

**VALUATION OF ECOSYSTEM SERVICES OF
SELECTED MANGROVE WETLANDS OF
KOZHIKODE DISTRICT, KERALA**

by

SUPRIYA, BABURAJ.M

(2014 - 20 - 108)

THESIS

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KERALA, INDIA

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DECLARATION

I, Supriya, Baburaj.M (2014–20–108) hereby declare that this thesis entitled **“Valuation of ecosystem services of selected mangrove wetlands of Kozhikode district, Kerala”** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Place: Vellanikkara

Date: 19-06-2020

Supriya, Baburaj.M

(2014 – 20 – 108)

CERTIFICATE

Certified that this thesis entitled “**Valuation of ecosystem services of selected mangrove wetlands of Kozhikode district, Kerala**” is a record of research work done independently by Miss. Supriya, Baburaj.M. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Place: Calicut

Date :

Biodiversity Division,

Centre,

673005

Dr. Vinod. K
Principal Scientist,
Marine

ICAR-CMFRI,
Calicut Research

West Hill (P.O.),
Calicut, Kerala -

CERTIFICATE

We, the undersigned members of the advisory committee of Miss. Supriya, Baburaj, M. a candidate for the degree of **B.Sc.–M.Sc. (Integrated) Climate Change Adaptation** agree that the thesis entitled “**Valuation of ecosystem services of selected mangrove wetlands of Kozhikode district, Kerala**” may be submitted by Miss. Supriya Baburaj, M. in partial fulfilment of the requirement for the degree.

Dr. Vinod K

(Major Advisor, Advisory Committee)
Principal Scientist
Marine Biodiversity Division
ICAR-Central Marine Fisheries Research Institute,
Calicut Research Centre,
West Hill (P.O.), Calicut, Kerala - 673005

Dr. Nameer P. O

(Member, Advisory Committee)
Special Officer
ACCER, KAU
Vellanikkara, Thrissur

Dr. P.K. Asokan

Kumar,

(Member, Advisory Committee)
Committee)
Principal Scientist & Scientist-in-charge,
Head,
ICAR-Central Marine Fisheries Research Institute,
Calicut Research Centre,
Centre
West Hill (P.O.),
Calicut, Kerala - 673 005,

Dr. R. Narayana

(Member, Advisory
Committee)
Principal Scientist &
SEETT Division,
Madras Research
of ICAR-CMFRI,
Santhome High Road,
Raja Annamalipuram,
Chennai – 600 028

EXTERNAL EXAMINER

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SYMBOLS AND ABBREVIATIONS

Abbreviation	Expansion
MoEF&CC	Ministry of Environment, Forests and Climate Change
CICES	Common International Classification of Ecosystem Services
UNEP	United Nations Environment Programme
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
A&N	Andaman and Nicobar Islands
INR	Indian Rupee
GSDP	Green Skill Development Programme
WTP	Willingness to Pay
CVM	Contingent Valuation Method
ZSI	Zoological Survey of India
ICAR	Indian Council of Agricultural Research
CMFRI	Central Marine Fisheries Research Institute
VT	Value Transfer
KG	Kinder Garten
LP	Lower Primary
UP	Upper Primary
HS	High School
SSLC	Secondary School Leaving Certificate
HS	Higher Secondary
UG	Under Graduation
PG	Post-Graduation
BPL	Below Poverty Line
APL	Above Poverty Line
SHG	Self Help Group
LPG	Liquefied Petroleum Gas

RCC	Reinforced Cement Concrete
IUCN	International Union for Conservation of Nature
FRAD	Fisheries Resources Assessment Division
NGT	National Green Tribunal
BOD	Biological Oxygen Demand
HP	Horse Power

INTRODUCTION

CHAPTER 1

INTRODUCTION

Wetlands are major elements in an ecosystem and deliver various benefits for the society. Wetlands are of great ecological and economic importance. They are essential for human development and social well-being, especially in a country like India, where a huge population closely depend on them for their basic needs such as food, drinking water and livelihoods. They are productive ecosystems that provide a wide range of goods that support provisioning, supporting, regulating and cultural services. There are many definitions used to define wetlands. In the Ramsar Convention(Article 1.1), wetlands are defined as “areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 m”. Article 2.1 of the Convention states that “wetlands may incorporate riparian and coastal zones adjacent to wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands”.

Wetlands provide many valuable services at the population, ecosystem and global level which signify the importance and need for their conservation. The wetland ecosystem in terms of economic value perceived by human beings and the need to consider the value of a wetland as a part of an integrated landscape differ from each other and most of the time in conflict. It is needless to mention that wetlands are highly productive ecosystems and are essential for preserving biodiversity and ecological security. Major functions of wetland ecosystem are climate change mitigation, stabilization of local climate, water storage, water purification, groundwater recharging and discharging, storm protection and flood mitigation(controlling the rate of runoff), shoreline stabilization(buffer shorelines against erosion and pollutants), and retention of sediments, nutrients and pollutants. Wetlands are habitat to aquatic flora and fauna including numerous species of native and migratory birds. Wetlands are an important resource for

sustainable tourism. They act as a genetic reservoir for various species of plants, especially rice.

Wetlands have been facing environmental degradation due to both natural and anthropogenic causes. Major threats faced by the wetland ecosystems include pollution (excessive pollutants are dumped into wetlands beyond the recycling capacity), siltation, encroachment, development of aquaculture farms and overfishing, weed infestation, changes in the hydrological cycle and sea level, overgrazing in marshy soils, habitat destruction and deforestation create ecological imbalance by altering the population of wetland species, and removal of sand from beds near seas make the wetland vulnerable to wave action and tidal bore. The various threats to wetland may result in a decline in biodiversity, deterioration of water quality, a decline in fish production, falls in migratory bird populations, sedimentation and shrinkage in areas under wetlands, flood, etc.

Wetlands are indispensable for the countless benefits or “ecosystem services” that they provide humanity, ranging from freshwater supply, food and building materials, biodiversity, to flood control, groundwater recharge, and climate change mitigation. It is therefore inevitable and vital responsibility of every citizen to protect wetlands. Measures like demarcation of wetlands using the latest technologies, proper enforcement of laws and stringent punishment for violation, preventing unsustainable aquaculture practices, scientifically treating industrial effluents and wastewater from farmlands before discharging into wetlands, artificial regeneration for a quick recovery, utilizing wetlands on a sustainable basis by giving enough time for natural regeneration, preventive measures to stop the introduction of exotic invasive species like water hyacinth, adoption of soil conservation measures, preventing grazing in the periphery of wetlands, eutrophication abatement by processing nutrient-rich discharge into the water body, wildlife conservation, sustainable eco-tourism, afforestation programmes, weed control, preventing entry of invasive species and sensitizing the local populace would be the keys for wetland conservation. The local communities need to be empowered and involved at every stage in the conservation process.

During the past few decades, globally several attempts have been made to prevent over-exploitation of wetlands. The Ramsar Convention and the Convention on Biological Diversity (CBD) are the two major focused initiatives towards the conservation of wetlands. India became a signatory to the Ramsar Convention in 1981, under which 27 wetlands from India have been included in the list of wetlands of international importance. Wetland conservation has been accorded a supreme priority in India. The Government of India has promulgated various Acts and legal provisions for the protection of the environment and conservation of natural resources. Some of these acts which give relevance for wetland conservation include the Forest Act (1972); the Forest (Conservation) Act, 1980; the Indian Wildlife (Protection) Act, 1972; the Water (Prevention and Control of Pollution) Cess Act, 1977 and the umbrella provisions of the Environmental (Protection) Act, 1986. Since 1987, under the National Wetlands Conservation Programme in India, the conservation activities for about 115 wetlands are being supported. The National Environment Policy, 2006, stressed the importance of wetlands as groundwater resources that need legally enforceable regulations. In addition to that, the Ministry of Environment, Forests and Climate Change (MoEF&CC) notified the Wetlands (Conservation and Management) Rules, 2010. These rules were framed to ensure better conservation and management of the existing wetlands in India. In September 2017, India adopted the Wetlands (Conservation and Management) Rules, 2017, the rule notified by the Environment Ministry, decentralize wetlands management by giving states powers to not only identify and notify wetlands within their jurisdictions but also keep a watch on prohibited activities.

The main objectives of the present study include documentation of biodiversity, identification of various ecosystem goods and services provided by the mangrove wetlands of Kallai and Kolavipalam, Kozhikode district, socio-economic survey to assess the living standard of stakeholders, Willingness To Pay survey to analyze how much amount they are willing to pay for the conservation, and ranking of their knowledge about various goods and services provided by the mangrove wetlands. The results of the study would be useful for

the policymakers or planners and environmental managers to take appropriate measures for the protection and restoration of the mangrove ecosystem.

Lack of scientific knowledge and information is often an impediment to arriving at the economic value of an ecosystem. In economic valuation, the main challenges are usability and acceptance, methodology and valuation techniques, awareness and knowledge. Some assumptions that need to be made before the outlined problem is explored further. These assumptions are purely based on the interviews held with the local stakeholders of the study area and secondary information that were gathered.

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

Mangrove wetlands in the entire world have been broadly explored by several researchers. In this chapter, an attempt was made to review the research works conducted in the context of the economic valuation of estuarine/mangrove wetlands. Both national and international studies have been reviewed to bring in more insights to the subject of study. Mangroves have evoked interest and curiosity to man for ages as they are known to provide numerous ecosystem services like provisional, cultural, supporting and regulating services. A perusal of literature on the natural and man-made effects on mangrove ecosystems have also been made in this chapter.

2.1 MANGROVES

The mangrove forest is an evergreen ecosystem found mainly in the tropics on the fringes of naturally protected shorelines such as deltas and estuaries. The paucity of species occurring in mangrove forests is due to the particular conditions of their existence; few plants being able to flourish and tolerate in saline mud and with frequent inundation by seawater. The mangrove habitat is a dynamic land–water interface zone that can change through rapidly varying depths of inundation in both space and time. Accordingly, mangroves provide a linkage between the land and sea. Plants, animals, plant nutrients and non-living material are transferred landwards or seawards through mangroves. It is axiomatic that the management of mangroves is always to be a part of the management of the surrounding habitats and ecosystems into which they integrate (Sukardjo, 2012).

2.2 ECOSYSTEM SERVICES

The first formal definition of ecosystem services was given by Daily (1997): “Ecosystem services are the conditions and processes through which

natural ecosystems and the species that make them up, sustain and fulfill human life. The most ubiquitous definition for the ecosystem services which are used as generalized one “Ecosystem services which are the benefits people obtain from the ecosystem (MEA, 2005).

The Common International Classification of Ecosystem Services (CICES) classification system groups ecosystem services into three categories: provisional, regulation and maintenance, cultural, described as such:

Provisional services – Defined as all energetic, material and nutritional outputs from the living systems. They are tangible things that can be traded or exchanged, as well as used or consumed directly by people in manufacturing. Medicines and foods are some of the major ubiquitous.

Regulating and maintenance services – Includes all the ways in which the living beings can mediate or moderate the ambient environment that affects human performance. It includes such services as the breakdown of wastes and toxic substances, , carbon sequestration purification of wastewater, flood controland, maintenance of biodiversity.

Cultural services – Includes all the non-material, and normally non-consumptive, outputs of ecosystems that affect the physical and mental states of the people. They include scenic, spiritual and recreational uses of the land and waters as well as the bequest and existence values people assign to places and species even from afar.

The Millennium Ecosystem Assessment’s (MA) definition of ecosystems as dynamic complexes of plant, animal, and microorganism communities and the non-living environment, interacting as functional units. It is important to note that this includes managed ecosystems such as agricultural landscapes and even urban areas. The MA classifies the services that ecosystems can provide into four broad categories: provisioning services, regulating services, cultural services, and supporting services (MEA,2003). Provisional services are the products people obtain from the ecosystem such as food, fuel, fiber, freshwater and genetic resources. Regulating services are the benefits people obtain from the regulation of ecosystem process, including air quality maintenance, climate regulation,

erosion control, regulation of human diseases, and water purification. Cultural services are the non-material benefits obtained from ecosystems through spiritual enrichment, cognitive development, reflection, aesthetic experience and recreation. Supporting services are those which are essential for the production of all other ecosystem services, such as primary production, oxygen production and soil formation.

2.3 ECOSYSTEM SERVICES OF MANGROVES

Mangroves deliver a wide range of environmental, social, economic benefits for living organisms collectively referred to as their ecosystem goods and services. Here the ecosystem services of mangroves are classified into three broad categories. These are provisional services - the goods that are obtained from ecosystems including fuelwood, food, honey and timber, regulating and supporting services, including regulation of ecosystem processes, our climate and the maintenance of healthy coastal ecosystems and cultural services, the non-material benefits people obtain from visiting or using the mangrove forests including for spiritual or religious practices ties with cultural heritage and recreational purposes (UNEP, 2014). The magnitude and quality of each of these goods and services are likely to vary among the three hydrogeomorphic zones and no zone can be designated as 'most' or 'least' important overall (Ewel *et al.*, 1998).

2.4 ECONOMIC VALUATION

The importance of coastal wetlands in providing various services such as provisioning, cultural or recreational, supporting and regulating services was known to ecologists for many decades. However, the studies conducted by social scientists particularly related to economic valuations are very few. Thus, appropriate policies to address the issue of wetland degradation are negligible. The literature search from the international database on valuation especially The Economics of Ecosystems and Biodiversity (TEEB), Harte Research Institute,

etc. shows that there is a limited number of studies that quantify the different provisioning, regulating and cultural services from coastal wetlands. Further, there is a wide variation between the studies ranging from a minimum of US\$ 3.00 to 14,100 for provisioning services, from US\$ 0.35 to 47,700 for regulating services, from US\$ 0.07 to 23,900,000 for cultural services and from US\$ 26 to 10,700 for supporting services. Thus, the valuation of the provisioning services varies substantially making it difficult for using the benefit transfer method to value the coastal wetlands (Pasupalati *et al.*, 2017).

Economic valuation is an effort to allocate quantitative values to the goods and services provided by the natural ecosystem (Constanza and Folke, 1997; Daily *et al.*, 1997). The economic valuation of the mangrove ecosystem can be useful in indicating the opportunity of other land-use practices. The range of value may vary according to the specificity approach used, but it can help in land-use decision-making. (Quoc *et al.*, 2012).

In India, (Hussain and Badola, 2008) conducted a study for estimating the contribution of mangrove forests to local livelihoods in the Bhitarkanika Conservation Area, east coast of India. The findings show that 14.2% of the fuel need of each household was being met by the forests. In this study, 14 species of fishes and 3 of shellfishes were recorded. The total catch for the inshore fishery was found as 3.77kg/ha having a market price of US\$ 2.25. In offshore fishery, the number of species caught as well as income from the catch was higher in areas with mangroves (US\$ 44.61ha⁻¹) than in those without mangroves (US\$ 2.62ha⁻¹). The market price of fishery and forestry products used by the people was estimated at US\$ 107 household⁻¹ annum⁻¹. The resources extracted from mangrove forests contributed to more than 14.5% of the total income of the household. The study suggests that provisioning services provided by the mangrove wetlands are of significant importance to the coastal communities as they increase the resilience and sustainability of the local economy. The total economic value of Andaman mangroves was worked out to be more than INR. 125 million per year (Chand *et al.*, 2013). The value of goods and services harvested per household per year was more than INR 61,000/-. Similarly, the

value of mangroves per hectare in the A & N Islands was more than INR 0.2 million. The people's perception of the use and ecological services delivered by mangroves was obtained from 120 respondents. About 95% of the respondents perceived that mangroves will die due to the change in sea level. 56% were of the opinion that damage of mangroves will result in a reduction in fish catch.

The Total Economic Valuation (TEV) of the mangrove forests of Kerala state was `117,947 million, which was 0.14 percent of the GSDP (2011-12). The estimated TEV was `12,744 million (residents), `335 million (fishermen), `13 million (paddy farmers) and `104,855 million (general public). The average Willingness to Pay (WTP) expressed by the respondents was `2,308 which ranges from `50 to 28,870. (Hema and Devi, 2015). The North Malabar area has a total of 3750 ha of mangrove wetlands; the ecosystem services value per year was estimated as $10960 \div 3750 = 41100000$ US\$. Approximately, it is equal to Rs.164crores and 40 lakhs (Khaleel and Jaleel, 2009). Joshi *et al.*, (2017) recorded that the value of different ecosystem services of marine and coastal environment has a direct effect on the total fish production of Kerala which was already showing a declining trend. This downward trend may have a direct impact on the Kerala state economy and livelihood issues of about 10lakh fishermen community. The provisional services estimated was about \$41422/ha/yr from the sectors such as fisheries and aquaculture being the highest value recorded from any ecosystem around the World.

The study conducted by Hema and Devi (2014) analyses the level of dependence of the marginalized communities on the mangrove ecosystem and its livelihood support level of various districts in Kerala. The respondents were those living close to mangroves and depending on mangrove related livelihood options, and mostly residing within a 100 m radius of mangrove areas. The mangrove forests were extensively explored in the past for various purposes like fuelwood, building materials for constructing houses and poles for spreading nets or anchoring canoes in the water. However, such dependence on these needs is currently declined. The life of all the respondents is very closely linked with the nearby mangrove ecosystem in one way or the other. Rapid actions are needed

to preserve the valuable traditional knowledge and culture associated with the mangroves in such a way that future generations can use and enjoy the coastal resource.

The study conducted by Khaleel (2012) on the socio-economic influence of the mangrove wetlands of North Malabar (Kerala) reveals that the mangrove wetlands have strong linkages with the coastal environment and agriculture and are considered areas for the sustenance of the coastal communities. According to Hema and Devi (2014), the life and property of the people in Kadalundi locality are preserved by the mangrove forests; however, they are not willing to take any action for its conservation and prefer to maintain a status quo. A constructive attitude has been slowly developing among the people through a series of seminars and interactive sessions organized by the community reserve management committee. The current problem of mangrove destruction would not be rectified simply by declaring mangrove area as a protected area but only through the co-ordination and enforcement mechanisms of the government, community reserve management committee and the local people, especially the stakeholders.

2.5 IMPACTS AFFECT COASTAL ENVIRONMENT AND MANGROVE ECOSYSTEM

The threat to mangroves comes from various forms of coastal development, pollution and human exploitation. Although global losses declined when compared to the 1980s (approximately 1.04% per year) to 2000-2005 time period (approximately 0.66% per year), mangroves are still destroyed at a rate three to five times faster than any other forest type (Spadling *et al.*, 2010). One comprehensive study of mangroves noted that climate change may prove to be the ultimate anthropogenic disturbance factor, resulting in a maximum loss of 10-15% of the mangrove ecosystem globally (Alongi, 2008). Mangrove habitats are regressing at an alarming rate, due to direct anthropogenic impacts and global change.

In order to assess the effects of mangrove habitat degradation on benthic

biodiversity and ecosystem functioning, the status of meiofaunal biodiversity (as a proxy of benthic biodiversity), benthic biomass and prokaryotic heterotrophic production (as proxies of ecosystem functioning) and trophic state in a disturbed and an undisturbed mangrove forests were examined and found that disturbed mangrove area showed a loss of 20% of benthic biodiversity, with the local extinction of four Phyla (Cladocera, Kynorincha, Priapulida, Tanaidacea), a loss of 80% of microbial-mediated decomposition rates, of the benthic biomass and the trophic resources (Carugati *et al.*, 2018). Most anthropogenic drivers of mangrove destruction and degradation are the results of land-use activities near human population centres along the coastal region. Globally, the primary and emergent anthropogenic threats to mangrove wetlands include (Spalding *et al.*, 2010; Van Bochove *et al.*, 2014):

- Coastal development (e.g., roads, ports and marinas, urban growth and tourism accommodations)
- Agriculture and aquaculture
- Pollution and environmental degradation
- Local exploitation (e.g., wood for cooking or building)
- Rising seas due to climate change.

In the Caribbean, Bacon (1993) and Ellison and Farnsworth (1996) identified five categories of anthropogenic disturbance to mangroves back in the 1990s, including the emergence of climate change:

- Disturbance resulting from extractive uses of mangroves and mangrove associated fauna
- Disturbance resulting from changes in upland hydrology due to construction activities
- Pollution of mangrove ecosystem
- Destruction of mangroves in association with reclamation for non-extractive uses
- Impacts of climate change resulting from increases in CO₂ and sea-level rise.

Unfortunately on a global scale, several hectares of mangroves were

cleared for the past two decades. Moreover, the ongoing climate change turned as a potential threat to the unique ecosystem. Loss of mangroves will spread its impact on the adjoining system in a significant way because it is the only coastal system that shares its resource with the nearby fragile systems like coral reef and seagrass beds. So, the mangrove loss will negatively influence the fishery resource of the tropical region and initiate regional and global socio-economical crisis (Sandilyan and Kathiresan, 2012).

