SOCIO-HEALTH DETRIMENTS OF THE COMMUNITY MEMBERS DUE TO WATER POLLUTION IN PAMBA RIVER

A STUDY WITH REFERENCE TO PERUNADU GRAMAPANCHAYAT

Dissertation submitted to the Mahatma Gandhi University, Kottayam

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By

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DECLARATION

I, **Ms. Alka Theres Bastin**, final semester MSW student of Marian College, Kuttikkanam (Autonomous) do hereby declare that this dissertation entitled, **"Socio-Health Detriments of the Community Members due to Water Pollution in Pamba River: A Study with Reference to Perunadu Gramapanchayat"** is a work done by me and no part of the dissertation has been presented for any degree, diploma, associateship, fellowship or other similar title or recognition of any University to the best of my knowledge and belief.

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BOD	**:**	Biochemical Oxygen Demand
CESS	**:**	Centre for Earth Studies
CPCB	**:**	Central Pollution Control Board
CSE	**:**	Centre for Science and Environment
DALY	**:**	Disability Adjusted Life Years
ETP	**:**	Effluent Treatment Plants
FAO	**:**	Food and Agricultural Organization
GHG	**:**	Green House Gas
IPCC	**:**	Intergovernmental Panel on Climate Change
ISWM	**:**	Integrated Sustainable Waste Management
KSPCB	**:**	Kerala State Pollution Control Board
LSG	**:**	Local Self Government
MLD	**:**	Million Liters per day
MSL	**:**	Mean Sea Level
RSPM	**:**	Respirable Suspended Particulate Matter
SPSS	**:**	Statistical Packages for Social Sciences
UN	**:**	United Nations
UNEP	**:**	United Nations Environment Programme
UNWWDR	**:**	United Nations World Water Development Report
WHO	**:**	World Health Organization
WWF	**:**	World Wide Fund for Nature

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CHAPTER I

INTRODUCTION

"Sooner or later we will have to recognize that the Earth has rights, too, to live without pollution. What mankind must know is that human beings cannot live without Mother Earth, but the planet can live without humans"

(Morales, 2006)

The earth's biosphere provides the land, air, water and energy necessary to sustain life. This life-support system is a complex and interdependent. Environment is, in fact can be considered as that set of surroundings, which influence the life and activities of our animate objects - human, animals and birds. In components of natural world, forest, water, soil, the sea, rivers and so on together make up the system called environment, which support all life on the planet earth.

Human societies have always altered their physical environments. They have used fire, cleared forests, tilled the soil, mined for mineral deposits, damned rivers, polluted streams, overgrazed grasslands and many more like. During the 20th century, especially since 1950, the pace as well as magnitude of the destruction on the physical surroundings rapidly increased, leading to high larger, wider, intensified and magnified negative environmental impacts (D Stanley Eitzen, Maxine Baca Zinn, 2000).

With this destruction pace continued and followed in more speedy level, then, in the words Bill McKibben, " the fate of the planet will be determined in the next few decades…" (D Stanley Eitzen, Maxine Baca Zinn, 2000) and human beings will have to suffer the consequences of the actions. All the societies around the world are at present experiencing phenomenal social changes that greatly owns to technological development and cultural upheavals. As prosperity grows and cultural taboos break down, millions of people in modem industrialized societies are left with several choices to increase their standard of living.

1.1. Man and His Environment

The most common perception of “the environment” is it as something separate from everyday lives. It is considered as a place that they may go for recreation, like for example picturesque wilderness areas, clear flowing mountain streams, exotic big game in natural parks, distant steaming tropical jungles, and so forth. There is a sharp contrast to these views when it comes to reality, which was known to many members of the traditional societies. The environment is a complex web of relationships and interdependencies of which the human beings are a part.

Human exists within his surroundings, feeling and perceiving, influencing and being influenced by them. There is a sense of mutual interdependence for long-term survival. The modern industrial man, but, has no such, mostly the traditional sense of environment and has only began to appreciate the similar but more sophisticated understandings of the ecological and environmental sciences (Kenneth A Dahlberg, 1985).

Environment is a set of relationships between man and nature. One among the concepts developed to understand the environment in a better manner is ‘Ecosystem’ which talks about this relation and dependency on environment. Ecosystem is referred as the environmental system in which the interplay between the living and non-living takes place. It composed of set of interrelated components which form a whole. If all the components interact in harmony, the ecosystem is said to be in balance. Unfortunately, the elements often conflict with one another, creating crisis and change within the system (Daniel J Curran, Clarie M Renzetti, 1987).

The relationship between the man and the environment has been established even from the early periods itself. Human beings live in the kingdom of nature and interact with it constantly. There are always influences of nature that could be found in lives of human beings, like the influence of nature in the form of the air he breathes, the water he drinks, the food he eats, and the flow of energy and information. Any change in the environment can not only result in devastating effects, but can also pose a threat to the human race (UNEP, n.d).

1.2. Environmental Detriments

The earth’s biosphere provides the land, air, water and energy necessary to sustain life. Since the earth’s creation millions of years of ago, the ecosystem has worked as an interdependent system relatively undisturbed by any outside forces. But recently,

especially since the Industrial Revolution, human beings have begun to disturb the delicate balance of the nature. Natural resources have been drastically depleted (forests have been decimated, fertile land eroded, water diverted and minerals used up), and the life support system of air, water and land has been poisoned by variety of waste products and chemicals (D Stanley Eitzen, Maxine Baca Zinn, 2000).

There are some major detriments that affect the environments in highly destructive manner. These are,

- Depletion of the natural resources
- Pollution.
- Global warming
- Climate change
- Deforestation
- Waste Accumulation

One of the most pressing problems in today's world is the accelerated rate of consumption of non-renewable resources. The greater is the number of people in the world, greater is the speed with which resources will be consumed. During most of human existence on earth mineral resources remained untouched. But the situation has changed over the past one hundred years or so (D Stanley Eitzen, Maxine Baca Zinn, 2000). In short, we are fast running out of resources. Along with Depletion of resources, pollution also bothers whole world.

1.2.1. Reasons for Problems

These twin problems of resource shortages and pollution are caused by three social forces.

✓The tremendous increase in population growth that constantly increases the demand for food, energy and other products. As the population rises year after year, the stress on the overburdened environment will be increased many fold.

✓A second source of the problem is the concentration of people in urban areas, where the ecosystem simply cannot absorb their waste products.

✓Finally, the environmental problems are exacerbated as there is an increased reliance on modern technology and its consumptiveness (D Stanley Eitzen, Maxine Baca Zinn, 2000).

Human beings are living organisms dependent on the ecosystem. However, they have tried to ignore this dependency and act in defiance of nature's limits.

1.3. Pollution

To consume more, we must produce more and thereby create more wastes. These by-products of our consumptions must go somewhere. Nature has many cycles to transform wastes into other useful forms, but currently we are overtaxing the nature's recycling capacity. We put too much waste, such as automobile emissions, in one place at the same time, and we have created new toxic substances that cannot be recycled safely. The result of all these activities is pollution. Pollution occurs when pollutants contaminate the natural surroundings that bring about changes that affect our normal lifestyles adversely. Pollutants are the key elements or components of pollution which are generally waste materials of different forms and leads to pollution. Pollution disturbs our ecosystem and creates imbalances in the environment. With modernization and development in lives of humans pollution has reached its peak; giving rise to global warming, human illness and destruction of the natural settings (Thio, 2004).

1.3.1. Types of Pollution

- **Air Pollution**: Air Pollution is the most prominent and dangerous form of pollution. Many reasons lead to the cause. Excessive burning of fuel which is a necessity of our daily lives for cooking, driving and other industrial activities; releases a huge amount of chemical substances in the air every day; all these pollute the air. Smoke from chimneys, factories, vehicles or burning of wood basically occurs due to coal burning; this releases sulphur dioxide into the air making it toxic.
- **Water Pollution**: Water pollution has taken toll of all the surviving species on this planet. Several factors contribute to water pollution; the industrial wastes dumped into the rivers and other water bodies cause an imbalance in the water leading to its severe contamination and death of aquatic species. Also, spraying insecticides, pesticides like DDT on plants pollutes the ground water system. The oil spills in the oceans have caused irreparable damage to the water bodies. Eutrophication is another big source; it occurs due to daily activities like washing clothes, utensils near lakes, ponds or rivers; this forces detergents to go into water which blocks sunlight from penetrating, thus reducing oxygen and making it inhabitable.
- **Soil Pollution**: Soil pollution occurs because of the incorporation of unwanted chemicals in the soil due to various human activities. The use of insecticides and pesticides absorbs the nitrogen compounds from the soil, thus making it unfit for plants

to derive nutrition from. Release of untreated industrial waste, mining and deforestation also exploits the soil.

- **Noise Pollution**: Noise pollution occurs when noise (any unwanted and unpleasant sound) affects our ears and leads to various psychological problems like stress, hypertension, hearing impairment, etc. It can be caused by machines in industries, loud music, vehicles etc.

- **Radioactive Pollution:** This is highly dangerous when it occurs. It can occur due to nuclear plant malfunctions, improper nuclear waste disposal, accidents, etc.

- **Thermal/Heat Pollution:** Thermal pollution occurs due to the excess heat in the environment that creates unwanted changes over long time periods and is caused due to huge number of industrial plants, deforestation and air pollution. It increases the earth's temperature, causing drastic and unpredictable climatic changes and extinction of wildlife.

- **Light Pollution:** Light pollution occurs due to prominent and excess illumination at an area. This is largely visible in big cities, on advertising boards and billboards, in sports or entertainment events at the night. In residential areas the lives of the inhabitants will be greatly affected by this (Rinkesh, 2009).

1.3.2. Effects of Pollution

Pollution has its adverse effects on various aspects of life. It leads to biological, social, psychological, environmental and economic imbalances.

1.4. Water Pollution

Among all other substances on earth, water is unique. Water is life, it sustains life and life would be impossible without it. For humans, it is not merely a biological necessity; the human civilizations grew around water: human cultures and endeavours depend on water. Water form the basis of bonds between all living organisms and non-living matter on earth.

More than two-thirds of the earth is covered with water. Yet, humans and majority of the living organisms can only use a small fraction, i.e. less than 0.01 percent of the total water which is fresh. This fresh water flows in the river, lies in the lakes below ground aquifers. This freshwater is highly variable, spatially and temporally, both in amounts and quality. With the introduction of industrialization, the demand on water in addition to biological requirement has greatly increased and diversified. At the same time, the exponential increase in human population, coupled with urbanization, has

augmented the water requirements in diverse ways. However, each and every use of water changes its quality and every other human activity far away from the water impinges on its quality (Gopal, 2007).

Every day, 2 million tons of sewage and industrial and agricultural waste are discharged into the world's water the equivalent of the weight of the entire human population of 6.8 billion people. The UN estimates that the amount of wastewater produced annually is about 1,500 km, six times more water than exists in all the rivers of the world (UNWWDR, 2003).

1.4.1. The Causes of Water Pollution

Varieties of human activities lead to water pollution at a large scale. Sewage from domestic households, factories and commercial buildings are often released untreated into water bodies causing pollution at a massive rate. Sewage can be more problematic when people flush chemicals and pharmaceutical substances down the toilet. Dumping solid wastes and littering by humans in rivers, lakes and oceans. Littering items include cardboard, Styrofoam, aluminum, plastic and glass.

Industrial waste from factories, which use freshwater to carry waste from the plant into rivers, contaminates the waters with pollutants such as asbestos, lead, mercury and petrochemicals. Oil Pollution caused by oil spills from tankers and oil from the ship travels is another major by which the water of the oceans and seas get polluted. The oil spilled out from the ships does not dissolve in water and forms a thick sludge, leading to death of animals living in and depending on these water systems. Burning fossil fuels in today's world is higher and this burning into the air causes the formation of acidic particles in the atmosphere. When these particles mix with water vapour, the result is acid rain, acting as another cause of water pollution (Mauro, 2017).

1.4.2. The Impact of Water Pollution

In the words of Justice V.R. Krishna Iyer, "the unconscionable industrialisation, the unpardonable deforestation and the inhuman extermination of living species betray an exploitative brutality and anti-social appetite for profit and pleasure which is incompatible with humanism and conservationism. Today a bath in Yamuna and Ganga is a sin against bodily health, not a salvation for the soul, so polluted and noxious are these holy waters now" (Reddy, 2004).

When the population of the world was limited, water supplies seemed endlessly renewable. We could then afford to foul one water source, abandon it, and move on to

another. However, this is no longer possible since the exponential growth rates of human population have already reduced the availability of water to below its per capita availability.

Worldwide, infectious diseases such as waterborne diseases are the number one killer of children under five years old and more people die from unsafe water annually than from all forms of violence, including war. Unsafe or inadequate water, sanitation, and hygiene cause approximately 3.1 percent of all deaths worldwide, and 3.7 percent of DALYs (Disability Adjusted Life Years) worldwide. Unsafe water causes 4 billion cases of diarrhoea each year, and results in 2.2 million deaths, mostly of children under five. This means that 15% of child deaths each year are attributable to diarrhoea – a child dying every 15 seconds. In India alone, the single largest cause of ill health and death among children is diarrhoea, which kills nearly half a million children each year (Pacific, 2010).

Water is an essential part of any ecosystem, in terms of both its quantity and quality. Reducing the availability of water for the natural environment will have devastating effects, as will the pollution from domestic, industrial and agricultural wastewaters. Just as the environment is integrally tied up with the social, health and economic impacts of water use, ensuring environmental sustainability and regeneration will also have positive effects on these areas. Damage to the environment is causing a greater number of natural disasters. Flooding occurs in areas where deforestation and soil erosion prevent the attenuation of flood waters. Climate change, which, it is suggested, is fuelled both by emissions and by degradation of the world's natural environment, is blamed for the increasing number of floods and droughts. The environment is also a source of many resources – food (agriculture, fisheries and livestock) and raw materials from forests (UNWWDR, 2003).

1.5. River Pollution

Demographic explosion, land development along river basin, urbanisation and industrialization have subjected the rivers to higher stress, giving rise to water pollution and subsequent environmental deterioration. The surface water pollution issue has been enlisted as one of the most serious and deleterious problem, especially in developing countries. Majority of the rivers in the urban areas in developing world are the destination of effluents discharged from the adjoining industries (Shajudeen P. A., 2014).

Recent studies in Europe emphasized that human alterations and impacts directly affect the physicochemical conditions of running waters and strongly influence aquatic biota. According to Tockner et al, nearly all European river basins are heavily affected by the widespread human interferences on the aquatic realm. The deteriorating water quality in Latin America due to untreated domestic and industrial sewage discharges are well established (Shajudeen P. A., 2014).

The case in India is not much different. When the spiritual reverence for rivers remains intact, its physical well-being show that we have totally failed in keeping our reverence for rivers. Rapid growth in industrialization to support the country's growing population and economy has polluted our rivers like never before. Studies show that domestic and industrial sewage, agricultural wastes have polluted almost all of Indian rivers. Most of these rivers have turned into sewage carrying drains. This poses a serious health problem as millions of people continue to depend on this polluted water from the rivers (Hudda, n.d).

Surveys undertaken by the Central Pollution Control Board (CPCB) and the Centre for Science and Environment (CSE) have come up with some hard facts on river pollution, in terms of statistical figures, which makes it a matter of really serious concern.

- Out of the 445 rivers surveyed, not even a quarter of them are fit for bathing.
- Indian cities generate 10 billion gallons or 38 billion litres of municipal waste water every day, out of which only 29% of it is treated.
- The Central Pollution Control Board also stated that there were only 160 sewerage systems and sewage treatment plants in nearly 8,000 towns surveyed in 2011.
- Only 20% out of nearly 40,000 million litres of sewage produced daily in Indian cities are treated (Hudda, n.d).

Kerala has not been showing a very bright picture regarding the conservation of rivers and saving it from pollution. As a result of the measures to satisfy the needs of the huge population, the rivers of Kerala have been increasingly polluted from the industrial and domestic waste and from the pesticides and fertilizer in agriculture. Industries discharge of hazardous pollutants like phosphates, sulphides, ammonia, fluorides, heavy metals and insecticides into the downstream reaches of the river.

The river Periyar and Chaliyar are very good examples for the pollution due to industrial effluents. It is estimated that nearly 260 million litres of trade effluents reach the Periyar estuary daily from the Kochi industrial belt. The major water quality problem associated with rivers of Kerala is bacteriological pollution. The assessment of river such as Chalakudy, Periyar, Muvattupuzha, Meenachil, Pamba and Achenkovil indicates that the major quality problem is due to bacteriological pollution and falls under B or C category of CPCB classification. There are local level quality problems faced by all rivers especially due to dumping of solid waste, bathing and discharge of effluents. With regard to groundwater, water quality characteristics of wells in Kerala are found to be affected by chemical and biological contaminants (Raju, 2014).

1.5.1. The Causes of River Pollution

There is no sign of river pollution being stopped. It is increasing day by day. There are several sources of water pollution, which work together to reduce overall river water quality. Industries discharge their liquid waste products into rivers. Our agriculture practice that uses chemical fertilizers and pesticides also contribute to river pollution as rainwater drains these chemicals into the rivers.

Domestic wastes that are thrown into rivers add to pollution levels. As population grows, the size of towns and cities also grows. With that the amount of domestic wastes that we throw into river increases. In most of the towns and cities, the municipal drains carry our wastes to rivers. There are examples of rivers catching fire because of high pollution levels. This shows how seriously polluted our rivers are (Hudda, n.d).

1.6. The Concept of 'River Health'

The concept of river health can be defined as 'The ability of the aquatic ecosystem to support and maintain key ecological processes and a community of organisms with a species composition, diversity, and functional organisation as comparable as possible to that of undisturbed habitats within the region' (Schofield N J, Davies P E, 1996).

Traditionally the assessment of river water quality has been based solely on the measurement of physical, chemical and some biological characteristics. But these measurements were only efficient for regulating effluent discharges and protecting humans, and were not very useful for large-scale management of catchments or for assessing whether river ecosystems are being protected.

Empirical evidence from studies of river ecosystems under stress suggests that a small group of biological ecosystem-level indicators can often be helpful to assess the river condition. However, physical and chemical features of the environment affect these indicators, the structure and function of which may be changed by human activities.

The term ‘river health’, applied to the assessment of river condition, is often seen as being analogous with human health, giving many a sense of understanding. Increased examination of relationships between environmental variables that affect aquatic biota, such as habitat structure, flow regime, energy sources, water quality and biotic interactions and biological condition, are required in the study of river health (Richard H Norris, Martin C Thomas, 1999).

According to the State of Victoria Department of Natural Resources and Environment, 2002, when it comes to an ecologically healthy river, it will have the following traits,

- in the river and riparian zone, the majority of plant and animal species are native and the presence of exotic species is not a significant threat to the ecological integrity of the system;
- natural ecosystem processes are maintained;
- major natural habitat features are represented and are maintained over time;
- native riparian vegetation communities exist sustainably for the majority of the river’s length;
- native fish and other fauna can move and migrate up and down the river;
- linkages between river and floodplain and associated wetlands are able to maintain ecological processes;
- natural linkages with the sea or terminal lakes are maintained; and
- associated estuaries and terminal lake systems are productive ecosystems

When any of the mentioned traits are lacked and also there has been consistent declaim in both quantity and quality of the river, the conclusion of low river health could be drawn.

1.7. The Pamba River

Pampa River is the third longest river in the South Indian state of Kerala. The river is one of the most stressed rivers in Kerala. Pamba originates at Pulachimalai hill

in the Peerumedu plateau of the Western Ghats at an altitude of 1650 MSL and flows through Ranni, Ayoor, Pathanamthitta, Thiruvalla, Chengannur, Kuttanad and Ambalappuzha taluks. Most part of the river is flowing through Pathanamthitta and Alappuzha District, both of which are densely populated and the river is depended for various domestic and agricultural purposes.

Sabarimala, which is one of the major pilgrimage centers of South India is located on the banks of the river Pamba. The pilgrimage season here is from December to February every year. Each year lakhs of pilgrims visit the place. These pilgrims depend on the river water for various sanitary purposes. The river water is also influenced by various other anthropogenic activities (Jalal FN, Kumar MGS, 2013).

1.8. Pollution of Pamba River

Despite being a most important river and highly visited pilgrim place, the Pamba does not have safe and sound picture to provide regarding its health and quality. As per the Central Pollution Control Board Report (2000), this river which is visited by more than millions per each year is highy polluted and the reasons include lack of sanitary latrines, lack of facilities for sewage collection and treatment accumulation of wastes discharged from hotels and commercial establishments located at Sabarimala (Shajudeen P. , 2014).

The daily average sewage generated in Pamba town was seven mld and 3.5 mld of untreated sewage. This was being discharged into the Pamba River. The daily average sewage generated in Sabarimala was 10 mld and the entire 10 mld of untreated sewage was being discharged into the river. It has been reported that open defection, discharge of raw sewage, domestic waste, commercial waste etc, during the Sabarimala pilgrim season spread over 65 days turn the Pamba river highly polluted and the count of coliform bacteria was found to reach a level of three lakhs per 100ml. The rich availability of organic nutrients, besides nitrate, phosphate and sulphate from agriculture runoff, facilitate the abundant growth of bacteria in the river which may exert stress on the biota in the downstream stretches of Pamba (Shajudeen P. , 2014).

1.9. Statement of the Problem

A river is defined as a large natural stream of water emptying into an ocean, lake, or other body of water and usually fed along its course by converging tributaries (Lenntech). Rivers are the most important freshwater resource for man. Social,

economic and political development has, in the past, been largely related to the availability and distribution of fresh waters contained in riverine systems (WHO, Rivers, 1996).

Carrying water and nutrients to areas all around the earth, rivers play an important role in water cycle, water source, drainage channels for surface water and providing an excellent aquatic environment for both flora and fauna.

