, Talcott Parsons (1951) published a groundbreaking work with a section on the application of functionalism in medical sociology. He dedicated a substantial part of his work to the elaboration of the sick role , explaining the social trajectories of the sick within the social system and how the health institutions can support individuals to return to normal roles in the society Parsons recognised the relevance of medicine for the society and drew attention to illness as a form of social deviance and the importance of sick role as a mechanism of social control (Freidson 1962; Stacey and Homans 1978). This is the first conscious application of sociological theory in the understanding of human illness. The sick role concept facilitated the expansion of other areas of research including the patient-physician relationship, illness behaviour, medicalization of deviance, and medical professionalism (Hafferty and Castellani 2006). The works of Freidson (1961a/1962, 1961b) and *Mechanic* (1966, 1968) also promoted the relevance and understanding of medical sociology.

Conrad (2007) described Eliot Freidson's works as revolutionary in medical sociology. Freidson (1961, 1970a, 1975) devoted his time to the study of professionalism and professionalization in medicine which presents a comprehensive view of the social and professional dynamics of medicine with a particular reference to how disease and illness are constructed, power relations between the physician and patients, division of labour, ethical conducts, increasing commercialism, and bureaucratic control in medical practice. Freidson's works were landmarks in the development of medical sociology. He practically demonstrated the relevance of sociology in medicine and health studies in general by situating his studies within applied domains.

Health behaviours encompass a wide range of personal behaviours that influence health, morbidity, and mortality. In fact, health behaviour explains about 40 percent of premature mortality as well as substantial morbidity and disability in the United States (McGinnis, Williams-Russo, and Knickman 2002). Some of these health behaviours—such as exercise, consuming nutritionally balanced diets, and adherence to medical regimens—tend to promote health and prevent illness, while other behaviors—such as smoking, excessive weight gain, drug abuse, and heavy alcohol consumption—tend to undermine health.

Many studies provide evidence that social ties influence health behaviour (see a review in Umberson, Crosnoe, and Reczek 2010). For example, Berkman and Breslow's (1983) prospective study in Alameda County showed that greater overall involvement with formal (e.g., religious organizations) and informal (e.g., friends and relatives) social ties was associated with more positive health behaviors over a ten-year period. Being married (Waite 1995), having children (Denney 2010), and ties to religious organizations (Musick, House, and Williams 2004) have all been linked to positive health behaviors (although, notably, as we will discuss below, marriage and parenthood have also been associated with behaviours that are not beneficial to health—including physical inactivity and weight gain).

Social ties influence health behaviour, in part, because they influence, or “control,” our health habits (Umberson et al. 2010). For example, a spouse may monitor, inhibit, regulate, or facilitate health behaviors in ways that promote a partner's health (Waite 1995). Religious ties also appear to influence health behaviour, in part, through social control (Ellison and Levin 1998). Social ties can instill a sense of responsibility and concern for others that then lead individuals to engage in behaviors that protect the health of others, as well as their own health. Social ties provide information and create norms that further influence health habits. Thus, in a variety of ways, social ties may influence health habits that in turn affect physical health and mortality.

Social support refers to the emotionally sustaining qualities of relationships (e.g., a sense that one is loved, cared for, and listened to). Hundreds of studies establish that social support benefits mental and physical health (Cohen 2004; Uchino 2004). Social support may have indirect effects on health through enhanced mental health, by reducing the impact of stress, or by fostering a sense of meaning and purpose in life (Cohen 2004; Thoits 1995). Supportive social ties may trigger physiological sequelae (e.g., reduced blood pressure, heart rate, and stress hormones) that are beneficial to health and minimize unpleasant arousal that instigates risky behaviour (Uchino 2006). Personal control refers to individuals' beliefs that they can control their life outcomes through their own actions. Social ties may enhance personal control (perhaps through social support), and, in turn, personal control is advantageous for health habits, mental health, and physical health (Mirowsky and Ross 2003; Thoits 2006).

Many studies suggest that the symbolic meaning of particular social ties and health habits explains why they are linked. For example, meanings attached to marriage and relationships with children may foster a greater sense of responsibility to stay healthy, thus promoting

healthier lifestyles (Nock 1998; Waite 1995). Studies on adolescents often point to the meaning attached to peer groups (e.g., what it takes to be popular) when explaining the influence of peers on alcohol, tobacco, and drug use (Crosnoe, Muller, and Frank 2004).

The meaning of specific health behaviors within social contexts may also vary. For example, Schnittker and McLeod (2005) argue that racial-ethnic identity may correspond with the meaning of certain health behaviors, such as consuming particular foods or avoiding alcohol, in ways that promote and sustain those behaviors. Moreover, the notion of “meaning” may help explain health behavior contagion across social networks: for example, the spread of obesity across social networks appears to be influenced by perceptions of social norms about the acceptability of obesity and related health behaviors (e.g., food consumption, inactivity) among network members who are socially close, rather than members who are simply geographically close (Christakis and Fowler 2007; Smith and Christakis 2008). In a more fundamental way, greater social connection may foster a sense of “coherence” or meaning and purpose in life, which, in turn, enhances mental health, physiological processes, and physical health (Antonovsky 1987).

Mental health is a pivotal mechanism that works in concert with each of the other mechanisms to shape physical health (Chapman, Perry, and Strine 2005). For instance, the emotional support provided by social ties enhances psychological well-being, which, in turn, may reduce the risk of unhealthy behaviors and poor physical health (Kiecolt-Glaser et al. 2002; Thoits 1995; Uchino 2004). Moreover, mental health is an important health outcome in and of itself. The World Health Organization identifies mental health as an essential dimension of overall health status (World Health Organization 2007). However, the prevalence of mental disorders and their consequences for individuals and societies are often underappreciated by policy makers and private insurers. Data from the National Comorbidity Survey Replication indicate that 26.2 percent of non institutionalized U.S. adults suffer from a mental disorder in a given year (Kessler et al. 2005). As the leading cause of disability in both low- and high-income countries, mental disorders account for over 37 percent of the total years of healthy life lost due to disability (Mathers et al. 2006)

Research shows that social ties influence multiple and interrelated health outcomes, including health behaviors, mental health, physical health, and mortality risk. Thus, a policy focus on social ties may prove to be a cost-effective strategy for enhancing health and well-being at

the population level (McGinnis et al. 2002; Mechanic and Tanner 2007). Social ties may be unique in their ability to affect a wide range of health outcomes and to influence health (thus cumulative health outcomes) throughout the entire life course. Moreover, interventions and policies that strengthen and support individuals' social ties have the potential to enhance the health of others connected to those individuals. For example, reducing strain and improving health habits of a married person may benefit the health of both partners, as well any children they care for.