The accumulation of sand near the pneumatophores of mangroves covers the breathing openings and results in its deterioration. The seed and seedlings of the mangrove were often found on the sand bars without getting flooded away by the tidal currents. The sand bars do not have a persistent nature and the in and outflows shift its location which results in unstable flats, where roots of mangrove saplings cannot flourish and cause dieback of mangroves in those areas. The long stretch of sand bars, block the free to and fro motion of water (both freshwater and brackish water) because of which mangroves deteriorate gradually (Bindu and Jayapal, 2016).

A study conducted by the Western Ghat regional station of the Zoological Survey of India categorically states that the sand mining activity along with illegal coastal construction poses a serious threat to the turtle nesting habitat at Kolavipalam (Gopi and Radhakrishnan, 2000). The sea wall which stretches continuously along the shore is in ruins at many places. It has thus become dysfunctional, noticeably near the estuary mouth, where it has sunk and waves are carrying away sand located beyond the sea wall. The sand deposits between the sea and the sea wall have been indiscriminately quarried. The Zoological Survey of India (ZSI) study states that unabated sand mining near the estuary mouth at the current intensity will degrade this nesting beach shortly. Sand mining may also be an ecologically hazardous problem, leading to irreversible degradation of coastal habitat, leading to beach erosion and subsidence and mangrove depletion (Gopi and Radhakrishnan, 2000).

Kallai in Kozhikode district lost its past glory of mangroves due to faulty land use (Mohandas *et al.*, 2012). A considerable stretch of Kallai riverside along

with their upper river courses from the estuaries, exhibit highly disrupted strip or fringe mangroves of varied structural configuration from shrubby thicket to woody vegetation. The estuary embayments in the near about areas of the Kolavipalam beach harbour is comparatively better, though fragmented, stands of mangroves edging the waters. The isolated settings of the Kolavipalam area together with the sandy shore bed and the mangrove ecosystem constitute perhaps one of the ideal habitat sites in the entire coastal-based ecosystem of the state (Radhakrishnan *et al.*, 2006).

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

The chapter describes the study area, background, sampling design, data collection methods and tools of analysis followed in the present study.

The study encompasses both primary and secondary data collection. Data on the socio-economic status of stakeholders, their Willingness to Pay, the various services provided by the ecosystem, biodiversity and data on the provisioning services were collected. Secondary data on fishing crafts, fishing gears and fish production were collected from research Institutes like ICAR-Central Marine Fisheries Research Institute(CMFRI) and state government agencies like the Matsyafed, Kerala and other organisations like the Fishermen Co-operative Societies functioning in the selected study locations (Chakkumkadavu landing centre of Kallai, Iringal landing centre of Kolavipalam in Kozhikode district of Kerala). Data about the wood industry of Kallai was collected from various timber merchants of Kallai.

The study mainly focused on two selected mangrove wetlands of Kozhikode district namely Kallai and Kolvipalam.

Kozhikode district (formerly known as Calicut) is one of the districts of Kerala, located in the northern part of the state. The district is bound on the west by the Arabian Sea, and on the north, east and south by the other districts of the state, namely Kannur, Wayanad and Malappuram respectively. Disrupted stretches of mangroves present along the banks of the Kallai river. Kolavipalam beach has fragmented stands of mangroves edging the waters.

Kolavipalam (11°56'54"N, 75°59'14"E) lies in the Payyoli municipality and is well known for its rich mangrove forest, marine capture fisheries and conservation of marine turtles. The isolated settings of the area together with the sandy shore bed and the mangrove ecosystem constitute perhaps one of the ideal habitat sites in the entire coastal- based ecosystem of the state. About a decade back, Kolavipalam had a lot of sandy beach area and the beach was well known for turtle nesting and a large number of turtles come to lay eggs. There is a Sea

turtle Conservation Centre supported and funded by the Social Forestry Division of the Kerala Forest Department in collaboration with the *Theeram Prakrithi Samrakshana Samithi*. But unfortunately, the beach erosion and the sea wall construction resulted in the shrinkage of beach and loss of the vast majority of the turtle nesting area. The mangrove restoration activities by the local community resulted in the successful succession of diversified mangrove patches in the Kolavipalam estuarine side.



Fig. 3.1 Study location: Kolavipalam

Kallai (11°42'0"N, 75°32'0"E) is famous for its timber industry. Kallai in Kozhikode district lost its past glory of mangroves due to faulty land-use. The considerable stretch of Kallai riverside along with their upriver courses from the estuaries, exhibit highly disrupted strip or fringe mangroves of varied structural configuration from shrubby thicket to woody vegetation. Due to the timber industry and other factors, this wetland appears to be polluted. The mangroves are also under threat due to different anthropogenic activities. The centuries-old wood yards on the Kallai river banks in the suburbs of Kozhikode city is famous for timber-based industries and allied business. Among the major timber trade centers in Malabar, Kallai bagged attention as one of the pioneer and premier centers of wood trade that antecede beyond the era of the Zamorins. Kallai is a small village on the banks of the Kallai river which links with the Chaliyar river on the south by a man-made canal. The Kallayi wood trade belt spreads over to

an extent of about 35 km on both sides of the Kallayi river. It remained under the Madras Presidency of British India government till 1947 and under Madras state till the formation of the state of Kerala in 1956. The factors that enabled Kallai the glory as a premier wood trade centre are the plentiful availability of wood raw materials and accessibility to the seaport. The period 1950-70 was the golden period of Kallai. But nowadays pollution, land encroachment, and the declining timber industry are the major three banes of Kallai that are related to one another.



Fig. 3.2 Study location: Kallai

3.1 BIODIVERSITY DOCUMENTATION

This study was conducted to unravel the species diversity of mangroves, mangrove associates, avian fauna, fishes, crustaceans *etc.* in the selected mangrove wetlands. Field surveys were conducted to identify the different species of mangroves and associated faunal communities. The identification of species was made using standard species identification catalogues. Also, secondary information on the biodiversity of the selected sites was collected from peer-reviewed articles, books, internet publications and various websites.

3.2 VALUATION OF PROVISIONAL SERVICES

Value Transfer (VT) is the method used for the economic valuation of provisioning services. The fishery data for the respective landing centre's of the study area viz., Chakkumkadavu (Kallai) and Iringal (Kolavipalam) were collected from the Fisheries Resources Assessment Division of ICAR-CMFRI and State Government organisations such as Matsyafed society-Iringal, Payyoli and the Thaikadappuram Matsya Thozhilali Vikasana Sahakarana Sangam.

The average price for the species was taken from the market price data of the Matsyafed. The fisheries valuation was done by market price method and estimated following the method of Bann (2000).

$$\text{Total Value} = \text{Unit Market Price} * \text{Quantity}$$

wherein market price varies according to seasonal changes. Market prices were obtained by surveying three local markets.

The revenue from shell collection was calculated according to the price at which shells were to be marketed to various purposes (the market price of shells). Data about the wood industry were collected through interviews of various wood merchants of Kallai to understand their dependency on the wetland for various timber-related uses.

3.3 SOCIO-ECONOMIC SURVEY

The primary data was gathered from 110 respondents belonging to both the study areas namely Kallai (number of respondents is 58) and Kolavipalam (number of respondents is 52) who were selected on a random basis. Data was collected through questionnaires and semi-structured interviews with the residing local community. Criteria used for selection of respondents were proximity to mangrove patch, proximity to estuary/sea, proximity to turtle interpretation centre (only in the case of Kolavipalam), *etc.* and an attempt was made to collect data from respondents of all economic strata residing in the study area (the basis of occupation, financial status, the standard of living *etc.*). The data collected included occupation, educational status, age, family size (number of family

members), family type (nuclear/joint), possession of various essential documents like Aadhar card, Bank account, membership in co-operative societies and microfinance, leadership positions, basic details of the house (type, area, etc), land details, family income and expenditure details, loan details, income and expenditure on various occupational sectors, the ranking of dependency on money lenders to understand the standard of living of the respondents of the selected study area. The questionnaire included details on (i) personal information (age, educational status *etc.*) (ii) economic status such as land holdings, occupation, family income, expenditure *etc.* (iii) a special section for fishermen community (crafts and gears used, average operating cost per trip, fishing season, *etc.*)

3.4 WILLINGNESS-TO-PAY(WTP)

Hoevenagel(1994) defines the Contingent Valuation Method (CVM) as a survey method in which respondents are asked how much they are willing to pay for the use and conservation of natural goods, where their preferences are assumed to be contingent upon alternative goods that are offered in a hypothetical market. According to Venkatachalam(2004), a well-designed WTP scenario in the questionnaire is very important and should be meaningful and understandable by the respondents. In addition to that Loomis *et al.*, (2000) suggests that obtaining accurate estimates of benefits through Contingent Valuation Method (CVM) needed in-depth information of the resource being valued, and thus efforts should be geared to carefully define and clearly show the current and proposed levels of ecosystem services to the respondents. Therefore, it is very important to minimize the underlying biases and make the respondents well informed before recording the WTP of environmental goods and services. Through this method, facing the offered prices in an assumed market condition, the respondents were asked to select only one option from the fixed options such as “yes” or “no”. The determined respondents are asked about their maximum willingness to pay and this was supported to a greater extent in the subsequent analyses to classify the remained effect. These mentioned reasons in the term of

respondents' WTP for the preservation or recreation involve several applied values, natural and ecological problems (Dehghani *et al.*,2010).

A random sample of households for the WTP questionnaire was selected to be representative of the total population in the study area (tried to include people of various age groups to determine the aspects of different generations). Face-to-face interviews were conducted for each of the samples (30 in Kallai and 55 in Kolavipalam; a total of 85 samples). A series of questions were asked about Willingness to Pay - how much, on what frequency, why they are willing to pay, why they are not willing to pay(replies are recorded as Strongly Agree(SA), Agree(A), Neutral(N), Disagree(D), and Strongly Disagree(SD) shows the attitude of the respondents very clearly). The amount of payment was marked using the 'Payment Ladder'.

The second section comprised of the ranking of goods and services provided by the mangrove ecosystem (ranking is based on how much extent these goods and services provided by the mangrove ecosystem are relevant to the responded stakeholder- marked as Highly Relevant, Moderately Relevant, Less Relevant, No Decision, Not Relevant) to check the knowledge of the respondents about the inherent value of the ecosystem goods and services.

The last section includes the current status of mangroves in the locality, patches, destruction activity and reasons, and people's perspective about the mangrove protection/conservation, willingness to participate in conservation activities(ranking of various aspects of conservation measures), and nesting details of turtles (collected from the *Theeram Prakrithi Samrakshana Samiti*).

3.5 IMPACTS ON THE MANGROVE ECOSYSTEM

The various factors affecting the mangrove ecosystem – both natural and anthropogenic factors were recorded through direct observation and structured and semi-structured interviews with various stakeholders. Secondary information was collected from peer-reviewed articles, books, internet publications and various websites.

RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 BIODIVERSITY DOCUMENTATION

Studies related to the biodiversity documentation of flora and fauna in association with the mangrove ecosystem was carried out. In comparison to our understanding and limitation about the status of the floral composition of mangroves and its associates, the knowledge about diversity and richness of fauna associated with them is far from adequate, let alone about their ecological interrelationship with this fascinating ecosystem.

Exploratory surveys in the coastal regions in northern Kerala revealed the fact that the best mangrove stocks existing in the state are mainly concentrated in the coastal districts of the Northern Kerala and also mangrove patches in Kozhikode district have been enormously washed out owing to urban-based developmental programmes. The coastal-zone degradation process like excessive extraction of sand deposits from the river bed and sandy-beach areas all along the coasts of the northern coastal districts of Kerala have further posed threats to the prevalence and perpetuity in the unique mangrove ecosystem (Radhakrishnan *et al.*,2006).

Information pertaining to the floral and the faunal associates of the mangrove ecosystem were recorded in both the locations, during the study period. Data were collected on the biodiversity of various species found in the mangrove ecosystem, through interview with the stakeholders and from secondary sources.



Fig. 4.1. Visiting study area and recording the biodiversity documentation at Kolavipalam

4.1.1 Mangroves and mangrove associates of Kolavipalam, Kozhikode

The Kottapuzha estuary of the river Kuttiady and the estuary embayments area closer to the Kolavipalam beach harbour comparatively better, though fragmented, stands of mangroves edging the waters. According to Radhakrishnan *et al.* (2006), the mangrove stands of Kolavipalam comprise mostly of *Avicennia officinalis*, *Bruguiera cylindrica*, *Rhizophora apiculata* and *Sonneratia alba*.

During the present study, 10 species of true mangroves and 10 mangrove associates were recorded from the Kolavipalam mangrove wetland (Table 4.1 and 4.2). True mangrove species belonged to 7 genera and 5 families. The table illustrates the different mangrove species identified, family, common name, vernacular name.

Table 4.1 Species of mangroves recorded at Kolavipalam

Mangrove species	Family	Common name	Vernacular name
<i>Acanthus ilicifolius</i> L.	Acanthaceae	Holly-leaved acanthus, Sea holly, Holly mangrove	Chullikandal
<i>Avicennia marina</i> (Forssk.) Vierh	Acanthaceae	Grey mangrove, White mangrove	Cheruppotti, Chakkapoo, Charakandal
<i>Avicennia officinalis</i> L.	Acanthaceae	Indian mangrove, Grey mangrove	Uppotti, Uppatti, Orayi Uppootha
<i>Excoecaria agallocha</i> L.	Euphorbiaceae	Milky mangrove, River poison tree, Blind your eye mangrove, Blinding mangrove	Kannampotti, Kambatti
<i>Sonneratia alba</i> J.E. Smith	Lythraceae	Sweet-scented apple mangrove	Chakkarakandal
<i>Bruguiera cylindrica</i> (L) Blume	Rhizophoraceae	Orange mangrove, Small-leaved mangrove	Kuttikandal, Cherukandal, Pichalakandal
<i>Bruguiera sexangula</i> (L) Savi	Rhizophoraceae	Golden orange mangrove	Swarnakandal
<i>Kandelia candel</i> (L) Druce	Rhizophoraceae	Kandelia	Cherukandal, Ezhuthanikandal
<i>Rhizophora apiculata</i> Blume	Rhizophoraceae	Red mangrove, Tall stilt mangrove	Kayakandal, Peekandal
<i>Rhizophora mucronata</i> Lam.	Rhizophoraceae	Red mangrove Asiatic mangrove	Branthakandal, Panachikandal

Table 4.2. Mangrove associates of Kolavipalam

Mangrove species	Family	Local Name	Vernacular name
<i>Wedelia biflora</i> (Osbeck)Merr.	Asteraceae		
<i>Terminalia catappa</i> L.	Combretaceae	Indian almond	Bhadham, Thallithenga
<i>Derris trifoliata</i> Lour	Fabaceae	Sea derris	Ponnumvalli, Karimeenvalli
<i>Flagellaria indica</i> L.	Flagellariaceae	Whip vine	Pambhuvalli
<i>Premna serratifolia</i> L.	Lamiaceae	Headache tree	Head ache tree
<i>Thespesia populnea</i> (L.)Sol.	Malvaceae	Indian tulip tree Pacific rosewood	Poovarashu
<i>Spinifex littoreus</i> (Burm.F.)Merr.	Poaceae		
<i>Acrostichum aureum</i> (L)	Pteridaceae	Golden leather fern	Machithol
<i>Morinda citrifolia</i> L.	Rubiaceae	Noni	
<i>Volkameria inermis</i> (L.) Gaertn.	Verbenaceae	Sea jasmine	Puzhamulla, Cherichinna

4.1.2 Associated faunal species in mangroves

Gastropods being herbivores, carnivores, scavengers, and filter feeders play a key role in the mangrove ecosystems; they help in maintaining the functioning and productivity of mangroves (Solanki *et al.*,2016).The molluscan species in the mangrove ecosystem (under Gastropoda and Bivalvia) are the rich sources of lime. A total of 730 species of molluscs were enlisted from the Kerala coast. Gastropods form 515 species representing 196 genera from 75 families, while bivalves are constituted by 171 species, belonging to 91 genera, 16 orders and 35 families. Cephalopods comprise of 28 species, belonging to 12 genera under 4 orders (Joshi, 2012). The molluscan, crustacean, mudskippers, snake species found in the Kolavipalam mangrove wetlands are listed in table 4.3. A total of 19 species of Crustacea were recorded belonging to 15 families, 19 species of gastropods were recorded from 9 families, 11 species of bivalves were recorded from 6 families, 5 species of cephalopods were recorded from 3 families, 2 species of Polyplacophora were recorded from 1 family, and three species of Mudskippers were recorded from 1 family Gobiidae and two different genera and three species of snakes.

According to the study conducted by Radhakrishnan *et al.*(2006)the findings show that the molluscs, *Telescopium telescopium* and *Cirrithidea cingulata* were the predominant species found associated with the muddy sandy beds of the Kolavipalam mangrove wetlands. Their empty shells were found occupied by hermit crabs in innumerable number. Sporadic assemblages of *Crassostrea madrasensis* and *Saccostrea cuculata* were often observed on mudflats and shallow waters, close to the banks of the upriver stretch from the estuary site. Other molluscs like *Dostia violacea* and *Littorina scabra* were recorded from within the mangrove sites. *Meretrix meretrix* in considerable abundance often congregated to form thick beds at different sites of the mangrove wetlands. Bounteous occurrence of shells of *Donax scrotum*, a marine species, accreted in thick deposits near sea mouth, extending even to much interior part of the estuary, is a ready resource for the lime industry.

Table 4.3. Checklist of crustaceans, molluscs, mudskippers and snakes recorded at Kolavipalam

Species Name (Scientific name)	Family
CRUSTACEANS	
<i>Dotilla blanfordi</i> (Alcock, 1900)	Dotillidae
<i>Macrophthalmus pectinipes</i> (Guerin, 1839)	Macrophthalmidae
<i>Macrophthalmus sulcatus</i> (H. Milne Edwards, 1852)	Macrophthalmidae
<i>Ashtoret lunaris</i> (Forskål, 1775)	Matutidae
<i>Uca (Austruca) annulipes</i> (H. Milne Edwards, 1837)	Ocypodidae
<i>Panulirus polyphagus</i> (Herbst, 1793)	Palinuridae
<i>Mierspenaeopsis sculptilis</i> (Heller, 1862)	Penaeoidea
<i>Penaeus monodon</i> (Fabricius, 1798)	Penaeoidea
<i>Heteropanope glabra</i> (Stimpson, 1858)	Pilumnidae
<i>Scylla serrata</i> (Forskål, 1775)	Portunidae
<i>Charybdis feriatus</i> (Linnaeus, 1758)	Portunidae
<i>Charybdis smithii</i> McLeay, 1838	Portunidae
<i>Metopograpsus messor</i> (Forskål, 1775)	Portunidae
<i>Parasesarma plicatum</i> (Latreille, 1803)	Sesarmidae
<i>Squilla mantis</i> (Linnaeus, 1758)	Squillidae
<i>Panulirus penicillatus</i> (Oliver, 1791)	Palinuridae
<i>Fenneropenaeus indicus</i> (H. Milne-Edwards, 1837)	Penaeidae
<i>Portunus pelagicus</i> (Linnaeus, 1758)	Portunidae
<i>Portunus sanguinolentus</i> (Herbst, 1783)	Portunidae
<i>Dotilla blanfordi</i> (Alcock, 1900)	Dotillidae
<i>Macrophthalmus pectinipes</i> (Guerin, 1839)	Macrophthalmidae
<i>Macrophthalmus sulcatus</i> (H. Milne Edwards, 1852)	Macrophthalmidae
MOLLUSCS	
Gastropods	
<i>Clypeomorus batillariaeformis</i> (Habe&Kosuge, 1966)	Cerithiidae
<i>Clypeomorus bifasciata</i> (G.B. Sowerby II, 1855)	Cerithiidae
<i>Cassidula nucleus</i> (Gmelin, 1791)	Ellobiidae
<i>Littoraria carinifera</i> (Menke, 1830)	Littorinidae
<i>Littoraria melanostoma</i> (Gray, 1839)	Littorinidae
<i>Littoraria scabra</i> (Linnaeus, 1758)	Littorinidae
<i>Littoraria undulata</i> (Gray, 1839)	Littorinidae
<i>Nassarius stolatus</i> (Gmelin, 1791)	Nassariidae
<i>Natica tigrina</i> (Roding, 1798)	Naticidae
<i>Clithon oualaniense</i> (Lesson, 1831)	Neritidae

Table 4.3 continued

<i>Nerita polita</i> (Linnaeus, 1758)	Neritidae
<i>Neritina violacea</i> (Gmelin, 1791)	Neritidae
<i>Cerithidea cingulata</i> (Gmelin, 1791)	Potamididae
<i>Cerithidea obtusa</i> (Lamarck, 1822)	Potamididae
<i>Cerithideopsilla cingulata</i> (Gmelin, 1791)	Potamididae
<i>Telescopium telescopium</i> (Linnaeus, 1758)	Potamididae
<i>Trochus radiatus</i> Gmelin, 1791	Trochidae
<i>Turritella attenuata</i> Reeve, 1849	Turritellidae
<i>Turritella duplicata</i> (Linnaeus, 1758)	Turritellidae
Bivalves	
<i>Anadara granosa</i> (Linnaeus, 1758)	Arcidae
<i>Tegillarca granosa</i> (Linnaeus, 1758)	Arcidae
<i>Villorita cyprinoides</i> (Gray, 1825)	Corbiculidae
<i>Donax scortum</i> (Linnaeus, 1758)	Donacidae
<i>Perna viridis</i> (Linnaeus, 1758)	Mytilidae
<i>Crassostrea madrasensis</i> (Preston, 1916)	Ostreidae
<i>Saccostrea cucullata</i> (Born, 1778)	Ostreidae
<i>Meretrix meretrix</i> (Linnaeus, 1758)	Veneridae
<i>Paphia malabarica</i> (Dillwyn, 1817)	Veneridae
<i>Meretrix casta</i> (Gmelin, 1791)	Veneridae
<i>Meretrix meretrix</i> (Linnaeus, 1758)	Veneridae
Cephalopoda	
<i>Loligo</i> sp. (Lamarck, 1798)	Loliginidae
<i>Cistopus indicus</i> (d'Orbigny, 1835)	Octopodidae
<i>Sepia aculeata</i> (Van Hasselt, 1835)	Sepiidae
<i>Sepiella inermis</i> (Van Hasselt, 1835)	Sepiidae
<i>Uroteuthis duvaucelli</i> (d'Orbigny, 1835)	Loliginidae
Polyplacophora	
<i>Ischnochiton</i> sp. (Gray, 1839)	Ischnochitonidae
<i>Ischnochiton (Haploplax) comptus</i> (Gould, 1859)	Ischnochitonidae
MUDSKIPPERS	
<i>Boleophthalmus dussumieri</i> Valenciennes, 1837	Gobiidae
<i>Periophthalmus waltoni</i> Koumans, 1941	Gobiidae
<i>Scartelaos histophorus</i> (Valenciennes, 1837)	Gobiidae
SNAKES	
<i>Acrochordus granulatus</i> (Schneider, 1799)	Acrochordidae
<i>Gerarda prevostiana</i> (Eydoux & Gervais, 1837)	Colubridae
<i>Cerberus rynchops</i> (Schneider, 1799)	Colubridae

4.1.3 Fishes in Kolavipalam

The ichthyofauna diversity recorded from the Kozhikode District, Kerala encompasses 142 fish species belonging to 86 genera under 45 families of 16 orders. The checklist also reveals fish diversity of about 65 species belonging to 49 genera of 27 families under 12 orders in the estuarine brackish water zone of the district (Gopi, 2006). During the study period, a survey of fish species of Kolavipalam coastal region were conducted and the list of species is shown in table 4.4.