Considering the Indian history, the role played by river is imperative. Along their banks the earliest settlements of India were made the first great cities grew up. The gifts showered by the Indus and her tributaries on the Punjab, the land of the five rivers and the fertilizing waters of the Ganges led early to the development of Indo-Gangetic plain for thousands of years the teeming population of India has cultivated the fertile valleys (Mehta, 2013). Importance of rivers in India can be imagined by the recent judgement of one of the high courts of the country. According to this judgement, High Court of Uttarakhand while hearing a Public Interest Litigation (PIL), declared the rivers Yamuna and Ganga as legal or juridical persons, enjoying all the rights, duties and liabilities of a living person (Gosh, 2017).

Kerala, an evergreen and agriculturally rich state, has 44 major rivers flowing elegantly through it. Availability of water at the right time through plenty of rains and irrigation from rivers and backwaters is what makes Kerala evergreen and agriculturally rich state. The rivers with their tributaries and feeders run across like arteries and veins of the land. The folklore of Kerala is rich with devotional tributes to rivers. The magnificent indigenous culture, developed and flourished along the banks of some of the largest rivers of Kerala, presents certain common features and astonishing similarity (Shajudeen P. A., Shodhganga, 2014; Shajudeen P. , 2014).

Though the hoary knowledge of rivers as the nerve of the world, country and state still subsists and are handed over to generations after generations, the detrimental fact of river pollution is often a major fact of concern. Declining quality of water in these systems threatens their sustainability and is therefore a cause for apprehension (Rathitha, 2012). Though rivers are waterways of strategic importance across the world, providing main water resources for domestic, industrial, and agricultural purposes, the rise of pollution at an alarming rate is hovering key concern.

Water pollution is defined as the undesirable change is physical, chemical and biological characteristics in the water bodies which may cause harmful effects on

human and aquatic life. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. The pollution in Indian rivers has now reached to a point of crisis due to rapid industrialization coupled with unplanned urbanization. The entire array of life in water is affected due to pollution in water. The rapid decline in water quality is devastating and several epidemiological and ecological perturbances are noted too (Shajudeen P. A., 2014).

Three important river systems of the north like Indus, Ganga and Brahmaputra are suffering from pollution. Maximum populated areas of the world are settled in all the three basins. In southern India, river Godavari, Cauvery, Krishna and Mahanadi are highly polluted. Rivers of India are no more rivers but have been converted into filthy drains (Kumar, n.d)

The story of Kerala Rivers is not different. The pollution tests conducted under the joint auspices of the World Malayali Council Kerala province and the science and technology wing of Labour India paint a grim picture on the health of Kerala Rivers. The studies, which were conducted in the 44 rivers of the State between November 7 and 12, indicated that most of the rivers were “polluted generally and the majority at an alarming level,” said V.J. George Kulangara, chairman of the council (The Hindu, 2010).

Pamba, the most important and vital riverine system in the Central Travancore of Kerala, do not have a pollution free elegant picture either. It is also one of the most important rivers in the South Western Hills of Kerala. The famous shrine of Sabarimala is situated in the hills of Pamba plateau which is one of the most popular pilgrim centres in South India and millions of pilgrims visit the shrine. Lack of sanitary latrines, lack of facilities for sewage collection and treatment accumulation of wastes discharged from hotels and commercial establishments located at Sabarimala are the major sources for the pollution of Pamba River (CPCB, 2000). The pollution is mainly due to human excreta and biodegradable waste like used leaves, vegetable wastes, discarded clothes, food wastes etc. Indiscriminate disposal of used plastic bottles forms the major portion of the non-biodegradable waste. The gathering of very large crowds over a short period of time every year in an ecologically sensitive area has given rise to various environmental problems (Shajudeen P. A., 2014).

Apart from the biological disadvantages that the pollution of rivers leads to, there are other social as well as health detriments that it causes especially to the community people depending on these polluted rivers as a source of water. Most of the diarrheal diseases occur through oral-faecal or hand-to-mouth transmission. Therefore, environment is considered as an important factor for people's health since they may work interactively with drinking water (Zang, 2010). In addition to diarrhoea, skin diseases, stomach and intestinal ailments and b 142 cases of water borne diseases reported during last four years in the study area. Skin diseases in the form of itching etc. was largely reported, infectious hepatitis/Jaundice, Diarrhea, Schistosomiasis in the form of continuous cold and other related problems, and typhoid are mainly reported during the past years. Bronchial problems are also results of the Pamba river pollution (George & John, 2015).

While causing serious health troubles to the people, the pollution does not fail to become a primary root in leading to various social problems faced by the members. The polluted water becomes totally unfit for any use in the households. The community is forced to find out another source drinking water. Even the ground water is getting polluted. The river water which was used for the agricultural purpose is no longer available to them leading to economic troubles.

One of the important social impacts identified due to pollution affected areas is that, there is steady reduction in marriage proposals in the affected area. The tendency for the people to migrate from the place is large and increasing at pace (George & John, 2015).

Thus the severe pollution in Pamba affects humans, flora and fauna alike. Though the well-versed human creates the entire problem, innocent lives are sacrificed. The river is literally choking because of the easy said and considered title 'Pollution'.

1.10. Need for the Study

Social work has been late to engage with the environmental movement. Often working with an exclusively social understanding of environment, much of the social work profession has overlooked the importance of environmental issues. However, recently, the impact of and worldwide attention to climate change, a string of natural disasters, and increased understanding of issues around environmental justice has put the environment, sustainability, and well-being in the spotlight (Mel Gray, 2013).

Pollution becomes such a topic wherein which an immediate attention is required. A process found throughout the globe, pollution had led to severe damages. The word has now become dangerously clichéd that people began to look into it as an everyday matter. Pollution destroys and harms not only the air, the water, and the environment, but also humans, animals, and plants. When there are various kinds of pollution classifications, water pollution is one foremost matter of concern.

Human civilizations originated, developed and thrived in places where there is an easy access to fresh water sources. Rivers being dynamic systems are subjected to physical, chemical and biological variations due to diverse human activities. Urbanization, agricultural and pilgrimage activities cause an increase of nutrient content in the water; resulting in increased productivity and increased concentration of dissolved substances to such an extent that the water becomes polluted. There is a closer link between pollution and health damages (George & John, Water Pollution and its Impact on Rural, 2015).

Five million people die each year because of polluted drinking water, poor sanitation and domestic unhygienity around the world (WHO, 1996). In India alone, nearly 1 million people die annually because of waterborne diseases (World Bank 2001). Dirty water and poor sanitation cause more than 500,000 infant deaths a year in the Asia pacific region.

Today there are many cities worldwide facing an acute shortage of water and nearly 40 percentage of the world's food supply is grown under irrigation and a wide variety of industrial processes depends on water. The environment, economic growth, and developments are all highly influenced by water-its regional and seasonal availability, and the quality of surface and groundwater. The quality of water is affected by human activities and is declining due to the rise of urbanization, population growth, industrial production, climate change and other factors. The resulting water pollution is a serious threat to the well-being of both the Earth and its population (Katakwar, 2016).

In India, river pollution has extended in every context. The Ganga River Pollution is now at such a high level that the amount of toxins, chemicals and other dangerous bacteria found in the river are now almost 3000 times over the limit suggested by the WHO as 'safe'. The river directly and indirectly affects the largest population of any river in the world with over more than 420 million people who rely on it for food, water, bathing and agriculture. And that is not to mention the tens of

Millions of pilgrims who venture to India's most holy of rivers each year to bathe and worship. Approximately 1 billion litres of raw, untreated sewage are dumped in the river on a daily basis. The amount has more than doubled in the last 20 years and experts predict another 100% increase in the following 20 years. Thousands of bodies are cremated on the banks of the river yearly with many being released into the river with hopes that their souls may have a direct path to heaven. Hundreds Unwanted or 'illegitimate' babies, cattle and other animal carcases are also dumped in the Ganges again with religious significance. The level of Coliform bacteria is over 2800 times the level considered safe by the W.H.O. One of the more alarming issues facing everybody remotely related to the river are the dead bodies of both humans and cattle which serenely float by almost completely unnoticed, or perhaps consciously ignored by busy bathers hoping to purify their souls. The bodies are released into the river with a hope that the soul will be saved and be immediately received by heaven (Jaiswal, 1993).

Kerala state is blessed with 44 rivers, numerous lakes and ponds, estuaries and back water system. Unfortunately, these aquatic systems which sustain the life and greenery of the state are at the verge of severe deterioration due to over exploitation of natural resources from active channels and flood plain areas. The rivers of Kerala have been increasingly polluted from the industrial and domestic wastes and from pesticides and fertilizers in agriculture. The river Periyar and Chaliyar are very examples for the pollution due to industrial effluents (State of Environment Report, 2005). The major water quality problem associated with rivers of Kerala is bacteriological pollution (George & John, Water Pollution and its Impact on Rural, 2015).

Pampa, otherwise called as southern Ganga, is the sacred river of Kerala. It is the third largest river in Kerala (176 km.) and has the fourth largest catchment area (2235 km.). The river originates from Pulanchimala, having an elevation of 1650 m in the Western Ghats. It flows through Iddukki, Pathanamthitta and Alleppey districts and is the lifeline of Central Kerala. River Pampa is the holy river of the Hindus in South India because of its historical relation with Sabarimala Temple and the epic of “Lord Ayyappa”. The famous forest shrine of “Swami Ayyappa” is situated in the north-western foothills of the Pampa plateau. It has become one of the most popular pilgrim centres and millions of pilgrims visit the shrine particularly during the months of November, December and January and also during the first of every Malayalam month. During the season around

50 million people visit Sabarimala Shrine. Around thirty thousand people stay at Sabarimala for two months for rendering services to these pilgrims.

It is on the sand beds of this river, that Asia's largest Christian congregation, Maramon convention is held every year. The river is also related with the cultural belief of central Travancore people, such as "Aranmula boat race" and "Thiruvonathoni". The conventions held on the river bed, and the direct discharge of untreated hospital and municipal wastes and agricultural runoff are causing untold damage to the river and seriously affecting the quality of life of the people who depend on Pampa river. Indiscriminate mining of sand from the river too caused the deterioration of the aquatic system. Large numbers of pumping stations are operating in the pampa river and the polluted water flow to surrounding communities without proper and effective treatment (George & John, Water Pollution and its Impact on Rural, 2015; George & John, water pollution and its impact on rural Health Micro Analysis Based on River Pamba, Kerala, India, 2015).

It has been reported that open defection, discharge of raw sewage, domestic waste, commercial waste etc, during the sabarimala pilgrim season spread over 65 days turn the Pamba river highly polluted and the count of coliform bacteria was found to reach a level of three lakhs per 100ml (Shajudeen P. A., Shodhganga, 2014; Shajudeen P. , 2014).

The deterioration of Pamba due to the above mentioned reasons led to serious health and social problems among the community members. When wide variety of health issues bothers the society, the social and economic troubles forces the society to find another water source or even to migrate from their hometown.

1.11. Objectives

1.11.1. General Objective

To study the socio-health detriments of the community members due to water pollution in Pamba River.

1.11.2. Specific Objectives

The specific objectives are

- To understand the social profile of the community members,
- To study the perspective of community members on the water pollution,

- To study the social problems faced by the community members due to water pollution in Pamba river,
- To study the health problems faced by the community members due to water pollution,
- To asses various interventions for protecting the river from water pollution,
- To study the involvement of the community members in protecting the river from pollution,
- To identify various methods that could be adopted so as to reduce the water pollution in Pamba River.

1.12. Conceptual Definition

1.12.1. Water Pollution: Water pollution refers to the presence in water of harmful and objectionable material —obtained from sewers, industrial wastes and rainwater run—off —in sufficient concentrations to make it unfit for use (UN, 2005).

1.12.2. Health Problems: By simplest definition, health means being sound in body, mind and spirit. The World Health Organization defines health as "not merely the absence of disease or infirmity," but "a state of complete physical, mental and social wellbeing (WHO, 1948).

1.12.3. Social Problems: According to Fuler and Mayer "A Social Problem starts with the awakening of people in a given locality, with the realization of certain cherished values that are threatened by the conditions that's have become acute" (Farooq, 2011). According to Horton and Leslie "Social Problem is a condition which many people consider undesirable and wish to correct" (Farooq, 2011).

1.13. Operational Definition

1.13.1. Water Pollution: In this research, water pollution can be defined as the presence of contaminating foreign substances in and low water quality of Pamba River caused due to the untreated domestic waste discharged into it, sewage directly opening into the river, commercial establishments releasing waste straight off, latrines for pilgrims connected to the it and the religious practices during the Sabarimala season.

1.13.2. River Pollution: River pollution is that situation in which any waste materials or pollutants are discharged into the Pamba River through the discharge of waste by the agricultural runoffs, directly opening sewage, domestic and industrial waste disposals,

hotel and commercial establishments releasing waste, religious practices and the visits of millions of pilgrims during the Sabarimala season, in a way that it harmfully affects the water quality and the aquatic life within the river.

1.13.3. Health Problems: Health problems are defined as any kind of physical illness, such as the occurrences of any seasonal diseases, allergies, water born diseases and skin diseases, that are caused as a result of the water pollution in Pamba River.

1.13.4. Social Problems: A situation in which the normal living condition of the community members is disrupted due to the water pollution in Pamba River and the people are forced to adopt alternatives such as depending on water source rather than the river or give up certain essential practices such as using the river water for household practices can be defined as a social problem.

1.13.5. Interventions: Any method adopted, either by the Government, Non-Governmental agencies, groups, families or individual, so as to protect the Pamba River from pollution and bring it back to the position where it could sustain life as it used to, can be defined as intervention.

1.14. Organization of Report

The entire research is organized in 5 chapters as follows.

Chapter I presents the Introduction which includes the need and significance of the current study carried out, statement of the problem, definition of key terms, objectives of the study and organization of the report.

Chapter II presents the review of the related literature which is categorized as theoretical review and review studies that have bearing on the present study.

Chapter III presents the methodology of the study which includes method chosen for the study, sample description, details on collection of data, the statistical tests used, limitations and scope of the study.

Chapter IV deals with the analysis and interpretation of data. The statistical tests were conducted based on the hypothesis.

Chapter V is the final chapter of the dissertation contains the findings, suggestions formed and the conclusion of the study.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

2.1. Human Beings and Environment

Human being is a product of organic evolution and natural environment. His very existence, survival and progress on earth depend on the quality of the environment. In his study on ‘Effectiveness of mass media in environment protection in Dindigul district a case study’, Paul Baskar J, mentions that the term environment comes from the Latin word 'environ' which is the combination of two words i.e. En (in) Viron (circle) which means to encircle or to surround. According to International Encyclopedia of Social Sciences, environment is the aggregate of all external conditions and influences affecting the life and gdevelopment of an organism. Environment consists of all the external sources of factors to which a person or aggregate of persons are actually or potentially responsive (Paul, 2013).

Thus, the word environment refers to the surroundings, the aggregate of circumstances of an organism or group of organisms specially the combination of external or extrinsic physical conditions that affect and influence the growth and development of organisms (Katakwar, 2016). According to another view the term 'environment' includes air, water and land and interrelationships which exist among and between these basic elements and human beings and other living organisms. Besides the physical and biological aspect, the 'environment' embraces the social, economical, cultural, religious, and several other aspects as well.

The environment, thus, is an amalgamation of various factors surrounding an organism that interact not only with the organism but also among themselves. It means the aggregation of all the external conditions affecting life and development of organs of human beings, animals and plants. Man has the creative ability of transforming his surroundings while doing so he can develop and enhance the quality of life for his fellow human beings. But, when needlessly applied the same creativity can cause harm to the environment. One can observe this destruction in every field. Human beings polluted the air, water, caused harm to the living beings on earth. Because of his actions

the ecological balance is disturbed. The actions of man caused harm to the physical, social and mental health of his fellow human beings. Natural resources are drained, ozone layer is depleted (Paul, 2013).

2.2. Environmental Problems

Darshana Kumari, through her research 'Environmental Problems and Management of E- waste in India', she points out various environmental issues. Environment destruction caused by humans has now become a global problem, and this is a problem that is increasing every day. By year 2050, the global human population is expected to grow by 2 billions people, thereby reaching a level of 9.6 billion people. The human effects on Earth can be seen in many different ways. One is the temperature rise, and according to the report "Our Changing Climate", the global warming that has been going on for the past 50 years, primarily due to human activities. Since 1895, the U.S. average temperature has increased from 1.3 °F to 1.9 °F, with most of the increase taking place since around year 1970 (Kumari, 2017).

According to Riley E. Dunlap and Andrew K. Jorgenson (2012), in recent decades environmental problems have become 'globalized in terms of their existence and impacts' as well as the socioeconomic forces that generate them. In their study 'Environmental Problems a deeper clarification has been given. Humans have faced poor environmental conditions throughout history, but what we think of as environmental problems became more common and apparent with industrialization and urbanization. In the United States, for example, air and water pollution from factories and dense urban living conditions attracted growing attention throughout the last century, and by the 1960s became recognized as significant problems. Concern over air and water pollution rapidly spread to a range of other conditions – soil erosion, pesticide contamination, deforestation, declining animal populations and species, and so on – through the efforts of environmental scientists, activists, and policy-makers. These diverse concerns gradually merged into environmental problems (or environmental degradation), and the 1970 Earth Day in the United States and then the 1972 United Nations Conference on the Human Environment in Stockholm helped turn "environmental quality" into a major international issue.

Dunlap and Jorgenson (2012) have mentioned the concept of Environmental problems 'vague' as it can differ based on the concept and the use of nature. When humans overuse an environment's ability to fulfill any single function, environmental

“problems” in the form of pollution, resource shortages, and overcrowding and/or overpopulation are the result. Yet, not only must the environment serve all three functions, but when a given environment is used for one function its ability to fulfill the other two can be impaired. Incompatibilities between the living-space and waste-repository functions are apparent, for example, when using an area for a waste site makes it unsuitable for living space. Similarly, if hazardous materials escape from a landfill and contaminate the soil or water, the area can no longer serve as a supply depot for drinking water or agricultural products. Finally, converting farmland or forests into housing subdivisions creates more living space for people, but means that the land can no longer function as a supply depot for food or timber or as habitat for wildlife (Riley E. Dunlap, Andrew K. Jorgenson, 2012).

2.2.1. The Negative Impacts

In the research, Environmental Problems and management of E-Waste in India, the negative impacts are also deeply studied. Human activities have many harmful impacts on the biophysical environment. For instance, the carbon dioxide equivalent of greenhouse gases (GHG) in the atmosphere has already exceeded 400 parts per million (IPCC Report). With this accelerated rate of greenhouse gases in the atmosphere, it will no longer be a far-fetched idea when we will have to start buying mini bottles of clean, pure air. This is evident from the fact that major cities, at least in India, witness the population wearing masks over the nose and mouth to avoid falling prey to asthma, COPD, etc.

Environment destruction caused by humans has now become a global problem, and this is a problem that is increasing day-by-day. By year 2050, the global human population is expected to grow by 2 billion people, thereby reaching a level of 9.6 billion people. More is the population more is going to be our dependence on environmental resources, which will thereby lead to various negative results (Kumari, 2017).

2.2.2. Types of Environmental Problems

Darshana Kumari (2017), in her study talks about different kinds of environmental problems that are being faced in today’s world. When unwanted material present in the environment cause pollution or problems.

There are numbers of environment problem but we basically classify it into four categories:

- Land-related environmental problems
- Air-related environmental problems
- Water-related environmental problems
- Other environmental problems (Kumari, 2017).

2.2.3. Environmental Problems: A Case Study of Pollution in the St. Lawrence River, North America

As per the study by Josh Neufeld, Samuel King and Philippe Roberge (2015), pollution in the St. Lawrence is naturally ever changing and difficult to recognize, due to the ecosystem dynamics of such a large drainage basin. The St. Lawrence River is an integral part of North American society. The river acts as an important waterway for fishing, shipping and receiving, and for the manufacturing industry situated on or near the river shoreline. It also houses agriculture and urban populations as well as indigenous populations using it for cultural traditions. It is a shared geographic border between Canada and the United States of America and there are currently 15 million and 30 million people from those countries respectively that live within the river basin. It comprises an area of more than 1,610,000 km and drains 25% of the world's fresh water. The St. Lawrence also houses a bevy of flora and fauna in the aquatic and land ecosystems within the river itself and its basin.

It is stated in the study that its complex usage and dynamic ecology, as well as its sheer size result in a rather wicked problem in regards to pollution management. A term coined by Rittel and Webber in 1973, a wicked problem can be identified as "a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize". The issues surrounding the St. Lawrence are a wicked problem in that there are many interacting and dynamic systems at work within the basin, numerous different values placed on river usage, ever changing physical characteristics and social dependencies that lead to a measure of uncertainty and that there is no concrete, one-fits-all solution to satisfy all of these aspects at once (Josh Neufeld, Samuel King, Philippe Roberge, 2015).

2.3. Pollution

"…pollution, like sin, is regularly denounced but vigorously practiced" says Michael Parenti as he explains profit is the main reason that drives the human society to exploit the nature to maximum. The figures are in millions (around 6 million) when it comes to acres of topsoil erosion that occurs due to chemicalized farming (Parenti, 2002).

The United Nations Environment Programme points out that "The beginning of a new millennium finds the planet Earth poised between two conflicting trends. A wasteful and invasive consumer society, coupled with continued population growth, is threating to destroy the resources on which human life is based (UNEP, 2002).

Martin P, in his study, titled 'Pollution studies on the perennial river Tambaraparani', provides an explanation on environmental pollution. A large number of industries and other development projects have been incorrectly sited, leading on the one hand, to over-congestion and over-pollution in our urban centres and on the other hand to diversion of population and economic resources from the rural areas. This has also resulted in the pollution of most of our water bodies which are major constituents of our life support system (Martin, 1994).

The depletion of the ozone layer and the dumping of the industrial effusions and radioactive, wastes in water ways kill our ocean. Parenthi says, "if our oceans die, so do we", as oceans produce most of the Earth's oxygen. The carbon dioxide build-up of today, mostly from the automobiles, is transforming the chemical composition of earth's atmosphere, which inturn accelerates the greenhouse effect by melting the polar ice caps and causing potentially cataclysmic climatic aberrations (Parenti, 2002).