Recent work also shows that some health outcomes can “spread” widely through social networks. For example, obesity increases substantially for those who have an obese spouse or friends (Christakis and Fowler 2007), and happiness appears to spread through social networks as well (Fowler and Christakis 2008). These findings suggest that the impact of social ties on one person's health goes beyond that person to influence the health of broader social networks. Thus, policies and interventions should capitalize on this natural tendency for health-related attitudes and behaviours to spread through social networks by incorporating these amplification effects into the mechanics of interventions and their cost-benefit estimates (Smith and Christakis 2008).

Many studies provide evidence that social ties influence health behaviour. Social ties were associated with more positive health behaviors over a ten-year period. Being married having children and ties to religious organizations have all been linked to positive health behaviors. Some of these health behaviours—such as exercise, consuming nutritionally balanced diets, and adherence to medical regimens—tend to promote health and prevent illness, while other behaviors—such as smoking, excessive weight gain, drug abuse, and heavy alcohol consumption—tend to undermine health. So, from these above mentioned literatures all are highlighted the positive aspects of wellness industry.

# CHAPTER 3

## METHODOLOGY

The Health and Wellness industry encompasses all activities which promote physical and mental wellbeing: from yoga to healthy eating, personal care and beauty, nutrition and weight-loss, meditation, spa retreats, workplace wellness and wellness tourism. The Indian wellness industry flourished by banking on the demand for alternative healing practices like the Ayurveda, yoga, naturopathy, etc., and then slowly expanded to include nutrition, fitness, and preventive healthcare. Wellness is an active process of making choices toward a healthy and fulfilling life. ... Wellness is especially important as we age because regular exercise and proper nutrition can help prevent a variety of ailments including cardiovascular disease, obesity, and fall risk behaviours.

The meaning of health has evolved over time. In keeping with the biomedical perspective, early definitions of health focused on the theme of the body's ability to function; health was seen as a state of normal function that could be disrupted from time to time by disease. An example of such a definition of health is: "a state characterized by anatomic, physiologic, and psychological integrity; ability to perform personally valued family, work, and community roles; ability to deal with physical, biological, psychological, and social stress". Then in 1948, in a radical departure from previous definitions, the World Health Organization (WHO) proposed a definition that aimed higher: linking health to well-being, in terms of "physical, mental, and social well-being, and not merely the absence of disease and infirmity". Although this definition was welcomed by some as being innovative, it was also criticized for being vague and excessively broad and was not construed as measurable. For a long time, it was set aside as an impractical ideal, with most discussions of health returning to the practicality of the biomedical model.

Just as there was a shift from viewing disease as a state to thinking of it as a process, the same shift happened in definitions of health. Again, the WHO played a leading role when it fostered the development of the health promotion movement in the 1980s. This brought in a new conception of health, not as a state, but in dynamic terms of resiliency, in other words, as "a resource for living". In 1984, WHO revised the definition of health defined it as "the extent to which an individual or group is able to realize aspirations and satisfy needs and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources, as well as physical

capacities." Thus, health referred to the ability to maintain homeostasis and recover from adverse events. Mental, intellectual, emotional and social health referred to a person's ability to handle stress, to acquire skills, to maintain relationships, all of which form resources for resiliency and independent living. This opens up many possibilities for health to be taught, strengthened and learned.

## OBJECTIVES

### General objectives

Wellness industry used among I.T Professionals.

### Specific objectives

- .1) To find out social economic – profile of the respondents.
- 2) To find out the diversified and modern wellness industry used by I.T professionals.
- 3) To find out the motivational factors among I.T professionals towards wellness industry.
- 4) To find out the gender disparities towards the wellness industry among I.T professionals and also to find out the merits and demerits of wellness industry.

### Classification of concepts

#### Operational definition

Wellness industry – In this study, The Health and Wellness industry encompasses all activities which promote physical and mental wellbeing. For e.g., yoga, Zumba, , beauty care, gym , diet, etc....

I.T Professionals – In this study, An I.T Professional is a person working in the field of information technology

## Variables

### Independent variables

In this study independent variables are Age, sex, income, occupation, education, religion, marital status.

### Dependent variables-

Satisfaction of I.T professionals.

### Tools for data collection

Telephonic interview will be used to collect data by the help of questionnaire.

### Universe

All the I.T professionals using wellness industry in Kochi city.

### Sampling method

The sampling technique is used here is snowball sampling and it is a non – probability sampling. There are many categories of I.T Professionals in Kochi city. Using snowball sampling technique, a sample of 50 respondents was chosen.

## SIGNIFICANCE OF THE STUDY

In the life of the professionals wellness industry plays many functions to maintain their personal and professional life, be fit and active. Although many of them were engaging 100% fully.