Table 4.4. Fish species available in Kolavipalam

Scientific Name	Family
<i>Arius arius</i> (Hamilton,1822)	Ariidae
<i>Arius jella</i> Day,1877	Ariidae
<i>Tylosurus crocodiles</i> (Peron& Lesuer,1821)	Belonidae
<i>Alepes djedaba</i> (Forsskal,1775)	Carangidae
<i>Alepes djeddaba</i> (Forsskal,1775)	Carangidae
<i>Alepes kleinii</i> (Bloch,1793)	Carangidae
<i>Parastromateus niger</i> (Bloch,1795)	Carangidae
<i>Scomberoides tol</i> (Cuvier,1832)	Carangidae
<i>Selar crumenophthalmus</i> (Bloch,1793)	Carangidae
<i>Trachinotus blochii</i> (Lacepede,1801)	Carangidae
<i>Chanos chanos</i> (Forsskal,1775)	Chanidae
<i>Chirocentrus dorab</i> (Forsskal, 1775)	Chirocentridae
<i>Anodontostoma chacund</i> (Hamilton,1822)	Clupeidae
<i>Escualosa thoracata</i> (Valenciennes,1847)	Clupeidae
<i>Nematalosa nasus</i> (Bloch,1795)	Clupeidae
<i>Sardinella fimbriata</i> (Valenciennes,1847)	Clupeidae
<i>Sardinella gibbosa</i> (Bleeker,1849)	Clupeidae
<i>Sardinella longiceps</i> Valenciennes,1847	Clupeidae
<i>Cynoglossus bilineatus</i> (Lacepede,1802)	Cynoglossidae
<i>Dussumieria elopsoides</i> Bleeker,1849	Dussumieriidae
<i>Thryssa malabarica</i> (Bloch, 1795)	Engraulidae
<i>Stolephorus indicus</i> (vanHasselt,1823)	Engraulidae
<i>Chiloscyllium griseum</i> Muller&Henle,1838	Hemiscyllidae
<i>Lactarius lactarius</i> (Bloch&Schneider,1801)	Lactariidae
<i>Leiognathus bindus</i> (Valenciennes, 1835)	Leiognathidae
<i>Lobotes surinamensis</i> (Bloch,1790)	Lobotidae
<i>Uroteuthis</i> sp. (Rehder,1945)	Loliginidae
<i>Lutjanus argentimaculatus</i> (Forsskal,1775)	Lutjanidae

Table 4.4 continued

<i>Chelon parsia</i> (Hamilton, 1822)	Mugilidae
<i>Mugil cephalus</i> Linnaeus, 1758	Mugilidae
<i>Eleutheronema tetradactylum</i> (Shaw, 1804)	Polynemidae
<i>Opisthopterus tardoore</i> (Cuvier, 1829)	Pristigasteridae
<i>Pellona ditchela</i> Valenciennes, 1847	Pristigasteridae
<i>Rhinobatos rhinobatus</i> (Linnaeus, 1758)	Rhinobatidae
<i>Scatophagus argus</i> (Linnaeus, 1766)	Scatophagidae
<i>Johnius dussumieri</i> (Cuvier, 1830)	Sciaenidae
<i>Otolithes ruber</i> (Bloch & Schneider, 1801)	Sciaenidae
<i>Rastrelliger kanagurta</i> (Cuvier, 1816)	Scombridae
<i>Scomberomorus commerson</i> (Lacepede, 1800)	Scombridae
<i>Scomberomorus guttatus</i> (Bloch & Schneider, 1801)	Scombridae
<i>Epinephelus diacanthus</i> (Valenciennes, 1828)	Serranidae
<i>Siganus canaliculatus</i> (Park, 1797)	Siganidae
<i>Sillago sihama</i> (Forsskal, 1775)	Sillaginidae
<i>Pampus argenteus</i> (Euphrasen, 1788)	Stromateidae
<i>Synodus indicus</i> (Day, 1873)	Synodontidae
<i>Terapon jarbua</i> (Forsskal, 1775)	Terapontidae

Source: Fisheries Resources Assessment Division (FRAD), ICAR-Central Marine Fisheries Research Institute

4.1.4 Checklist of avian fauna of Kolavipalam, Kozhikode

Avifauna also abounds in the wetland systems associated with the integrated habitat environs of mangrove-estuarine systems and sandy beaches. Of the 105 species of birds recorded from these areas, about 46 species are winter migrants. Among the most abundant of them included Lesser Sand Plover (*Charadrius mangolus*), Whimbrel (*Numenius phaeopus*), Bar-tailed Godwit (*Limosa lapponica*), etc. Among the Kingfishers observed during the study included the rare black-capped Kingfisher (*Halcyon pileata*) also. Rare birds such as the Oyster Catcher (*Haematopus ostralegus*), Crab Plover (*Dromas ardeola*), Avocet (*Recurvirostra avosetta*) Oriental Pratincole (*Glareola maidivaram*), Black tailed Godwit (*Limosa lapponica*), Terek Sandpiper (*Trinka terek*) Dunlin (*Calidris alpina*), Sanderling (*Calidris alba*), Grey Plover (*Pluvialis squatarola*) Eastern Knot (*Calidris leniuroslris*) and Sandwich Tern (*Sterna scandivicensis*), reported

for the first time from Kerala by Neelakantan (1986), could be observed visiting the Kottapuzha estuary and its mangrove ecosystem environs.

Birds are one of the several animal group that are integral to the wetlands and they significantly augment the ecological services that the wetlands offer. In modern times, there has been a focus on the wetlands for the habitat that provides various kinds of fauna especially the birds. This study brings out a checklist of avian fauna which is based on observation during our field visit to Kolavipalam and also based on the published reports. A total of 64 species of birds under 29 families have been recorded; of these, 40 species are resident (R), 23 species are migratory (M) and the remaining 1 species is local migratory (LM). Kolavipalam mangrove wetland is a calm and best ground for roosting of various species (Table 4.5).

Table 4.5. Checklist of avian fauna found in Kolavipalam mangrove wetland

SI No	Avian fauna	Scientific Name	Family	R/M/LM**
1	House crow	<i>Corvus splendens</i> (Vieillot, 1817)	Corvidae	R
2	Large-billed crow	<i>Corvus macrorhynchos</i> (Wagler, 1827)	Corvidae	R
3	Asian koel	<i>Eudynamys scolopaceus</i> (Linnaeus, 1758)	Cuculidae	R
4	Common myna	<i>Acridotheres tristis</i> (Linnaeus, 1766)	Sturnidae	R
5	Jungle myna	<i>Acridotheres fuscus</i> (Wagler, 1827)	Sturnidae	R
6	Rufoustreepie	<i>Dendrocitta vagabunda</i> (Latham, 1790)	Corvidae	R
7	Racket-tailed drongo	<i>Dicrurus paradiseus</i> (Linnaeus, 1766)	Dicruridae	R
8	Brahminy kite	<i>Haliastur indus</i> (Boddaert, 1783)	Accipitridae	R
9	Black kite	<i>Milvus migrans</i> (Boddaert, 1783)	Accipitridae	R
10	White-cheeked barbet	<i>Psilipogon viridis</i> (Boddaert, 1783)	Megalaimidae	R
11	Rock pigeon	<i>Columba livia</i> (J F Gmelin, 1789)	Columbidae	R
12	Purple sun bird	<i>Cinnyris asiaticus</i> (Latham, 1790)	Nectariniidae	R
13	Purple-rumped sunbird	<i>Leptocoma zeylonica</i> (Linnaeus, 1766)	Nectariniidae	R
14	Blue-tailed bee-eater	<i>Merops philippinus</i> (Linnaeus, 1767)	Meropidae	R
15	Common kingfisher	<i>Alcedo atthis</i> (Linnaeus, 1758)	Alcedinidae	R
16	White-throated kingfisher	<i>Halcyon smymensis</i> (Linnaeus, 1758)	Alcedinidae	R
17	Stork-billed kingfisher	<i>Pelargopsis capensis</i> (Linnaeus, 1766)	Alcedinidae	R
18	Oriental magpie robin	<i>Copsychus saularis</i> (Linnaeus, 1758)	Muscicapidae	R
19	Black-headed oriole	<i>Oriolus larvatus</i> (Lichtenstein, 1823)	Oriolidae	R
20	Greater coucal	<i>Centropus sinensis</i> (Stephens, 1815)	Cuculidae	R
21	Rose-ringed parakeet	<i>Psittacula krameri</i> (Scopoli, 1769)	Psittaculidae	R
22	Pale-billed flower pecker	<i>Dicaeum erythrorhynchos</i> (Latham, 1790)	Dicaeidae	R
23	Common tailorbird	<i>Orthotomus sutorius</i> (Pennant, 1769)	Cisticolidae	R
24	White-breasted waterhen	<i>Amaurornis phoenicurus</i> (Pennant, 1769)	Rallidae	R
25	Ashy prinia	<i>Prinia socialis</i> (Sykes, 1832)	Cisticolidae	R

Table 4.5 continued

26	Little egret	<i>Egretta garzetta</i> (Linnaeus,1766)	Ardeidae	R
27	Intermediate egret	<i>Ardea intermedia</i> (Wagler,1827)	Ardeidae	R
28	Great egret	<i>Ardea alba</i> (Linnaeus,1758)	Ardeidae	R
29	Cattle egret	<i>Bubulcus ibis</i> (Linnaeus,1758)	Ardeidae	R
30	Pond heron	<i>Ardeola grayii</i> (Sykes,1832)	Ardeidae	R
31	Grey heron	<i>Ardea cinerea</i> (Linnaeus,1758)	Ardeidae	R
32	Striated heron	<i>Butorides striata</i> (Linnaeus,1758)	Ardeidae	R
33	Western Reef heron	<i>Egretta gularis</i> (Bosc,1792)	Ardeidae	R
34	Black crowned night heron	<i>Nycticorax nycticorax</i> (Linnaeus,1758)	Ardeidae	R
35	Purple heron	<i>Ardea purpurea</i> (Linnaeus,1766)	Ardeidae	R
36	Little cormorant	<i>Microcarbo niger</i> (Vieillot, 1817)	Phalacrocoracidae	R
37	Lesser whistling duck	<i>Dendrocygna javanica</i> (Horsfield,1821)	Anatidae	R
38	Oriental darter	<i>Anhinga melanogaster</i> (Pennant,1769)	Anhingidae	R
39	Black-rumped flame back	<i>Dinopium benghalense</i> (Linnaeus,1758)	Picidae	R
40	Common snipe	<i>Gallinago gallinago</i> (Linnaeus,1758)	Scolopacidae	R
41	Black-headed Ibis	<i>Threskiornis melanocephalus</i> (Latham,1790)	Threskiornithidae	LM
42	Little stint	<i>Calidris minuta</i> (Leisler,1812)	Scolopacidae	M
43	Common sandpiper	<i>Actitis hypoleucos</i> (Linnaeus,1758)	Scolopacidae	M
44	Brown-headed gull	<i>Chroicocephalus brunnicephalus</i> (Jerdon,1840)	Laridae	M
45	Black-headed gull	<i>Chroicocephalus ridibundus</i> (Linnaeus,1766)	Laridae	M
46	Eurasian curlew	<i>Numenius arquata</i> (Linnaeus,1758)	Scolopacidae	M
47	Lesser sand plover	<i>Charadrius mongolus</i> (Pallas,1776)	Charadriidae	M
48	Kentish plover	<i>Charadrius alexandrinus</i> (Linnaeus,1758)	Charadriidae	M
49	Lesser crested tern	<i>Thalasseus bengalensis</i> (Lesson,1831)	Laridae	M
50	Common greenshank	<i>Tringa nebularia</i> (Gunnerus,1767)	Scolopacidae	M
51	Common redshank	<i>Tringa tetanus</i> (Linnaeus,1758)	Scolopacidae	M

Table 4.5 continued

52	Whimbrel	<i>Numenius phaeopus</i> (Linnaeus,1758)	Scolopacidae	M
53	Bar-tailed godwit	<i>Limosa lapponica</i> (Linnaeus, 1758)	Scolopacidae	M
54	Oystercatcher	<i>Haematopus ostralegus</i> (Linnaeus, 1758)	Haematopodidae	M
55	Crab-plover	<i>Dromas ardeola</i> (Paykull,1805)	Dromadidae	M
56	Avocet	<i>Recurvirostra avosetta</i> (Linnaeus, 1758)	Recurvirostridae	M
57	Large Indian pratincole	<i>Glareola maldivarum</i> (J.R.Forster,1795)	Glareolidae	M
58	Black-tailed godwit	<i>Limosa limosa</i> (Linnaeus,1758)	Scolopacidae	M
59	Terek sandpiper	<i>Xenus cinereus</i> (Guldenstadt,1775)	Scolopacidae	M
60	Dunlin	<i>Calidris alpine</i> (Linnaeus,1758)	Scolopacidae	M
61	Sanderling	<i>Calidris alba</i> (Pallas,1764)	Scolopacidae	M
62	Grey plover	<i>Pluvialis squatarola</i> (Linnaeus,1758)	Charadriidae	M
63	Eastern knot	<i>Calidris tenuirostris</i> (Horsfield,1821)	Scolopacidae	M
64	Sandwich tern	<i>Thalasseus sandvicensis</i> (Latham,1787)	Laridae	M

** R- Resident fauna; L M- Local Migratory; M - Migratory

4.2 WILLINGNESS TO PAY (WTP) - KOLAVIPALAM

Surveys have been conducted (i) to understand the perception of local people about the importance of mangroves and ways by which they are willing to conserve this critical habitat; (ii) to value each goods and services provided by the mangrove ecosystem, and (iii) to collect information about the current status of mangrove wetlands and turtle nesting. WTP indicates the strength of ones preference for environmental quality and it is influenced typically by several other factors such as individual income, gender, education and cultural preference.

Surveys have shown that most of the local people are well aware of the importance of mangroves, and they are willing to conserve this critical habitat through payment and also by voluntary activities. Valuing a mangrove essentially means valuing the characteristics of the mangrove ecosystem.

Investment in the conservation and management of mangroves is increasingly seen as a key element of sustainable livelihood, risk reduction and disaster management. The average Willingness to Pay (WTP) expressed by the respondents was about 2308/annum, ranges from 50 to 28,870 for the study conducted for the economic valuation of mangrove ecosystems of Kerala (Hema and Devi, 2015)

4.2.1 Willingness to Pay (WTP)

About 49% of people are willing to pay for the conservation activities and the remaining 51% are not willing to pay, out of the 55 samples studied (fig. 4.2). They are ready to pay an amount according to their income (i.e. an amount affordable to them).

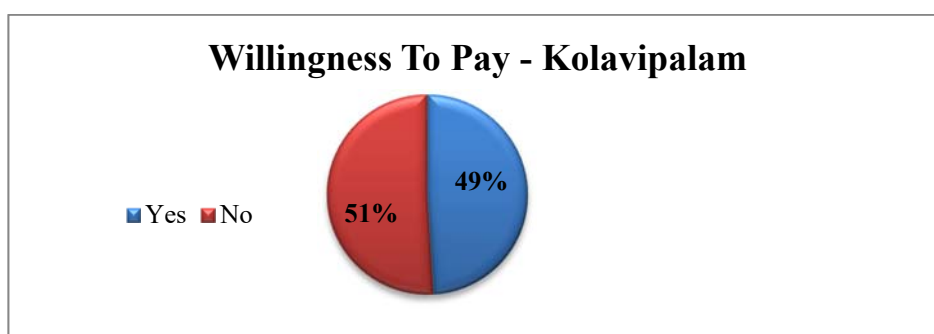


Fig. 4.2. Number of respondents who were willing to pay and not willing to pay at Kolavipalam

4.2.2. Payment Ladder

The range of payment committed by the stakeholders is from Rs.10 to Rs.2000 in the payment ladder that ranged between Rs.0-50,000. The preference of payment was either single time or in monthly installment basis. Average willingness to pay by the people of Kolavipalam was Rs.1,351. The attitudes expressed by the stakeholders is shown in table 4.6.

Table 4.6. Payment ladder indicating the amount respondents are WTP

Sl.No.	Amount (Rs.)	One time (No. of respondents)	Installment (No. of respondents)			Total (Rs.) (per annum)
			Weekly	Monthly	Yearly	
1	0	28				
2	10			6		720
3	50	1		11		6,650
4	100	2		2		2,600
5	500	1				500
6	1,000			2		24,000
7	2,000	1				2,000
8	5,000					
9	10,000					
10	25,000					
11	50,000					
Grand Total						36,470

4.2.3.Reasons for Willingness To Pay

Various reasons for willingness to pay were categorized into a scale of 5 attributes namely (i) Strongly agree (SA); (ii) Agree (A), (iii) Neutral (N); (iv) Disagree (D) and (v) Strongly Disagree (SD). The respondents were asked to mark the reasons according to their opinion on this scale (Table 4.7).

Table 4.7. Response of the stakeholders to the reasons for willingness to pay

Sl.No	Particulars	SA	A	N	D	SD
1	Because I am more aware about mangroves	22(81%)	4(15%)	1(4%)	-	-
2	It is my moral duty to protect mangroves	21(77%)	4(15%)	1(4%)	-	1(4%)
3	Conservation is better for nature sustainability	22(81%)	4(15%)	1(4%)	-	-
4	Reasonable amount (affordable)	18(67%)	9(33%)	-	-	-
5	Concerned about degradation	21(77%)	4(15%)	1(4%)	1(4%)	-

***SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree**

Note: Figures in parentheses indicate % to row total

Regarding the awareness about mangroves, 81% of the respondents strongly agreed, 15% agreed and the remaining 4% remained neutral. This indicates that 96% of people are aware of the importance of mangrove conservation and the goods and services provided by these ecosystems. Regarding the moral responsibility to protect mangroves, 77% of the respondents strongly agreed, 15% agreed, 4% strongly disagreed and the remaining 4% remained neutral. The second reason mainly supports the mental aspect or emotional attachment and the moral duty to protect the mangrove wetlands; 92% of respondents considered conservation as their moral duty.

The third reason is ‘conservation is better for nature sustainability’. Mangrove ecosystem is one of the coastal wetlands which protect the coastal areas from various natural calamities like flood, cyclone, tsunami, etc. and even regulate micro climatic condition and provide various goods and services. This is also an important ecosystem that provides roosting place for birds, nursery

ground for fishes and provides food and shelter for crustaceans, molluscs and other faunal biodiversity. Eighty one percent of the respondents strongly agreed, 15% agreed and the remaining 4% remained neutral.