As Parenti puts it "the relentless unyielding hunger for profits is the central operating imperative" motive that forces man to destroy and butcher the nature around him (Parenti, 2002).

2.3.1. Population and Pollution

As Hunter (2001) explains it, 'Global population size is inherently connected to land, air and water environments because each and every individual uses environmental resources and contributes to environmental pollution'. Even if the scale of production and waste generated varies for each individual and across culture context, the fact that

every human need the land, water and air for his survival is unchanged and persistent (Mooney, Knox, & Schacht, 2002).

2.3.2. Effects of Pollution

Parenti points out that “everyone is victimized” by the contamination of the environment. But some are affected more than others. One study found that the poor are more vulnerable to get cancer and other diseases, and more likely to die from these kind of diseases than by the rich category, partly because the poor have less access to health care and they are more likely to delay when it comes to “seeking treatment”. Another major reason for the poor takes ill at significantly higher rates since they tend to live in areas that are among the most toxic. They are also more likely to work in dirtier, non-union jobs that often offer less protective from occupational hazards (Parenti, 2002).

According to Parenti, the “entire world” is affected. The effluents from various sources such as industries, domestic and commercial are poured into world’s oceans, rivers, and atmosphere by “fast profit, unrestricted multinational corporations operating in Asia, Africa, and Latin America (Parenti, 2002).

Billions of pounds of buried toxic waste, leaking from thousands of sites all over the world, contaminate very wide areas of ground-water. Further it leads to various health problems among human beings including birth defects, cancer and skin diseases. According to some ecologists, a leading cause that results in death in United States is the air that the people breathe, the water that they drink and the food that they eat (Parenti, 2002).

The chemical compounds released into the air through various human activities, deplete the planet’s protective ozone layer, making the sun the enemy instead of the source of life it is (Parenti, 2002).

2.4. Water Pollution

In his study ‘An Investigation into Water Pollution of River Cauvery’ by R Lakshmi Narayana, he talks about water pollution. Water is unique, because it has properties of dissolving and carrying in solution a variety of chemicals and other matters. In this process, it easily gets contaminated. The return of water from consumptive uses like irrigation, power generation, domestic and industrial uses has necessarily polluted this precious natural resource (Narayana, 1995).

As per the study conducted by Pacific Institute and the United Nations, World Water Development, 2003, every day, 2 million tons of sewage and industrial and agricultural waste are discharged into the world's water, the equivalent of the weight of the entire human population of 6.8 billion people (UNWWDR, Pacific Institue, 2003).

Water pollution in India has now reached a crisis point. Almost every river system in India is now polluted to a considerable extent. As assessed by the scientists of the National Environmental Engineering Research Institute (NEERI) Nagpur, nearly 70% of water in India is polluted (Narayana, 1995).

In the study 'Pollution studies on the perennial river Tambaraparani', Martin P points out that Water is polluted by four kinds of substances: traditional organic waste, waste generated from industrial processes, chemical agents of fertilizers and pesticides used for crop protection and silt from degraded catchments. While it is estimated that three- fourths volume of the waste water is generated from municipal sources, industrial wastes contribute over one-half of the total pollutant load, and major portion of this is coming from large and medium industries. There has been a steady increase in the amount of waste water produced from urban communities and industries. Generally this water is discharged into lagoons or dumped on low lying areas without any pre-treatment, thereby creating sewage pools, contaminating ground waters, salinizing good quality lands around cities, acting as a source of foul smell and breeding grounds for mosquitoes and other pathogens. At many places this waste water is discharged into drains and rivers causing serious water pollution (Martin, 1994).

2.4.1. The Impact of Water Pollution on Human Health

Worldwide, infectious diseases such as waterborne diseases are the number one killer of children under five years old and more people die from unsafe water annually than from all forms of violence, including war (WHO, 2002). Unsafe or inadequate water, sanitation, and hygiene cause approximately 3.1 percent of all deaths worldwide, and 3.7 percent of DALYs (disability adjusted life years) worldwide. Unsafe water causes 4 billion cases of diarrhoea each year, and results in 2.2 million deaths, mostly of children under five. This means that 15% of child deaths each year are attributable to diarrhoea – a child dying every 15 seconds. In India alone, the single largest cause of ill health and death among children is diarrhoea, which kills nearly half a million children each year (WHO & UNICEF, 2000)

2.4.2. The Impact of Water Pollution on Ecosystem

There has been widespread decline in biological health in inland (non-coastal) waters. Globally, 24 percent of mammals and 12 percent of birds connected to inland waters are considered threatened. In some regions, more than 50% of native freshwater fish species are at risk of extinction, and nearly one-third of the world's amphibians are at risk of extinction (Vié, Hilton-Taylor, & Stuart, 2009). Freshwater species face an estimated extinction rate five times greater than that of terrestrial species. Freshwater ecosystems sustain a disproportionately large number of identified species, including a quarter of known vertebrates. Such systems provide more than US$75 billion in goods and ecosystem services for people, but are increasingly threatened by a host of water quality problems. The greatest single service freshwater ecosystems provide—marshes in particular—is water purification and the assimilation of wastes, valued at US$ 400 billion (2008$) worldwide (Vié, Hilton-Taylor, & Stuart, 2009).

With the Millennium Development Goals, the international community committed to halving the proportion of people without access to safe water and sanitation by 2015. Meeting this goal means some 322 million working days per year gained, at a value of nearly US$ 750 million (SIWI 2005), and an annual health sector cost saving of US$ 7 billion. Overall, the total economic benefits of meeting the MDG target have been estimated at US$ 84 billion (SIWI, 2005). Poor countries with access to clean water and sanitation services experienced faster economic growth than those without: one study found the annual economic growth rate of 3.7 percent among poor countries with better access to improved water and sanitation services, while similarly poor countries without access had annual growth of just 0.1 percent (UNWWDR, Pacific Institue, 2003).

2.5. River Pollution

According to R Lakshmi Narayana, the river has been defined as a body in which the water moves continuously in a definite direction carrying along with it load of materials. Importance of rivers in maintaining healthy and prosperous nation, is amply understood since the dawn of civilization. The river systems are closely interwoven with human civilization and the river water is primarily used to satisfy the daily needs of living world in and around them (Narayana, 1995).

Michael Parenti, in his work “Ecology for the Money”, mentions about an incident in which a group of environmentalist asks a company executive to justify dumping industrial effluent untreated into the river, to which the answer was swift and clearly, “the river dumping was the most cost efficient way of removing” the waste. An “adequate profit” was made through this means and helps in maintaining the “competitive edge” for the company. An incident so well portrayed by the author that draws the picture of hoe dangerously the “profit oriented” minds of the world neglects the environment and causes river pollution (Parenti, 2002).

Dashiell Bennet, in his study, mentions that according to the new report by the Environmental Protection Agency, the majority of rivers and streams in this USA can't support healthy aquatic life and the trend is going in the wrong direction. The report labels 55 percent of the nation's water ways as being in "poor" condition and another 23 percent as just "fair." Only 21 percent of rivers are considered "good" and "healthy biological communities." Even worse, the number of rivers and streams that qualify as "good" went down seven percent between 2004 and 2009 (Bennet, 2013)

2.6. River Pollution in India

India has five major river systems, namely, the Ganga, the Brahmaputra, and the Indus river system in North, and the Peninsular East Coast and the West Coast river systems in the South (Jhingran, 1991). The river has always occupied a central place in India’s material life and scared culture. In common with the other riparian Civilisations of antiquity, the civilizations of Indus and the Ganga valleys developed a water cosmology, a belief in the waters as the origin and sustaining principle of life. The association of rivers with treasure is precise. In the early monsoon economy, the rivers alluvial deposits rendered the land fertile, made agriculture possible.

The river has also been a crucial pivot in political life. Immortalised as a garden of paradise in various mythic traditions; the land between the rivers has been a coveted prize too: in India, the agrarian histories of the Ganga-Yamuna doab in the north and the Krishna – Thungabhadra doab in the south mark the waxing and warning of imperial destinies. It is said that the rivers of India have a natural capacity to cleanse themselves.

With growing Urbanization, agricultural demand for water is increasing and sewage spewing into our depleted river system, by innate capacity of rejuvenates is being sorely tested. The Yamuna, which in the lean months is reduced to a trickle and

the Sabarmati, are the most polluted rivers of the country. Pollution level rises phenomenally when the water in the rivers decreases. There are also disturbing a report of the Ganga drying up because the Gangogtri glacier, its main source of water, is receding at the rate 10-30 meters a year. Dr. R.C Trivedi, of the Central Pollution Control Board (CPCB), who is monitoring water quality at 507 points on all major rivers in the country is extremely concerned about the fate of our rivers. The horrifying fact is that all government efforts to rejuvenate the water bodies have come to naught (Shajudeen P. A., 2014).

In his study 'An Investigation into Water Pollution of River Cauvery', R Lakshmi Narayana, talks about river pollution in India. A limnological survey was carried out by Bhaskaran (1965) in 21 Km stretch of the river Gomati in the vicinity of Lucknow receiving 19.84 million gallons of wastes per day from pulp and paper factory, distillery and sewage (Bhaskaran, Cakraborty, & Trivedi, 1965). Heavy fish mortality was reported in Rihand reservoir due to high free chlorine content (62 ppm) discharged from Kanoria Chemical Industries (Arora, 1970). The organic wastes from a sugar factory and a distilleries plant cause year round pollution of the small river Daha.

Wastes from different factories such as those engaged in the manufacture of paper, chemicals, sugar, cement etc., are the major sources discharging over 4 million gallons of wastes per day into the river Son (Motwana, Banerjee, & Karamchandani, 1956).

The class 1 cities (population of over 1,00,000 generates 16,000 mld (million liters daily). Of the 17,600 million liters of waste water generated in the country every day, only 4,000 million liters are treated. Vast quantities of untreated waste water are getting into our water bodies and the environment. Of the 45,000 km length of our rivers. 6,000 km have a bio oxygen demand (BOD) above 3 mg/l, which means they are unfit for drinking. Dilip Biswas, Chairman of the CPCB. 2001. The Sabarmati has a BOD of 15 to 20 mg/l and the Yamuna, a critically sick river, a BOD of 35 to 40 mg/l. The Coliform count in the Yamuna is as high as in raw sewage (Shajudeen P. A., 2014).

The river Hooghly at Calcutta receives wastes from various types of factories dealing with pulp and paper, distillery, tannery, textile, heavy chemicals, paints and varnishes, shellac, hydrogenated oil, matches, cycle rim, petroleum oil, tarpigrnent, insecticides and fungicides. Of these, wastes from paper and pulp, distillery, chemicals,

textiles, shellacs and a number of domestic outfalls contribute substantially to the pollution complex (Basu, 1996).

River Damodar, which flows through the coal belt area in Bihar is also a seriously polluted area. The river experiences pollution due to the wastes released from large number of industries such as the Sindri Unit of the Fertilizer Corporation of India, the Bihar Governmental's Superphosphates factory and the associated cement company. The entire Asansol - Durgapur industrial belt on lower Damodar valley suffers from severe pollution caused by the discharge of wastes containing high phenol, cyanide and nitrogen (Dhaneswer, 1972).

River Godavari at Rajahmundry (Andra Pradesh) is polluted by the effluents of Andhra paper mill at Rajahmundry. The river Kalu in Bombay receives highly acidic and untreated wastes from Amar Dye and chemical company, Indian Dyes, Century Rayon, National Rayon, Central Chemicals, etc. Effluents of the Uwalior Rayon factory at Mavoor, about 21 Km from Beypore, have created a pollutional hazard in the river Chaliyar at Calicut, Kerala. A large scale fish mortality reported by Venkataraman (1966) was attributed to highly putrescible organic matter creating almost anaerobic conditions in the river with very low or nil oxygen (Martin, 1994).

In Tamil Nadu River Cooum at Madras gets polluted by the washings from a large number of slums, cattle yards, overflow from sewage pumping station, wastes from automobile workshops and many factories. Nearly 300 tanneries are spread along the banks of river Palar over a stretch of 120 Km from Vaniambadi to Ranipet. The wastewater discharge from these tanneries affects the ground water quality because of sodium and chlorides present in the tannery waste (Subramaniam and Kulasekaran, 1985). River Cauvery is polluted by Mettur Chemical and Industrial Corporation Ltd., Mettur Dam. River Vaigai receives effluents from many chemical and soap factories, and large quantities of municipal sewage (Mahadevan & Krishnaswamy, 1983).

The rate of pollution in South Indian rivers seems to be higher than those of the North Indian rivers. The main reason for this is the summer season during which the icebergs get melted and the melted water is drained into the major North Indian rivers like the Ganges, the Brahmaputra etc. During the rainy season rivers get a good current from the natural shower itself. The only possibility of pollution for such rivers is, by the catchment of pollutants when they pass through the urban and the industrial belts. Whereas, the South Indian rivers do depend upon the north- east and the southwest

monsoons. Deforestation also affects rainfall and ultimately changing the river flow in South Indian rivers. Already these rivers are under stress due to lack of rainfall caused by deforestation and pollution is an additional / secondary stress (Martin, 1994).

2.6.1. A Case Study of the Ganga River Pollution

The Ganga rises on the southern slopes of the Himalayan ranges from the Gangotri glacier at 4,000 m above mean sea level. It flows swiftly for 250 km in the mountains, descending steeply to an elevation of 288 m above mean sea level. In the Himalayan region the Bhagirathi is joined by the tributaries Alaknanda and Mandakini to form the Ganga. After entering the plains at Hardiwar, it winds its way to the Bay of Bengal, covering 2,500 km through the provinces of Uttar Pradesh, Bihar and West Bengal (Figure I.2). In the plains it is joined by Ramganga, Yamuna, Sai, Gomti, Ghaghara, Sone, Gandak, Kosi and Damodar along with many other smaller rivers (Sharma, 1997).

The river Ganga occupies a unique position in the cultural ethos of India. Legend says that the river has descended from Heaven on earth as a result of the long and arduous prayers of King Bhagirathi for the salvation of his deceased ancestors. From times immemorial, the Ganga has been India's river of faith, devotion and worship. Millions of Hindus accept its water as sacred. Even today, people carry treasured Ganga water all over India and abroad because it is "holy" water and known for its "curative" properties. However, the river is not just a legend; it is also a life-support system for the people of India. It is important because:

• The densely populated Ganga basin is inhabited by 37 per cent of India's population.

• The entire Ganga basin system effectively drains eight states of India.

• About 47 per cent of the total irrigated area in India is located in the Ganga basin alone.

• It has been a major source of navigation and communication since ancient times.

• The Indo-Gangetic plain has witnessed the blossoming of India's great creative talent (Sharma, 1997)

According to the WHO report (1997), in the recent past, due to rapid progress in communications and commerce, there has been a swift increase in the urban areas along the river Ganga, As a result the river is no longer only a source of water but is also a

channel, receiving and transporting urban wastes away from the towns. Today, one third of the country's urban population lives in the towns of the Ganga basin. Out of the 2,300 towns in the country, 692 are located in this basin, and of these, 100 are located along the river bank itself (WHO, 1997).

The report also explores the reason if the pollution. The belief the Ganga river is "holy" has not, however, prevented over-use, abuse and pollution of the river. All the towns along its length contribute to the pollution load. It has been assessed that more than 80 per cent of the total pollution load (in terms of organic pollution expressed as biochemical oxygen demand (BOD) arises from domestic sources, i.e. from the settlements along the river course. Due to over-abstraction of water for irrigation in the upper regions of the river, the dry weather flow has been reduced to a trickle. Rampant deforestation in the last few decades, resulting in topsoil erosion in the catchment area, has increased silt deposits which, in turn, raise the river bed and lead to devastating floods in the rainy season and stagnant flow in the dry season. Along the main river course there are 25 towns with a population of more than 100,000 and about another 23 towns with populations above 50,000. In addition there are 50 smaller towns with populations above 20,000. There are also about 100 identified major industries located directly on the river, of which 68 are considered as grossly polluting. Fifty-five of these industrial units have complied with the regulations and installed Effluent Treatment Plants (ETPs) and legal proceedings are in progress for the remaining units. The natural assimilative capacity of the river is severely stressed. The principal sources of pollution of the Ganga River can be characterised as follows:

• Domestic and industrial wastes. It has been estimated that about 1.4 × 106 m3 d-1 of domestic wastewater and 0.26 × 106 m3 d-1 of industrial sewage are going into the river.

• Solid garbage thrown directly into the river.

• Non-point sources of pollution from agricultural run-off containing residues of harmful pesticides and fertilisers.

• Animal carcasses and half-burned and unburned human corpses thrown into the river.

• Defecation on the banks by the low-income people.

• Mass bathing and ritualistic practices (WHO, Case Study of Ganga , 1997).

Cameron Conaway, in the article 'The Ganges River is dying under the weight of modern India', points out the devastating condition of the River. In January 2015, more than 100 corpses were washed to the canal that is connected to the Ganga river. The infamously polluted River now has dead bodies floating around. What's flowing beneath the surface is much worse: Millions of gallons of industrial effluents and raw sewage drain into the Ganges each day. The results are devastating. Diarrhoea, often caused by exposure to faecal matter, kills 600,000 Indians per year, and waterborne diseases throughout the Ganges River basin, many a result of the polluted waters, cost families $4 billion per year. Sanitation and water pollution issues cause 80 percent of the diseases that afflict rural Indians (Conaway, 2015).

According to the report published by World Wide Fund for Nature (WWF), the Ganga is one among the top 10 polluted rivers in the World. Water withdrawal poses a serious threat to the Ganges. Over-extraction for agriculture in the Ganges has caused the reduction in surface water resources. This has increased dependence on ground water, the loss of water-based livelihoods, and the destruction of habitat for 109 fish species, and other aquatic and amphibian fauna. Lowering water levels have indirectly led to deficiencies in soil organic content, and reduced agricultural productivity. Lastly, over-extraction of ground water has seriously affected water quality. Inadequate recharging of groundwater impairs the natural cleansing of arsenic which becomes water soluble when Water over-extraction exposed to air, and threatens the health of 75 million people who are likely to use water contaminated with up to 2Mg/L of arsenic (WWF, 2007).

2.7. River Pollution in Kerala

The conditions of the Kerala Rivers are also not promising. Majority of the rivers are polluted at an alarming level.

The Hindu published the news titled 'Kerala rivers polluted by faecal contamination: PCB study' stating the massiveness of the problem. Coliform count in most of the Kerala Rivers and ground water is far above the permissible limits whereas air in most cities was thick with Respirable Suspended Particulate Matter (RSPM), warned the Kerala State Pollution Control Board.

The findings are part of the Water and Air Quality Directory-2013. The Board came out with water data after monitoring water samples from 128 stations covering 42 rivers, seven rivulets/tributaries and six reservoirs. Three fresh water lakes, eight estuarine lakes, three canals, two ponds and 34 stations in groundwater too were covered under this mammoth monitoring programme. And as per the report, water quality of Kerala Rivers mostly conforms to the category A, which is defined as "drinking water source without conventional treatment but after disinfection under the Best Designated Use classification of Central Pollution Control Board". The study indicated an increasing trend in Coliform count and the Biochemical Oxygen Demand (BOD) in the rivers across the State. The BOD, indicator of water pollution, is defined as the "amount of oxygen required by aerobic microorganisms to decompose the organic matter in water," it warned (The Hindu, 2014).

According to the report published by India Today, Kerala's rivers are in peril. A study by the Kozhikode-based Centre for Water Resources Development & Management (CWRDM) has found that the increasing solid waste dumping and inflows of untreated sewage could soon sound a death knell for the 44 rivers in the state. Relatively smaller than its counterparts elsewhere in the country, Kerala's rivers are faster flowing because of the state's topography. Thus far, scientists say, heavy monsoonal rains have saved the rivers by annually reviving the water quality. The study, however, warns that now, despite the monsoons, contamination is rising steadily thanks to the toxic combination of urbanisation and poor waste management (Jacob, 2017).

The rivers of Kerala have been increasingly polluted from the industrial and domestic waste and from the pesticides and fertilizer used in agriculture. Industries discharge hazardous pollutants like phosphates, sulphides, ammonia, fluorides, heavy metals and insecticides into the downstream reaches of the river. The major rivers namely Periyar and Chaliyar are apt examples for the pollution due to industrial effluents. It is estimated that nearly 260 million liters of industrial effluents reach the Periyar river daily from the Kochi industrial belt (Shajudeen P. A., 2014).

The river Periyar, the longest river of the state (CESS, 1984) is considered to be the life line of Central Kerala. It originates from the Sivagiri peaks (1800m MSL) of Sundaramala in Tamil Nadu. The total length is about 300 Kms (244 Kms in Kerala) with a catchment area of 5396 Sq. Kms (5284 Sq. Kms in Kerala). The total annual of

flow is estimated to be 11607 cubic meters. During its journey to the Arabian Sea at Cochin the river is enriched with water of minor tributaries like Muthayar, Perunthuraiar, Chinnar, Cheruthony, Kattappanayar and Edamalayar at different junctures. Periyar has been performing a pivotal role in shaping the economic prospects of Kerala, as it helps in power generation, domestic water supply, irrigation, tourism, industrial production, collection of various inorganic resources and fisheries. However, as in the case of many other inland water bodies, River Periyar is gradually undergoing eco-degradation throughout its course of flow due to various anthropogenic stresses, which include indiscriminate deforestation, domestic-agricultural-industrial water pollution, excessive exploitation of resources, large scale sand mining and various interferences in the flow of water (Baker, 2007).

The industrial belt of Eloor in Kerala is one of the world's 'top toxic hot spots', according to international environment group Greenpeace. Unchecked pollution in the area, says an elaborate study conducted by Greenpeace, has led to people in Eloor near Kochi suffering from higher rates of death and disease. Greenpeace holds the Hindustan Insecticides Ltd (HIL) that has been manufacturing pesticides at its Eloor plant responsible for making the industrial village a toxic hotspot (Baker, 2007).