Professionals were more stressed and more depressive, so the role of wellness industries gave relief and also maintained their physical and emotional aspects. Many functions that can be

seen while using wellness industries. It gives a healthy diet plan, fit and active body without any exhaustion. It is clear from the investigation that the respondents show more worry for their wellbeing as it assists with forestalling or deal with their different wellbeing conditions, including coronary illness, hypertension and so on and likewise improves their state of mind. Today 50% of the whole youthful urban Indian are been influenced with way of life infirmities like terrifying diabetes, coronary illness, stoutness , pressure and so forth because of the expert weight at their workplaces or in the workplaces.(Monica Behr;2013) The causes are essentially the equivalent – liquor, tobacco , lousy nourishment and an inactive way of life. This adds to low degrees of physical exercises. A sound way of life must be a vital piece of one's life. The current present day way of life would absolutely realize a great deal of negative effects sooner rather than later. As life is about new tests and new experiences receiving new social insurance choices instead of adhering to ordinary ones would have any kind of effect over a brief period. Subsequently this investigation centers around the human services choices taken up by the experts for a sound way of life.

This study focused on the IT professionals that use various wellness industries for the maintaining their body fit and active and also how wellness industries affects the professional life as well as personal life too. And this study focused on how many of them was using wellness industries and whether it was affected or not.

# CHAPTER 4

## DATA ANALYSIS AND INTERPRETATION

This chapter deals with the data analysis and interpretation. The study is aimed at measuring the role of wellness industry among I.T Professionals, and it is the process of assigning meaning to the collected data and determining the conclusions, significance, and implications of the findings.

Table 4.1

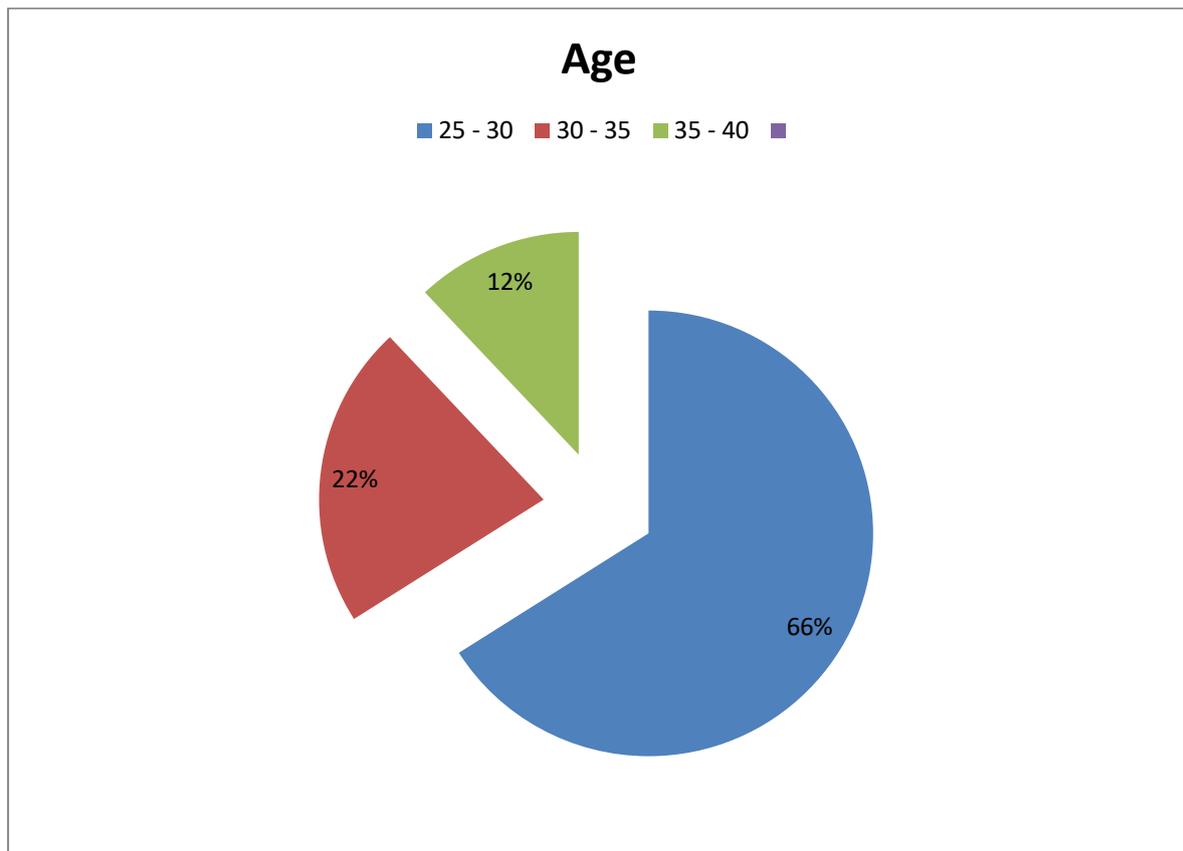
Table showing frequency distribution of the respondents with regard to gender

Gender	Frequency	Percentage
Male	34	68
Female	16	32
Total	50	100

From the above table, the majority of the respondents are male and it is 68%. Because females already engaged in household activities and workplace duties. So they didn't get enough time to participating or engaged in wellness activities.