The fourth reason is “reasonable amount”, that means the affordable amount which they can pay from their income. Here, the respondents marked only two options namely strongly agree (67%) and agree (33%). It is observed that though most of the local communities do not belong to a very high-income group, they are willing to pay for the ecosystem. The fifth and the last most important reason put forward was “concerned about degradation”. Seventy seven percent of the respondents strongly agreed, 15% agreed, 4% strongly disagreed, while the remaining 4% remained neutral (not aware of the degradation). About 92% are more concerned about degradation and 8% are unaware of this. Degradation is due to both natural and anthropogenic factors that impact the ecosystem. Natural impacts include climate change, sand bar formation, changes in tidal action, changes in the natural flow of rivers, etc. Anthropogenic impacts include pollution by dumping of waste into water bodies by various industries, pesticides and fertilizers from agricultural fields, deforestation for alternate uses, fuelwood, etc.

4.2.4. Reasons for not willing to Pay

Out of the 55 respondents, 28 reported that they are not willing to pay for the conservation of mangrove wetland. Their response was brought in a 5 point scale namely strongly agree (SA), Agree (A), neutral (N), disagree (D) and strongly disagree (SD)(Table 4.8)

Table 4.8 Response of the stakeholders to the reasons for not willing to pay

Sl.No	Particulars	SA	A	N	D	SD
1	I have no spare income but would otherwise contribute	14(50%)	3(11%)	8(28.5%)	2(7%)	1(3.5%)
2	I donot believe that the system would bring changes	14(50%)	7(25%)	1(4%)	4(14%)	2(7%)
3	It is the Government's responsibility	20(71%)	4(14%)	-	3(11%)	1(4%)
4	I feel that environmental protection of mangroves is unimportant	4(14%)	4(14%)	2(7%)	11(40%)	7(25%)
5	The user should pay	16(57%)	7(25%)	1(4%)	2(7%)	2(7%)
6	I fail to understand the question	1(4%)	-	20(71%)	3(11%)	4(14%)
7	We cannot place a monetary value on biodiversity	9(32%)	11(40%)	3(11%)	2(7%)	3(11%)
8	I would rather have the current situation than pay more	10(36%)	4(14%)	4(14%)	4(14%)	6(22%)
9	I believe that this improvement will take place without my contribution	12(43%)	7(25%)	2(7%)	3(11%)	4(14%)

***SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree**

Note: Figures in parentheses indicate % to row total

For the first reason “I have no spare income but would otherwise contribute”, 50% of respondents strongly agreed, 11% agreed, 28.5% were neutral, 7% disagreed and 3.5% strongly disagreed. Kolavipalam is a coastal village where most of the people were working on a daily wage basis for meeting their livelihood needs. Therefore, they spend their income mainly on their family requirements such as food, fuel, cloth, medicine, education, etc.

For the second reason “I donot believe that the system would bring changes”, 50% of the respondents strongly agreed, 25% agreed, 4% were neutral, 14% have disagreed and 7% strongly disagree. The third reason put forth was “It is the Government’s responsibility”. Most of the people felt that the Central and State Government have lot of funding programs to protect the coastal zones and these funding opportunities should be enchased for conservation activities. About 71% strongly agreed, 14% agreed, 11% have disagreed and 4% strongly disagreed.

The fourth reason is “I feel that environmental protection of mangrove is unimportant”. Some of the local people considered mangroves as nuisance as they turn out to be habitat for stray dogs, dumping pits of waste, etc. About 14% strongly agreed, 14% agreed, 7% were neutral, 40% disagreed and 25% strongly disagreed.

The fifth reason put forth was “the user should pay”, which means the people who actually reap the benefits of goods and services from the mangroves should pay for its conservation. For this reason, 57% of the respondents strongly agree, 25% agree, 4% were neutral, 7% disagree and 7% strongly disagree.

For the sixth reason “I fail to understand the question”, 4% marked as strongly disagree, 71% as neutral, 11% disagree and 14% strongly agree. The seventh reason put forth was “We cannot place a monetary value on biodiversity” and for this 32% marked strongly agree, 40% agreed, 11% were neutral, 7% disagree and 11% strongly disagree. The eighth reason was “I would rather have the current situation than pay more”. This was to understand the respondent's attitude that they are satisfied with the current status and hence there is no need to pay more. For this, 36% strongly agreed, 14% agreed, 14% were neutral, 14% have disagreed and 22% of respondents strongly disagreed. The ninth reason was “I believe that this improvement will take place without my contribution”. In this, the respondent's withdrawal attitude is shown, as they expect the improvement to happen without their contribution of monetary inputs. For this, 43% of the respondents strongly agreed, 25% agreed, 7% were neutral, 15% disagree and 14% strongly disagreed.

4.2.5. Involvement in conservation activity on non-monetary terms

Out of the 28 respondent, those who are not willing to pay, there was another set of questions to show if they are willing to involve in conservation activity on non-monetary terms such as act as volunteer, involve as labourer, or involve in awareness programmes (Table 4.9).

Table 4.9. Number of respondents volunteered in the conservation of mangroves

Sl. No.	Particulars	Willing	Not willing
1	Act as volunteer in conservation activity of mangroves	5(18%)	23(82%)
2	Involve as labourer	5(18%)	23(82%)
3	Organise and give support to awareness programmes	6(21%)	22(79%)

Note: Figures in parentheses indicate % to row total

About 18% of the respondents were willing to act as volunteers in conservation activities of mangroves. Another 18% suggested that they would involve as labourers in conservation activities. The remaining 82% of the above two are not willing for both. About 21% of the respondents are willing to organize and provide support to awareness programmes related to mangrove conservation. They were willing to spend an average of 5 days per month for the conservation activities of this mangrove ecosystem.

4.2.6. Ranking of goods and services

The respondents were asked to rank the various goods and services provided by mangrove wetland according to their relevancy, as perceived by them, based on their knowledge (Table 4.10).

The local communities depend on the mangrove wetlands ecosystem for livelihood activities. Mangroves forest is major source of food, fodder, medicines and wood and many other goods for the local communities. Owing to the changes in the demand (social and economic behavior) and the supply (depletion of mangroves) conditions, this dependence has been reduced substantially. Still there exists some level of dependence, for fuelwood, fodder and poles. The large scale fishery activity includes a collection of bivalves, shrimps, shellfishes, finfishes and crabs. The life of fishermen near the mangrove wetlands is closely associated with it deriving both direct and indirect benefits (Hema, 2013).

The mangrove ecosystem is a good source of 'blue carbon'. About 18% of the respondents ranked 'carbon sequestration' by mangroves as highly relevant,

13% ranked it as moderately relevant, 49% ranked it as less relevant, 15% have no decision, 5% responded as not relevant. The groundwater recharging is another important for which 58% of the respondents ranked it as highly relevant, 16.5% ranked it as moderately relevant, 16.5% as less relevant, 2% have no decision, 7% responded as not relevant.

The service 'water quality maintenance' is important as the mangrove plant sieve out the salt crystals from water and secretes it out through the leaves, thereby it purifies the water. About 60% respondents ranked it as highly relevant, 13% respondents as moderately relevant, 16% responded as less relevant, 5.5% have no decision and the remaining 5.5% responded as not relevant.

Shoreline protection is another service as the mangrove acts as shelterbelt which protects the shore from storm surges and sea-level rise, coastal erosion, etc. About 58% respondents ranked it as highly relevant, 9% responded as moderately relevant, 22% responded as less relevant, 5.5% have no decision and the remaining 5.5% responded as not relevant.

For sedimentation, meaning that mud accumulates faster in mangrove areas, 69% respondents ranked it as highly relevant, 20% ranked as moderately relevant, 4% ranked as less relevant, 7% have no-decision. For the service 'reduce Green House Effect', 60% responded as highly relevant, 18% responded as moderately relevant, 9% responded as less relevant, 11% have no decision and the remaining 2% responded as not relevant.

Table 4.10. Ranking of goods and services of Kolavipalam mangrove wetlands by the respondents

Goods/ Services	Importance				
	Highly relevant	Moderately relevant	Less relevant	No decision	Not relevant
1. Carbon sequestration	10(18%)	7(13%)	27(49%)	8(15%)	3(5%)
2. Ground water recharging	32(58%)	9(16.5%)	9(16.5%)	1(2%)	4(7%)
3. Water quality maintenance	33(60%)	7(13%)	9(16%)	3(5.5%)	3(5.5%)
4. Shoreline protection	32(58%)	5(9%)	12(22%)	3(5.5%)	3(5.5%)
5. Sedimentation	38(69%)	11(20%)	2(4%)	4(7%)	-
6. Reduce Green House Effect	33(60%)	10(18%)	5(9%)	6(11%)	1(2%)
7. Protection from Tsunami/cyclone/flood	31(56%)	8(15%)	8(15%)	3(5%)	5(9%)
8. Reducing soil erosion	48(87%)	1(2%)	3(5%)	2(4%)	1(2%)
9. Protecting from UV-B radiation	34(62%)	7(13%)	5(9%)	9(16%)	-
10. Protection against sea level rise	25(45%)	6(11%)	11(20%)	8(15%)	5(9%)
11. Nutrient sink	35(64%)	11(20%)	1(2%)	8(14%)	-
12. Nursery ground for fishes	45(82%)	5(9%)	2(4%)	3(5%)	-
13. Roosting place for birds	46(84%)	4(7%)	3(5%)	2(4%)	-
14. Fish wealth	45(82%)	3(5.5%)	4(7%)	3(5.5%)	-
15. Source of medicine	2(4%)	2(4%)	18(33%)	14(25%)	19(34%)
16. Source of food	1(2%)	-	16(29%)	18(33%)	20(36%)
17. Source of fodder	18(33%)	3(5%)	10(18%)	12(22%)	12(22%)
18. Source of fuel wood	3(5%)	1(2%)	13(24%)	18(33%)	20(36%)
19. Source of honey	1(2%)	1(2%)	14(25%)	20(36%)	19(35%)
20. Source of tannin	2(4%)	-	14(25%)	20(36%)	19(35%)
21. Source of manure/ bio fertilizer	6(11%)	2(4%)	14(25%)	14(25%)	19(35%)
22. Source of materials for thatching roofs, mats& baskets	1(2%)	1(2%)	13(24%)	19(34%)	21(38%)

Note: Figures in parentheses indicate % to row total

Protection from tsunami/ cyclone/ flood are the major services that protect from various extreme weather events which happens drastically and causes loss of life. For this, 56% responded as highly relevant, 15% responded as moderately relevant, 15% responded as less relevant, 5% have no decision and the remaining 9% responded as not relevant. Reducing soil erosion is one of the most important services provided by the mangroves and for this 87% of respondents marked as highly relevant, 2% responded as moderately relevant, 5% responded as less relevant, 4% have no decision and the remaining 4% responded as not relevant. Protecting from the UV-B radiation is a service provided by the mangroves. By using their metabolic compounds called flavonoids, they absorb the UV-B radiations into leaves and stems. For this service, 62% responded as highly relevant, 13% responded as moderately relevant, 9% responded as less relevant and 16% have no-decision. (Response to question number 6 and 9 mainly depend on their experience:-cooling effect even in the hot summer).

Protection against sea-level rise - mangrove acts as protective shield against sea-level rise and reduces the intensity of tidal amplitude or its action. About 45% responded as highly relevant, 11% responded as moderately relevant, 20% responded as less relevant, 15% have no decision and the remaining 9% responded as not relevant. The mangrove forest is source or sink of dissolved nutrients through tidal exchange and hence being a 'nutrient sink' is also another important service. About 64% of respondents marked this service as highly relevant, 20% responded as moderately relevant, 2% responded as less relevant and 14% have no-decision.

The mangroves serve as breeding and nursery ground for fishes and many other invertebrates. About 82% responded as highly relevant, 9% responded as moderately relevant, 4% responded as less relevant and 5% have no-decision. The roosting place for birds is an important service, as the birds also depend on mangroves for their food and shelter. About 84% responded as highly relevant, 7% responded as moderately relevant, 5% responded as less relevant and 4% have no-decision. The mangrove habitats have high fish production values and

for this service, 82% responded as highly relevant, 5.5% responded as moderately relevant, 7% responded as less relevant, 5.5% have no-decision. Most of the services provided by the mangroves help in mitigation of climate change and for maintaining a sustainable environment.

The next set of rankings is for the various goods that can be obtained from various mangrove species and by utilizing various parts of the mangrove. Source of medicine - mangrove is a good source of medicine for curing various diseases. For this service, 4% responded as highly relevant, 4% responded as moderately relevant, 32% responded as less relevant, 25% have no decision and the remaining 34% responded as not relevant. Source of food: various fruits obtained from the mangroves are consumed. About 2% responded as highly relevant, 29% responded as less relevant, 33% have no decision and the remaining 36% responded as not relevant. Source of fodder: leaves of various species of mangroves are reliable for the ruminant animal's consumption. About 33% responded as highly relevant, 5% responded as moderately relevant, 18% responded as less relevant, 22% have no decision and the remaining 22% responded as not relevant. Source of fuelwood: mangrove wood have high calorific value and for this, 5% responded as highly relevant, 2% responded as moderately relevant, 24% responded as less relevant, 33% have no decision and the remaining 36% responded as not relevant.

Source of honey: flowers of various species provide honey for insects in search for the nectar. For this service, 2% responded as highly relevant, 2% responded as moderately relevant, 25% responded as less relevant, 36% have no decision and the remaining 35% responded as not relevant. Source of tannin: various species have tannin content which can be extracted for various purposes. About 4% of the respondents responded as highly relevant, 25% responded as less relevant, 36% have no decision and the remaining 35% responded as not relevant.

Source of manure/biofertilizer: leaves, barks of various species are used to increase the fertility of the soil. About 11% responded as highly relevant, 4%

responded as moderately relevant, 25% responded as less relevant, 25% have no decision and the remaining 35% responded as not relevant. Source of materials for thatching roofs, mats and baskets: different parts of various species of mangroves are used to make different useful and handicraft materials. About 2% responded as highly relevant, 2% responded as moderately relevant, 24% responded as less relevant, 34% have no decision and the remaining 38% responded as not relevant.

Due to the existing rules and regulations for the conservation and management of mangrove ecosystems, people do not cut mangroves. Mangroves are protected by law and hence conservation efforts will be fruitful.

4.2.7. Current status

Kolavipalam is a coastal village with natural as well as planted mangroves. The current status of mangrove ecosystem was surveyed (fig. 4.3). About 78% of respondents expressed that the condition of mangroves have improved, while 20% felt that the condition has depleted and remaining 2% expressed that there has been no change.

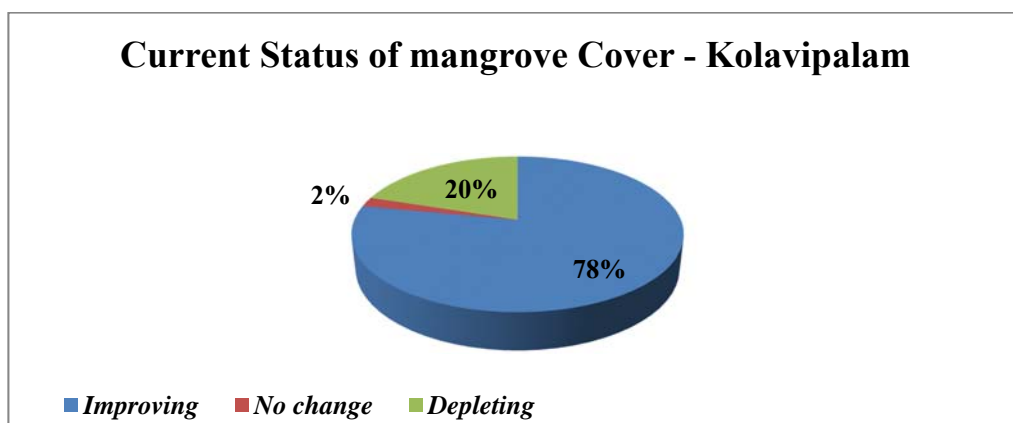


Fig. 4.3. Status of Kolavipalam mangrove wetland as perceived by the stakeholders

For the improvement of mangrove ecosystem, the respondents listed out certain reasons such as more plantation activities (fig. 4.4), no anthropogenic disturbances, water availability, favourable tidal action and efficient conservation activities initiated by *Theeram Prakrithy Samrakshana Samithy*. For the

depletion also, the respondents listed out some points like sandbar formation which reduces the flow of water in the estuary, high sedimentation rate which causes the death of mangrove due to smothering of pneumatophores, discharge of polluted water from the agricultural land which contain pesticides and fertilizers, discharge of industrial effluents and other anthropogenic activities.



Fig. 4.4.Planted mangroves (*Rhizophora mucronata*) at Kolavipalam

4.2.8.Destruction activity and reasons for destruction

To find out if there is any destruction activity in Kolavipalam mangrove wetland, 95% of the respondents answered “no” and only 5% of respondents responded “yes”. The response of the respondents to the destruction of mangroves and the reasons for the destruction is given in fig. 4.5and Table 4.11 respectively.

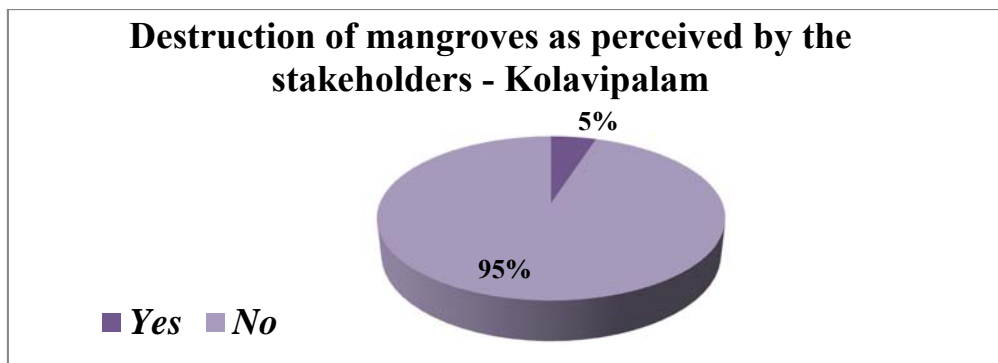


Fig.4.5. Destruction of mangroves as perceived by the stakeholdersat Kolavipalam

Reasons for the destruction of mangroves in the study area were categorized into five reasons and ranked upon their priority (Table 4.11).

Table 4.11. Reasons for mangrove destruction: Ranking by the stakeholders

Sl.No.	Particulars	Rank
1.	Climate Change	3
2.	Forest fire	4
3.	Destruction of mangroves for alternate uses	2
4.	Cutting for tourism promotion	5
5.	Large-scale exploitation of mangrove trees for fuelwood and fodder	1

Large-scale exploitation of mangroves trees for fuelwood and fodder' (collect twigs, timber for fuel, leaves of *Avicennia* used as fodder) scored rank 1. 'Destruction of mangroves for alternative uses' was given the second rank. Alternative uses such as use of *Acanthus ilicifolius* as biofertilizer, especially for coconut plantations; utilisation of leaves of *Avicennia* spp., *Sonneratia* spp. and *Bruguiera* spp. as fodder; use of *Kandelia candel* leaves as coverage for 'ada' preparation, a traditional food item cooked in steam; use of *Avicennia* burned smoke to cure Asthma, *Acanthus ilicifolius* tender plant parts when ground and turned into paste and applied to throat for curing goitre like diseases, *Excoecaria agallocha* roots and stem used for making traditional nets for fish catch, the seeds of *Kandelia candel* cut and made into ornaments such as bracelets, pendant, chain, earring etc., by using these ornaments people believe that it will satisfy their various wishes or dreams into reality, tannin in *Rhizophora* help to strengthen the line of hook and line for catching fish are common.

The 'climate change' is ranked as the third reason for the destruction of mangroves. The major causes of climate change also affect the health of mangrove ecosystem. This may be by two means: natural and anthropogenic. Natural effects like sand bar formation due to changes in the tidal action, changes in the natural flow of the river and the anthropogenic activities including dumping of plastic wastes, slaughterhouse wastes, agricultural wastes, discharge of pollutants from various factories and automobiles, etc. The fourth rank is for

the “forest fire”. The natural cause for spreading of forest fire is very few. But anti-social activities lead to uncertain generation of forest fire. Last but not the least is ‘cutting for tourism promotion’. For the promotion of tourism, destruction of mangroves in Kolavipalam is a very rare scene.

4.2.9. Scenario, if mangroves are completely destructed

For the question “If mangroves in your locality are completely destroyed, will it affect your life and locality?” More than half of the respondents (about 56%) answered “yes” and the remaining 44% replied as “no”. They clarified and substantiated their answers with their knowledge, life experiences and various case studies which they have heard. Those who responded “yes” sketched out various reasons for their comment - the mangrove ecosystem help to maintain water quality, prevent saltwater intrusion, increases the fish wealth by providing nursery ground, sedimentation activity, prevent soil erosion, protect from cyclone, tsunami, shoreline protection etc.