According to an epidemiological study that Greenpeace conducted at Eloor, an island in the Periyar river, unchecked pollution from HIL has resulted in diseases like cancer, congenital birth defects, bronchitis, asthma, allergic dermatitis and stomach ulcers in the local population. Greenpeace collected samples of water and sediments from an adjacent creek and soil from the nearby wetlands. Its detailed analysis found that the water at Eloor contained 100 organic compounds that included DDT and its metabolites, endosulfan and several isomers like hexachlorocylcohexane, a persistent pesticide. It says the chances of the residents of Eloor inhabitants contracting cancer are 2.85 times higher than similar toxic areas in India (Baker, 2007).

With regard to groundwater, water quality characteristics of wells in Kerala are found to be affected by chemical and biological contaminants. The ground water quality problems in the coastal areas are mainly because of the presence of excess chloride. The chloride concentration >250mb/l was detected in the well water samples of Azhicode, Kakkathuruthy, Edathinjil, Kadalundi, Chellanum, Nallalam, Mankombu and Haripad. in Alappuzha district, and fluoride concentration in the pumping wells was also observed to be high. In midland region, with regard to ionic concentration, the

concentration of flouride iron and chloride were found to be on the higher side. The flouride content was observed to be beyond the permissible limit of 1 mg/1.Deep wells in Chittur taluk and Knajikod areas of Palakkad district are found to contain fluoride concentration greater than 1mg/l (Baker, 2007).

Open wells of Kerala are under the threat of bacteriological comtamination. About 60% of the population in the State relies on ground water for drinking. Studies have shown that faucal contamination is present in 90% of drinking water wells. The open character of the wells, conventional maintenance habits, use of buckets and rope to draw water, kitchen wastes and pit latrines with average family load factor (5 members) at a distance of less than 5 meters from wells are some of the factors contributing to the bacteriological contamination. Ground water contamination due to industrial pollution has been reported from places of Kochi (eastern part of Aluva), Palakkad and some parts of Kollam and Kozhikode (Paul, 2013).

As per the news report published in Malayala Manorama, amid the state government's efforts to rejuvenate and reclaim water sources, a study has come up with a startling finding that 26.90 per cent of water sources in Kerala are "completely" polluted. As many as 46.10 per cent of over 3000 water sources including ponds, canals, river and backwater stretches and public wells, surveyed in 2003 wards across the southern state, are "partly polluted," it said (Manorama, 2017).

2.8. The Pamba River Pollution

The research conducted by Thomas George and Shaju K John does a micro analysis on the pollution of Pamba River. A detailed picture of Pamba and its importance has been given in the analysis. Pampa, otherwise called as southern Ganga, is the sacred river of Kerala. It is the third largest river in Kerala (176 km.) and has the fourth largest catchment area (2235 km.). The river originates from Pulanchimala, having an elevation of 1650 m in the Western Ghats. It flows through Iddukki, Pathanamthitta and Alleppey districts and is the lifeline of Central Kerala. River Pampa is the holy river of the Hindus in South India because of its historical relation with Sabarimala Temple and the epic of ‘Lord Ayyappa’. The famous forest shrine of ‘Swami Ayyappa’ is situated in the northwestern foothills of the Pampa plateau. It has become one of the most popular pilgrim centres and millions of pilgrims visit the shrine particularly during the months of November, December and January and also during the first of every Malayalam month. During the season around 50 million people visit

Sabarimala Shrine. Around thirty thousand people stay at Sabarimala for two months for rendering services to these pilgrims. It is on the sand beds of this river, that Asia's largest Christian congregation, Maramon convention is held every year. The river is also related with the cultural belief of central Travancore people, such as 'Aranmula boat race' and 'Thiruvonathoni'. The river stretch around the Sabarimala is seen polluted very much due to the pilgrim factor. River around the downstream municipalities and in parts of Kuttanadu is also known for poor quality of water. The conventions held on the river bed, and the direct discharge of untreated hospital and municipal wastes and agricultural runoff are causing untold damage to the river and seriously affecting the quality of life of the people who depend on Pampa River. Indiscriminate mining of sand from the river too caused the deterioration of the aquatic system. Large numbers of pumping stations are operating in the pampa river and the polluted water flow to surrounding communities without proper and effective treatment (George & John, Water Pollution and its Impact on Rural Health; A micro analysis based on River Pamba, India, 2015).

In the study 'Water Quality Dynamics and Sustainability Evaluation of Pamba River, Kerala', Divya S Rajan and Anila K A scientifically explore the water quality of Pamba River. The study area that they chose i.e. is polluted because of the high amount of the waste accumulation. Polluted conditions will equally affect both the human being as well as the other living organisms. It will cause harmful effect on our environment. There are numerous causes including increasing number of industries and various other anthropogenic activities in the neighbouring regions, global climatic changes that lead to the degradation of the quality of water. This study helped to find the important values of the natural recourses and will remind the need for conserving the biodiversity. Their study also helped to remind the need for conservation of water bodies. The study was concluded by pointing out the importance of a concerted effort to address the issues related to sustainability of the Pamba River by considering the ecosystem deterioration as a component of a suite of anthropogenic activities (Rajan & A, 2018).

P A Shajudeen's research titled 'A study on the Pamba river pollution and its possible treatment strategies' includes various strategies that could be adopted so as to solve the issue. The treatment strategy developed by him is very effective and can even be applied online at large scale as an alternate system to the existing water treatment methods newline. The Pamba river water is heavily polluted with suspended and

dissolved solids, total and faecal coliforms and heavy metals besides high dissolved organic load. Chlorine has been the most widely used disinfectant for the purification of water systems throughout the world. Pamba river water has high amount of faecal coliforms and suspended solids. The method he put forth mainly has chlorination in it (Shajudeen P. A., 2014).

Punnakkadu, (2003), reported that fertilizer and pesticide inflow from agricultural fields and plantations situated in the upland catchment of Achencovil, Pamba, Manimala and Meenachil Rivers were significant. Hospital wastes and sewage from all towns in the upstream part flowed to these rivers. Apart from these 20,000 tons of fertilizer per year added to the rice fields and 50 tons of pesticides contributed to the pollution load. The total colifom number per 100 ml was reported to be from 40,000 to 46,000 MPN at Pamba. The polluted Pamba river water has become host to many waterborne diseases in the District of Pathanamthitta and Alappuzha. Rivers being polluted by the discharge of wastes from toilets in the foothills of Sabarimala as well as the towns of Ranny, Erumely, Kozhencherry and Chengannoor. Dumping of wastes from slaughter houses and chicken corners in to the Pamba was another major issue. The purity of water at Pamba is deteriorated day by day due to the heavy influx of pilgrim tourism in every year. The dumping of huge quantity of water generated at the oottupura of Sree Parthasarathy Temple at Aranmula on the bank of Pamba river and the liquid waste flowing directly in to the river have been causing pollution of the river. The pollution status of the river has gone up considerably with the beginning of the festival season of vallasadya, ritualistic feast given to Oars men of snake boats, at the Temple. The Pamba river system has assumed alarming dimension and is very much essential for reviving the depleting fish stocks as well as for improving the general water quality (Punnakadu, 2003).

The news published by Malayala Manorama stated that there has been initiatives from the part of the State Government to make Sabarimala, the pilgrim centre near to Pamba, a National Pilgrimage Centre. The government will put forward this need in-front of the National government. Making it a pilgrim centre of national level, its importance will rise, ensuring more facilities provided to the pilgrims who visit there. This in-turn can reduce the pressure on the River as millions of pilgrims currently depend on the River for meeting primary needs. This will also help in setting up Water

plants in the River and therby reducing the effect of pollution (Manorama, Make Sabarimala a National Pilgrimgrim Centre: CM, 2017).

The study conducted by the Leibniz Center for Tropical Marine Ecology (ZMT) shows the severity of the pollution. The ZMT scientists tested different sections of the river characterized by specific land uses like tea and rubber plantations, settlements with horticulture, rice crops and the pilgrimage site of the Sabarimala Temple. More than 50 million Hindus from all over the world flock to the sanctuary each year. Every day countless pilgrims take a bath in the Pamba to wash away their sins.

“Near the Sabarimala Temple we found large quantities of ammonium nitrogen as a result of human waste. We measured 3.1 kg per hectare and year,” says Tim Jennerjahn, one of the researchers of the ZMT. “Close to the pilgrimage site the phosphorus load from detergents was also high.” With 5.6 kg per hectare and year the concentration of nitrate nitrogen resulting from fertilisers used in plantations and gardens was also considerable in the corresponding sections of the rivers (Eickhoff D. S., 2015).

The news published by Hindu (05/01/2004) is another report that pictures the seriousness of the issue. The report goes like, ‘the high level of pollution in the Pampa during the annual Mandalam-Makaravilaku pilgrim season at Sabarimala is posing a serious health hazard to lakhs of people living in the downstream reaches of Attathode, Vadasserikkara, Ranni, Kozhencherry, Aranmula, Chengannur, etc. Periodic flushing of the squalid waters from the Pampa bathing ghats in the foothills of Sabarimala has increased pollution in the downstream reaches…’ The report also mentions about the studies conducted by the KSPCB. ‘Studies conducted by the PCB show that in spite of the flushing of the Pampa bathing ghats on alternate days, the average coliform count at the Pampa-Triveni was 60,000 to 70,000 per 100 ml, mainly due to the heavy inflow of filth from the Sannidhanam through the Njunangar stream and Kakkathode. The maximum permissible limit of coliform count is 500 per 100 ml of water’ (Kuttoor, 2004).

In the words of George Iype, “the annual pilgrimage to Sabarimala by millions of devotees and Christian and Hindu religious conventions held every year on the banks of the Pampa are destroying the river and its environment, say government-instituted studies”.As many as 30 million Hindu pilgrims from across the country travel to Lord Ayyappa's temple deep inside the hill forests of Sabarimala every year. Dozens of tributaries originating from Sabarimala -- surrounded by 18 hills -- join the River Pampa

at various spots. The CESS (Centre for Earth Science Studies) study has pointed out that these religious meets produce tons of plastic material and other garbage, which is almost entirely dumped into the river. "The Pampa, which becomes a swirling torrent of muddy waters during the monsoon, turns into patches of stagnant pools during summer," the report says. A similar study conducted by the Kerala Pollution Control Board has revealed that water contamination in the Pampa is so high that it is unfit for even bathing. "The river water is further being contaminated by the dumping of waste material and sewage from towns, markets, hospitals, rubber factories, and slaughter houses," it says (Iype, Rediff, 2002).

2.9. Environmental or Green Social Work

Ramsay and Boddy talks about this in the article ‘Environment Social Work: A concept Analysis’. Environmental social work and related terms have been used widely to describe an approach to social work practice that is founded on ecological justice principles. However, practice applications of environmental social work are scant and there are various terms and a range of interpretations of the practice that exist. In essence, environmental social work assists humanity to create and sustain a biodiverse planetary ecosystem and does this by adapting existing social work methods to promote societal change (Ramsay & Boddy, 2016).

According to Katie Kapro, Green social work is a branch of social work that deals with the impact of the faltering environmental stability upon human populations. It is essentially a broadening of the definition of environment, sociologically speaking, from referring exclusively to someone’s immediate surroundings to referring to the planet that we all share. In 2010 the Council on Social Work Education declared sustainability the number one social justice issue of the new century. Since then, the area of green social work has evolved and come into its own (Kapro, 2016).

CHAPTER III

METHODOLOGY

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METHODOLOGY

3.1. Title of the Study

Socio-Health Detriments of the Community Members due to Water Pollution in the Pamba River: A Study with Reference to Perunadu Gram Panchayat

3.2. Area of the Study

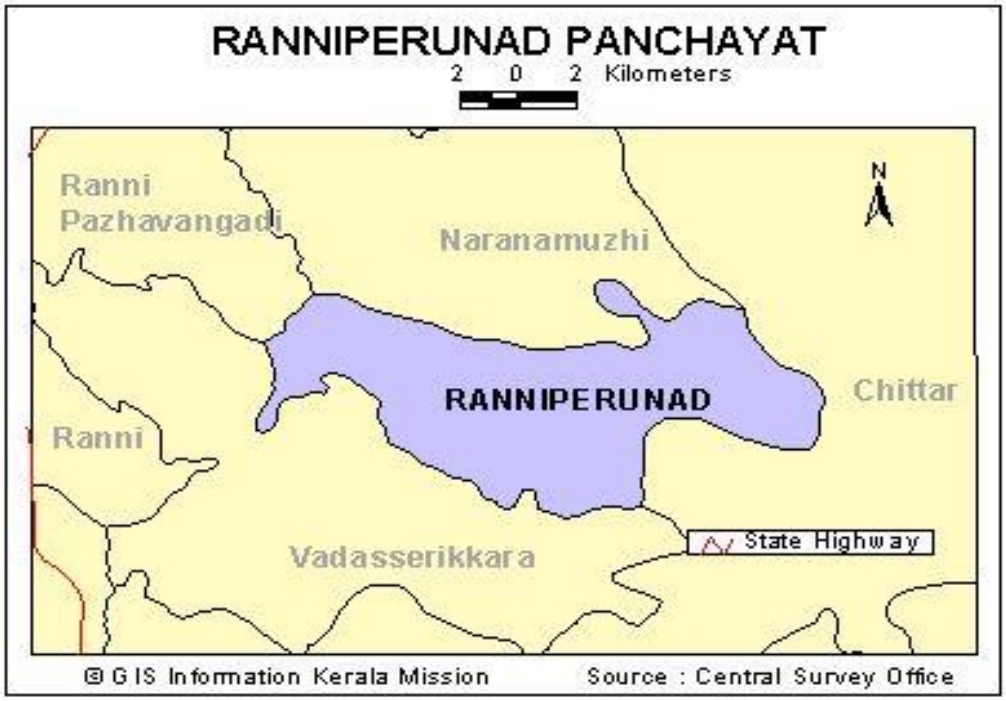
Perunadu Grampanchayat in Pathanamthitta district is chosen as the area of the study. Pathanamthitta, the youngest district in the state of Kerala, is a town and a municipality situated in the Central Travancore region in the state of Kerala, South India, spread over an area of 2,642 km^2. As per the census (2011), the town has a population of 37,538. Under the three tier system of Panchayat in rural areas, Pathanamthitta has one district panchayat, 9 block panchayats and 57 Gram Panthayats. Pathanamthitta, engrossed on the hilly terrain of Kerala can be called the headquarters of pilgrimage tourism in the state of Kerala. Sabarimala, an important Hindu pilgrimage centre attracts crores of pilgrims from the different parts of India and the state. The district has more or less has same climatic condition throughout the year, just like most other districts of Kerala. Pathanamthitta is a true tropical diversity adorned with fertile agricultural land, plantations and forest. Paddy, tapioca, various vegetables and spices like cardamom, pepper etc., are extensively cultivated in the region. The district also abounds in extensive rubber plantations (Kerala G. , n.d).

Perunadu village is located in Ranni Tehsil of Pathanamthitta district in Kerala, India. It is situated 18km away from sub-district headquarter Ranni and 24km away from district headquarter Pathanamthitta. Located to the South-east bend of the Western Ghats, it is the 4^{th} biggest panchayat among the 54 panchayats of Pathanamthitta. With a total area of 82.06 square kilometres, the panchayat had one third of its land forest. It has 15 wards, 10 of which are located on the banks of rivers including Pamba River. As per the census data of 2011, the total population of the area is 22130. Farmers constitute most of the population of this rural region (LSG Kerala, n.d). River Pamba plays a major role in the life of the people here. Two rivers that flow

through the panchayat include the Pamba River and ones of its main tributary, Kakkattu. A major concern of the panchayat is pollution of the River Pamba, especially during the Sabarimala pilgrimage season.

Figure No. 3.1

Map of the Panchayat



(http://lsgkerala.in/chittarpanchayat/services/e-governance/)

In Perunadu Grampanchayat, there are 15 wards. Among these 15 wards, Sabarimala ward is more focused for the study as it is more closer to the River and the implications of the pollution is most visible here. The ward begins from Laha and extends till Sannidanam, the main pilgrim centre where the Lord Ayyapa temple is located. The overall population of the region is near to 1600. A major emphasis is given to the Attathodu region, situated near to the Pamba and has deep impact of pollution and is divided into western part and the centre. Some regions of the ward that are included in the study are Miladumpara, Thllapally, Nillakal, Challakkayam, Laha and Pamba.

3.3. Research Design

The Research design selected for the present study is Diagnostic research Design.

Diagnostic research design is mainly directed towards ‘why’ it is happening and ‘what’ can be done about it. It is directly concerned with the casual relationships with implications for action. Diagnostic studies aim at identifying the relationship of any existing problem. It would also help to suggest methods to solve the problem (Potti, n.d).

In this research, the cause of pollution and what can be done to overcome the problem is searched. The research is also focused on what are the social and health implications of the problem. By using the fact finding enquires, this work is concentrated at identifying the problem and finding a possible solution for it.

3.4. Universe of the Study

The universe of the study is the community members of the Perunadu Panchayat.

3.5. Unit of the Study

Each community member in the Perunadu Panchayat depending on the Pamba River for various purposes such as for drinking water, for domestic chores, bathing, automobile cleansing and for recreational reasons is considered as the unit of the study.

3.6. Study Population and Sampling Technique

The study population of the study is the community members of Perunadu Grampanchayat who are depended on the River for various purposes. The total population of the Perunadu Gram Panchayat (censes of 2011) is 22350. In the panchayat, special focus is provided to the Sabarimala ward, with a population near to 1600. In the ward, as per the conclusions made from the pilot study, more attention is provided to the Attathodu region. Attathodu has a total of 290 families, among which 230 belongs to tribal community.

The population chosen for the study are the people who face numerous problems, such as health and social detriments, as a result of the pollution occurring in the River. These are the people who are affected by the pollution and demand a

solution. They are laymen who mostly depend purely on the natural resources around them, without which their survival will w questioned.

In this study, simple random sampling method of probability sampling is used. A probability sampling method is any method of sampling that utilizes some form of random selection. In order to have a random selection method, there is some process or procedure that assures that the different units in the population have equal probabilities of being chosen (Trochim, 2006). Simple random sampling method is based on probability for the selection of each item. In this method each item has its own chance of being selected. Here every member of the population is known and has equal chance of getting selected.

In this research, the members of the population are already known and the chance or probability of any member to get selected is equal. And thus the sampling design chosen is probability sampling design and the method selected is simple random sampling.

3.7. Sample Size

There are a total of 290 families in the chosen area, i.e., Attathodu region of the Sabarimala ward. Among these 250 families, 70 families were chosen for the research purpose.

3.8. Pilot Study

On 10th October, 2017 the pilot study was carried out at Perunadu Grampanchayat which aimed at studying the feasibility of the research. The Panchayat office was visited and detailed study on the region was done through discussions with the Panchayat Secretary, ward members and ST promoters. Through the discussions, information regarding the most affected area due to pollution, the population size of the area, implications of the pollution and ways in which panchayat deals with the problem were gathered. The Primary Health Centre (PHC) of Perunadu Panchayat was also visited for the purpose and discussions were done with the head nurse and staff nurses. The primary observation of the area was performed through the study.

3.9. Pre-test

The pre-test was done carried out on 15th November 2017 and it aided the researcher to find the feasibility and practicability of the tool generated among the

respondents. It was conducted among 30 community members inorder to test the rationality of the tool. The validity was checked through this pre-test.

3.10. Tool for the Study

The tool used for the study is Questionnaire that includes both open ended and close ended questions. The questionnaire contained questions regarding the socio-demographic features, social and health problems faced, opinions about and interventions for solving the issue of river pollution.

A Focus Group Discussion was also conducted as part of the research, through which the community members openly talked about and shared their concerns and opinions regarding the pollution of Pamba River. Various suggestions on how to solve the issue was also brought up during the discussion.

3.11. Source of the Data

Both primary and secondary sources of data were used in the research. Primary data was collected through the questionnaires, enquires and discussions that were conducted in and around the Sabarimala ward and Perunadu Grampanchayat. The secondary data was gathered via secondary sources such as books, newspapers, journals, articles, magazines, research thesis, government publications and websites.

3.12. Analysis of the Data

IBM SPSS version 20 was used to analyze the collected data. The data was presented using descriptive statistics and inferential statistics was followed for the process of data analysis. One-way ANOVA is used to test the variation of the variables chosen and Chi-square test is applied to check the associations.

3.13. Inclusion and Exclusion Criteria

The community members of Attathodu region who live by the river bank and has more dependency on river and thus who are severely affected by the pollution in comparison to others are included the study. But those who live beyond a distance of 5 kilometres are not considered and are excluded in this research.

3.14. Study Period

The study was commenced by June, 2017 and was concluded by the end of February.

3.15. Limitations of the Study

One major limitation of the study include that no small level intervention will generate a positive outcome to this problem of pollution of the 3rd longest river of Kerala, Pamba. So interventions must be applied in a large scale and policy level changes must be initiated, unless which a sustainable solution may not be possible.

Another prime concern is about the religious sensitivity of the issue. The visits of numerable number of devotees during the pilgrimage season and their dependency on the river as part of the ritual and for other everyday routines and needs mount as major causes of the quality deterioration of the River. Changes and interventions had to be brought in policy level, but without hurting the religious sentiments and dealing with the matter with caution. Even if policy changes are been made, it is a time consuming activity and lies beyond the time period of this study.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

4.1	The Social Profile of the Respondents
4.1.1	Gender of the Respondents
4.1.2	Educational Qualification
4.1.3	Occupation of the Respondents
4.1.4	Monthly Income of the Respondents
4.2	Farming and River Water for Agriculture
4.3	The Use of Chemical Fertilizers by the Farmers
4.4	Source of Drinking Water
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CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The current chapter provides the analysis of the collected data. The analysis is carried out in the form of tables and graphs. Also it is done on the basis of the objectives of the study. Statistical Packages for Social Sciences (SPSS) is used for analysis. It includes the social profile of the respondents and their answers various other questions framed and asked for the achievement of the objectives of the study, which mainly focuses on identifying the social and health detriments of the community members caused due to water pollution in Pamba River.