Figure 1

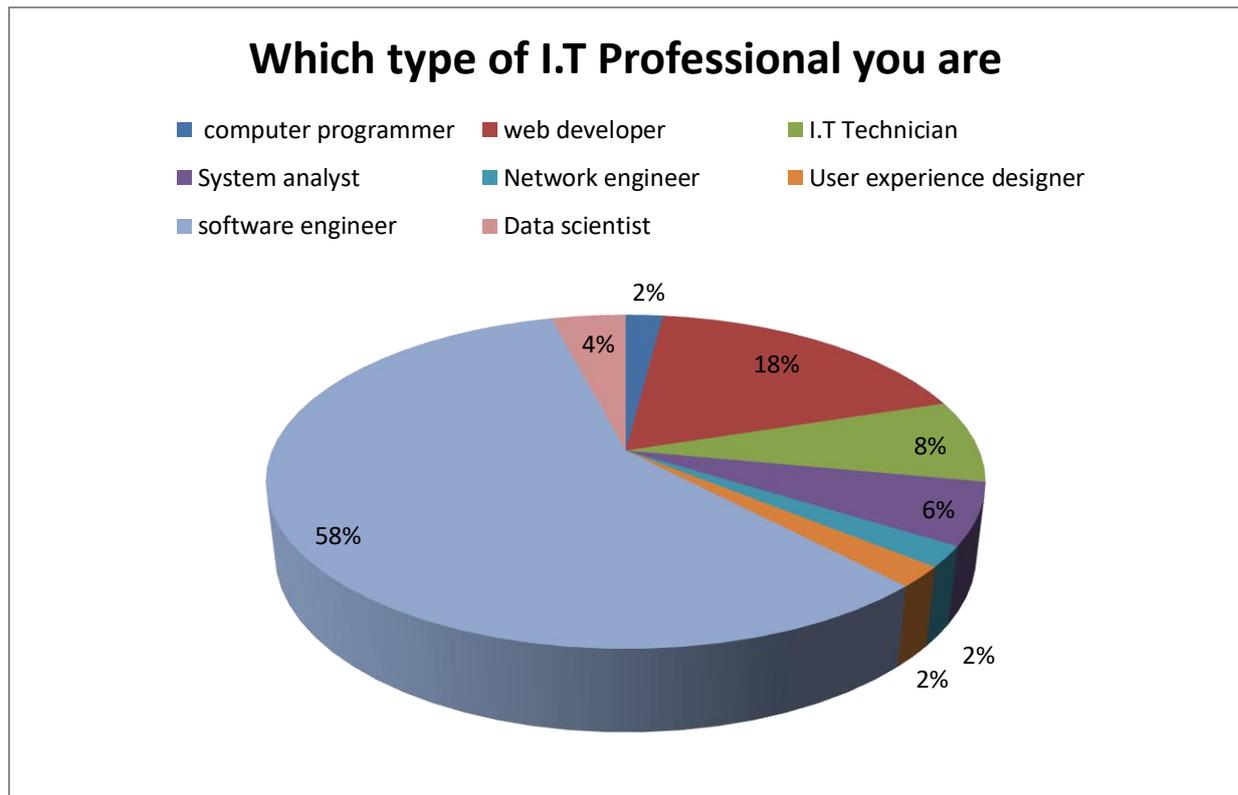
The figure showing the frequency distribution of the respondents with regard to age.



From the above respondents in this, the majority of age group belongs to 25 – 30, that is 66%. Because youngsters are more focused on their physical appearance and wellbeing.

Figure 2

The figure showing the frequency distribution of the respondents with regard to different specialised sectors in I.T Profession



From the above figure, we can say that majority of the respondents are software engineers, that is 58% and also we can see that user experience designer and network engineer are less, that is 2% . Because everyone were attracted towards the high scale salary.

Table 4.2

Table showing the frequency distribution of the respondents with regard to family

Family	Frequency	Percentage
Nuclear family	35	70
Joint family	14	28
Extended family	1	2
Total	50	100

From the above table, we can see that, the respondents in this, nuclear family has majority that is 70%. The majority is nuclear family; the primary reason is availability of more space and resources for each members of the family. People today consider it as an ideal arrangement to raise a family.

Table 4.3

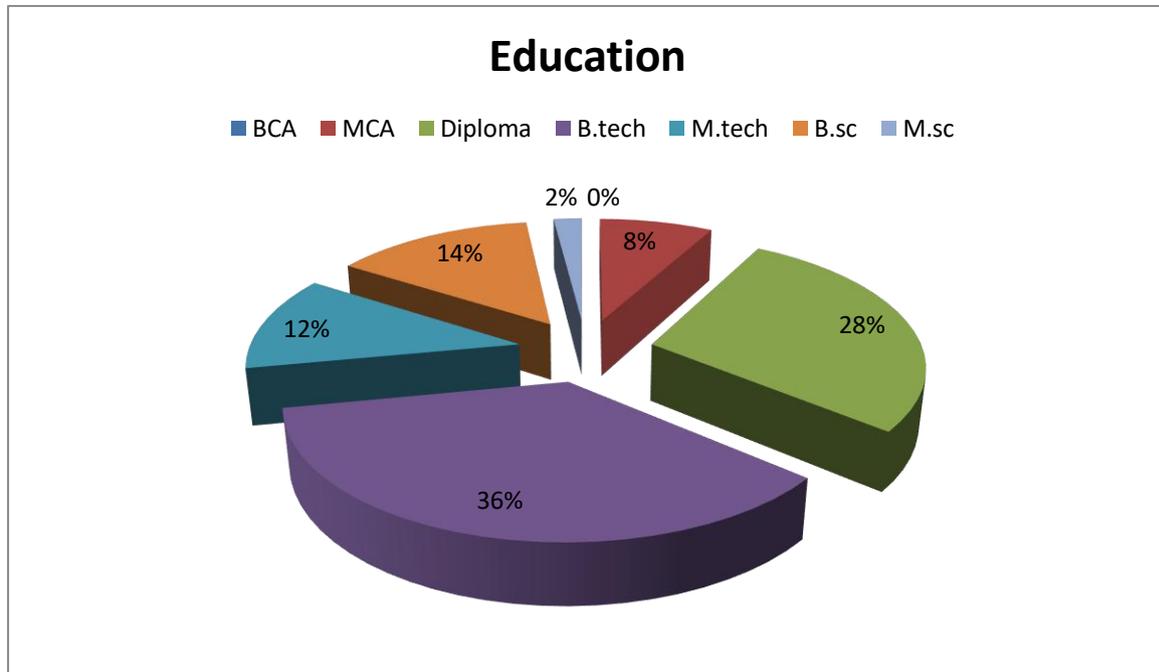
Table showing the frequency distribution of the respondents with regard to marital status

Marital status	Frequency	Percentage
Married	22	44
Unmarried	26	52
Divorce	1	2
Widow	1	2
Total	50	100

From the above table, we can see that the majority of the respondents are unmarried that is 52%. Because unmarried people have less role and responsibilities compared to others. So they get more time to engage in physical or wellness activities.

Figure 3

The figure showing the frequency distribution of the respondents with regard to education.