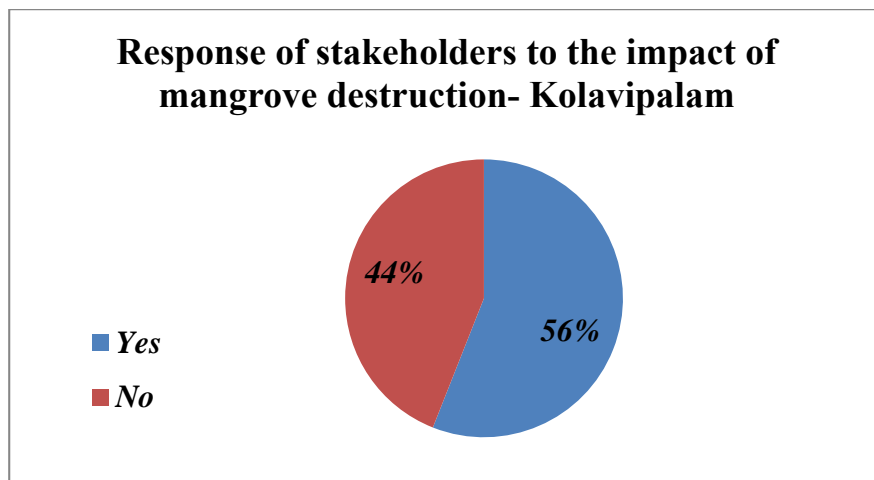


Fig.4.6. Response of stakeholders to the impact of mangrove destruction at Kolavipalam

And those who responded “no” to the questions also tried to substantiate their approach by listing out various reasons. They said that the roots of mangroves trap lot of water and because of this it emanates obnoxious smell. Some of the respondents informed that the sandbar formation at estuarine mouth is mainly due to the mangroves, reducing the rate of flow of water which also

poses difficulty for easy transportation of fishing crafts. Inside the mangrove forests, presence of poisonous snakes, stray dogs, monitor lizards and mongoose have become nuisance and threat to the local community.

4.2.10. Perception of stakeholders in conservation of mangroves

When the local communities were asked about their interest and commitment for the conservation of mangroves, 32% of respondents showed great degree of interest to get involved in conservation activities, while 22% respondents mentioned that they are only moderately interested. So more than half of the respondents were interested to get involved in conservation and management program and take initiative for the conservation activities. But unfortunately remaining 42% did not show any interest towards conservation actions.

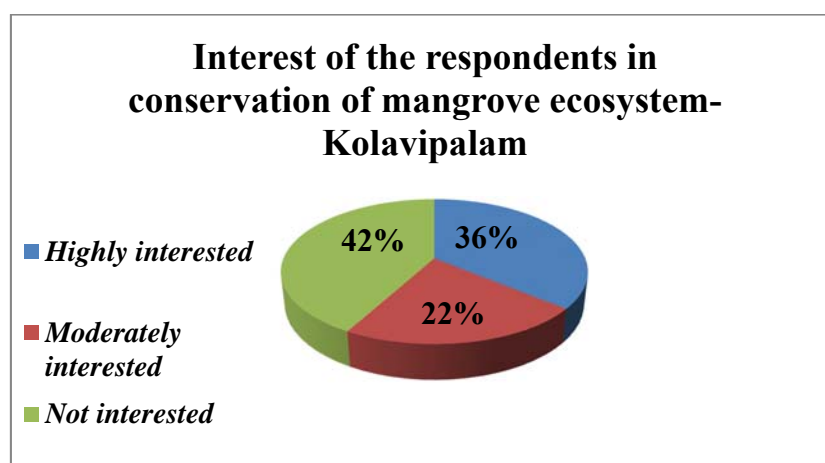


Fig. 4.7. Interest of the respondents in the conservation of mangrove ecosystem

The interested respondents were asked to give the reasons and rank them. (Table 4.12). Conserving existing one, planting saplings, giving awareness to the local community are the various options they chose in the order of priority for the conservation of mangroves. For conserving the existing one, 28% marked rank-1, 66% marked rank-2 and remaining 6% marked rank-3. For the planting of saplings, 56% chose as rank-1, 22% chose as rank-2 and the remaining 22% chose as rank-3. The last option in conservation and management is that giving

awareness to local community, rank-1 labeled by 16%, rank-2 labeled by 12% and the remaining 72% labeled as rank-3.

Table 4.12. Reasons for the interest of stakeholders

Sl.No.	Particulars	Rank 1	Rank 2	Rank 3
1.	Conserve existing one	9(28%)	21(66%)	2(6%)
2.	Planting saplings	18(56%)	7(22%)	7(22%)
3.	Give awareness to local community	5(16%)	4(12%)	23(72%)

Note: Figures in parentheses indicate % to row total

4.2.11. Turtle nesting status

According to the perception of the local community of Kolavipalam, turtle nesting has declined gradually with no doubt shown in fig. 4.8. They also revealed many reasons for the decline which clearly shows in table 4.13.

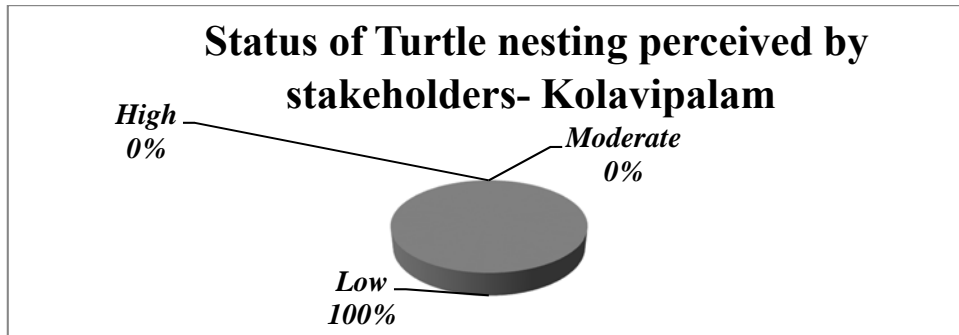


Fig. 4.8. Status of turtle nesting perceived by the stakeholders



Fig. 4.9 Visit to the Marine Turtle Interpretation Centre, Kolavipalam

Table 4.13. Status of turtle nesting at Kolavipalam from 1998-2019

Year	No. of turtles	No. of eggs laid	No. of young ones released
1998 – 1999	52	4501	3328
1999 – 2000	65	5843	4900
2000 – 2001	65	6264	5508
2001 – 2002	51	5605	4646
2002 – 2003	48	5255	4692
2003 – 2004	26	3171	2826
2004 – 2005	8	894	740
2005 – 2006	8	738	544
2006 – 2007	23	2040	1766
2007 – 2008	9	944	733
2008 – 2009	6	820	710
2009 – 2010	11	1214	947
2010 – 2011	7	707	406
2011 – 2012	10	1054	760
2012 – 2013	5	527	439
2013 – 2014	6	645	475
2014 – 2015	6	770	254
2015 – 2016	4	322	248
2016 – 2017	3	292	176
2017 – 2018	2	173	26
2018-2019	2	154	67

Source: *Theeram Prakrithi Samrakshana Samithi*

* Species is mostly the Olive Ridley turtles

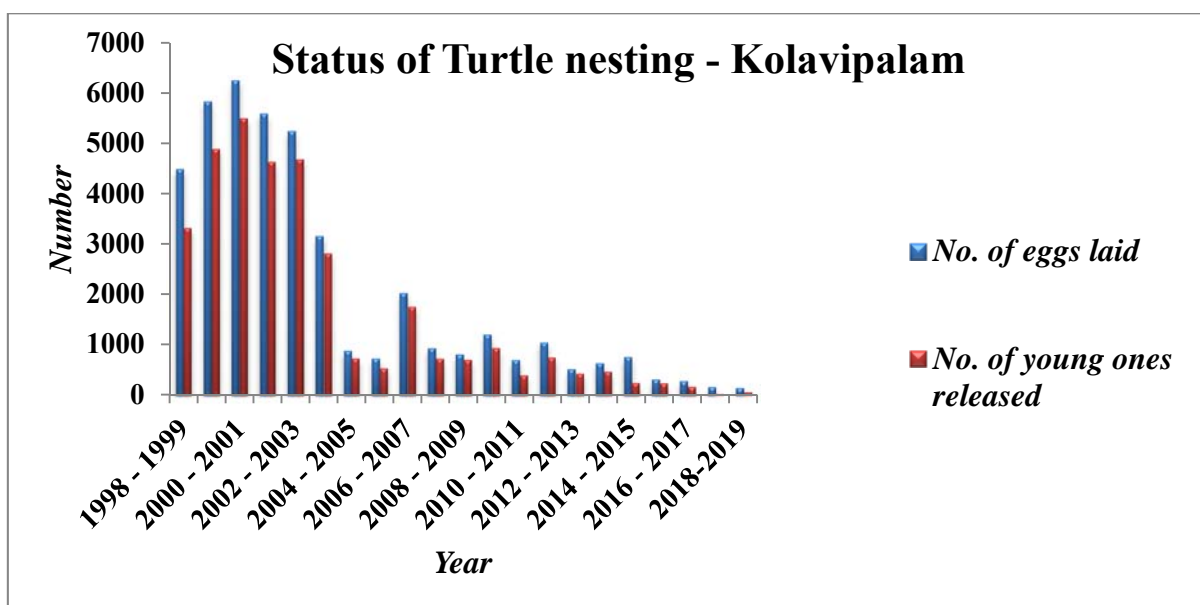


Fig. 4.10 Status of turtle nesting at Kolavipalam from 1998-2019

Kolavipalam beach which is also known as ‘Turtle Beach’ is located south of the Murad river. Most of the turtles that reach the beach are the Olive Ridley turtles (*Lepidochelys olivacea*). Kolavipalam, for many years is well known for turtle nesting and turtle conservation. Some local people are involved in conservation of marine turtles in association with a nature club namely *Theeram Prakrithi Samrakshana Samithi* with the support of the Forest Department. The turtle conservation center also carries out rescue operations of injured turtles. The turtles that are injured are brought to the conservation centre, treated and released back. The fishermen community in this region made a great effort, has in a short period, gained a great achievement, for the conservation of turtles and coastal ecosystem of the area. *Theeram Prakrithi Samrakshana Samithi* (Coastal Ecosystem Protection Committee) is the product of a fishing community at Kolavipalam, Kerala, that organize to protect the coastal biodiversity especially turtles and mangroves. The present study regarding turtle nesting mainly focused on the status of turtle nesting and includes the number of turtles reached the shore for nesting, number of eggs laid, number of turtles released and also tried to find out the reasons for the declining trend in nesting. Figure 4.7 is the secondary data collected from the *Theeram Prakrithi Samrakshana Samithi* which gives the status of turtle nesting from the period 1998-1999 to 2018-2019. The results show an alarmingly declining trend from 1998-1999 (52 turtles reached the shore for nesting, 4501 eggs laid, 3328 young ones released) to 2018-2019 (nesting by 2 turtles, 154 eggs laid, 67 young ones released). This study found that the decline in turtle nesting is due to various reasons such as the reduction in beach area due to construction of a seawall, death of turtles trapped in fishing nets, poaching for meat or killed as a revenge for destroying the nets. Illegal sand mining, beach erosion, coastal afforestation, accelerated coastal development in the form of seawall, tourism are the major threats to the turtle habitat and nesting sites. The study comes out with few recommendations that include i) organizing awareness programmes and campaigns for turtle conservation, ii) banning of illegal sale of meat and eggs, iii) provide financial support for the Coastal Ecosystem Protection Committee like *Theeram* for turtle

conservation, iv) shoreline protection using geotextiles, v) conduct coastal clean-up programmes, vi) curbing the contamination of coastal area by dumping of waste including release of industrial effluents and vii) strengthening the coordination between the concerned authorities for strict vigilance of sand mining in the coast, illegal trawling, *etc.*

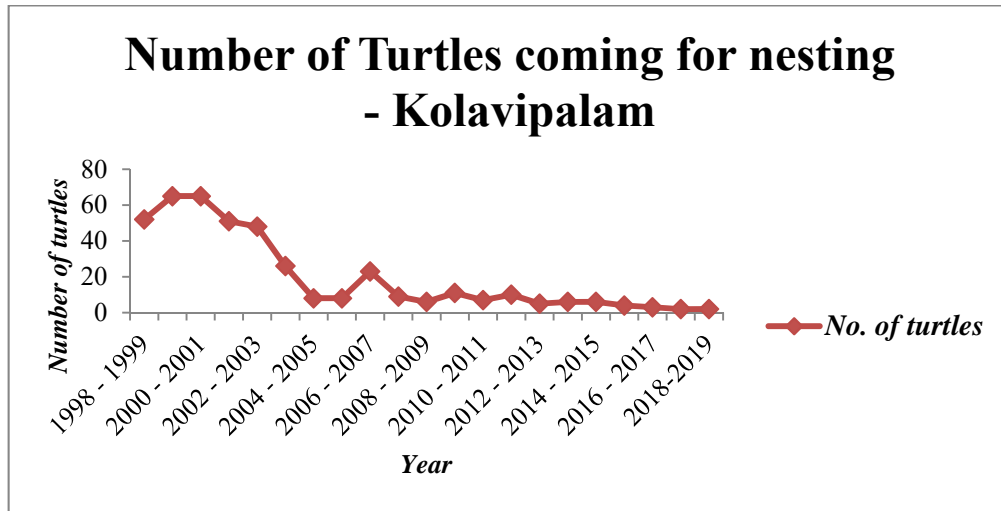


Fig. 4.11. Graph showing the number of turtles coming for nesting in Kolavipalam beach

Of late, due to the construction of seawall along the Kolavipalam beach, the number of turtles that come here for nesting have dwindled alarmingly. While asking about the status of turtles nesting in the Kolavipalam coastal area (in recent years), all the respondents responded univocally that the turtle nesting has come down in the recent years. According to the local people, various reasons for the decline in turtle nesting include both natural and anthropogenic factors. Natural factors include beach erosion as a result of which turtles have lost their beach area for egg-laying. Anthropogenic factors include, illegal sand mining from seashore, construction of sea wall, incidental catch of turtles in fishing nets, ghost fishing, pollution, and destruction of laid eggs by humans, birds, dogs, etc. Also the human interference or presence at the time of laying eggs will lead to withdrawal of laying eggs in the shore.



(a)

(b)

Figure 4.12 Turtles conserved in Marine Turtle Interpretation Centre

Fig 4.12(a) Hatchlings ready to be released to the sea

Fig 4.12(b) badly injured rescue and rehabilitate by stakeholders

4.3. ANALYSIS OF SOCIO-ECONOMIC SURVEY - KOLAVIPALAM

Socio-economic survey was conducted at Kolavipalam and a total of 52 households have been surveyed (Questionnaire is included as Annexure 1). The socio-economic studies were conducted to understand the demographic details such as standard of living, family details, income, fishing details like crafts and gears used, investment, operating cost, fishing days, expenditure pattern, indebtedness etc. The total population of the 52 households was 241 members.

4.3.1. Respondents' occupational status

Respondents are those who respond to the questions that are asked for the socio-economic analysis. Regarding the occupational status (Table 4.14), about 75% of the respondents depend on fishing and allied sectors. Kolavipalam being a coastal village, the people were found to depend mostly on the productive wetland and coastal ecosystem for their needs. Seven per cent of the respondents are involved in labour work such as construction work, agricultural fieldwork, etc. and 4% of respondents are teachers. The remaining 14% are involved either as boat drivers (2%), carpenters (2%), coir labourers (2%), drivers (2%), shopkeepers (2%), toddy tappers (2%) and ration shop licensee (2%) as their

primary occupation. As income from fishing is not sufficient, some fishermen take up other avocations like auto driver (8%), boat driver (22%), bus cleaner (8%), business(fish) (8%), construction worker (15%), cook (8%), hotel worker (8%), labour work (15%) and musician (8%) jobs during the lean fishing seasons (Table 4.15).

Table 4.14. Primary occupation of the respondents at Kolavipalam

<i>Primary Occupation</i>	<i>No.</i>	<i>% to total</i>
Boat Driver	1	2
Carpenter	1	2
Coir labour	1	2
Driver	1	2
Fishing	39	75
Labour	4	7
Ration shop(licensee)	1	2
Shop keeper	1	2
Teacher	2	4
Toddy tapper	1	2
Total	52	100

Table 4.15. Secondary occupation of the respondents at Kolavipalam

<i>Secondary Occupation</i>	<i>No.</i>	<i>% to total</i>
Auto driver	1	8
Boat Driver	3	22
Bus cleaner	1	8
Business (fish)	1	8
Construction worker	2	15
Cook	1	8
Hotel worker	1	8
Labour	2	15
Musician	1	8
Total	13	100

4.3.2 Educational status of the people of Kolavipalam

Analysis of the educational status revealed that 2.90% of the people are illiterate(due to poor living conditions and other miserable life situations) and the remaining 97.1% are educated. The literate group include children going to Kindergarten(0.83%), those attained Lower Primary(LP) education (17.01%), Upper Primary(UP) education (14.93%), High School(HS) level (10.79%),

passed Secondary School Leaving Certificate(SSLC) or Matriculation level (22.82%), Higher Secondary(HSC) level (12.45%), diploma holders (1.66%), Under Graduation(UG) (6.64%), and Post-Graduation(PG) level (1.24%). The remaining 8.71% were in the pre-schooling stage. (Table 4.16)

Table 4.16. Educational status of the people of Kolavipalam

<i>Educational status of family</i>		
Level	No.	% to total
Illiterate	7	2.90%
Nursery (Kindergarten)	2	0.83%
Lower Primary	41	17.01%
Upper Primary	36	14.93%
High School	26	10.79%
SSLC passed	55	22.82%
Higher Secondary	30	12.45%
Diploma	4	1.66%
Graduation	16	6.64%
Post-graduation	3	1.24%
Children prior to age of schooling	21	8.71%
Total	241	100

4.3.3 Occupation of the people of Kolavipalam

Most of them engage in various occupations according to their willingness and physical condition (Table 4.17). Thirty nine per cent of the people are involved in various labour work(39%), 25% are engaged in fishing activities, 8% of the people work as drivers, 6% execute their business and 4% of the people work as carpenters. The remaining 8% work as either coir makers (2%), teachers (2%), clerks (2%) or employed abroad (2%). Unfortunately 10% of them are unemployed youth.

Table 4.17. Occupation of the people of Kolavipalam

Occupation	No.	% to total
Fishing	12	25
Labour	19	39
Carpentry	2	4
Driver	4	8
Business	3	6
Coir maker	1	2
Teacher	1	2
Clerk	1	2
Abroad	1	2
Unemployed youth	5	10
Total	49	100

4.3.4 Status of family

Among the ration card holders, 38 households were holding Below Poverty Line(BPL) cards while 13 households were possessing the Above Poverty Line(APL) ration cards and one of them does not possess the ration card. All of them possess Aadhaar card and bank account. Forty-four respondents have membership in micro-finance like Kudumbasree (Self Help Group, SHG) and 8 does not possess any membership positions. About 34 respondents have membership in co-operative society such as Matsyafed and 18 does not have any membership. Thirty nine households avail the benefit of Liquefied Petroleum Gas(LPG) subsidy for the purchase of cooking gas cylinder and 13 does not avail LPG subsidy. Only 13 samples (including family members) have leadership positions such as President, Secretary, Treasurer, etc. in Kudumbasree (SHG), *Theeram Prakrithi Samrakshana Samithi* and Matsyafed (Table.4.18)

Table 4.18. Status of the family at Kolavipalam

Possession of Ration card		Possession of AADHAR CARD		Having BANK ACCOUNT		Member of MICRO FINANCE group		Membership in COOPERATIVES		Availing LPG SUBSIDY		LEADERSHIP	
		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
APL	13	52	0	52	0	34	18	44	8	39	13	13	0
BPL	38	0	0	0	0	18	18	8	8	13	13	0	39
NOT POSSESSING	1												

4.3.5 Housing status

Fortunately, most of them have their own houses with basic amenities and the required household materials. Only one family resides in a rental house, but they possess their own landholdings (Table 4.19). Therefore, it was observed that there are no landless people at Kolavipalam and they live in better economic conditions. Housing pattern or type of house is considered as one of the indicators of the standard of living of the households. The households having Reinforced Cement Concrete(RCC) houses or concrete houses are considered as well to do households and those living in tiled houses have a medium level of standard of living. Those who reside in Katcha houses or thatched houses are considered as very poor. Eighty one percent of people are residing in RCC or concrete houses which indicate that most of the people lead a high standard of living. Fifteen percent of them reside in tiled houses indicating that they lead a medium status in their standard of living. The remaining 4% of people have only Katcha or thatched houses and belong to the lower strata in the standard of living. In the context of the area of houses, all houses are constructed according to their necessity and income. The area of 54% of houses are between 500 to 800sq. ft., while 23% have 800 to 1000 sq. ft. and another 23% of houses are less than 500 sq. ft. in area.