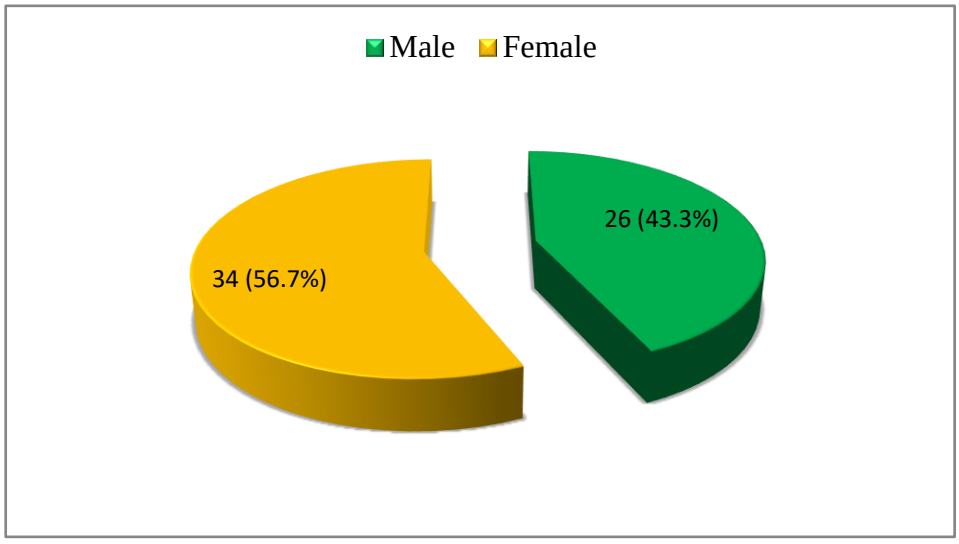
4.1. The Social Profile of the Respondents

The Social Profile of the respondents includes the gender, educational qualification, occupation and monthly income of the family.

4.1.1. Gender of the Respondents

Graph No: 4.1

Gender of the Respondents



Gender is the range of characteristics pertaining to, and differentiating between, masculinity and femininity. The above graph shows that among the respondents a majority, i.e. 34 members of the total population which makes up 56.7% are female whereas 26 (43.3%) are males.

4.1.2. Educational Qualification

Educational qualification can refer to the degrees, diplomas, certificates, professional titles and so forth that an individual has acquired whether by full-time study, part-time study or private study.

Table No: 4.1

Educational Qualification of the Respondents

Educational Qualification	Frequency	Percent
Illiterate	6	10.0
Lower primary	12	20.0
SSLC	13	21.7
Higher secondary	25	41.7
Degree and above	4	6.7
Total	**60**	**100.0**

Educational qualification can often affect and determine the actions, interventions and perceptions of people. Table 4.1 shows the educational background of the respondents. Of the total population, only 4, i.e.6.7% has an educational qualification of degree or above. Those with Higher Secondary qualification are of 25 in number and are 41.7%. Respondents with SSLC are 13 and make up 21.7% of the total population. People from lower primary background are 12 and are 20% of the population. The illiterate are of 6 in number and make up 10% of the total respondents.

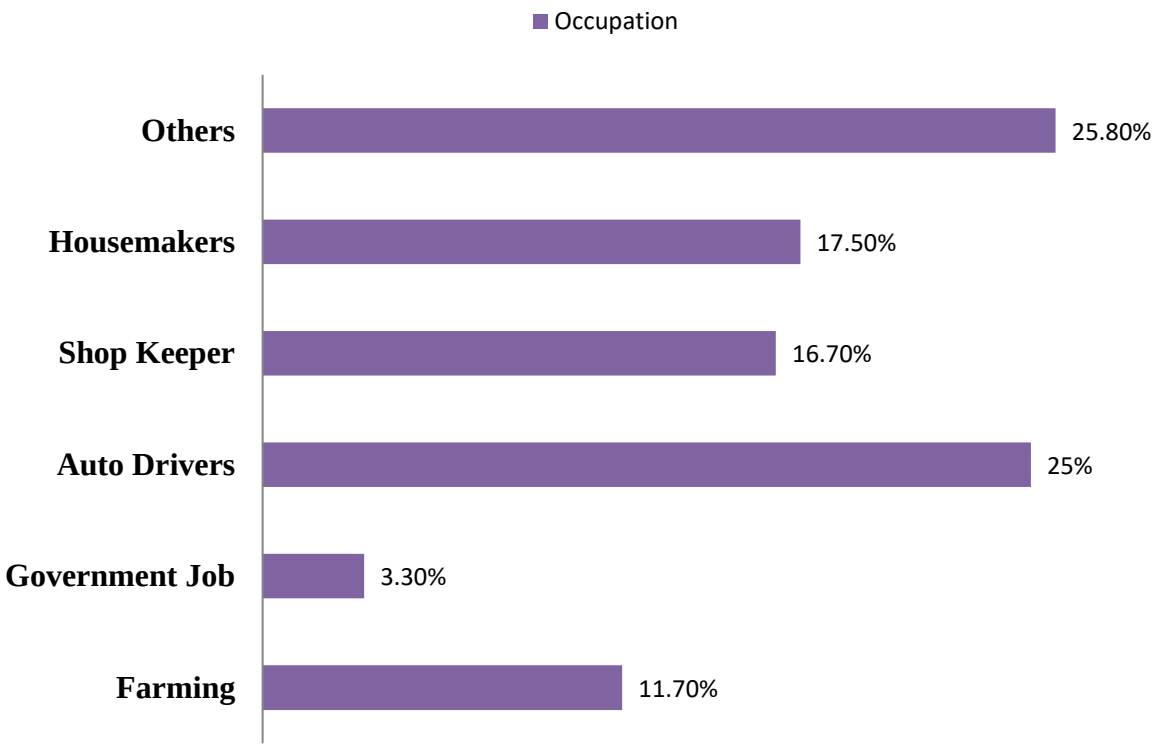
4.1.3. Occupation of the Respondents

An occupation or job is the role of a person that he or she carries out in a society. An individual can contribute to the society through the occupation. When it

comes to pollution, the activities of an individual can add or minor its effect. And thus occupation of a person can lead to either positive or negative contributions

Graph No: 4.2

Occupation of the Respondents



In Graph 4.2, the occupation of the respondents is shown. Among the respondents, a percentage of 11.70 are farmers. 3.30% are employed in government jobs. When a percentage of 25 are auto-drivers, 16.70% are employed as shop keepers. Housemakers make up 17.50% of the total population. And a percentage of 25.80% are engaged in other activities.

4.1.4. Monthly Income of the Respondents

An income can be defined as the amount of money that the respondents acquire through the occupation they carry out. Here the monthly income of the people is asked and analysed. The economic background of the chosen area, i.e. Attathodu region, Perunadu Grampanchayat can be drawn through this analysis. Also, it can determine the magnitude of the aftermath of the pollution on the local people there.

Table No: 4.2

Monthly Income of the Respondents

Monthly Income	Frequency	Percent
Less than or equal to5000	5	8.3
Less than or equal to 10000	36	60.0
More than 10000	19	31.7
Total	**60**	**100.0**

In the samples collected, 8.3%, i.e. 5 of the families have an income less than on equal to 5000 rupees. A percentage of 60.0 which is 36 families has monthly income less than or equal to10000 rupees. More than 10000 rupees is earned per month by 19 families which make 31.7% of the total population.

4.2. Farming and River Water for Agriculture

Farming is an occupation that is closely associated with the nature. A deep impact of pollution can be observed in this field of livelihood as it will directly be affected by the pollution. Also, it is well known that agriculture is the single largest user of freshwater resources, using a global average of 70% of all surface water supplies. Except for water lost through evapotranspiration, agricultural water is recycled back to surface water and/or groundwater. However, agriculture is both cause and victim of water pollution. It is a cause through its discharge of pollutants and sediment to surface and/or groundwater, through net loss of soil by poor agricultural practices, and through salinization and waterlogging of irrigated land. It is a victim through use of wastewater and polluted surface and groundwater which contaminate crops and transmit disease to consumers and farm workers. Agriculture exists within a symbiosis of land and water and, as FAO (1990) makes quite clear, "... appropriate steps must be taken to ensure that agricultural activities do not adversely affect water quality so that subsequent uses of water for different purposes are not impaired" (FAO,

n.d). And that's why there is a need to identity the number of families depended on agriculture.

Table No: 4.3

Farming and River Water for Agriculture

Response		River Water for Farming		Total
		Yes	**No**	
Farming	**Yes**	15 (25%)	5 (8.3%)	20 (33.3%)
	No	0 (0%)	40 (66.7%)	40 (66.7%)
Total		**15 (25%)**	**45 (75%)**	**60 (100%)**

In Table 4.3, the cross tab shows the number of families who are depended on farming and among those families the ones depended on the River water for their farming is shown. Among the total population of 60, a number of 20 families, i.e. 33.3% are depended on the agricultural field. In those 20 members, 15 (25%) are dependent on the River for as the source of water to their agricultural field. 5 members, on the other hand, are not using River water for farming. A 75% of total respondents are not engaged in farming activities and neither do they depend on the River water for agricultural activities.

4.3. The Use of Chemical Fertilizers by the Farmers

Fertilizers and pesticides are among the many common storm-water pollutants that can degrade the water quality. Though fertilizers contain chemicals that can lead to better yields when used properly, excessive amounts applied gets washed off and can pollute the water bodies nearby. Fertilizers are made of nutrients, such as nitrogen and phosphorus. When it rains, these nutrients are carried by storm-water into the nearest water body. Too many nutrients in water can cause algae to grow, which uses up the oxygen in the water. Low levels of oxygen in water can hurt aquatic wildlife and even lead to fish kills.

All the members of the population live in a close vicinity of the River Pamba. So while using chemical fertilizers in their farm can actually get washed away to the river sooner or later. And so analysing the number of people using chemical fertilizers becomes important

Table No: 4.4

The Use of Chemical Fertilizer by Farmers

Use	Frequency	Percent
Always	0	0
Sometimes	10	16.7
Never	50	83.3
Total	**60**	**100.0**

Table 4.4 shows the number of people who use chemical fertilizers in their farms. Among the total population of 60 members, nobody uses chemical fertilizers always. But a population of 16.7%, i.e. 10 members use chemical fertilizers sometimes in their farms. Large frequencies of 50 members of the total 60, which make up 83.3%, never use of chemical fertilizers.

4.4. Source of Drinking Water

The source of drinking water can often determine the health detriments occurring in a community. The safer and cleaner the drinking water is, the better health condition the community will have. As per the WHO report, 844 million people lack even a basic drinking-water service, including 159 million people who are dependent on surface water.

Table No: 4.5
The Source of Drinking Water

Source	Frequency	Percent
River	6	10.0
Well	19	31.6
Surface water or Rainwater	33	55.0
Bore-well	1	1.7
Others	1	1.7
Total	**60**	**100.0**

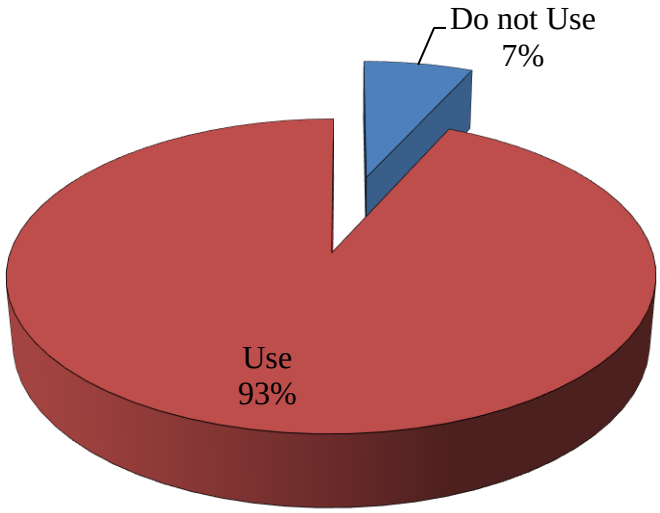
Globally, at least 2 billion people use a drinking water source contaminated with faeces. Contaminated water can also transmit diseases such diarrhoea, cholera, dysentery, typhoid, and polio. Contaminated drinking water is estimated to cause 502000 diarrhoeal deaths each year (WHO, 2017).Among the total population of 60, 6 people which makes up 10% of the total population, are depended on the River for the drinking water. 31.6% of families use Wells as source of their drinking water. A major population, i.e. 33 members, which is 55.0%, are depended on the surface water or rainwater collected for their drinking purpose. A percentage of 1.7 use bore-wells and the rest 1.7% are depended on other sources.

4.5. The Uses of River Water

For the people living in a close proximity of a river, their various activities will be depended on the river. Though there are only small population that depends on the River for drinking purpose, there are numerous other reasons why the community members use the River for.

Graph No: 4.3

People Using River Water



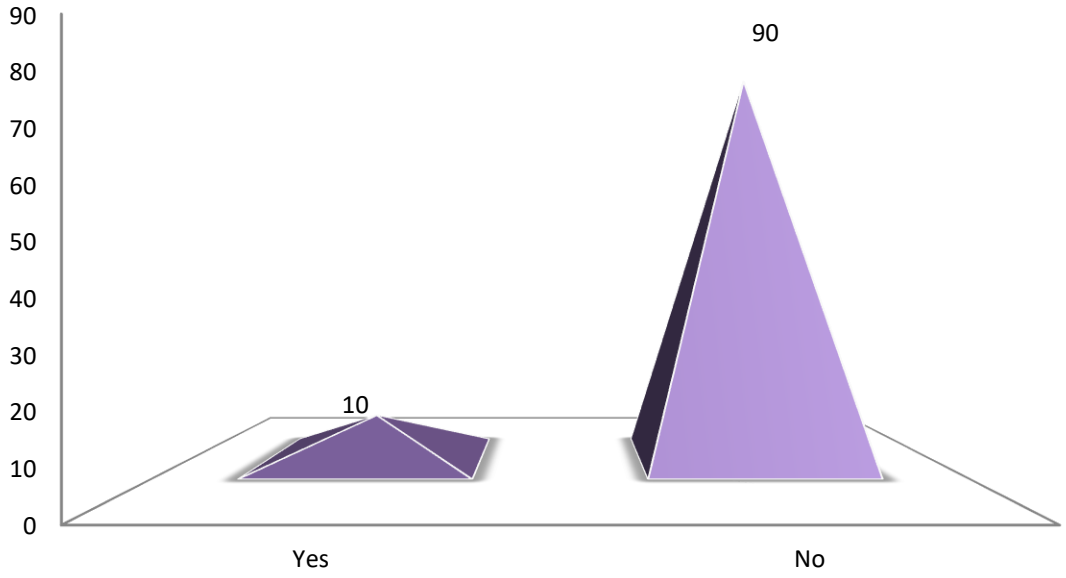
Graph 4.6 shows the percentage of people who use the Pamba River water. 93% of the total population are depended on the River water for various purposes. Whereas a percentage of 7 say they do not use the River water for any purposes

4.6. River as a Source of Drinking Water

River water can be used for various purposes. One of the major uses of the River is using it as a source of drinking water. The quality of the drinking water can affect the health problems of those using it. When affected with pollution, a major aftermath will be suffered by those people who consider River water as their source of drinking water.

Graph No: 4.4

River as a Source of Drinking Water



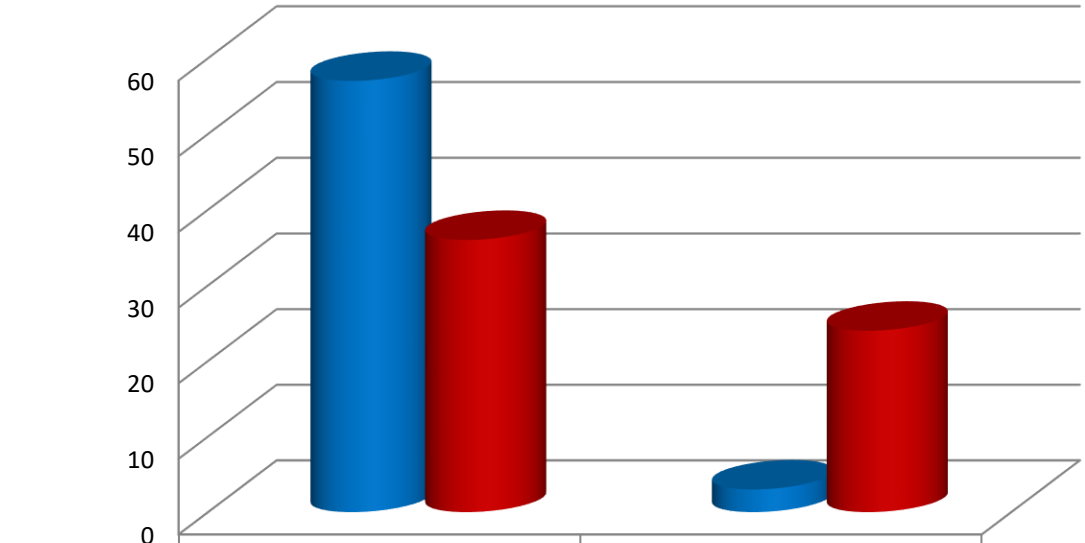
The above graph shows the percentage of residents that are depended on the River as their drinking source. When percentage of 10 depends on the River as their source of drinking water, 90% are depended on other sources of drinking water.

4.7. Washing and Recreational Usages of the River

Two major purpose of the River will be its usage for washing and for recreational purposes. Being a village area, a major use of the River by the community members will be usage of its water for washing the clothes and other domestic utensils. The nature always calms minds and provides energy. The river banks are excellent recreational places that are being used by human beings for pulling themselves up together. The serenity of the riverbanks provides peace and happiness to minds. People often use river banks for recreational activities such as taking walks, playing, community gatherings, etc.

Graph No: 4.5

Washing and Recreational Usages of the River



	Yes	No
Washing	57	3
Recreational	36	24

Table 4.5 shows the number of people who depend on the River for washing purposes and recreational purposes. Among the total population of 60, 57 of the respondents which make 95 % use the river for washing either their clothes or other domestic utensils. A percentage of only 5, i.e. 3 out of 60 members do not use the River water for washing. Whereas, a number of 36, i.e. 60% of the people use River for recreational activities whereas the rest 40%, i.e. 24 members do not engage in recreational activities.

4.8. Number of Visits to the River

The number of visits made by the respondents to the River shows how integral the role of the river is in their lives. Also how badly they could be affected due the pollution of the Pamba River. The number of visits made by the members per day is analysed here.

Table No: 4.6

No: of Visits to the River

No: of Visits	Frequency	Percent
1	20	33.3
2	29	48.3
3	9	15.0
More than 3	1	1.7
No visits	1	1.7
Total	**60**	**100.0**

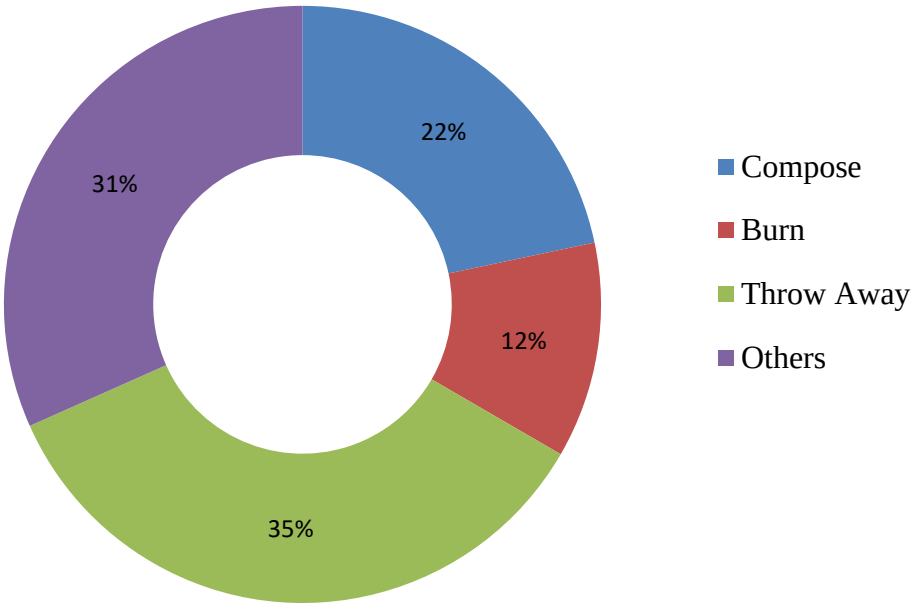
According to Table 4.6, those who visit the River for 1 time is 20 which makes 33.3% of the total population. The significant difference between those visiting the River for 2 times per day and 3 times per day is 33.3%, i.e. 20 out of total population of 60. Those who make visits more than 3 times per day are 1.7% , which is same as those who make no visit at all to the River per day.

4.9. Waste Disposal Methods

The cause and effects of water pollution by waste settlement seems to be one of the major sources and causes water pollution that provides the most obvious impact. Wastes that end up in water bodies negatively change the chemical composition of the water. Technically, this is called water pollution. This will affect all ecosystems existing in the water. It can also cause harm to animals that drink from such polluted water.

Graph No: 4.6

Waste Disposal Method Followed



As per the Graph 4.6, 22% of the total population compose the domestic waste generated. The significant difference between those who throw away the waste and employ other methods of waste methods such as dumping in a pit is 4%. The percentage of population who burn their waste is 12%.

Residential waste (household) is one of the causes of water pollution due by human activity itself. Residential Waste contains domestic waste in the form of organic waste and inorganic waste and detergents. Organic waste is waste that can be described or decomposed by bacteria, such as the remaining vegetables, fruits, and leaves. While inorganic waste include paper, plastic, glass or glass, fabrics, woods, metals, rubber, and leather. Inorganic waste cannot be broken down by bacteria (non-biodegrable). In addition to organic and inorganic waste, residential waste detergent is the most potentially polluting the water. And that's why the disposal of waste and its analysis is important. The unscientific and careless disposal of the waste materials from the house hold can also be a reason that leads to the Pamba River Pollution. The best way of disposal is by composing the waste, due to which the water can be safeguarded from pollution and organic manure can be obtained.