From the above figure we can clearly see that, majority of the respondents were comes under in B.tech and that is 36%. Because B.tech professionals are highly paid compared to others.

Table 4.4

Table showing the frequency distribution of the respondents with regard to monthly income

Monthly income	Frequency	Percentage
Below 15000	14	28
15000 – 25000	18	36
25000 – 35000	8	16
35000 – 45000	7	14
45000 above	3	6
Total	50	100

From the above table we can say that, the majority of the respondents having monthly income in between 15000 – 25000, that is 36%. Because, in any organization executive members are less and the middle sector professionals are more.

Table 4.5

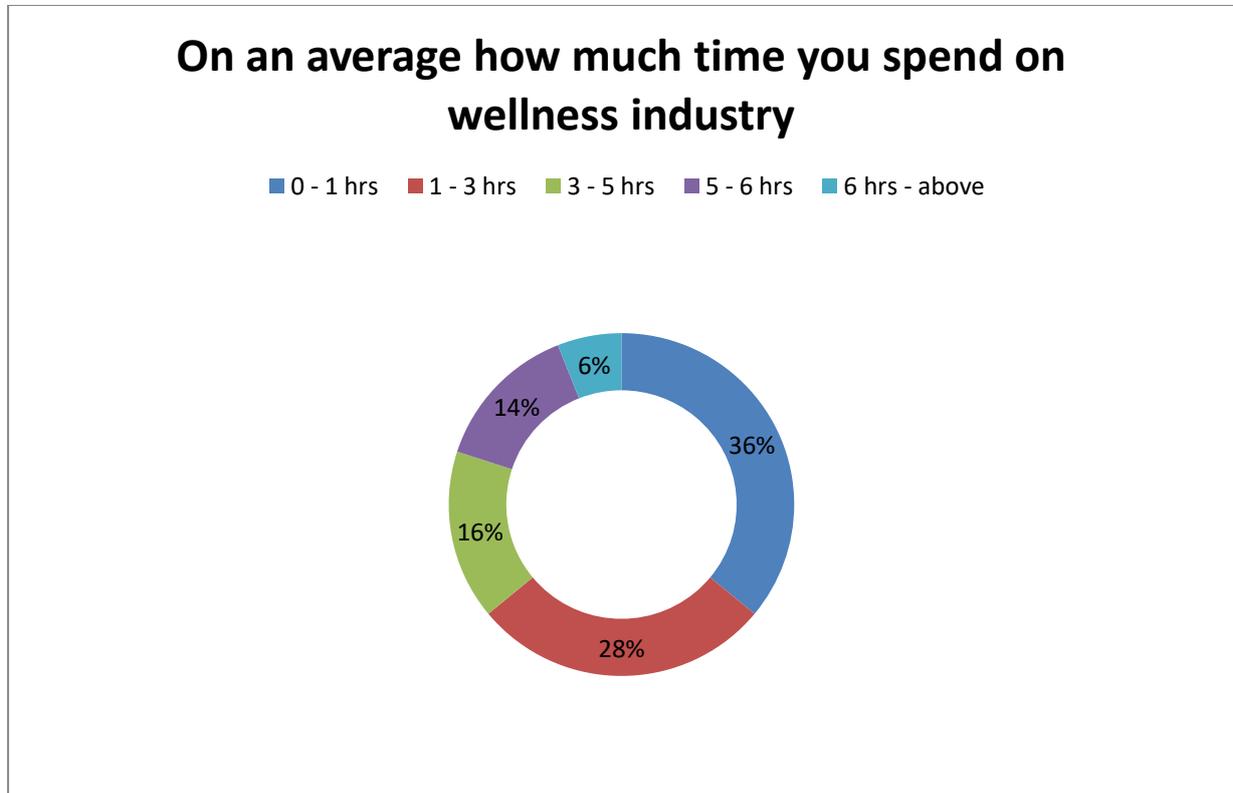
Table showing the frequency distribution of the respondents with regards to wellness industry

Do you use wellness industry	Frequency	Percentage
Yes	50	100
No	0	0
Total	50	100

From the above table, we can say that, the respondents were 100%. So, we can say that all are aware of physical health and wellbeing.

Figure 4

The figure showing the frequency distribution of the respondents with regard to spending time for wellness industry



From the above figure, we can say that majority of the respondents are comes under in

0 – 1 hrs and that is 36%. Because I.T Professionals time schedule is very tight or they have to work even in late night to complete their task. So they have little time to contribute to physical activities.

Table 4.6

The table showing the frequency distribution of the respondents with regard to using different kinds of wellness industry

Which of these wellness industry you using	Frequency	Percentage
Gym	18	36
Zumba	8	16
Yoga	3	6
Cardio	14	28
Any other	7	14
Total	50	100

From the above table we can say that majority of the respondents were in gym and that is 36%. Here, women are more focused on yoga, because it is a kind of mind self purification process. But today's generation all are more aware about physical appearance and beauty, so most of them are engaged in gym.

Table 4.7

The table showing the frequency distribution of the respondents with regard to place for accessing wellness industry

Where do you most often to access wellness industry	Frequency	Percentage
Workout centres	34	68
Home	16	32
Total	50	100

From the above table, we can say that, majority of the respondents were comes under in workout centres and that is 68% .Because workout centres have all the needy equipments and machines to enhance physical fitness, but in home we lack these facilities. In workout centres there is a time schedule but in home we cannot able to make a correct timetable for engage in physical activities.

Table 4.8

The table showing the frequency distribution of the respondents with regard to buying equipments for wellness industry

How much amount do you spend or buying equipments for wellness industry	Frequency	Percentage
2000 – 4000	6	12
4000 – 6000	11	22
6000 – above	33	66
Total	50	100

From the above table, we can say that more respondents are comes under in option 6000 – above and it is 66%. From this, we can see that all are aware about their own health and fitness, at the same time they are well paid also. So, they spend above 6000 or above 6000 rupees for purchasing those equipments.