Table 4.19. House ownership status and type of housing of the residents at Kolavipalam

<i>OWNERSHIP</i>		<i>% to total</i>	<i>TYPE</i>		<i>% to total</i>	<i>AREA (sq.ft)</i>		<i>% to total</i>
RENT	1	2	THATCHED	2	4	<500	12	23
OWN	51	98	TILED	8	15	500-800	28	54
			CONCRETE	42	81	800-1000	12	23

4.3.6 Land status

Landholding of 47 households (90%) are with title deed, but the remaining 5 (10%) are without the title-deed. All the households possess their land. Four percent of the respondents have less than 5 cents of land and 48% have 6 to 10

cents. Thirty-three percent have 11 to 25 cents, while 12% have 26 to 50 cents and the remaining 4% of families have more than 50 cents. (Table 4.20).

Table 4.20. Details of landholdings of the local communities at Kolavipalam

<i>TITLE DEED</i>		<i>% to total</i>	<i>AREA (cents)</i>		<i>% to total</i>
With title deed	47	90	0	0	0
Without title deed	5	10	<5	2	4
			6 to 10	25	48
			11 to 25	17	33
			26-50	6	12
			>50	2	4

4.3.7 Family status

There are two types of family: the joint and nuclear family. Half of the families are joint and the remaining half is nuclear. Sixty five percent of families were big comprising of 4 to 6 persons and 25% of family size is small comprising of 1 to 3 persons and the remaining 10% are large families comprising of 7 to 10 family members (Table 4.21).

Table 4.21. Type of family and family size at Kolavipalam

<i>Family type</i>		<i>Family size</i>		<i>% to total</i>
JOINT	26	1 to 3 (small)	13	25
NUCLEAR	26	4 to 6 (big)	34	65
		7 to 10 (large)	5	10

4.3.8 Fishery status

In Kolavipalam, most of the people depend on fishery sector for their livelihood. According to the survey, 12 persons have fully owned crafts and 3 have partially owned (shared basis) crafts. The gears used by the fishermen community of Kolavipalam region are drift net(1), gill net(9), cast net(8), ring seine(2), hooks and line(1), stake net(3) {figures in bracket represents the number of fishermen who use that type of nets} (Table 4.22).

Table 4.22. Number of fishermen who possess crafts (ownership) and various types of gears: Kolavipalam

Gears	Drift net	1
	Gillnet	9
	Cast net	8
	Ring seine	2
	Hooks & line	1
	Stake net	3
Crafts	Fully owned	12
	Partially owned	3

4.3.8 Loan and financial survey

Out of the 52 respondents, 15 were taking loans from financial institutions to fulfill their needs. Surveys have shown that people avail loan for various purposes including investment in fishery sector (buying crafts, gears and other components needed for fishing), buying new vehicle, for housing (house construction, house maintenance), for education, for personal needs (marriage, purchase of home appliances). About 27% of people avail loan for investment in fishery sector and for personal needs, while 20% avail loan for purchase of vehicle and for housing. Only 6% take loan for educational purposes (Table 4.23).

Table 4.23. Purpose for which loan is availed from financial institutions: Kolavipalam

LOAN		
<i>Purpose</i>	<i>No.</i>	<i>Percentage (%)</i>
Fishery	4	27
Vehicle	3	20
Personal	4	27
House	3	20
Education	1	6

During the survey, ranking was done to ascertain as to whom the local people contact when they are in need of money. The details were listed in ranking charts and prioritised. Many of them (46%) ranked rank-1 (R1) for the Co-operative Society and 54% ranked rank-2 (R2) for Self Help Group (SHG). About 48%

ranked rank-3(R3) for Public Bank. Rank-4 i.e. private bank was opted by 35%.
(Table: 4.24)

Table 4.24. Ranking (contact, when need of money): Kolavipalam

RANKING(Contact, when need of money)	Rank	No.	% to total
Money lender	R1	6	12
	R2	0	0
	R3	10	19
	R4	18	35
	R5	12	23
	R6	6	12
Self Help Group	R1	12	23
	R2	28	54
	R3	8	15
	R4	3	6
	R5	1	2
	R6	0	0
Cooperative Society	R1	24	46
	R2	18	35
	R3	7	13
	R4	3	6
	R5	0	0
	R6	0	0
Private bank	R1	4	8
	R2	0	0
	R3	2	4
	R4	18	35
	R5	9	17
	R6	19	37
Public bank	R1	6	12
	R2	0	0
	R3	25	48
	R4	6	12
	R5	12	23
	R6	3	6
Auctioneer	R1	0	0
	R2	6	12
	R3	0	0
	R4	5	10
	R5	19	37
	R6	22	42

R1-Rank 1, R2-Rank 2, R3-Rank 3, R4-Rank 4, R5-Rank 5, R6-Rank 6

4.3.9 Income and Expenditure pattern analysis

A detailed study was made to understand the annual income and expenditure pattern of various households. For understanding the expenditure pattern, the recurring costs were taken into consideration. The annual income less than Rs.50,000 is about 9.5% which was considered as a relatively very poor

income group. About 46% of people have an annual income of about Rs.50,000 to Rs.1,00,000. Fifteen percent of people had an annual income of Rs. 1,00,000 to Rs.2,00,000, while 9.5% of them had an annual income of Rs.2,00,000 to Rs.3,00,000. Remaining 6% of the households had a comparatively high-income of Rs.3,00,000 to Rs.5,00,000. (Table: 4.25)

Among the families with an annual income of less than Rs.50,000, most of the income were spent on food, 25% for medical needs, 9% for education, 6% for clothing, 5% for social obligations, 4% for fuel, 2% for rent(house) and 12% for other expenses,. In the case of families with an annual income of Rs.50,000 to Rs.1,00,000, the expenditure pattern was 45% for food, 13% for medical purpose, 11% for education, 7% for both clothing and social obligations, 3% for fuel and 14% for other purposes. In the next category of annual income 1,00,000 to Rs.2,00,000, the families spent 46% for food, 10% for medical purposes, 9% for clothing, 8% for both education and social obligations,3% for fuel and 16% for other needs. Families with an annual income of Rs.2,00,000 to Rs.3,00,000, 47% of the expenditure was made for food, 14% for clothing, 12% for medical requirements, 8% for social obligations, 3% for fuel and 16% for other requirements. In the income category of Rs.3,00,000 to Rs.5,00,000, 37% expenditure was for food, 16% for medical requirements, 11% for clothing, 9% for social obligations, 4% for education, 3% for fuel and 20% for other purposes. From the analysis, it was found that all categories of people spent more money to meet their requirement for food.

Income and Expenditure Analysis

Table 4.25. Income and expenditure pattern (% to the total-avg)

Annual Income (Rs.)	Class	Sample size	% to total	Expenditure pattern(avg)							
				Food (Rs) (% in bracket)	Fuel (Rs) (% in bracket)	Rent (Rs) (% in bracket)	Clothing (Rs) (% in bracket)	Education (Rs) (% in bracket)	Med (Rs) (% in bracket)	Social (Rs) (% in bracket)	Others (Rs) (% in bracket)
<50,000	Very low	5	10%	18,200 (46%)	1,560 (3%)	1,000 (2%)	2,100 (4%)	4,000 (7%)	9,600 (24%)	1,940 (3%)	4,600 (11%)
50,000-1,00,000	Low	24	45%	24,792 (45%)	1,808 (3%)	0	4,979.167 (7%)	6,827(11%)	7,671(13%)	4,125(7%)	7,708(14%)
1,00,000-2,00,000	Medium	15	29%	27,067 (46%)	1,757 (3%)	0	6,160(9%)	6,078(8%)	6,180(10%)	4,927(8%)	9,840(16%)
2,00,000-3,00,000	High	5	10%	30,200 (47%)	2,100 (3%)	0	9,600 (14%)	0	7,940 (12%)	5,200 (8%)	10,960 (16%)
3,00,000-5,00,000	Very high	3	6%	38,333 (37%)	3,500 (3%)	0	12,667 (11%)	6,500 (4%)	16,667 (16%)	8,667 (9%)	21,667 (20%)

4.4 IMPACTS AFFECT COASTAL ENVIRONMENT AND MANGROVE ECOSYSTEM

Mangroves also process huge amounts of organic matter, dissolved nutrients, pesticides and other pollutants which are dumped into mangrove regions due to various anthropogenic activities (Upadhyay *et al.*, 2002). Wetland destruction and degradation are reducing the area of wetlands, resulting in the decrease in population of various flora and fauna. Increasing use of wetlands for various purposes is altering the characteristics and dynamics of the entire wetland ecosystem. Threats include over-exploitation of wetland resources, drainage and siltation of wetlands and aquaculture. Wetlands are also polluted by sewage, industrial effluents, agricultural fertilizers, pesticides, plastic pollutants etc

Kolavipalam was identified as one of the major coastal erosion hotspots along the southwest coast of India. Wave overtopping in the affected area and the seawall is partially and completely damaged in Kolavipalam region. Erosion at Kolavipalam is an example for 'fishing gap erosion' (Noujas and Thomas, 2015). Seawall construction along the shore that alters turtle nesting area from sandy to rocky, incidental capture of turtle during fishing operation, nest depredation by feral animals leads to the alarming decline of olive ridley turtle nesting ground and its population in Kolavipalam. (Thirumalaiselvan *et al.*, 2018).



Fig. 4.13 Partially destroyed seawall and uprooted trees due to beach erosion

Various issues faced by the local people residing in Kolavipalam village are illegal sand mining, beach erosion, partially or fully destroyed sea wall, sand

accretion, fishing gap erosion, dwindling rate of turtle nesting, declined fish catch, migration of fishes into deeper oceans, vanishing of various species of fishes. Illegal sand mining affects the natural flow of the river. The local people perceive that a decline in the fish catch is due to increased sea surface temperature and over-exploitation by trawlers in the coastal and inshore waters. Migration of fishes to deeper oceans due to increased temperature is also a cause for the decrease in fish availability in the inshore waters. Many species of fishes which were available in the past are not available at present. Some fishes like koomansravu, kakkatherandi (*Mobula* spp.), chuvannakora (*Nemipterus randalli*), redmullent, navuetta, mullan (*Leiognathus* spp.), vala (*Chirocentrus dorab*) and some species of shrimps have disappeared, according to fishermen.

4.5 GENERAL ANALYSIS - KOLAVIPALAM

Kolavipalam is a coastal village and so most people primarily depend on fishery sector for their basic livelihood needs. The local community is educated at basic level to Post-Graduate level. Majority of people have an occupation to meet their various basic needs. They are involved in different occupations in different strata of occupational status. They are aware and updated about social and political conditions of society, possess ration card, Aadhaar card, bank account and have membership in various micro-finance and co-operative societies. Local communities give priority to family relationships and maintain a strong bond within the community. They join their hands together for many local issues. All of them possess their landholdings. Out of the 52 families, 51 are living in their own houses. Some people depend on fishery and have their own crafts and gears. The number of people who avail loans is less. The majority borrow money from the co-operative bank which is the first priority and Self Help Group (SHG) which is the second priority. According to their income, most of them are categorized under the middle class. Very few come under the extremely low and extreme high-class people. Generally, the attitude of the people was supportive and helpful. They showed tremendous interest during the survey, in answering the questionnaire.

4.6 BIODIVERSITY DOCUMENTATION OF KALLAI

Since time immemorial, wetlands have provided sustenance to humans, not to talk about a large array of other life forms. Mangrove ecosystem act as a reservoir of various species of fauna and associated flora. Biodiversity research is a major concern for researchers and policymakers concerning biodiversity conservation and sustainable development. So the identification and conservation of these coastal wetlands are crucial for the welfare and long term sustenance of humans and other associated species.



Fig. 4.14 Field visit to Kallai estuary

The estuarine premises of these rivers are almost entirely devoid of mangroves, owing to varied kinds of pressures from urban settlements, port development and other industrial activities. As part of the port facility enhancement at Beyport Port, dredging-cum-deep trenching works of the river channel, at the estuary, is a recurring periodic practice, with the result that natural hydrologic process of silt/sediment deposition at the river mouth has, forever, come to stand still, with the resultant stoppage of any kind of natural deltaic aggradations processes facilitating the growth or regeneration of mangroves. In the Kallai river, the natural process of alluvial sediment transport/deposition in the estuarine habitat environs have practically ceased because of the ubiquitous practice of a large number of timber saw-mills on either side of the river banks, dumping tons of commercial timbers in the river stretch, considerably blocking the sediment transport to the estuary. The Kallai, from time immemorial

associated with its timber industry has been a famous, trading centre to the entire Middle East(Radhakrishnan *et al.*, 2006)

4.6.1 Mangroves and mangrove associates

A considerable stretch of both Kallai and Chaliyar riversides along with their upriver courses from the estuaries, exhibit highly disrupted strip or fringe mangroves of varied structural configuration from shrubby thicket to woody vegetation. These patches are mostly predominated with the species *Avicennia officinalis* with an admixture assemblage of other halophytic plants in varying stages of growth, even with secondary level succession or stunted appearance(Radhakrishnan *et al.*, 2006).

During the present study, 5 species of true mangroves and 4 mangrove associates were recorded from the Kallai mangrove wetland. True mangrove species belonged to 4 genera and 4 families. Table 4.26 illustrates the species, family, common name, vernacular name and table 4.27 illustrates mangrove associates

Table 4.26. Mangrove species recorded in Kallai

MANGROVE SPECIES	FAMILY	COMMON NAME	VERNACULAR NAME
<i>Acanthus ilicifolius</i> L.	Acanthaceae	Holly-leaved acanthus, Sea holly, Holly mangrove	Chullikandal
<i>Avicennia marina</i> (Forssk.) Vierh	Acanthaceae	Grey mangrove, White mangrove	Cheruppotti, Chakkapoo. Charakandal
<i>Avicennia officinalis</i> L.	Acanthaceae	Indian mangrove, Grey mangrove	Uppotti, Uppatti, Orayi, Uppootha
<i>Excoecaria agallocha</i> L.	Euphorbiaceae	Milky mangrove, River poison tree Blind your eye mangrove, Blinding mangrove	Kannampotti Kambatti
<i>Rhizophora mucronata</i> Lam.	Rhizophoraceae	Red mangrove, Asiatic mangrove	Branthankandal , Panachikandal

Table 4.27. Mangrove associates of Kallai

MANGROVE ASSOCIATES	Family	Local Name	VERNACULAR NAME
<i>Derris trifoliata</i> Lour	Fabaceae	Sea derris	Ponnumvalli, Karimeenvalli
<i>Flagellaria indica</i> L.	Flagellariaceae	Whip vine	Pambhuvalli
<i>Acrostichum aureum</i> (L)	Pteridaceae	Golden leather fern	Machithol
<i>Volkameria inermis</i> (L.) Gaertn.	Verbenaceae	Sea jasmine	Puzhamulla, Cherichinna

4.6.2 Fishes in Kallai

Major fauna associated with the mangrove-lined wetland system is the fishes, mostly the marine forms frequenting the brackishwater systems in the tidal inflows. Local fishermen amply make use of the premises of mangrove-lined river stretch for their fishing activities since fishes in good diversity and abundance are available in these stretches of both the rivers (Radhakrishnan *et al.*, 2006). Major fish species available in Kallai shown in table 4.28

Table 4.28. Fish species available in Kallai

Scientific Name	Family
<i>Arius arius</i> (Hamilton,1822)	Ariidae
<i>Arius jella</i> Day,1877	Ariidae
<i>Tylosurus crocodiles</i> (Peron& Lesuer,1821)	Belonidae
<i>Alepes djedaba</i> (Forsskal,1775)	Carangidae
<i>Alepes djeddaba</i> (Forsskal,1775)	Carangidae
<i>Alepes kleinii</i> (Bloch,1793)	Carangidae
<i>Parastromateus niger</i> (Bloch,1795)	Carangidae
<i>Scomberoides tol</i> (Cuvier,1832)	Carangidae
<i>Selar crumenophthalmus</i> (Bloch,1793)	Carangidae
<i>Trachinotus blochii</i> (Lacepede,1801)	Carangidae
<i>Chanos chanos</i> (Forsskal,1775)	Channidae
<i>Chirocentrus dorab</i> (Forsskal, 1775)	Chirocentridae
<i>Anodontostoma chacunda</i> (Hamilton,1822)	Clupeidae
<i>Escualosa thoracata</i> (Valenciennes,1847)	Clupeidae
<i>Nematalosa nasus</i> (Bloch,1795)	Clupeidae
<i>Sardinella fimbriata</i> (Valenciennes,1847)	Clupeidae
<i>Sardinella gibbosa</i> (Bleeker,1849)	Clupeidae
<i>Sardinella longiceps</i> Valenciennes,1847	Clupeidae
<i>Cynoglossus bilineatus</i> (Lacepede,1802)	Cynoglossidae
<i>Cynoglossus bilineatus</i> (Lacepede,1802)	Cynoglossidae

Table 4.28 continued

<i>Dussumieria elopsoidea</i> Bleeker, 1849	Dussumieriidae
<i>Thryssa malabarica</i> (Bloch, 1795)	Engraulidae
<i>Stolephorus indicus</i> (van Hasselt, 1823)	Engraulidae
<i>Chiloscyllium griseum</i> Muller & Henle, 1838	Hemiscyllidae
<i>Lactarius lactarius</i> (Bloch & Schneider, 1801)	Lactariidae
<i>Leiognathus bindus</i> (Valenciennes, 1835)	Leiognathidae
<i>Lobotes surinamensis</i> (Bloch, 1790)	Lobotidae
<i>Uroteuthis</i> (Rehder, 1945)	Loliginidae
<i>Lutjanus argentimaculatus</i> (Forsskal, 1775)	Lutjanidae
<i>Chelon parsia</i> (Hamilton, 1822)	Mugilidae
<i>Mugil cephalus</i> Linnaeus, 1758	Mugilidae
<i>Eleutheronema tetradactylum</i> (Shaw, 1804)	Polynemidae
<i>Opisthopterus tardoore</i> (Cuvier, 1829)	Pristigasteridae
<i>Opisthopterus tardoore</i> (Cuvier, 1829)	Pristigasteridae
<i>Pellona ditchela</i> Valenciennes, 1847	Pristigasteridae
<i>Rhinobatos rhinobatus</i> (Linnaeus, 1758)	Rhinobatidae
<i>Scatophagus argus</i> (Linnaeus, 1766)	Scatophagidae
<i>Johnius dussumieri</i> (Cuvier, 1830)	Sciaenidae
<i>Otolithes ruber</i> (Bloch & Schneider, 1801)	Sciaenidae
<i>Rastrelliger kanagurta</i> (Cuvier, 1816)	Scombridae
<i>Scomberomorus commerson</i> (Lacepede, 1800)	Scombridae
<i>Scomberomorus guttatus</i> (Bloch & Schneider, 1801)	Scombridae
<i>Epinephelus diacanthus</i> (Valenciennes, 1828)	Serranidae
<i>Siganus canaliculatus</i> (Park, 1797)	Siganidae
<i>Sillago sihama</i> (Forsskal, 1775)	Sillaginidae
<i>Pampus argenteus</i> (Euphrasen, 1788)	Stromateidae
<i>Synodus indicus</i> (Day, 1873)	Synodontidae
<i>Terapon jarbua</i> (Forsskal, 1775)	Terapontidae

Source: Fisheries Resources Assessment Division (FRAD), ICAR-Central Marine Fisheries Research Institute

4.6.3 Associated faunal diversity of crustaceans, molluscs, mudskippers and snakes

4.6.3.1 Mollusks

Molluscan fauna of mangrove ecosystem and its estuary are notable in northern Kerala. Molluscs, living as filter as well as deposit feeders, constituted one of the major groups of faunal community among mud dwellers associated with the mangrove-marsh wetlands. On the intertidal mudflats flushed by tides, many molluscs were recorded. Environmental factors such as sediment grain size, tidal elevation, organic carbon and nitrogen, and bacterial density are

considered to set limits for distribution and abundance of most of these deposit feeders. Sand flats also support large populations of bivalves of some species. Some forms live buried within mud, with their protruding siphons above surface when they are covered by the tide. However, their distribution is generally patchy. A number of bivalve molluscs have been recognized as key components of the ecosystem. In the case of molluscs, the wide range of possible salinity and temperature combinations is considered as the probable reason for the success of many species in sandy/mudflat environs associated with the mangrove-estuarine systems. Mangrove-estuarine habitat environs in northern Kerala were found to have a diversity of about 29 species (Radhakrishnan *et al.*, 2006)

4.6.3.2 Crustaceans

The aquatic habitats associated with the mangrove wetlands and its surroundings, including estuaries and vast areas of brackishwater supported and sheltered the populations of crustaceans. Under these faunal categories, the communities of crabs and shrimps dominated. Studies have also shown the presence of about 20 species of crabs (Radhakrishnan *et al.*, 2006). Details of the identified species of crustaceans, molluscs, mudskippers and snakes in Kallai shown in table 4.29

Table 4.29. Identified species of crustaceans, molluscs, mudskippers and snakes in Kallai