4.10. Domestic Sewages and Agricultural Runoffs Opening into the River

The sewages opening up into the River from houses carry the domestic effluents into the River directly adding to the pollution. Agricultural runoffs include both organic and inorganic fertilizers that are being used for the farming purposes mixed in it. Untreated sewage can include waste water from kitchen and bathroom. While the organic ones causes less damages, the contributions of the chemical fertilizers and pesticides can increase the pollution of the River. When the untreated sewage is released into the water carelessly it can lead to considerable consequences.

Table No: 4.7

Domestic and Agricultural Sewages Opening into the River

Sewages	Response		Total
	Yes	No	
Domestic Sewages	5 (8.3%)	55 (91.7%)	60 (100%)
Agricultural Sewages	8 (13.3%)	52 (86.7%)	60 (100%)

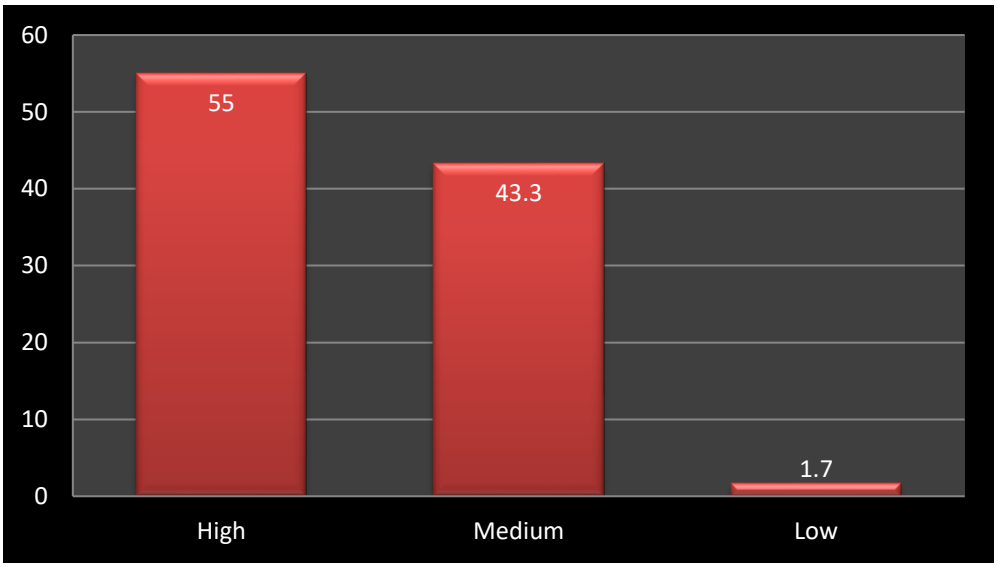
From the above table 4.7, it is clear that only 8.3% of the total population has sewages directly opening into the River. A population of 91%, i.e. 55 of the total respondents do not have sewages directly opening into the River. Also, the frequency of agricultural runoffs opening into the River is 8 which make up 13.3% of the total population. While a percentage of 86.7, i.e. 52 members have no agricultural runoff opening into the River.

4.11. Perception on Pollution Level

The Community members have clear idea of the rate of water pollution in Kerala as well as that of the Pamba River. The Pollution Level of the Pamba River is being chosen by the members on the basis of the real life experiences they face daily. The first and second graphs provided below shows their perception of the water pollution level of Kerala and that of the Pamba River respectively.

Graph No: 4.7

Kerala Water Pollution Level



Graph 4.7 shows the perception of the respondents on Kerala Water Pollution level. 55% of the response pointed out that the water pollution in Kerala is high. When a percentage of 43.3 respondents thought the water pollution in Kerala is medium, only 1.7% of them thought it was low.

4.12. The Level of Pollution in Pamba River

The Pamba River with a length of 176 km rises in the Western Ghats mountains, flows through the Kerala State and discharges into the Vembanad lake which, in turn, provides the connection to the Arabian Sea. An average of 400 people lives within one square kilometre of land in the river catchment.

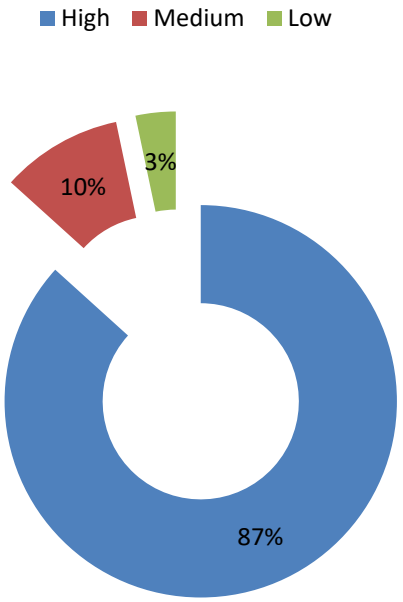
During the study conducted by the ZMT (Leibniz Centre for Tropical Marine Ecology), scientists tested different sections of the river characterized by specific land uses like tea and rubber plantations, settlements with horticulture, rice crops and the pilgrimage site of the Sabarimala Temple. More than 50 million Hindus from all over the world flock to the sanctuary each year. Every day countless pilgrims take a bath in the Pamba to wash away their sins.

The scientists, near the Sabarimala Temple, found large quantities of ammonium nitrogen as a result of human waste. They measured 3.1 kg per hectare and year. Close

to the pilgrimage site the phosphorus load from detergents was also high. With 5.6 kg per hectare and year the concentration of nitrate nitrogen resulting from fertilisers used in plantations and gardens was also considerable in the corresponding sections of the rivers (Eickhoff D. S., 2015).

Graph No: 4.8

Pollution Level in Pamba River



Graph 4.8 shows the view of the community members, adhering to the River for various purposes, on its pollution. 87% of the total population agree to the fact that the Pamba is highly polluted. When 10% believes that Pamba is only medially polluted, 3% still think Pamba is polluted in low degree.

4.13. The Reasons of Pollution in Pamba River

When there are numerous reasons that contribute to the Pamba River pollution, a major five among them were chosen. From the five the respondents were asked to choose the most relevant and the most apt cause for the pollution.

Reasons	Frequency	Percent
The religious ritual practiced	8	13.3
Personal chores done by the pilgrims due to absence of proper facilities	39	65.0
Automobile cleanings	1	1.7
Bathing	0	0
Domestic chores	0	0
All the above	12	20.0
Total	**60**	**100.0**

Table No: 4.8

The Reasons of Pollution in Pamba River

In the given choices, a percentage of 13.3, i.e. a frequency of 8 members thought the reason behind the pollution is the religious practices that are being followed by the pilgrims during the Sabarimala seasons. 65% of the respondents believed that the pollution was the aftermath of the personal chores done by the pilgrims due to absence of proper facilities for them at the Sabarimala pilgrim centre. 1.7% of the respondents chose it was due the automobile washings and cleanings that takes place in the River. When none chose it bathing and domestic chores of the community members as the soul reasons of the pollution, all five of them, i.e. the religious practices, absence of proper facilities, automobile cleanings, bathing and domestic chores of community members, were considered as the reason pollution by 20% of the respondents.

4.14. The Responders' Perception on each cause of Pollution

Each of the five reasons was specifically asked to know the magnitude of pollution caused by each.

4.14.1. Activities of the Community Members

The community members depended on the river for various activities. They used the River Water for domestic chores as well as for other purposes. Each of these was stated and the perceptions of the members on its magnitude as a cause for pollution were enquired.

Table No: 4.9

Activities of Community Members

Activities	Rate of Pollution			Total
	High	Medium	Low	
Bathing	14 (23.3%)	17 (28.3%)	29 (48.3%)	**60 (100%)**
Domestic Chores	15 (25%)	9 (15%)	36 (60%)	**60 (100%)**
Automobile Cleanings	25 (41.7%)	32 (53.3%)	3 (5.0%)	**60 (100%)**

Table 4.9 shows the perception of the respondents on the rate of pollution caused due to various community activities that depend on the River. 23.3% which is a frequency of 14 members said it lead to high pollution. When 17 members think it will only lead to medium level pollution, 48.3% believed it will only lead to low level pollution. The community members often depended on the River for various domestic chores such as washing clothes and other domestic utensils. When 15 members thought that this activity leads to high pollution in Pamba River, 9 members assumed that it will only cause medium level pollution. Also, 60% of the total population assumed that domestic chores of the community members only caused low level pollution in the River.

Another major reason that was pointed out as a reason of the pollution was the automobile cleanings that were carried out in the River. Automobile cleanings often led to oil spills and heavy washing. A percentage of 41.7 presumed it as a major cause of pollution and regarded that it led to high pollution of the River. 32 members alleged that it only led to medium level pollution of the River. A percentage of 5, but, thought automobile cleanings will only lead to low level pollution of the waterbody.

4.14.2. Pilgrim Activities

Apart from the community activities, that is not a major cause behind the pollution of River Pamba, the pilgrim activities also contribute in large scale pollution.

Table No: 4.10

Pilgrim Activities

Activities	Rate of Pollution			Total
	High	Medium	Low	
Religious Practices	49 (81.7%)	9 (15.0%)	2 (3.3%)	**60 (100%)**
Due to Absence of Facilities	57 (95%)	3 (5%)	0 (0%)	**60 (100%)**

T s followed by the pilg proper facilities. These often lead to pollution in a colossal level.

Table 4.10 shows that 81.7% of the respondents supposed that it led to high level pollution of Pamba River. The significant difference between those who perceived the cause to be medium and low is 11.7%. A notable percentage of 95 believed that this led to high pollution of the Pamba River and is a major cause behind its pollution. The rest 5% assumed that it caused only medium level pollution of the River. There were no members who perceived that the careless activities of the pilgrims caused only low level pollution of the River.

4.15. The Impacts of Pamba Pollution on Health

One major after effect of the Pamba pollution is the health issues and diseases that are being faced by the community members. Polluted and contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid, and polio. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks. This is particularly the case in health care facilities where both patients and staff are placed at additional risk of infection and disease when water, sanitation, and hygiene services are lacking.

Inadequate management of urban, industrial, and agricultural wastewater means the drinking-water of hundreds of millions of people is dangerously contaminated or chemically polluted. Some 842000 people are estimated to die each year from diarrhoea as a result of unsafe drinking-water, sanitation, and hand hygiene. Yet diarrhoea is largely preventable, and the deaths of 361 000 children aged under 5 years could be avoided each year if these risk factors were addressed (WHO, World health organization, 2017). And thus analysing the health impact of Pamba pollution becomes vital.

Table No: 4.11

The Rate of Health Problems Caused due to Pamba Pollution

Rate of Health Problems	Frequency	Percent
High	35	58.3
Medium	21	35.0
Low	4	6.7
Total	**60**	**100.0**

Table 4.11 shows rate of health problems that are being caused due the Pamba Pollution. 58.3% of the respondents said as a result of the pollution, high health troubles are faced by the society. Whereas 21 respondents, which makes up 35% of the

population, said the rate of health problems is medium. Only 4 members concluded that the rate of detriments caused as an upshot of Pamba Pollution is low.

Table No: 4.12

The Frequency of Allergies and Diarrhoea

Diseases	Frequency of Occurrence			Total
	Always	Sometimes	Never	
Allergies	16 (26.7%)	40 (66.7%)	4 (6.7%)	**60 (100%)**
Diarrhoea	18 (30%)	27 (45%)	15 (25%)	**60 (100%)**

A major outcome of River pollution is the health detriments faced by the people living by its close vicinity. Among the health implications a foremost ones are different allergies and diarrhoea that the people are left to suffer with. Allergies such as skin diseases, continuous cold, etc. are being caused. Table 4.12 shows the frequency of allergies and diarrhoea occurring in the community. When 26.7 % said the pollution always leads to allergies, 66.7% alleged the pollution sometimes led to allergies. Also, 4 members believed that pollution never caused allergies of any kind. The table also pictures the frequency of occurrence of the diarrhoea among community members. 30% of the members believe that the diarrhoea always occurs when the River is contaminated. When those who assume sometimes are in 27 in number, the respondents who suppose it never occurs are in 15 in number.

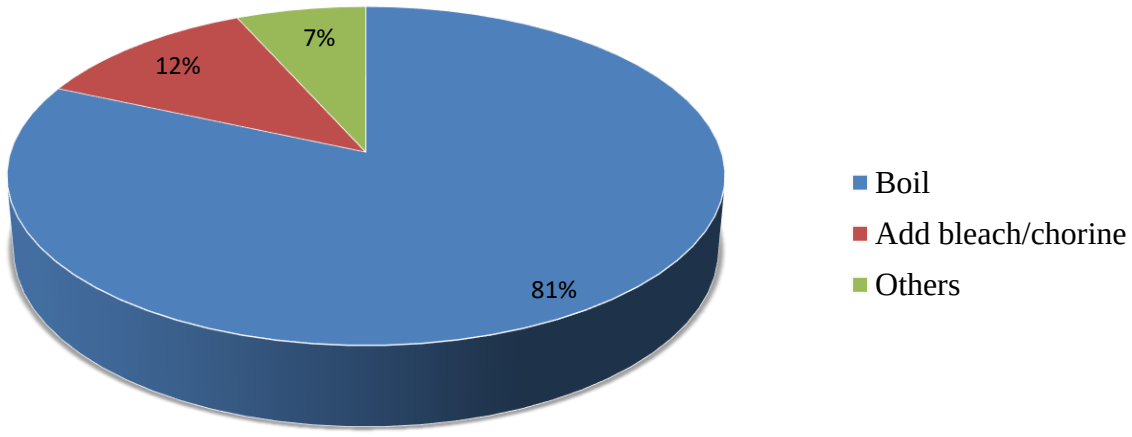
As per the WHO report the number of people who die due to diarrhoeal infections per each year due to contaminated water is estimated to be 8,42,000 (WHO, 2017). Diarrhoea is a serious repercussion of water pollution that can lead to massive deaths in very short period of time. Various allergies including serious skin diseases are also caused due to this pollution. This is the reason why analysing the frequency of diarrhoeal infection becomes vital in this study regarding water pollution.

4.16. Water Purification Methods

As stated by the report published by the Water Aid (2017 , 7% of the total 67% of India's rural population are living without access to clean water, India's rural poor are highly vulnerable to the effects of extreme weather events and climate change. Also, India has the highest number of people in the world without access to safe water, the report released said. The country has 75.8 million people, at least 5% of its 1.25 billion populations, without access to clean water, the report by Water Aid (Agarwal, 2016). In a situation like this adopting proper method to make the water suitable plays a vital role. Different methods from boiling, add bleach or chlorine, using purifiers, etc. are some methods adopted so as to make the water safe for drinking.

Graph No: 4.9

Water Purification Ways Adopted by the Respondents



Graph 4.9 shows the methods adopted by the community members to make their water suitable for drinking. A majority of 81% boils the water to make it safe for drinking. Boiling is one of the surest way to kill any pathogens included in the water. This method mainly aids and makes the water safe of those depending on the River Water as their drinking source. A percentage of 12 respondents add bleach to safeguard

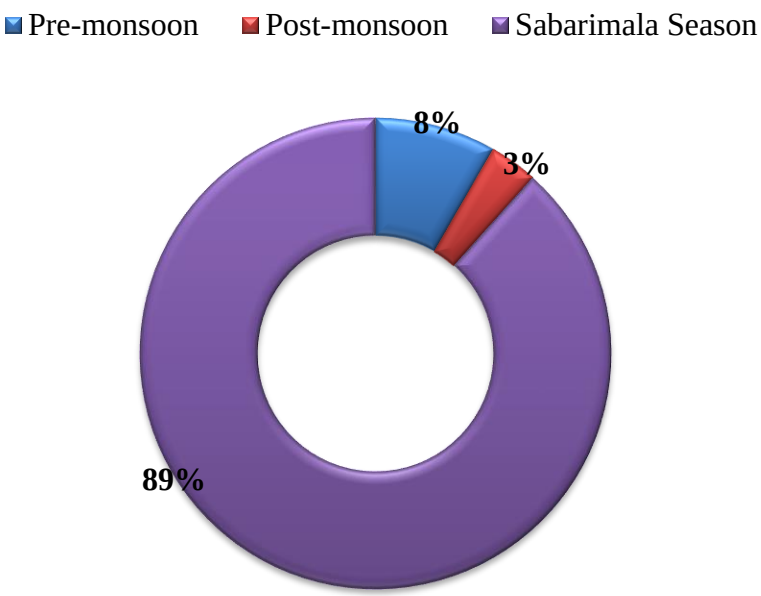
their water and 7% adopt other methods such as using purifiers to ensure the water is safe for drinking.

4.17. Most Polluted Period of Pamba

Inorder to analyse the pollution level of Pamba, a major question to answer is during which period Pamba will be most polluted. The magnitude of the impacts of pollution might be larger during this period of time when compared to other times.

Graph No: 4.10

Most Polluted Period of Pamba



Graph 4.10 shows the response of the community members to the question of which season is Pamba most polluted. A major proportion of the respondents chose Sabarimala season. It was during the Sabarimala pilgrimage season that the Pamba was most polluted. When 8% of the answers were pre-monsoon time, only 3% choose post –monsoon season as the most polluted time.

4.18. Interventions by Stakeholders

The magnitude of the problem is so high that it requires sudden and effective interventions from the part of the government as well as that from the part of the community members. Any method that is adopted to reduce the degree of the River

pollution and its aftermath can be considered as an intervention. The initiation can arise from anywhere.

Table No: 4.13

Presence of Government Interventions

Response	Frequency	Percent
Yes	29	48.3
No	13	21.7
Don't know	18	30.0
Total	**60**	**100.0**

Table 4.13 depicts the presence of government intervention in the region so as to reduce the effect of pollution and to overcome it. When 48.3% pointed out that there were government interventions and initiations that happen to reduce the pollution effect, a number of 13 members said that there were no initiations from the government side to tackle the problem. Also, there were 30% of respondents who said that they didn’t know if there are or there aren’t any interventions from the government side.

Table No: 4.14

Community Interventions

Response	Frequency	Percent
Yes	6	10.0
No	34	56.7
Don’t know	20	33.3
Total	**60**	**100.0**

Community Interventions also play a chief role in minimizing the upshots of pollution and leading to a cleaner and safer waterbody. As per Table 4.14, only 10% of respondents are aware about any kind of interventions from the part of the community

members. A Percentage of 56.7, i.e. 34 members says that there are no initiation from the part of the community so as to deal with the issue. Among the population, 33.3% do not know if there have been community interventions or no

4.19. The Responders' Perception on Action of Stakeholders

When it comes to a social problem like Water pollution, there are a number of stakeholders associated with it who will be responsible to tackle the problem. Stakeholder participation is viewed as critical in the current water sector reforms taking place. When it comes to a major River such as Pamba, which has religious significance, the number of stakeholders and their duties increase. The stakeholders associated with the issue include the Kerala State Government, the Kerala Pollution Control Board (KPCB), the Devaswom Board, the Panchayat, NGOs, Community, etc. The performance of each stake holder is analysed here based on the response of the community members about their actions.

Table No: 4.15

Perception on Action of Stakeholders

Stakeholders	Perception of Actions					
	Doing Everything	**Doing Enough**	**No Opinion**	**Not Doing Enough**	**Not Doing Anything**	**Total**
Kerala Government	0 (0%)	3 (5%)	3 (5%)	35 (58.3%)	19 (31.7%)	**60 (100%)**
Perunadu Panchayat	0 (0%)	10 (16.7%)	7 (11.7%)	28 (46.75)	15 (25%)	**60 (100%)**
Devaswom Board	0 (0%)	2 (3.3%)	8 (13.3%)	18 (30%)	32 (53.3%)	**60 (100%)**
KSPCB	0 (0%)	2 (3.3%)	8 (13.3%)	21 (35%)	29 (48.3%)	**60 (100%)**
Community	0 (0%)	3 (5%)	27 (45%)	19 (31.7%)	11 (18.3%)	**60 (100%)**
Others	0 (0%)	17 (28.3%)	25 (41.7%)	10 (16.7%)	8 (13.3%)	**60 (100%)**

An important role is played by the Government of Kerala as the issue is of great importance. A government is responsible to take necessary steps when it comes to a River that has a national level religious significance and is a major water resource of the State. When no respondents believed that the Government of Kerala is doing everything to protect the River, only 5% thinks that the Government is doing enough to protect the River. When 3 of the respondents have no opinion about the Government actions, 35 thinks that the Government is not doing enough to tackle the issue of pollution. It is observed that a percentage of 31.7 believe that the Government is not doing anything at all to save the River from pollution.

It also depicts the perception of the respondents towards the actions and interventions of the Perunadu Grampanchayat. It can be observed that none of the respondents thought that the Panchayat is doing everything to save the River. When 10 members assumed that the Panchayat is doing enough, 7 respondents have no opinion about the actions of the Panchayat. The significant difference between those who think that the Panchayat is not doing anything with that of those who think Panchayat is not doing anything is 21.7%.

Devaswom Board is the socio-religious trusts in Kerala that comprise members nominated by both government and community. Their main aim is to manage Hindu temple, their assets and surroundings and to ensure their smooth operation in accordance with traditional rituals and customs. They too are largely responsible in protecting the River with religious significance from Pollution and to reduce its aftermath. The table shows the respondents perception on the action of Devaswom board in solving the problem of pollution. When not any of the respondents think that the Board is doing everything to tackle the issue, 2 of them thinks the Board is doing enough to protect the River. 13.3% of the respondents have specific opinion regarding the action of the Board. 18 members pointed out that the Board is not doing enough. A significant number of 32 members say that Devaswom Board is not doing anything to save the River from Pollution.