Table 4.9

The table showing the frequency distribution of the respondents with regard to using wellness industry

Are you using wellness industry	Frequency	Percentage
Daily	26	52
Weekly	1	2
Alternate days	22	44
Depends on mind	1	2
Total	50	100

From the above table, we can see that majority of the respondents were comes under in daily and that is 52% and also we can say that there is only less frequency in the two options, i.e.,

weekly 2% and in depends on mind 2% . From this it is clear that more are engaged in daily physical activities, because it gives a positive energy to start a working day with less stress and more energy. Because I.T Professional is a hectic job.

Table 4.10

The table showing the frequency distribution of the respondents with regard to using online media for doing wellness industry

Do you use online media for doing wellness industry in your life	Frequency	Percentage
Yes	16	32
No	34	68
Total	50	100

From the above table we can say that, majority of the respondents opted no, that is 68%. Because most of them are using direct methods to enhance their own physical health because in a workout place there is a physical trainer and he gives more guidance and tips to maintain healthy body because there is a monthly fees for it, but in online service most of them are unpaid services and lack seriousness.

Table 4.11

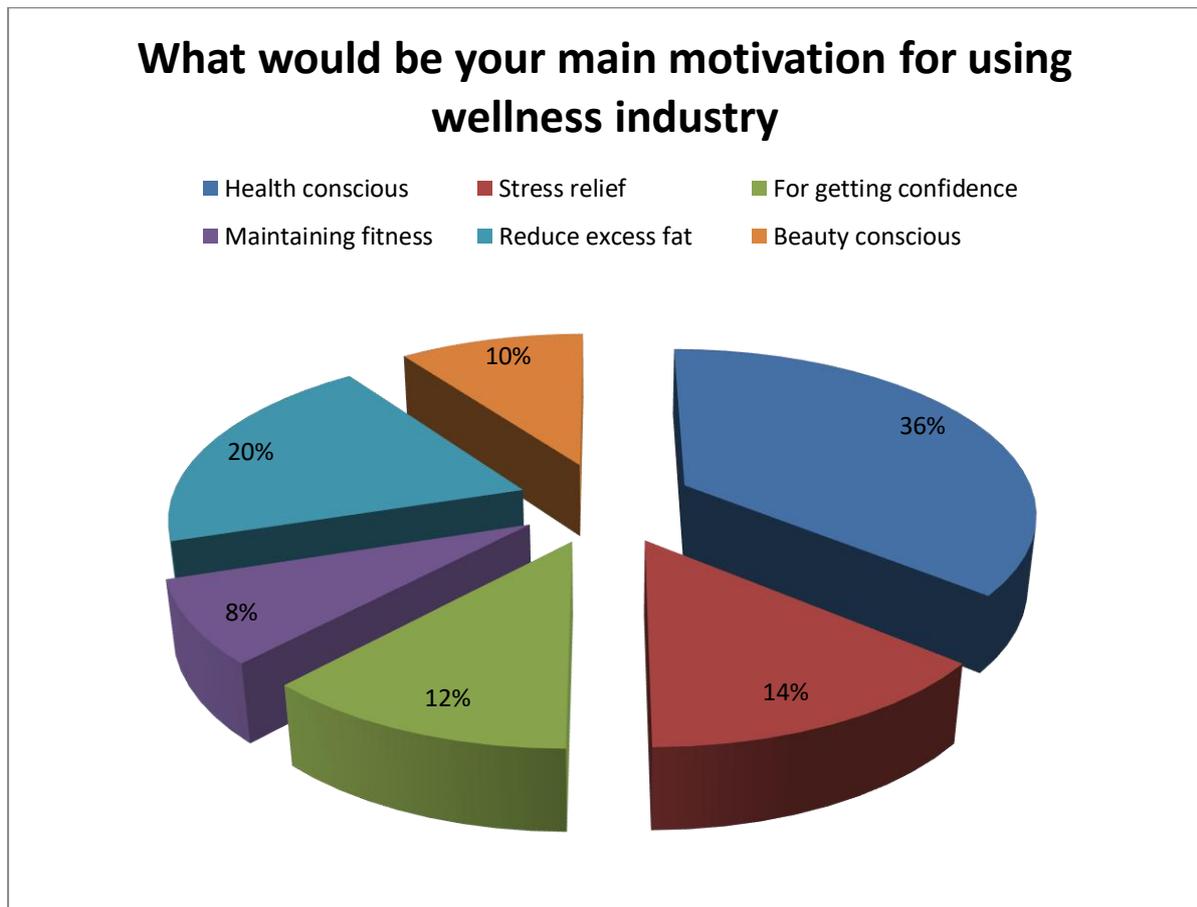
The table showing the frequency distribution of the respondents with regard to health insurance or mediclaim policy

Do you have any health insurance or mediclaim policies	Frequency	Percentage
Yes	30	60
No	20	40
Total	50	100

From the above table, we can see that majority of the respondents having health insurance or mediclaim policy and that is 60%. Because in today's generation health insurance place a major role for securing our health and also safety and security for their family members.

Figure 5

The figure showing the frequency distribution of the respondents with regard to main motivation for using wellness industry



From the above figure it's clearly shown that majority of the respondents were health conscious, that is 36%. Today's society there is no time for healthy eating and healthy cooking, all are behind fast food restaurants. So, it is not healthy for their body, at the same time they are fully aware about it. So, they regain this health they engaged in physical wellness or wellbeing.

Table 4.12

The table showing the frequency distribution of the respondents with regard to time preferring being engaging in wellness industry

Which time do you prefer being engaged in wellness industry	Frequency	Percentage
Anytime of the day	6	12
Evening	33	66
Morning	11	22
Total	50	100

From the above table, we can see that, majority of the respondents were preferring evening time and that is 66%. Because evening time is comfortable because it is the free time they get in their busy schedule.

Table 4.13

The table showing the frequency distribution of the respondents with regard to body shaming

Do you aware about body shaming	Frequency	Percentage
Yes	35	70
No	15	30
Total	50	100

From the above table we can say that, more respondents were comes under the category of yes, and that is 70%. Majority of them are aware of body shaming most of them are faced this issues in any point of their lifetime. So they work out hard to maintain their physical fitness.