<i>Species Name (Scientific name)</i>	<i>Family</i>
CRUSTACEANS	
<i>Dotilla blanfordi</i> (Alcock, 1900)	Dotillidae
<i>Macrophthalmus pectinipes</i> (Guerin, 1839)	Macrophthalmidae
<i>Macrophthalmus sulcatus</i> (H. Milne Edwards, 1852)	Macrophthalmidae
<i>Ashtoret lunaris</i> (Forskål, 1775)	Matutidae
<i>Uca (Austruca) annulipes</i> (H. Milne Edwards, 1837)	Ocypodidae
<i>Panulirus polyphagus</i> (Herbst, 1793)	Palinuridae
<i>Mierspenaeopsis sculptilis</i> (Heller, 1862)	Penaeoidea
<i>Penaeus monodon</i> (Fabricius, 1798)	Penaeoidea
<i>Heteropanope glabra</i> (Stimpson, 1858)	Pilumnidae
<i>Scylla serrata</i> (Forskål, 1775)	Portunidae
<i>Charybdis feriatus</i> (Linnaeus, 1758)	Portunidae
<i>Charybdis smithii</i> McLeay, 1838	Portunidae
<i>Metopograpsus messor</i> (Forskål, 1775)	Portunidae

Table 4.29 continued

<i>Parasesarma plicatum</i> (Latreille, 1803)	Sesarmidae
<i>Squilla mantis</i> (Linnaeus, 1758)	Squillidae
<i>Panilirus penicillatus</i> (Oliver, 1791)	Palinuridae
<i>Fenneropenaeus indicus</i> (H. Milne-Edwards, 1837)	Penaeidae
<i>Portunus pelagicus</i> (Linnaeus, 1758)	Portunidae
<i>Portunus sanguinolentus</i> (Herbst, 1783)	Portunidae
MOLLUSCS	
Gastropods	
<i>Clypeomorus batillariaeformis</i> (Habe & Kosug, 1966)	Cerithiidae
<i>Clypeomorus bifasciata</i> (G.B. Sowerby II, 1855)	Cerithiidae
<i>Littoraria undulata</i> (Gray, 1839)	Littorinidae
<i>Cassidula nucleus</i> (Gmelin, 1791)	Ellobium
<i>Littoraria melanostoma</i> (Gray, 1839)	Littorinidae
<i>Littoraria carinifera</i> (Menke, 1830)	Littorinidae
<i>Littoraria scabra</i> (Linnaeus, 1758)	Littorinidae
<i>Nassarius stolatus</i> (Gmelin, 1791)	Nassariidae
<i>Natica tigrina</i> (Roding, 1798)	Naticidae
<i>Neritina violacea</i> (Gmelin, 1791)	Neritidae
<i>Clithon oualaniense</i> (Lesson, 1831)	Neritidae
<i>Nerita polita</i> (Linnaeus, 1758)	Neritidae
<i>Onchidium</i> spp. (Agassiz, 1846)	Onchidiidae
<i>Cerithidea cingulata</i> (Gmelin, 1791)	Potamididae
<i>Cerithidea obtusa</i> (Lamarck, 1822)	Potamididae
<i>Cerithideopsis cingulata</i> (Gmelin, 1791)	Potamididae
<i>Telescopium telescopium</i> (Linnaeus, 1758)	Potamididae
<i>Trochus radiatus</i> Gmelin, 1791	Trochidae
<i>Turritella duplicate</i> (Linnaeus, 1758)	Turritellidae
<i>Turritella attenuate</i> Reeve, 1849	Turritellidae
Bivalves	
<i>Anadara granosa</i> (Linnaeus, 1758)	Arcidae
<i>Villorita cyprinoides</i> (Gray, 1825)	Cyrenidae
<i>Donax scortum</i> (Linnaeus, 1758)	Donacidae
<i>Perna viridis</i> (Linnaeus, 1758)	Mytilidae
<i>Crassostrea madrasensis</i> (Preston, 1916)	Ostreidae
<i>Saccostrea cucullata</i> (Born, 1778)	Ostreidae
<i>Meretrix meretrix</i> (Linnaeus, 1758)	Veneridae
<i>Paphia malabarica</i> (Dillwyn, 1817)	Veneridae
<i>Meretrix casta</i> (Gmelin, 1791)	Veneridae
<i>Meretrix meretrix</i> (Linnaeus, 1758)	Veneridae
<i>Tegillarca granosa</i> (Linnaeus, 1758)	Arcidae
<i>Hecuba scortum</i> (Linnaeus, 1758)	Donacidae
Cephalopoda	
<i>Loligo</i> sp. Lamareck, 1798	Loliginidae
<i>Uroteuthis duvaucelli</i> (D'Orbigny, 1835)	Loliginidae
<i>Cistopus indicus</i> (D'Orbigny, 1835)	Octopodidae
<i>Sepia aculeata</i> (D'Orbigny, 1835)	Sepiidae

Table 4.29 continued

<i>Sepiella inermis</i> (D'Orbigny, 1835)	Sepiidae
<i>Polyplacophora</i>	
<i>Ischnochiton winckworthi</i> (Leloup, 1936)	Ischnochitonidae
<i>Ischnochiton (Haploplax) comptus</i> (Gould, 1859)	Ischnochitonidae
MUDSKIPPERS	
<i>Boleophthalmus dussumieri</i> (Valenciennes, 1837)	Gobiidae
<i>Periophthalmus waltoni</i> (Koumans, 1941)	Gobiidae
<i>Scartelaos histophorus</i> (Valenciennes, 1837)	Gobiidae
SNAKES	
<i>Acrochordus granulatus</i> (Schneider, 1799)	Acrochordidae
<i>Gerarda prevostiana</i> (Eydoux & Gervais, 1837)	Colubridae
<i>Cerberus rynchops</i> (Schneider, 1799)	Colubridae

4.6.4 Checklist of avian fauna of Kallai

Birds are not precisely aquatic creatures but a large number of them depend vitally on the aquatic environment for their survival. In urban landscapes like Kallai, the habitat dynamics are entirely dictated by the human population and the subsequent anthropogenic activities are primarily responsible for the habitat change. The degradation caused to urban wetlands have an incalculable effect on the wildlife, water quality, hydrological cycles and other wetland functions and values. Birds prefer habitats that provide them plenty of food.

Avifauna comprises mostly of water birds of resident population, majority of which also make use of the mangrove vegetation and the habitat environs associated with it for their shelter, foraging and progeny development and sustenance. These waterbirds depend not only on small fishes as their food but also on a host of invertebrates thriving in the exposed and secluded river banks, including the muddy-marsh wetland system adjoining the mangrove stands in the Kallai River (Radhakrishnan *et al.*, 2006)

Mangroves are the roosting ground for various avian faunal species. In Kallai mangrove wetland, there are about 50 species of avian fauna; some are residents, others are migratory and the third one is local migratory. Based on their occurrence, a checklist of avian fauna of Kallai region was prepared which is shown in table 4.30

Table 4.30. Checklist of avian fauna found in Kallai

Sl No	Avian fauna	Scientific name	Family	R/M/LM**
1	House crow	<i>Corvus splendens</i> (Vieillot, 1817)	Corvidae	R
2	Large-billed Crow	<i>Corvus macrorhynchos</i> (Wagler,1827)	Corvidae	R
3	Asian koel	<i>Eudynamys scolopaceus</i> (Linnaeus,1758)	Cuculidae	R
4	Common myna	<i>Acridotheres tristis</i> (Linnaeus,1766)	Sturnidae	R
5	Jungle myna	<i>Acridotheres fuscus</i> (Wagler,1827)	Sturnidae	R
6	Rufoustreepie	<i>Dendrocitta vagabunda</i> (Latham,1790)	Corvidae	R
7	Racket-tailed drongo	<i>Dicrurus paradiseus</i> (Linnaeus,1766)	Dicruridae	R
8	Brahminy kite	<i>Haliastur Indus</i> (Boddaert,1783)	Accipitridae	R
9	Black kite	<i>Milvus migrans</i> (Boddaert,1783)	Accipitridae	R
10	White-cheeked barbet	<i>Psilipogon viridis</i> (Boddaert,1783)	Megalaimidae	R
11	Rock pigeon	<i>Columba livia</i> (J F Gmelin,1789)	Columbidae	R
12	Purple sunbird	<i>Cinnyris asiaticus</i> (Latham,1790)	Nectariniidae	R
13	Purple-rumped sunbird	<i>Leptocoma zeylonica</i> (Linnaeus,1766)	Nectariniidae	R
14	Blue-tailed bee-eater	<i>Merops philippinus</i> (Linnaeus,1767)	Meropidae	R
15	Common kingfisher	<i>Alcedo atthis</i> (Linnaeus,1758)	Alcedinidae	R
16	White-throated kingfisher	<i>Halcyon smymensis</i> (Linnaeus,1758)	Alcedinidae	R
17	Stork-billed kingfisher	<i>Pelargopsis capensis</i> (Linnaeus,1766)	Alcedinidae	R
18	Oriental magpie robin	<i>Copsychus saularis</i> (Linnaeus,1758)	Muscicapidae	R
19	Black-headed oriole	<i>Oriolus larvatus</i> (Lichtenstein, 1823)	Oriolidae	R
20	Greater coucal	<i>Centropus sinensis</i> (Stephens, 1815)	Cuculidae	R
21	Rose-ringed parakeet	<i>Psittacula krameri</i> (Scopoli,1769)	Psittaculidae	R
22	Pale-billed flowerpecker	<i>Dicaeum erythrorhynchos</i> (Latham,1790)	Dicaeidae	R

Table 4.30 continued

23	Common tailorbird	<i>Orthotomus sutorius</i> (Pennant,1769)	Cisticolidae	R
24	White-breasted waterhen	<i>Amaurornis phoenicurus</i> (Pennant,1769)	Rallidae	R
25	Ashy prinia	<i>Prinia socialis</i> (Sykes,1832)	Cisticolidae	R
26	Little egret	<i>Egretta garzetta</i> (Linnaeus,1766)	Ardeidae	R
27	Intermediate egret	<i>Ardea intermedia</i> (Wagler,1827)	Ardeidae	R
28	Great egret	<i>Ardea alba</i> (Linnaeus,1758)	Ardeidae	R
29	Cattle egret	<i>Bubulcus ibis</i> (Linnaeus,1758)	Ardeidae	R
30	Pond heron	<i>Ardeola grayii</i> (Sykes,1832)	Ardeidae	R
31	Grey heron	<i>Ardea cinerea</i> (Linnaeus,1758)	Ardeidae	R
32	Striated heron	<i>Butorides striata</i> (Linnaeus,1758)	Ardeidae	R
33	Western Reef heron	<i>Egretta gularis</i> (Bosc,1792)	Ardeidae	R
34	Black-crowned night heron	<i>Nycticorax nycticorax</i> (Linnaeus,1758)	Ardeidae	R
35	Purple heron	<i>Ardea purpurea</i> (Linnaeus,1766)	Ardeidae	R
36	Little cormorant	<i>Microcarbo niger</i> (Vieillot, 1817)	Phalacrocoracidae	R
37	Lesser whistling duck	<i>Dendrocygna javanica</i> (Horsfield,1821)	Anatidae	R
38	Oriental darter	<i>Anhinga melanogaster</i> (Pennant,1769)	Anhingidae	R
39	Black-rumped flame back	<i>Dinopium benghalense</i> (Linnaeus,1758)	Picidae	R
40	Common snipe	<i>Gallinago gallinago</i> (Linnaeus,1758)	Scolopacidae	R
41	Black-headed Ibis	<i>Threskiornis melanocephalus</i> (Latham,1790)	Threskiornithidae	LM
42	Common sandpiper	<i>Actitis hypoleucos</i> (Linnaeus,1758)	Scolopacidae	M
43	Eurasian curlew	<i>Numenius arquata</i> (Linnaeus,1758)	Scolopacidae	M
44	Black-winged stilt	<i>Himantopus himantopus</i> (Linnaeus,1758)	Recurvirostridae	M
45	Lesser sand plover	<i>Charadrius mongolus</i> (Pallas,1776)	Charadriidae	M
46	Kentish plover	<i>Charadrius alexandrines</i> (Linnaeus,1758)	Charadriidae	M

Table 4.30 continued

47	Little tern	<i>Sternula albifrons</i> (Pallas,1764)	Laridae	M
48	Common greenshank	<i>Tringa nebularia</i> (Gunnerus,1767)	Scolopacidae	M
49	Common redshank	<i>Tringa tetanus</i> (Linnaeus,1758)	Scolopacidae	M
50	Whimbrel	<i>Numenius phaeopus</i> (Linnaeus,1758)	Scolopacidae	M

**R-Resident, M-Migrant, LM- Local Migrant

4.7 WILLINGNESS TO PAY (WTP) - KALLAI

A survey was conducted (i) to understand the perception of the local community on the importance of mangrove ecosystem, their ecosystem services and the steps they are willing to adopt to conserve this critical habitat; (ii) to evaluate each goods and services provided by the mangrove wetlands, and (iii) to collect information about the current status of mangrove wetlands of Kallai. CVM is a survey-based approach, in which an individual independently states his or her willingness to pay (WTP) for the conservation of environmental services in a particular location. In this study, CVM was employed to estimate the WTP for the restoration of mangrove forest in the Kallai mangrove wetlands of Kozhikode district.

Surveys have shown that most of the local people are not aware of the importance of mangroves, and they are not willing to conserve this critical habitat through a payment basis and also by voluntary activities. Also, most of the people are not willing to respond to the survey because they are unaware and do not have a proper idea. Local community residing in this area considered this ecosystem as harmful to them in many ways. Most of the people in this locality do not know about the mangrove ecosystem and in some cases, photographs of mangroves had to be shown for their understanding.

4.7.1.WTP

A total of 30 respondents were willing to respond in this section of the survey. Due to various reasons like unawareness and not ready to face the survey due to personal reasons, the sample size is less compared to Kolavipalam. About 40% of people are willing to pay for the conservation activities and the remaining 60% are not willing to pay, out of the 30 respondents(Fig. 4.15). The respondents are ready to pay an amount by considering their income and living conditions (an amount which they can afford to pay)

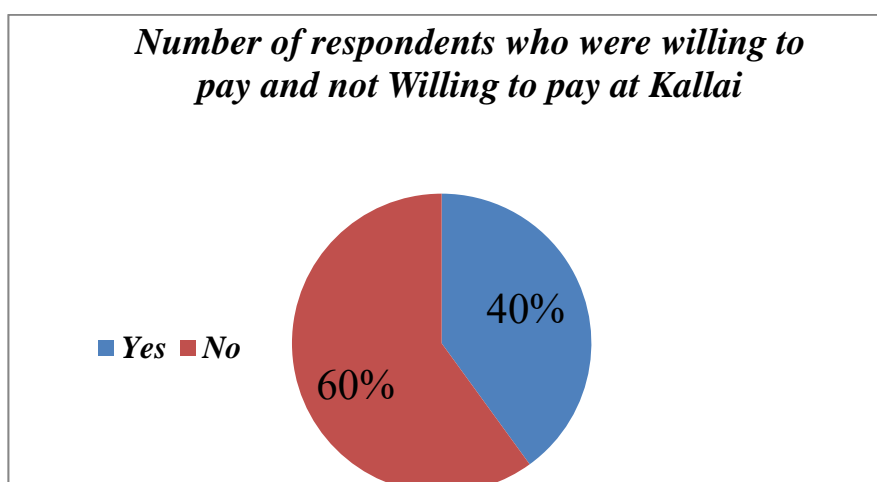


Fig. 4.15 Percentage of respondents who were willing to pay and not Willing to pay at Kallai

4.7.3 Payment Ladder

The range of payment which the respondents were willing to pay is from Rs.10 to Rs.2,000 in the payment ladder that ranged between Rs.0-50,000. The preference of payment was either single time or in monthly installment basis. The respondents chose an amount from Rs.10 (monthly) to Rs.500 (one-time) only. Average willingness to pay by the people of Kallai was Rs.362. The attitude expressed by the stakeholders is shown in table 4.31

Table: 4.31 Payment ladder indicating the amount respondents are willing to pay

Sl.No	Amount (Rs.)	One time (No. of respondents)	Installment (No. of respondents)			Total (Rs.)
			Weekly	Monthly	Yearly	
1	0	18				0
2	10			2		240
3	50			3		1,800
4	100	3				300
5	500	4				2,000
6	1,000					
7	2,000					
8	5,000					
9	10,000					
10	25,000					
11	50,000					
Grand Total						4,340

4.7.3.Reasons for Willingness To Pay

Various reasons for willingness to pay are categorized into a scale of 5 attributes namely (i) Strongly agree (SA); (ii) Agree (A); (iii) Neutral; (iv) Disagree (D) and (v) Strongly disagree (SD). The respondents were asked to mark the reasons according to their opinion on this scale (Table 4.32).

Table 4.32. Response of the stakeholders to the reasons for willingness to pay (n=12)

Sl.No	Particulars	SA	A	N	D	SD
1	Because I am more aware about mangroves	7(58%)	3(25%)	-	-	2(17%)
2	It is my moral duty to protect mangroves	8(67%)	3(25%)	-	1(8%)	-
3	Conservation is better for nature sustainability	6(50%)	5(42%)	-	1(8%)	-
4	Reasonable amount (affordable)	10(83%)	2(17%)	-	-	-
5	Concerned about degradation	8(67%)	4(33%)	-	-	-

*SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

Note: Figures in parenthesis indicate % to row total.

Regarding the awareness about mangroves, 58% of the respondents strongly agreed, 25% agreed and the remaining 17% strongly disagreed. This indicates that 83% of people are aware of the importance of mangrove conservation and the goods and services provided by these ecosystems. Regarding the moral responsibility to protect mangroves, 67% of the respondents strongly agreed, 25% agreed while 8% disagreed. The second reason mainly supports the mental aspect or emotional attachment and the moral duty to protect the mangrove wetlands; 92% of respondents considered conservation as their moral duty.

The third reason is ‘conservation is better for nature sustainability’. Mangrove ecosystem is one of the coastal wetlands which protect the coastal areas from various natural calamities like flood, cyclone, tsunami, etc. and even regulate micro climatic condition and provide various goods and services. This is also an important ecosystem that provide roosting place for birds, nursery

ground for fishes and provide food and shelter for crustaceans, molluscs and other fauna. Fifty percent of the respondents strongly agreed, 42% agreed and the remaining 8% disagreed.

The fourth reason is “reasonable amount”, that means the affordable amount which they can pay from their income. Here, the respondents marked only two options namely strongly agree (83%) and agree (17%). It is observed that though most of the local communities do not belong to very high income group, they are willing to pay for the ecosystem, most of them engaged in an occupation which gets daily wages. The fifth and the last important reason put forward was “concerned about degradation”. Sixty seven percent of the respondents strongly agreed, 33% agreed; this shows the anxiety of the stakeholders to protect the ecosystem. About 100% are more concerned about the degradation aspects. Degradation is due to both natural and anthropogenic factors that impact the ecosystem. Natural impacts include climate change, sand bar formation, changes in tidal action, sedimentation, due to various erosion activities, changes in natural flow of river, etc. Anthropogenic impacts include pollution by dumping of waste into water bodies by various industries, pesticides and fertilizers from agriculture fields, deforestation for alternate uses, fuelwood, etc.

4.7.4 Reasons for not willing to Pay

Out of the 30 respondents, 18 reported that they are not willing to pay for the conservation of mangrove wetland. Their response was brought in a 5 point scale namely strongly agree, agree, neutral, disagree and strongly disagree. (Table 4.33)

Table:4.33 Response of the stakeholders to the reasons for not Willing to Pay(n=18)

Sl.No	Particulars	SA	A	N	D	SD
1.	I have no spare income but would otherwise contribute	6(33%)	9(50%)	-	2(11%)	1(6%)
2.	I donot believe the system would bring changes	7(39%)	4(22%)	-	2(11%)	5(28%)
3.	It is the Government's responsibility	15(83%)	3(17%)	-	-	-
4.	I feel that environmental protection of mangroves is unimportant	2(11%)	5(28%)	2(11%)	-	9(50%)
5.	The user should pay	2(11%)	7(39%)	8(44%)	1(6%)	-
6.	I fail to understand the question	-	4(22%)	12(67%)	-	1(11%)
7.	We cannot place a monetary value on biodiversity	7(38%)	9(50%)	-	1(6%)	1(6%)
8.	I would rather have the current situation than pay more	2(11%)	6(33.5%)	2(11%)	2(11%)	6(33.5%)
9	I believe that this improvement will take place without my contribution	4(22%)	5(28%)	2(11%)	3(16%)	5(28%)

*SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

Note: Figures in parenthesis indicate % to row total

For the first reason “I have no spare income but would otherwise contribute”, 33% of respondents strongly agreed, 50% agreed, 11% disagreed and 6% strongly disagreed. Kallai is a developing town area, where most of the people were working on a daily wage basis for meeting up their livelihood needs. Therefore, they spend their income mainly on their family requirements such as food, fuel, cloth, medicine, education, etc. For the second reason “I don’t believe the system would bring changes”, 39% of the respondents strongly agreed, 22% agreed, 11% have disagreed and 28% strongly disagree. The third reason put forth was “It is the Government’s responsibility”. Most of the people felt that the Central and State Government have lot of funding programs to protect the coastal zones and these funding opportunities should be utilized for conservation activities also. About 83% strongly agreed and 17% agreed that conservation is the Government’s responsibility. The fourth reason is “I feel that environmental protection of mangrove is unimportant”. Some of the local people considered mangroves as nuisance as they turn out to be habitat for straydogs, dumping pits

of waste, etc. About 11% strongly agreed, 28% agreed, 11% were neutral and 50% strongly disagreed.