The role of Kerala State Pollution Control Board (KSPCB) cannot be avoided in an issue like this. KSPCB is one among the major stakeholders which is responsible to deal with the challenge and find apt solutions for it. Null percentage of the respondents thinks that the KSPCB is doing everything to protect the River and to reduce the after effect of the pollution. 3.3 % of the population believes that the Board is doing enough to safeguard the holy River. When a percentage of 13.3 have no opinion regarding their actions and interventions, 35% thinks the Board is not doing enough. A significant percentage, i.e. 48.3% of the population believes that KSPCB is not doing anything to resolve the problem of pollution.

The interventions of community members also play a vital role in protecting and limiting the aftershocks of the pollution of the River. When none of the respondents were aware of the fact that the community is not doing everything they could to protect the river, a 5% of them believed that community is doing enough to deal with the issue. The table reveals that a noteworthy percentage. i.e. 45% of the total population had no

opinion about the community interventions. When 11 members suggested that the community is not doing anything, 19 members advocated that the community is not doing enough to safeguard the River from pollution.

In addition to the government support and self-initiations from the part of community members, there are other stakeholders like NGOs, private enterprises, etc. are also included in the mission to save the natural resource from pollution and degradation. The respondents were familiar with some such private firms due to which 28% of them suggested that ‘others’ are doing enough to protect the River. When none of the population went for doing everything, majority percentage (41.7%) that comprises 25 members said they had no opinion regarding the actions. When 10 members opted for not doing enough, 8 members believed that ‘others’ are not doing anything to minimize the effect of the pollution in the River.

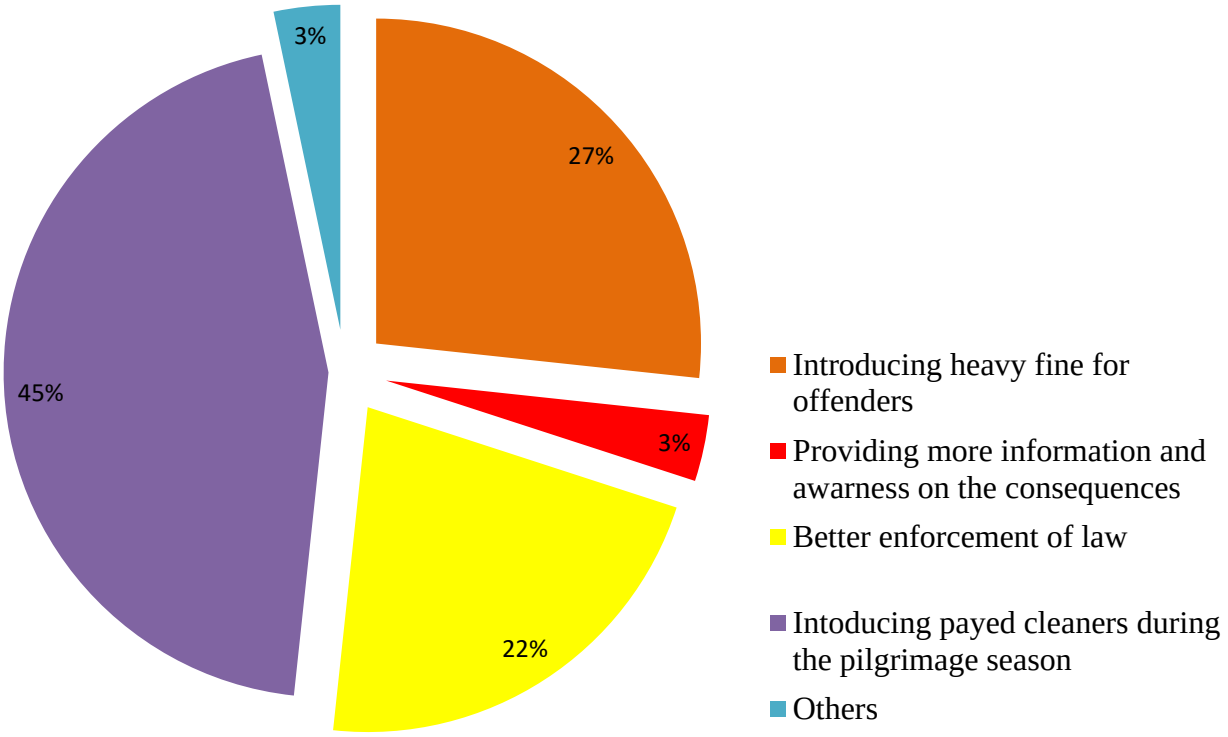
Thus the intervention strategies of various stakeholders are analysed. Though there are efforts that are forth, an effective system to tackle the problem is missing as year after year the problem pollution is increasing rather than decreasing.

4.20. The Suggested Solutions

In case of pollution as well as to mitigate its consequences, there are several methods that could be adopted. Beginning from responsible use of fertilizers and pesticides in farms, it includes treating the sewage before releasing into the river, banning throwing waste into the water bodies, etc. that are in individual level, it can lead to policy level interventions that are being initiated in the government level. Given options of five, the respondents chose the best one they think could solve the problem of the pollution.

Graph No: 4.11

Solutions Chosen by the Responders



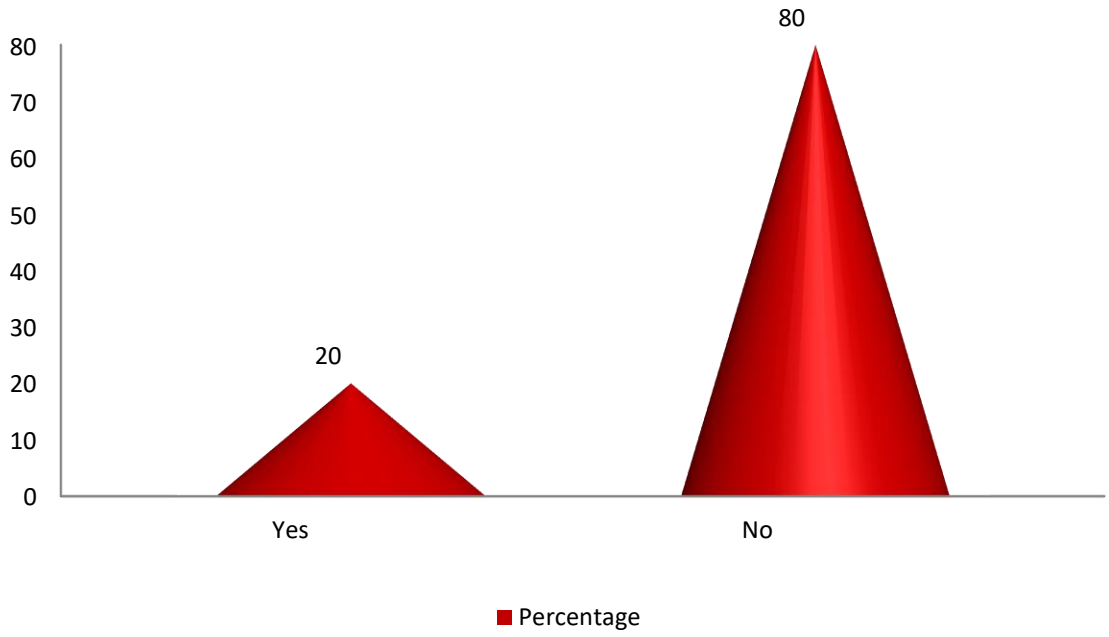
Graph No 4.11 shows the respondent's choice of the best solution to solve the problem of pollution. A 45% percentage of the population think Introducing payed cleaners during the pilgrimage season is the best way to solve the challenge of pollution in River Pamba. The significant difference between those who chose Introducing heavy fine for offenders and those who suggested better enforcement of law is 5%. When a percentage of 3 chose providing more information and awareness on the consequences of the problem can somehow reduce the after effect, 3% chose the option of 'others'.

4.21. Personal Initiatives

The final enquiry was based on whether they have carried out any individual initiatives to tackle the problem as he or she is one among the community member who is directly affected by the pollution of the River.

Graph No: 4.12

Personal Initiatives of the Respondents



Graph 4.12 shows the percentage of individual initiatives by the community members. When only 20% carried out some activity to deal with the problem, 80% were not able to do anything to reduce the effect of the problem of the River pollution.

4.22. Variation between Age Group and Individual Interventions

There are 20% of individual interventions. The analysis is carried out so as to check if there is any association between the age of the respondent with that of his or her individual initiations to solve the problem of pollution. As per the review, there was no marked difference in attitudes towards the environment between different sex, age, and social groups (Eccelston, 2007). People beyond retirement age and mostly above 45 are tended to express more concerned attitudes than younger people.

Table 4.17 shows the ANOVA that was carried out to know if there are any variations between the individual interventions with that of the age of the respondents.

Table No: 4.16

Age Group and Individual Interventions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.836	6	0.473	**3.704**	**0.004**
Within Groups	6.764	53	0.128		
Total	**9.600**	**59**			

H_0 = There is no significant variation in individual interventions with regard to age group of the respondents

H_1 = There is a significant variation in individual interventions with regard to age group of the respondents.

The P valve is less than 0.010 (0.004) and so the null hypothesis is rejected at 1% level of significance, i.e. there is a significant variation between the individual intervention and the age group of the respondents. As the age increases, there is an increased participation from the side of the respondents to carry out activities to overcome the issue of pollution.

4.23. Association between Most Polluted Time and Most Health Detriments Faced Time

The major after effect of Water pollution is the health detriments that it can lead to. The source of the drinking water and its quality can often determine the health of a community. When the water is contaminated diseases like diarrhoea, allergies, malaria, etc. will be some of the consequences to be faced by those using it. Here, an analysis of if there is association between the pollution of the River and the health detriments faced

by the community is checked. A Chi-Square test was carried out so as to infer the association between the two times as specified.

Table No: 4.17

Most Polluted Time and Time of High Health Detriments

Time of High Health Detriments	Most Polluted Time				Total
	Pre-monsoon	**Monsoon**	**Post-monsoon**	**Sabarimala season**	
Pre-monsoon	4 (6.7%)	0 (0%)	0 (0%)	0 (0%)	**4 (6.7%)**
Monsoon	0 (0%)	0 (0%)	0 (0%)	1 (1.7%)	**1 (1.7%)**
Post-Monsoon	1 (1.7%)	0 (0%)	2 (3.3%)	1 (1.7%)	**4 (6.7%)**
Sabarimala Season	0 (0%)	0 (0%)	0 (0%)	51 (85%)	**51 (85%)**
Total	**5 (8.3%)**	**0 (0%)**	**2 (3.3%)**	**53 (88.3%)**	**60 (100%)**

χ^2 =

80.151 df = 6 P Value= 0 .001

H_0 = There is no significant association between most polluted time and most health detriments faced time

H_1 = There is significant association between most polluted time and most health detriments faced time.

A chi-square test was carried out to test the association between the time of most pollution and time of high health detriments. The chi-square value is 80.151 in 6 degree of freedom. The P value is 0.001, which means $P < 0.010$. Since the P value is less than 0.010, we reject the null hypothesis at 1% level of significance. Hence it can be concluded that there is association between the time of high health detriments and the most polluted time of the river. The people face more health issues when there is more pollution in the river.

With the rise of pollution, the members face more health issues. When only 7 respondents believed that it was during other seasons that they faced high health issues, a vast majority of 53 pointed out that it was during the Sabarimala season, in which the River was most polluted, they faced utmost health detriments.

4.24. Variation between Occupation and Individual Interventions

Many a times, the occupation of a person can often affect it views and actions. Those working in the informal sectors will be more affected due to pollution when compared with those who have a secured job within the boundaries of four walls. In that case, these people who work in the informal sector such as agriculture will have a tendency to protect the environment more. Water pollution, though affects the entire community, the individual initiations are not taken up by all. ANOVA is done so as to understand the variation between Occupation and Individual Initiation.

Table No: 4.18

Occupation and Individual Interventions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.707	4	0.427	**2.973**	**0.027**
Within Groups	7.893	55	0.144		
Total	**9.600**	**59**			

H_0 = There is no significant variation in individual interventions with regard to occupation of the respondents

H_1 = There is significant variation in individual interventions with regard to occupation of the respondents.

The P value is 0.027, which is less than 0.050. And so the null hypothesis is rejected at 5% level of significance, i.e. there is a significant variation between the individual intervention and the occupation done by the respondents. When people involved in certain jobs, mainly in the informal sector, carry out activities to protect the River, others do not take part or initiate any activities to protect the River.

4.25. Association between Rate of Pollution and Health Detriments

Pollution of water happens on many levels and affects human health in many ways. Ingestion of poorly treated water can cause diarrhoea, cholera, stomach infections and typhoid. Dirty or polluted water is the preferred breeding ground for mosquitoes and other pests. Mosquito bites adversely affect human health and can cause diseases such as Malaria, Dengue and Chikungunya. Thus pollution can lead to various health detriments. A Chi-square test is carried out so as to know the association between rate of health detriments and pollution.

Table 4.19

Rate of Pollution and Health Detriments

Pamba Water Pollution Level	Rate of Health Problems		Total
	High	**Medium**	
High	35 (58.3%)	19 (31.7%)	**54 (90%)**
Medium	0 (0%)	6 (10%)	**6 (10%)**
Low	0 (0%)	0 (0%)	**0 (0%)**
Total	**35 (58.3%)**	**25 (41.7%)**	**60 (100%)**

χ^2 = **9.3**

df = 1 **P Value= 0 .004**

H_0 = There is no significant association between rate of health detriments and rate of Pamba Water Pollution level.

H_1 = There is significant association between rate of health detriments and rate of Pamba Water Pollution level.

The Chi-square test carried out to test the association between the rate of Pamba Pollution with the rate of the health detriments faced by the community members. The chi-square value is 9.3 with 1 degree of freedom. The P value is 0.004, indicating it is less than 0.010. Since the P value is less than 0.010, we reject the null hypothesis at 1% level of significance. This shows that the chosen two variables, rate of pollution and health detriments are associated with high level of significance. With more pollution the community members are left to suffer with more health issue

CHAPTER V

FINDINGS, SUGGESTIONS AND CONCLUSION

CHAPTER V

FINDINGS, SUGGESTIONS AND CONCLUSION

This Chapter deals with the major findings, suggestions and the conclusion that are being formed as a result of the study and are based on the objectives of the research. The researcher came to the findings and suggestions on the basis of the analysis and interpretation carried out in the former chapter.

The study, titled ‘Socio-Health Detriments of the Community Members due to Water Pollution in Pamba River: A study with Reference to Perunadu Grampanchayat’, mainly focus on identifying the major reasons for pollution, its social and health implication on the community members, to identify the existing intervention strategies and to learn about its effect on minimizing the pollution.

Urbanization, agricultural and pilgrimage activities cause an increase of nutrient content in the water; resulting in increased productivity and increased concentration of dissolved substances to such an extent that the water becomes polluted. There is a closer link between pollution and health damages. Five million people die each year because of polluted drinking water, poor sanitation and domestic un-hygienity around the world. In India alone, nearly 1 million people die annually because of waterborne diseases. Dirty water and poor sanitation cause more than 500,000 infant deaths a year in the Asia pacific region (WHO, 2017).

Pamba, the 3rd largest river in Kerala (176 km), is one of the major Rivers of the State with a high religious significance. But despite its prominence in social, economic, religious and environmental realms, the River is currently under very dangerous threat of pollution. As per the research conducted by Centre for Earth Science Studies, Pamba has "reached horrifying levels of pollution and degradation". In addition to the colossal environmental degradation it causes, the communities associated directly with the River also faces various social and economical aftermaths. The tons of plastic materials and other garbage that are dumped into the river often make it a stagnant pool of waste. Apart from this, the River is further contaminated by the dumping of waste material and sewage from towns, markets, hospitals, rubber factories, and slaughter houses (Iype, Rediff, 2002).

5.1. Findings

5.1.1. The Social Profile of the Respondents

Among the respondents, 56.7% were females and the rest 43.3% were males. Also those belonging to the age below 40 include 31 members and those above 40 include 29. Among the 31 members, 10 were below the age of 20 and in those 29 members, 3 were above 60 and 1 was above 70. Of the total population, only 4, i.e.6.7% has an educational qualification of degree or above. Those with Higher Secondary qualification are of 25 in number and are 41.7%. Respondents with SSLC are 13 and make up 21.7% of the total population. People from Lower primary background are 12 and are 20% of the population. The illiterate are of 6 in number and make up 10% of the total respondents.

Only 3.30% of the total population depend on farming and related activities. The rest are involved in other occupations such as shop keeping, auto drivers, and other activities such as business. Also a percentage of 17.50 are house makers. The economic stability of the members can be evaluated by analysing their monthly income. When only 19 families have income more than Rupees 1000, the rest 41 families have the monthly income equal to or less than Rupees 10000.

5.1.2. The Agriculture Field and Pollution

A deep impact of pollution can be observed in the agricultural sector. A percentage of 3.33 depend on farming. And among these 3.33%, 25% depend on the River water for agriculture purposes. So due to pollution these people will be affected more than those depending on other sources of water.

The use of chemical fertilizers by farmers who in this context live in the very close proximity of the River can adversely affect the water body and will be a cause of pollution. Through analysing the chemical usage by farmers, it was found out that none of the farmers are always depended on chemical fertilizers. Whereas, 16.7% of the farmers use chemical fertilizers ‘sometimes’ in the farms. A vast majority of the population, 83.3%, but do not use chemical fertilizers, thus reducing the impact of pollution.

5.1.3. The Uses of River

Beginning from playing a vital role in hydrologic cycle, the uses of River and River water extends to being the source of drinking water, for transportation, for

generating power and for leisure purposes. In case of a community that lives in a close proximity of the River, there will be various uses of the River water. The consumptions can range from using it as a drinking source to merely visiting the River banks for recreational time. A massive majority of the population, i.e. 93%, uses the River water for various purposes.

In the total population only 10% depend on the River as a drinking source. Thus it could be inferred that these 10 will be most affected due the pollution. 31.6% of families use Wells as source of their drinking water. A major population, i.e. 33 members, which is 55.0%, are depended on the surface water or rainwater collected for their drinking purpose. A percentage of 1.7 use bore-wells and the rest 1.7% are depended on other sources. From the analysis it could be found that large number of families are depended on rainwater or the surface water that are collected as their drinking source. Living near the forest, the members were able to find out many natural springs that flowed throughout the year and carried fresh water. Unless those living far down and closer to the river, most community members were dependent on this natural drinking source.

Among the total population of 60, 57 of the respondents which make 95 % were found using the river for washing either their clothes or other domestic utensils. A percentage of only 5, i.e. 3 out of 60 members do not use the River water for washing. Also 60% of the population were found using the River for various recreational purposes. The number of visits made to the River per day signifies it importance and role in the lives of the community members. When only 1.7% pays no visits to the River per day, the rest 99.3% visit the River at least once in each day.

5.1.4. Waste Disposal and Pollution

Despite environmental regulations that protect the quality of streams, lakes, and wetlands, solid waste in the form of trash, litter, and garbage often ends up in these surface waters. Because surface waters collect in low-lying areas, anything that is dropped or blown into a watershed can eventually reach a drainage-way. In urban areas, trash and litter (general terms for dry solid waste) often are transported by stormwater runoff. In both urban and rural areas, these items sometimes are illegally dumped directly into a waterbody or wetland, or deposited along riverbanks or lakeshores. Trash also comes from people who fish or participate in other forms of water-related

recreation. Regardless of source or type, trash is a form of water pollution (Richmond, 2016).

The disposal of waste has to do much with pollution. Untreated sewages disposed into the waterbodies are one among the major cause of pollution in the world. In the case of Pamba River, there are urban, industrial and household discharges that happen. In the chosen community, since it is rural and has no industrial belt, only the household and agricultural sewages are disposed in the river. Through the analysis, it was found that the majority of the members (35%) merely throw the waste away careless, which may or may not affect the River directly. The best way of waste disposal, i.e. composing it, is being followed by 22%.

Also, it was observed that only 8.3% of the total population has sewages directly opening into the River. A population of 91%, i.e. 55 of the total respondents do not have sewages directly opening into the River.

5.1.5. Perception on Pollution

On the basis of the real life experiences and observations the community members assessed the rate of water pollution in Kerala and that of in Pamba. It was found that 55% of the response pointed out that the water pollution in Kerala is high. When a percentage of 43.3 respondents thought the water pollution in Kerala is medium, only 1.7% of them thought it was low. When it comes to Pamba Pollution, a vast majority of 87% said that the pollution level is high now.

5.1.6. The Reasons of Pollution

The water of the River, Pamba is influenced by the waste water from the pilgrim centre Sabarimala in the upper reaches of the river including the place, Pamba, where the pilgrims arrive. The discharge of waste water from Municipalities in the middle and lower reaches of the Pamba also leads to the pollution. Forestry and farming especially, the application of fertilizers and pesticides used in plantations and other sources like rubber factories and further industrial and commercial activities also contributes a batter part in the pollution (CESS, 2004).

A prime reason of the study was to figure out the reason for the Pamba pollution. Given the choices between the activities of the community members that included bathing, washing and automobile cleanings and that of the activities of the pilgrims during the Sabarimala season, a notable number (78.3%) chose the latter one as

the primary reason. Also each of the activity was analysed and it was found that 23% thought that bathing in River led to high pollution. It was found that 25% assumed domestic chores depending on the River led to high rate of pollution. 41.7% of the total population thought that automobile cleanings created a huge pollution.

Pilgrim activities such as the religious practices were also considered as a major reason of pollution by 81.7%. A major finding of the research is that it was analysed that a majority of the respondents (95%) pointed out that the rate of pollution caused due to absence of proper facilities in for the pilgrims is high and is identified as major source of the pollution.

5.1.7. The Social Detriments

A chief objective of this study was to find out various social problems faced that are encountered by the community members due to the pollution of Pamba River. Any problem or issue that influences a considerable number of individuals within a society can be considered as social problems. Thus, environmental pollution itself becomes a social problem. Many after effects of pollution, such as environmental degradation, decreased quality and quantity of resources, accumulation of waste, etc. also becomes social problems as they affect not just one individual but masses.