Table 4.14

The table showing the frequency distribution of the respondents with regard to difficulties in wellness industry

Did you face any difficulties in wellness industry	Frequency	Percentage
Yes	40	80
No	10	20
Total	50	100

From the above table, we can see that, majority of the respondents comes under no option, which means, didn't face difficulties in wellness industry, and that is 80%. Some of them experience chronic pain. It is the major challenge, lack of safety measures in unorganized sectors, fatigue etc, may be the reason.

Table 4.15

The table showing the frequency distribution of the respondents with regard to whether wellness industry is good or bad

According to your aspect whether wellness industry is good or bad	Frequency	Percentage
Good	50	100
Bad	0	0
Total	50	100

From the above table, we can say that, all the respondents were selected the option good, and that is 100%. Wellness industry plays a major role in building healthy generations and all are interested to make use of it.

Table 4.16

The table showing the frequency distribution of the respondents with regard to print media and social media

Which is more preferable for you to maintain wellness	Frequency	Percentage
Print media	5	10
Social media	45	90
Total	50	100

From the above table, we can say that, most of the respondents preferred social media, and that is 90%. From this it is clear that social media, place a major role in promoting physical health because it is a good platform for sharing up to date or latest information, news, services, etc and it is very easy to handle and access information.

Table 4.17

The table showing the frequency distribution of the respondents with regard to mental peace

Do you give preference towards yoga or meditation for getting mental health peace	Frequency	Percentage
Yes	30	60
No	20	40
Total	50	100

From the above table, we can say that, majority of the respondents were comes under in the option yes, which means they give importance towards meditation or yoga, and that is 60%. From this it's clear that majority are using meditation for purifying the mind and the self because in today's generation all the relationships are impersonal and formal.

Table 4.18

The table showing the frequency distribution of the respondents with regard to medical issues while engaging in wellness industry

Did you face any medical issues while you using or engaging in wellness industry	Frequency	Percentage
Yes	12	24
No	38	76
Total	50	100

From the above table, we can say that majority of the respondents didn't face medical issues while using or engaging wellness industry and that is 76%. From this it is clear that used of wellness industry reduces the risk of certain diseases.

Table 4.19

The table showing the frequency distribution of the respondents with regard to , wellness industry is costly while it is operated.

Have you ever think the wellness industry is costly while it is operated	Frequency	Percentage
Not that much	30	60
A little	5	10
Very much	10	20
Never	5	10
Total	50	100

From the above table, we can say that majority of the respondents were selected not that much option and that is 60%. The study based on I.T Professionals, so they have some sort of financial stability and the rate of wellness industries did not act as a burden.

Table 4.20

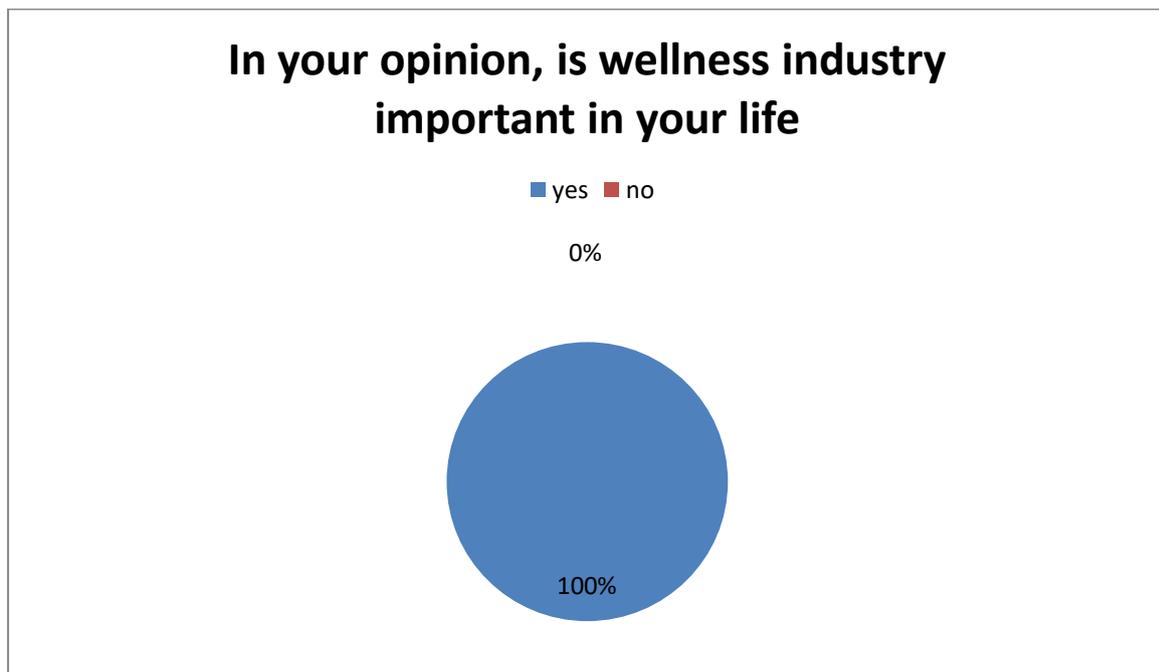
The table showing the frequency distribution of the respondents with regard to, is wellness industry helps to remove bad habits

Will wellness industry helps you to remove your bad habits from your life	Frequency	Percentage
Yes	40	80
No	2	4
Not fully	6	12
A little bit	2	4
Total	50	100

From the above table, we can say that majority of the respondents were selected yes option, and that is 80%. From this study, it is clear that majority agreed that physical wellness gives a sort of positive feeling and eliminating negative energy like tension, stress, anxiety and bad habits like smoking, alcohol consumption etc.

Figure 6

The figure showing the frequency distribution of the respondents with regard to importance of wellness industry



From the above figure, we can say that all the respondents were selected option yes, and that is 100%. From this figure, it is noted that wellness industries have a very important position to maintain our day to day life in more manageable and positive manner.

Table 4.21

The table showing the frequency distribution of the respondents with regard to satisfaction related to wellness industry

Overall, are you satisfied with all types of wellness industry	Frequency	Percentage
Very much	35	70
Yes	10	20
No	2	4
A little bit	3	6
Total	50	100

From the above table, majority of the respondents are very much satisfied with all types of wellness industry that is 70%. From this table, it is clear that majority of the respondents are very much satisfied with wellness industry to maintain physical and mental health and lead a better quality of life.

From the above data it is found that everyone gave importance to their health and physical fitness and when comparing the both genders male are contributing much more importance to physical fitness than females. All the respondents confirmed the positive aspects of wellness industry and it also helps them to lead a healthy wellbeing.

# CHAPTER 5

## FINDINGS AND CONCLUSION

After having detailed study on wellness industry we can see a great change in the behaviour of people in many manners like eating habits, lifestyle pattern etc. In earlier times people are not that much aware about their wellness industries like gym, Zumba, yoga, cardio, and beauty products, but now people changed their lifestyle patterns because of increasing technology day by day, these technology helps to people to conscious about wellness.

Engaging in regular physical activity may produce improvements in an individual's physical health, cognitive performance, and psychological well-being. Physical benefits include, but are not limited to, reduced risk for diseases, and improvements in physical functioning, fitness, and overall quality of life. Literature supports a link between exercise and cognitive benefits related to academic performance, brain function, and aging. Psychological benefits incurred from physical activity pertain to improvements in mood and self-esteem, and potential reductions in stress, anxiety, and depression. Strong scientific evidence indicates that adopting a physical activity regimen may positively impact health. However, individuals react differently to exercise and may face unique challenges and barriers when beginning and maintaining an exercise program. One may engage in behavioural modification strategies to enhance physical activity. Useful strategies include: identifying personally perceived barriers to physical activity, increasing self-efficacy, effectively setting goals, planning for setbacks, and self-monitoring progress.

In this study, we can recognize that males are acquiring wellness industry more, that is 68%, the persons who belongs to 25 – 30 age group having high percentage of using wellness industry and its 66%, in different types of I.T Professionals we can say more persons are software engineers and i.e., 58%, and majority of wellness industry users are comes under in nuclear family and that is 70%, in marital status more users of wellness industries are married and its 44%. From the educational status we can clearly says that persons who studied B.tech are more using wellness industry and its 36%. Most of the people are saying their main motivation for wellness industries were they are health conscious and that is 36%. And in the case of mental health peace 60% of people give preference towards yoga and meditation. 80% of people say that by the using or help of wellness industry, so many persons can remove their bad habits from their life.

According to this survey, we can clearly say that wellness industry is important in life and all are very much satisfied with wellness industry.

### SUGGESTIONS

1. Allowing flexible employee scheduling to engage in wellness activities.
2. Promote workplace wellness by encouraging widespread connection.
3. Share healthy tips with colleagues.
4. Make aware of them about the risky factors while using wellness industry.

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# APPENDIX

A STUDY ON WELLNESS INDUSTRY USED AMONG I.T PROFESSIONALS IN KOCHI CITY

QUESTIONNAIRE

( We would like to more about how you use wellness industry. You can help us to learn more by filling out the questionnaire. We do not share your answers with anyone else so they remain confidential. )

1. Name -.....
2. Address -  
.....  
.....
3. Contact or E – mail ID -.....
4. Gender
  - Male
  - Female
5. Age group
  - 25 – 30
  - 30 – 35
  - 35 – 40
6. Which type of I.T Professional you are
  - Computer programmer
  - Web developer
  - I.T Technician
  - System analyst
  - Network designer
  - User experience designer
  - Software engineer
7. Family
  - Nuclear family
  - Joint family
  - Extended family

8. Marital status

- Married
- Unmarried
- Divorced
- Widow

9. Education

- BCA
- MCA
- Diploma
- B.tech
- M.tech
- B.sc
- M.sc

10. Monthly income

- Below 15000
- 15000 - 25000
- 25000 - 35000
- 35000 - 45000
- 45000 above

11. Do you use wellness industry

- Yes
- No

12. On an average how much time you spend on wellness industry

- 0 – 1 hrs
- 1 – 3 hrs
- 3 – 5 hrs
- 5 – 6 hrs
- 6hrs - above

13. Which of these wellness industry you using

- Gym
- Zumba
- Yoga
- Cardio
- Any other

14. Where do you most often to access wellness industry

- Workout centres
- Home

15. How much time do you spend or buying equipments for wellness industry

- 2000 - 4000
- 4000 - 6000
- 6000 - above

16. Are you using wellness industry

- Daily
- Weekly
- Alternate days
- Depends on mind

17. Do you use online media for using wellness industry in your life

- Yes
- No

18. Do you have health insurance or mediclaim policies

Yes

No

19. What would be your main motivation for using wellness industry

Health conscious

Stress relief

For getting confidence

Maintaining fitness

Reduce excess fat

Beauty conscious

20. Which time do you prefer being engaged in wellness industry

Any time of the day

Evening

Morning

21. Do you aware about body shaming

Yes

No

22. Did you face any difficulties in wellness industry

Yes

No

23. According to your aspect whether wellness industry is good or bad

Good

Bad

24. Which is more preferable for you to maintain wellness

Print media

Social media

25. Do you give preference towards yoga or meditation for getting mental health peace

Yes

No

26. Did you face any medical issues while you using or engaging in wellness industry

Yes

No

27. Have you ever think the wellness industry is costly while it is operated

Not that much

A little

Very much

Never

28. Will wellness industry helps you to remove your bad habits from your life

Yes

No

Not fully

A little bit

29. In your opinion , is wellness industry important in your life

Yes

No

30. Overall, are you satisfied with all types of wellness industry

Very much

Yes

No

A little bit

THANK YOU.....