In the case of Pamba pollution there are many social detriments that the members face. A foremost one among that is that the water becomes unfit for usages. The people depend on the River for various purposes as mentioned earlier. When this water becomes unfit to be employed for any purposes, these depended people had to choose another way to satisfy their needs. This will have a wide impact on those who depend on the water as a drinking source. Also, it affects their usage of water for various domestic chores such as cooking and cleaning. According to Arpita De, water pollution in general also leads to unsanitary and unhygienic conditions. Use of polluted water for cleaning purposes does not yield any benefit. The water is unable to remove the accumulated germs and it in turn affects human health and thereby causing diseases (Arpita, 2017).

Next major issue will be the accumulations of waste in the River and nearby surroundings. Due to pollution an entire area becomes contaminated and filled with waste. A major impact of this can be the health troubles that are resulting due to this waste accumulation. In addition to getting accumulated, the waste also emits odours that

will be spread in the area. This creates difficulty for the people, especially those living near in the close proximity of the River.

The usual flow of the River will also be disturbed due to this accumulated waste, leading to stagnant water that will serve as breeding grounds for pathogens. Among the accumulated waste, the plastic waste comprises a large amount and disposing this properly even after collecting them from the River turns out to be another imperative detriment faced due to pollution.

5.1.7. The Health Detriments

To observe if there is any health detriments faced by the community and identify some are another objective of this study on Pollution of Pamba River. As per the analysed data it was found that, 58.3% of the respondents pointed out that as a result of the pollution, high health troubles are faced by the society. Whereas 21 respondents, which makes up 35% of the population, said the rate of health problems is medium. Only 4 members concluded that the rate of detriments caused as an upshot of Pamba Pollution is low. Thus to infer, health issues are caused due to the pollution. Some of health issues faced by the members, as analysed by the collected data include, diarrhoea, allergies and skin diseases and sometimes even malaria and jaundice.

5.1.8. Most Polluted Time and Time of High Health Detriments: An Association

A major finding of the study is that it is when the Pamba River is most polluted the community members face most health detriments. Based on the chi-square test carried out that resulted in a P value less than 0.010, the association between the time when most health detriments are faced with the most polluted time of the River is highly significant. This implies that, the higher the pollution rate, the higher is the health issues faced by a community. To the question ‘When is health detriments most observed?’ 51 members pointed out that it was during the Sabarimala season. Also to the question ‘During which time do you think the water is more polluted?’ more than 50 answered it was during the Sabarimala pilgrim season. So basically the pollution that is resulted from the absence of proper facilities for the pilgrims, leads to the pollution which then leads to the health detriments of the community.

As per the news published by Hindu the high level of pollution in the Pampa during the annual Mandalam-Makaravilaku pilgrim season at Sabarimala is posing a serious health hazard to lakhs of people living in the downstream reaches of Attathode,

Vadasserikkara, Ranni, Kozhencherry, Aranmula, Chengannur, etc. Periodic flushing of the squalid waters from the Pampa bathing ghats in the foothills of Sabarimala has increased pollution in the downstream reaches. The average coliform count at the Pampa-Triveni was 60,000 to 70,000 per 100 ml, mainly due to the heavy inflow of filth from the Sannidhanam through the Njunangar stream and Kakkathode. The maximum permissible limit of coliform count is 500 per 100 ml of water (Kuttoor, The Hindu, 2004).

5.1.9. Perception of the Responders on Existing Intervention Stratergies.

It's not that there are no interventions carried out to deal with the pollution, its just that they are not working as efficient as it should be. Different of initiatives are carried out to tackle the issue of pollution from various levels. Enquiries of interventions done by State Government, Perunadu panchayat, Kerala State Pollution Control Board, others including NGOs and private sectors and finally the community were conducted and analysed. As per the analysis it was found that, 48% of the people said that there were some activities done by government to mitigate the effect and the rest said there weren't or they were not aware of it. When asked to rate the activities done by each stakeholder, all pointed out that none of the stakeholders are doing everything to solve the issue. It was found that, in the case of Kerala Government only 5% thinks that the Government is doing enough to protect the River. When 3 of the respondents have no opinion about the Government actions, 35 thinks that the Government is not doing enough to tackle the issue of pollution. It is observed that a percentage of 31.7 believe that the Government is not doing anything at all to save the River from pollution.

By analysing the response to the actions of the Perunadu Grampanchayat, it was found that 10 members assumed that the Panchayat is doing enough, 7 respondents have no opinion about the actions of the Panchayat. The significant difference between those who think that the Panchayat is not doing anything with that of those who think Panchayat is not doing anything is 21.7%. In the case of Kerala State Pollution Control Board (KSPCB) 3.3 % of the population believes that the Board is doing enough to safeguard the holy River. When a percentage of 13.3 have no opinion regarding their actions and interventions, 35% thinks the Board is not doing enough. A significant percentage, i.e. 48.3% of the population believes that KSPCB is not doing anything to resolve the problem of pollution. The analysis of Devaswom board actions shows that 2

of the respondents think the Board is doing enough to protect the River. 13.3% of the respondents have specific opinion regarding the action of the Board. 18 members pointed out that the Board is not doing enough. A significant number of 32 members say that Devaswom Board is not doing anything to save the River from Pollution.

Apart from the government support, there are NGOs and other private enterprises that offer their support to help the community solve the problem. The respondents mentioned about the Amritapuri project that took place there. It was under Amala Bharat (cleaning project of Amritapuri Ashram) thousands of volunteers of the Ashram joined together to clean and save Pamba River (Amala Bharat, 2012).

The community members are the ones most affected by the problem. So activities and practices followed by them also can influence the pollution in positive or negative manner. Also, these people know what exactly the problem is and what to do precisely to deal with it. Often times, interventions put forth by community members can bring about better and efficient results than other methods. And this is the reason why the intervention initiated by community members was also analysed. It was found out that the respondents were aware of the fact that the community is not doing everything they could to protect the river, a 5% of them believed that community is doing enough to deal with the issue. Also, a noteworthy percentage, i.e. 45% of the total population had no opinion about the community interventions. When 11 members suggested that the community is not doing anything, 19 members advocated the choice that the community is not doing enough to safeguard the River from pollution.

5.1.10. Solutions Suggested by the Responders

Water is one of our basic needs for our survival and hence it must be one of the best interests of human beings to keep the resource protected. Water pollution can be reduced from personal level to international level. The crucial solutions to this problem ultimately come down to personal responsibility because every one of us is to be blamed for the pollution of water. Measures of prevention and control are essential in improving the quality of water and reducing the costly treatment measures that are taken to treat water (Bajracharya, 2013). Pamba Pollution also has various solutions that could be applied so as to solve and mitigate its effects. There are several methods that could be adopted for the same.

Among the 5 responses, the respondents' choices were analysed and it was found that a 45% percentage of the population think Introducing payed cleaners during

the pilgrimage season is the best way to solve the challenge of pollution in River Pamba. Those who went for 'Introducing fine for offenders' were 27% and the ones chose better enforcement of law are 22%. When a percentage of 3 chose providing more information and awareness on the consequences of the problem can somehow reduce the after effect, 3% chose the option of 'others'.

A majority of the population also talked about corruption in the administrative level, if solved or atleast minimized, can also lead to better protection and conservation of the River and its surroundings. Implementing more water treatment plants were also suggested by the members, who also mentioned that the problem can only be solved if those plants worked properly and efficiently.

5.1.11. Individual Initiations to check Pollution of the River

Solutions and tackling methods can always come from the ones most affected people. So individual initiation from the part of the community can never be excluded in this study. It was found that only 20% of the population initiated some means to protect the River. Also, as per the tests carried out Individual initiation is closely related with the age and occupation of the member.

5.2. Suggestions

This section includes suggestions that are put forth based on the findings.

5.2.1. Individual Level Interventions

As they are already aware about the problems they are facing, various interventions to cease water pollution from their part must be undertaken. The domestic waste must be properly disposed. As there are farming practiced in the area, organic waste can be composed. The inorganic waste must be collected from each house hold and disposed in a bin that should be provided and also collected regularly by the Panchayat. Agricultural runoffs and domestic sewages should not be directly opened into the River.

By collaborating with the Health department, each member should take special health care during the pilgrimage season such as taking up preventive medicines and only using boiled water for drinking purposes.

5.2.2. Integrated Sustainable Waste Management (ISWM)

Application of Integrated Sustainable Waste Management to tackle the problem of mass discharge of waste during the Sabarimala pilgrimage season can produce better and efficient results.

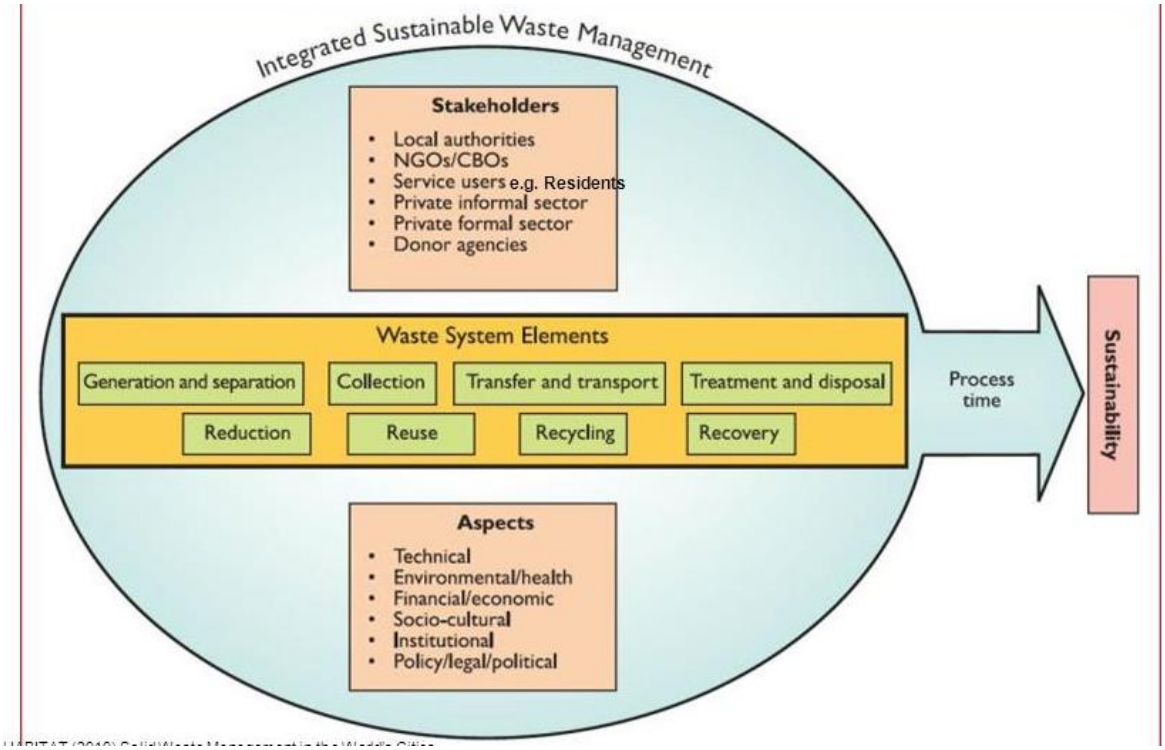
The core concept of Integrated Sustainable Waste Management (ISWM) has been developed out of experience, to address certain common problems with municipal waste management in low-and middle-income countries, and also in countries in transition. ISWM recognises three important dimensions in waste management: (1) stakeholders, (2) waste system elements and (3) sustainability aspects. The waste management hierarchy – a policy guideline that is part of many national environmental laws and policies – is also a cornerstone of the ISWM approach (ISWM, nd).

While applying this in the current context, each of the dimensions can be explained as followed. The stakeholders, as discussed earlier, includes the State Government, the Perunadu Grampanchayat, Pollution Control Board, Devaswom Board, NGOs, private enterprises, the pilgrims and finally each of the community members who depend on the River for different purposes.

ISWM recognises the high-profile elements ‘collection’, ‘transfer’ and ‘disposal’ or ‘treatment’. It gives equal weight to the less well understood elements of ‘waste minimisation’, ‘reuse’ and ‘recycling and composting’. The elements here include cloths, plastic and other materials collected during the season. It also includes those thrown into the River by the community. A full ISWM process seeks to supplement the existing system so that all elements are represented. Usually this means adding waste prevention or minimisation, reuse and recycling to the existing mix.

Figure No: 5.1

ISWM Flowchart



(http://slideplayer.com/slide/6289028/21/images/7/Integrated+sustainable+solid+waste+management.jpg)

ISWM has 5 aspects distinguished through which the system can be expanded. It includes financial, environmental, political/legal, institutional and socio-cultural. In the current context, major focus must be provided to two aspects. First is the environment that focus on the effects of waste management on land, water and air; on the need for conservation of non-renewable resources; pollution control and public health concerns. The next one is the Institutional aspect that is related to the political and social structures which control and implement waste management: the distribution of functions and responsibilities; the organisational structures, procedures and methods implicated; the available institutional capacities; and the actors such as the private sector who could become involved. Planning is often considered the principal activity

in relation with institutional and organisational aspects.

5.2.3. Administrative Level Interventions

An initial step that must be taken by the governing body is to ensure providing the adequate facilities to the pilgrims and thereby reducing their dependency on the Pamba River. The government must continue the steps to make Sabarimala a national pilgrim centre which will ensure more support from central level.

Waste management must be taken up based on the ISWM system either completely by the government or by public-private partnership. Inviting and collaborating with NGOs will also lead to efficient working of the system, especially during the Sabarimala pilgrimage season as the numbers of devotees coming are more than lakhs. Rather than waiting for volunteers to take up the colossal tasks of cleaning up the River and collecting the waste, the stakeholders must introduce payed cleaners which will be more effective. There must be separate waste bins for plastic, bottles and organic items, the collection of which must be ensured by the Devaswom Board members.

Setting up water treatment plants in Sabarimala can reduce the pollution in drastic level. The Water Authority of the State must take initiative for this and also the functioning must be strictly monitored unless which the implementation will not provide the expected outcome.

5.2.4. Policy Level Interventions

Throwing waste into the river and other surroundings must be prohibited by law and must turn into a punishable offence. This must be monitored by the Police Department and a minimum fine of Rupees 5000 must be charged on the offenders. Mere awareness have ceased to work and this points out for a strict rule, the violation of which will be punishable by law.

5.2.5. Social Work Intervention

Social Work, apart from helping the individuals and community to help themselves, also strives for building a sustainable environment where in which human beings stop butchering the nature for resources and fill the earth with garbage. To protect the River and reduce the health and social detriments faced by the community

due to pollution, interventions as given below the Figure 5.2 can be followed. ISWM or Integrated Sustainable Management of Waste, facilitating social actions, conducting researches, monitoring the efficient functions of the implemented system, linking works, policy level interventions, bringing forth start-ups for waste management, etc. are some means to intervene as a Social Worker.

Figure 5.2

Social Work Intervention

5.3. Conclusion

The study is concerned with the Socio health Detriments of the community members due to water pollution in Pamba River. It is guided by the following objectives (1) To understand the social profile of the community members (2) To study the perspective of community members on the water pollution (3) To study the social problems faced by the community members due to water pollution in Pamba river (4) To study the health problems faced by the community members due to water pollution (5) To asses various interventions for protecting the river from water pollution (6) To study the involvement of the community members in protecting the river from pollution (7) To identify various methods that could be adopted so as to reduce the water pollution in Pamba River.

Air and water are two most essential ingredients necessary for the existence of life. Air is unlimited, but there is limitation of fresh water, required for the human beings consumption. Our indispensable water resources have proven themselves to be greatly resilient, but they are increasingly vulnerable and threatened. A major threat faced by water resources around is the water pollution (WHO, World health organization, 2017). This pictures the need to conserve water and bring about solutions for pollutions.

A major River of Kerala, the 3rd largest one, the Pamba River is under threat due to pollution. This study tries to find out the reasons for pollution and its effect on the community members who depend on the River for various purposes. Various reasons like discharge of untreated sewage, use of chemical fertilizers and pesticides, open defecation, waste disposals etc are identified as main reasons of pollution. It has been reported that open defection, discharge of raw sewage, domestic waste, commercial waste etc, during the sabarimala pilgrim season spread over 65 days turn the Pamba river highly polluted and the count of coliform bacteria was found to reach a level of three lakhs per 100ml (Shajudeen, 2014).

It was found through the study that there are different health detriments such as diarrhoea and allergies that are resulted due pollution in the community members. They also face social detriments which often lead to economic troubles among the members. There are intervention strategies that are put forth by government, others and also even by community members, which was also identified through the study.

The present study also opened up a scope for future researches. Now with the fact that community members are being forced to suffer due to pollution, which is not majorly a result of their action alone, the next step should be identifying and implanting the perfect sustainable intervention. Through this method, the members should be made free of their detriments and the Pamba River must be able to breath in novel air through which she will sustain for ever. By ‘being a part of solution, and not of pollution’ the River which is a life line vein on this Earth could be saved.

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APPENDIX

Socio-Health Detriments of the Community Members due to Water Pollution in Pamba River

1. Age:
2. Gender a. Male ☐ b. Female ☐
3. Education
   a. Illiterate ☐ c. SSLC ☐ e. Degree and Above ☐
   b. Lower Primary ☐ d. Higher Secondary
4. Occupation
   a. Farming ☐ c. Business ☐ e. Others __
   b. Government Job ☐ d. Shop Keeper ☐
5. Marital Status
   a. Single ☐ c. Divorced ☐
   b. Married ☐ d. Widowed ☐

a. No: of family members
   a. 2 ☐ c. 4 ☐ e. more than 5 ☐

b. No: of earning members of the family: _____

c. Monthly Income of the Family (approx.): _____

9. Are you engaged in any kind of farming?
   a. Yes ☐ b. No ☐
10. If yes, what kind of farming?

    _____

11. Do you use chemical fertilizers in your farm?
    a. Always ☐ b. Sometimes ☐ c. Never ☐

12. Distance to the River

a. >50m ☐ b. >150 m ☐ c. <150m ☐

13. What is the source of your drinking water?

a. River ☐ d. Bore well ☐

b. Well ☐ e. Public Standpipe ☐

c. Surface water/Rain water ☐ d. Other(specify)_____

14. For what purposes do you use River water?

a. Drinking ☐ c. Bathing ☐ e. All the above ☐

b. Washing ☐ d. Recreational ☐ f. Do not use ☐

15. No: of visit to the River per day (approx.)

a. 1 ☐ c.3 ☐ e. No visits ☐

b. 2 ☐ d. More than 3 ☐

16. Amount of waste generated in your house/shop (approx.)

a. <1 kg ☐ c. 5-10 kg ☐ e. Don't Know ☐

b. >1kg ☐ d. <10 kg ☐

17. What do you do with the waste?

a. Compose ☐ c. Throw away ☐

b. Burn ☐ d. Others _____

18. Are there sewages from your house/shop opening into the Pamba River?

a. Yes ☐ b. No ☐

19. Are there agricultural runoffs flowing to the River?

a. Yes ☐ b. No ☐ c. Don't know ☐

19. How bad do you think water pollution in Kerala is?

a. High ☐ b. Medium ☐ c. Low ☐

20. How much do you think is the Pamba River polluted?

a. High ☐ b. Medium ☐ c. Low ☐

21. What do you think is the major cause of Pamba Pollution?

a. The religious ritual ☐

b. Personal chores by the pilgrims due to absence of proper facilities ☐

c. Automobile cleanings ☐

d. Domestic chores ☐

e. Bathing ☐

f. All the above ☐

23	**Cause of pollution**	**High**	**Medium**	**Low**
23.1	Activities of community members			
23.2	Bathing in the River			
23.3	Domestic chores depending on the River			
23.4	Religious rituals practices during Sabarimala season			
23.5	Absence of proper facilities for the pilgrims			
23.6	Automobile cleanings			

24. How are the community members affected by the pollution in your opinion?

25. What is the rate of health problems caused due to pollution?

a. High ☐ b. Medium ☐ c. Low ☐

26. What are some health problems caused due to the pollution of Pamba river?

27. Are allergies caused because of the pollution?

a. Always ☐ b. Sometimes ☐ c. Never ☐

28. Is diarrhoea caused due to the pollution?

a. Always ☐ b. Sometimes ☐ c. Never ☐

29. Health problems are observed most in

a. Pre-monsoon ☐
b. Monsoon ☐
c. Post-monsoon ☐
d. Sabarimala Season ☐
e. All the seasons ☐

30. What ways do you adopt so as to make the water safe for usage?

a. Boil ☐
b. Add bleach/chlorine ☐
c. Use water filter ☐
d. Other_____

31. During which time do you think is the water more polluted?

a. Pre-monsoon ☐
b. e. All the seasons ☐
c. Monsoon ☐
d. Post-monsoon ☐
e. Sabarimala Season ☐

32. Are there any interventions from the side of the government to tackle the problem of water pollution?

a. Yes ☐ b. No ☐ c. Don't know ☐

If yes, specify _____

33. Are there any interventions from the side of the government to tackle the problem of water pollution?

a. Yes ☐ b. No ☐ c. Don't know ☐

If yes, specify _____

34. Are there any interventions from the side of the community to tackle the problem of water pollution?

a. Yes ☐ b. No ☐ c. Don't know ☐

If yes, specify _____

35. Do you think each of the following is currently doing enough to protect the Pamba from pollution?

Sl No:		1.Doing Everything	2. Doing Enough	0. No opinion	3. Not doing enough	4.Not doing anything
1	State Government					
2	Perunadu Panchayat					
3	Devosom Board					
4	Kerala Pollution Control Board					
5	Community					
6	Others					

36. In your opinion, which of the following is would be the most effective means to tackle the river pollution?
    a. Introducing heavy fine for the offenders ☐
    b. Providing more information on the environmental consequences and water pollution. ☐
    c. Better enforcement of law ☐
    d. Introducing payed cleaners and volunteers during the Sabarimala pilgrimage season ☐
    e. Others (specify) _____

37. As an individual, have you taken any initiative against the water pollution?
    a. Yes ☐ b. No ☐

38. If yes, what is it?

39. According to your opinion, what methods could be adopted to save Pamba from Pollution?

THANK YOU.