The fifth reason put forth was “the user should pay”, which means the people who actually reap the benefits of goods and services from the mangroves should pay for its conservation. For this reason, 11% of the respondents strongly agree, 39% agree, 44% were neutral, and the remaining 6% disagreed. For the sixth reason “I fail to understand the question”, 11% marked as strongly disagree, 67% as neutral while 22% agreed. The seventh reason put forth was “We cannot place a monetary value on biodiversity” and for this 38% marked strongly agree, 50% agreed, 6% disagree and 6% strongly disagree. The eighth reason was “I would rather have the current situation than pay more”. This was to understand the respondent's attitude that they are satisfied with the current status and hence no need to pay more. For this, 11% strongly agreed, 33.5% agree, 11% were neutral, 11% have disagreed and 33.5% strongly disagreed. The ninth reason was “I believe that this improvement will take place without my contribution”. In this the respondent's withdrawal attitude is shown, as they expect improvement without their monetary inputs. For this, 22% of the respondents strongly agreed, 28% agreed, 11% were neutral, 16%disagree and 28% strongly disagree.

4.7.5. Involvement in conservation activity on non-monetary terms

Out of the 18 respondents who were not willing to pay, there was another set of questions to ascertain whether they are willing to involve in conservation activities on non-monetary terms such as work as volunteers, involve as labourer, or involve in awareness programmes (Table 4.34).

Table: 4.34 Number of respondents volunteered in the conservation of mangroves (n=18)

Sl. No	Particulars	Willing	Not willing
1	Act as Volunteer in conservation activity of Mangroves	4 (22%)	14(78%)
2	Involve as labourer	4 (22%)	14(78%)
3	Organise and make support to awareness programme	4 (22%)	14(78%)

Note: Figures in parenthesis indicate % to row total

About 22% of the respondents were willing to act as volunteers in conservation activities of mangroves. Another 22% suggested that they would involve as labourers in conservation activities. About 22% of the respondents are willing to organize and provide support to awareness programmes related to mangrove conservation. The remaining 78% of the above three are not willing to involve in conservation activity on non-monetary terms. They were willing to spend an average of 2 days per month for the conservation activities of this mangrove ecosystem.4.7.6.

4.7.6 Ranking of goods and services

The respondents were asked to rank the various goods and services provided by mangrove wetland according to their relevancy, as perceived by them, based on their knowledge shown in table 4.35.

The mangrove ecosystem is a good source of 'blue carbon'. About 43% of the respondents ranked 'carbon sequestration' by mangroves as highly relevant, 30% ranked it as moderately relevant, 17% ranked it as less relevant, 7% have no decision, 3% responded as not relevant. The groundwater recharging is another service as the mangrove roots help to recharge the groundwater table. About 46% of the respondents ranked it as highly relevant, 23% ranked it as moderately relevant, 17% as less relevant, 7% have no decision, 7% responded as not relevant. The service 'water quality maintenance' is important as the mangrove plant sieve out the salt crystals from water and secretes it out through the leaves, thereby it purifies the water. About 54% of the respondents ranked it as highly relevant, 20% respondents as moderately relevant, 13% responded as less relevant, 3% have no decision and the remaining 10% responded as not relevant. Shoreline protection is another service as the mangrove acts as shelterbelt which protects the shore from storm surges and sea-level rise, coastal erosion, etc. About 50% respondents ranked it as highly relevant, 17% responded as moderately relevant, 20% responded as less relevant, 3% have no decision and the remaining 10% responded as not relevant. For sedimentation, meaning that mud accumulates faster in mangrove areas, 50% respondents

ranked it as highly relevant, 20% ranked as moderately relevant, 17% ranked as less relevant, 3% have no-decision and the remaining 10% responded as not relevant. For the service 'reduce Green House Effect', 57% responded as highly relevant, 20% responded as moderately relevant, 10% responded as less relevant, 3% have no decision and the remaining 10% responded as not relevant.

Protection from tsunami/ cyclone/ flood are the major services that protect from various extreme weather events which causes loss of life. For this, 50% responded as highly relevant, 23% responded as moderately relevant, 13% responded as less relevant, 3% have no decision and the remaining 10% responded as not relevant. Reducing soil erosion is one of the most important services provided by the mangroves and for this 57% of respondents marked as highly relevant, 20% responded as moderately relevant, 13% responded as less relevant, and the remaining 10% responded as not relevant. Protecting from the UV-B radiation is a service provided by the mangroves. By using their metabolic compounds called flavonoids, they absorb the UV-B radiations into leaves and stems of the mangrove. For this service, 54% responded as highly relevant, 23% responded as moderately relevant, 10% responded as less relevant and 3% have no-decision and the remaining 10% responded as not relevant. (Response to question number 6 and 9 mainly depend on their experience:-cooling effect even in the hot summer).

Protection against sea-level rise: mangrove acts as a protective shield against sea-level rise and reduces the intensity of tidal amplitude or its action. About 50% responded as highly relevant, 23% responded as moderately relevant, 14% responded as less relevant, 3% have no decision and the remaining 10% responded as not relevant. The mangrove forest is a sink of dissolved nutrients through tidal exchange. About 54% of respondents marked this service as highly relevant, 30% responded as moderately relevant, 3% responded as less relevant, 3% have no-decision and the remaining 10% responded as not relevant.

Table4.35 Ranking of goods and services of Kallai mangrove wetland by the respondents

Goods/ Services	Importance				
	Highly relevant	Moderately relevant	Less relevant	No decision	Not relevant
1. Carbon sequestration	13(43%)	9(30%)	5(17%)	2(7%)	1(3%)
2. Ground water recharging	14(46%)	7(23%)	5(17%)	2(7%)	2(7%)
3. Water quality maintenance	16(54%)	6(20%)	4(13%)	1(3%)	3(10%)
4. Shoreline protection	15(50%)	5(17%)	6(20%)	1(3%)	3(10%)
5. Sedimentation	15(50%)	6(20%)	5(17%)	1(3%)	3(10%)
6. Reduce Green House Effect	17(57%)	6(20%)	3(10%)	1(3%)	3(10%)
7. Protection from tsunami/cyclone/flood	15(50%)	7(23%)	4(13%)	1(3%)	3(10%)
8. Reducing soil erosion	17(57%)	6(20%)	4(13%)	-	3(10%)
9. Protecting from UV-B radiation	16(54%)	7(23%)	3(10%)	1(3%)	3(10%)
10. Protection against sea level rise	15(50%)	7(23%)	4(14%)	1(3%)	3(10%)
11. Nutrient sink	16(54%)	9(30%)	1(3%)	1(3%)	3(10%)
12. Nursery ground for fishes	21(70%)	3(10%)	3(10%)	-	3(10%)
13. Roosting place for birds	20(67%)	6(20%)	3(10%)	-	1(3%)
14. Fish wealth	19(64%)	4(13%)	4(13%)	-	3(10%)
15. Source of medicine	1(3%)	1(3%)	3(10%)	3(10%)	22(74%)
16. Source of food	1(3%)	1(3%)	3(10%)	3(10%)	22(74%)
17. Source of fodder	-	2(7%)	3(10%)	3(10%)	22(73%)
18. Source of fuel wood	-	2(7%)	3(10%)	3(10%)	22(73%)
19. Source of honey	-	1(3%)	2(7%)	3(10%)	24(80%)
20. Source of tannin	-	1(3%)	2(7%)	3(10%)	24(80%)
21. Source of manure/ bio fertilizer	-	2(7%)	2(7%)	3(10%)	23(76%)
22. Source of materials for thatching roofs, mats& baskets	-	2(7%)	2(7%)	3(10%)	23(76%)

Note: Figures in parenthesis indicate % to row total

The mangroves serve as breeding and nursery ground for fishes and many other invertebrates. About 70% responded as highly relevant, 10% responded as moderately relevant, 10% responded as less relevant and the remaining 10% responded as not relevant. The roosting place for birds is an important service, as the birds also depend on mangroves for their food and shelter. About 67% responded as highly relevant, 20% responded as moderately relevant, 10% responded as less relevant and the remaining 3% responded as not relevant. The mangrove habitats have high fish production values and for this service 64% responded as highly relevant, 13% responded as moderately relevant, 13% responded as less relevant and the remaining 10% responded as not relevant. Most of the services provided by the mangroves help in mitigation of climate change and for maintaining a sustainable environment.

The next set of rankings is for the various goods that can be obtained from various mangrove species and by utilizing various parts of the mangrove. Source of medicine: mangrove is a good source of medicine for curing various diseases. For this service, 3% responded as highly relevant, 3% responded as moderately relevant, 10% responded as less relevant, 10% have no decision and the remaining 74% responded as not relevant. Source of food: various fruits obtained from the mangroves are consumed. About 3% responded as highly relevant, 3% responded as moderately relevant, 10% responded as less relevant, 10% have no decision and the remaining 74% responded as not relevant. Source of fodder: leaves of various species of mangroves are reliable for the ruminant animals' consumption. About 7% responded as moderately relevant, 10% responded as less relevant, 10% have no decision and the remaining 73% responded as not relevant. Source of fuelwood: mangrove wood have high calorific value and for this, 7% responded as moderately relevant, 10% responded as less relevant, 10% have no decision and the remaining 73% responded as not relevant.

Source of honey: flowers of various species provide honey for insects in search for the nectar. For this service, 3% responded as moderately relevant, 7% responded as less relevant, 10% have no decision and the remaining 80% responded as not relevant. Source of tannin: various species have tannin content

which can be extracted for various purposes. About 3% of the respondents responded as moderately relevant, 7% responded as less relevant, 10% have no decision and the remaining 80% responded as not relevant.

Source of manure/ biofertilizer: leaves, barks of various species are used to increase the fertility of the soil. About 7% responded as moderately relevant, 7% responded as less relevant, 10% have no decision and the remaining 76% responded as not relevant. Source of materials for thatching roofs, mats& baskets: different parts of various species are used to make different useful and handicraft materials. About 7% responded as moderately relevant, 7% responded as less relevant, 10% have no decision and the remaining 76% responded as not relevant.

Due to the existing rules and regulations for the conservation and management of mangrove ecosystems, people do not cut mangroves. Mangroves are protected by law and hence conservation efforts have been fruitful. But Kallai once the 'hub of timber market' in south Asia dictated the international timber prices for several decades and probably the mangroves of this region were not given the desired attention.

4.7.7.Current status

Kallai is a small village on the banks of Kallai river which links with the Chaliyar river on the south by a man-made canal. The Kallai wood trade belt spreads over 35 km on both sides of the Kallai river. The Kallai River have disrupted stretches of mangroves along their margins. The current status of mangrove ecosystem was surveyed were shown in figure 4.16. About 77% of respondents expressed that the condition of mangroves have improved, while 17% felt that the condition has depleted and remaining 6% expressed that there has been no change. For the improvement of the mangrove ecosystem, the respondents listed out certain reasons such as self-propagation, water availability and favourable tidal action. For the depletion also, the respondents listed out some points like sandbar formation, which reduces the flow of water in the estuary, high sedimentation rate which causes the death of mangrove due to smothering of pneumatophores, discharge of polluted water from the hospitals,

which contain chemicals and medical wastes which may be infectious and hazardous, discharge of industrial effluents and various anthropogenic activities (disposal of household waste, food waste like plastic glass, plates dumping on the thick forest after the function).

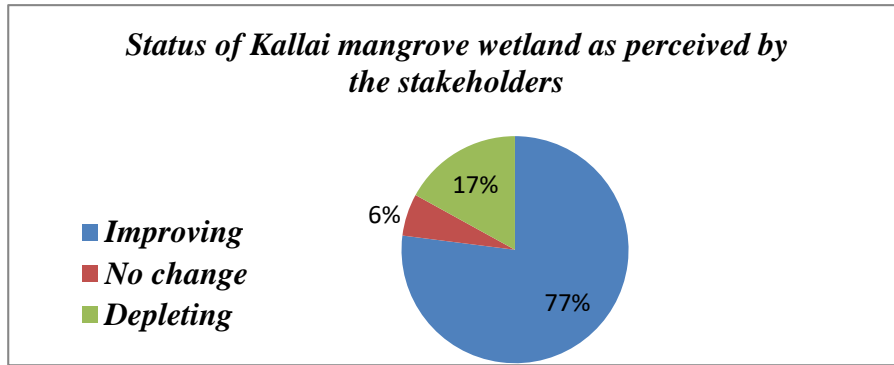


Fig. 4.16 Status of Kallai mangrove wetland as perceived by the stakeholders

To find out if there is any destruction activity in Kallai mangrove wetland, 93% of the respondents answered “no” and only 7% of respondents responded “yes”, out of the 30 respondents. The response of the respondents to the destruction of mangroves and the reasons for the destruction is given in fig. 4.17 and table 4.36 respectively.

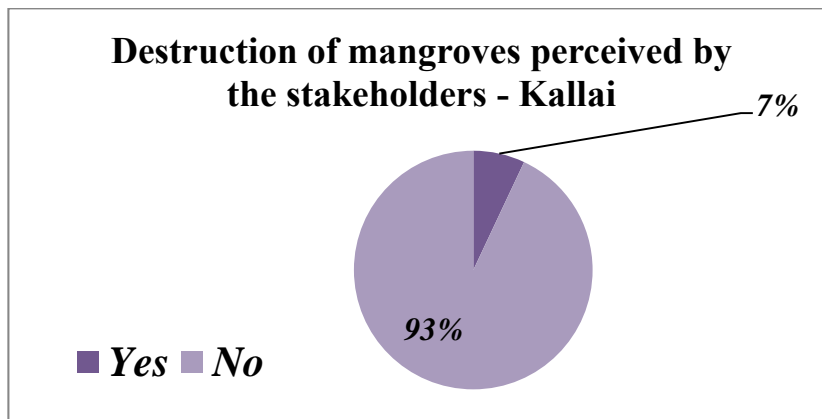


Fig. 4.17 Destruction of mangroves perceived by the stakeholders at Kallai

Reasons for the destruction of mangroves in the study area were categorized into five reasons and ranked on priority.

Table 4.36 Reasons for mangrove destruction: Ranking by the stakeholders

Sl.No	Particulars	Rank
1	Climate Change	2
2	Forest fire	5
3	Destruction of mangroves for alternate uses	4
4	Cutting for tourism promotion	1
5	Large-scale exploitation of mangrove trees for fuelwood and fodder	3

4.7.9. If mangroves completely destructed...

For the promotion of tourism, destruction of mangroves in Kallai scored rank 1. Destruction of mangroves for the developmental activities, to change the Kallai riverbank into the Kallai city. The ‘climate change’ is ranked as the second reason for the destruction of mangroves. The major causes of climate change also affect the health of mangrove ecosystem. This may be by two means: naturally and anthropogenically. Natural effects like sand bar formation due to changes in the tidal action, changes in the natural flow of the river and the anthropogenic activities including the dumping of plastic wastes, slaughterhouse wastes, agricultural wastes, discharge of pollutants from various industries, etc. ‘Large-scale exploitation of mangrove trees for fuelwood and fodder’ (collect twigs, timber for fuel, leaves of *Avicennia* used as fodder) scored the third rank. ‘Destruction of mangroves for alternative uses’ was given the fourth rank. Alternative uses such as use of *Acanthus ilicifolius* as biofertilizer, especially for coconut plantations. The fifth rank is for the “Forest fire”. The natural cause for spreading of forest fire is very few. But anti-social activities and the sparks from the burning of industrial wastes lead to forest fire.

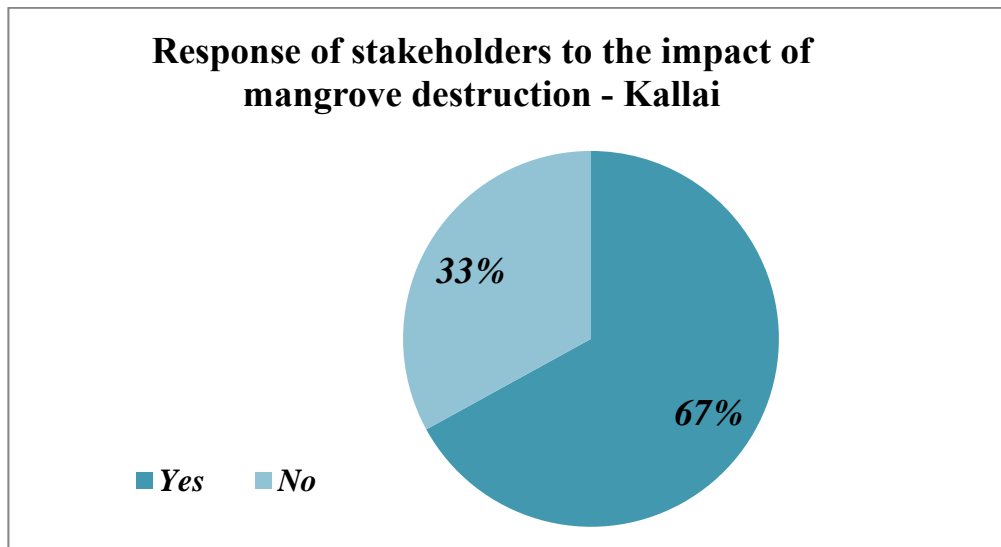


Figure: 4.18. Response of stakeholders to the impact of mangrove destruction at Kallai

For the question “If mangroves in your locality is completely destroyed, will it affect your life and locality?”, more than half of the respondents(67%) answered “yes” and the remaining 33% replied as “no” and their responses illustrates in figure 4.17 They clarified and substantiated their answers with their knowledge, life experiences and various case studies which they have heard. Those who responded “yes” sketched out various reasons for their comment - the mangrove ecosystem help to increase the fish wealth by providing nursery ground, maintain water quality, prevent saltwater intrusion, sedimentation activity, prevent soil erosion, protect from cyclone, tsunami, shoreline protection etc.

And those who responded “no” to the questions also tried to substantiate their approach by listing out various reasons. They said that the roots of mangroves trap lot of wastes and because of this it emanates obnoxious smell. Some of the respondents informed that the sandbar formation at estuarine mouth is mainly due to the mangroves, reducing the rate of flow of water which also poses difficulty for easy transportation of fishing crafts. Inside the mangrove forests, presence of poisonous snakes, stray dogs, monitor lizards and mongoose have become nuisance and threat to the local community.

4.7.10. Perception of stakeholders in conservation of mangroves

When the local communities were asked about their interest and commitment for the conservation of mangroves, 40% of respondents showed great degree of interest to get involved in conservation activities, while 13% respondents mentioned that they are only moderately interested. So more than half (53%) of the respondents were interested to get involved in this conservation and management program and take initiative for the conservation activities. But unfortunately, remaining 47% did not show any interest towards this sustainable action.

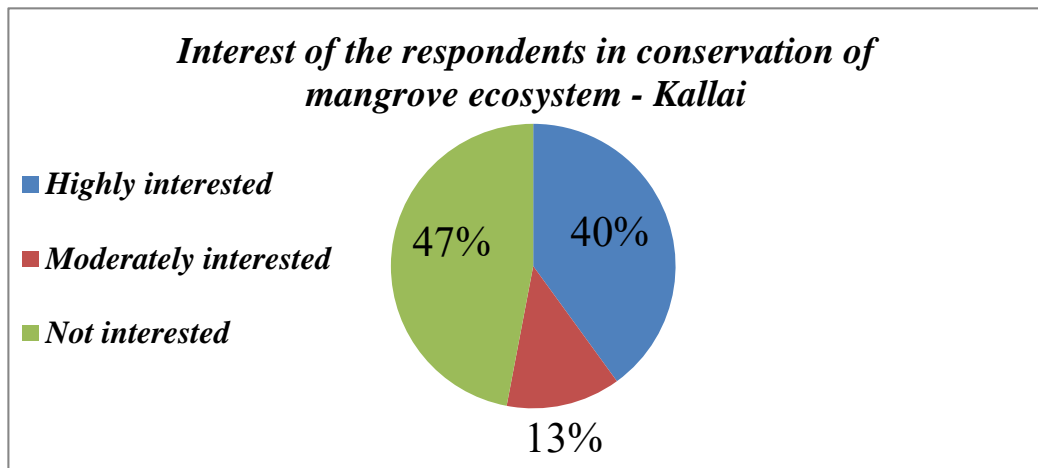


Fig. 4.19 Interest of the respondents in the conservation of the mangrove ecosystem

The interested respondents were asked to give reasons for the same and rank them (Table 4.37). Conserving existing one, planting saplings, giving awareness to the local community are the various options they chose in the order of priority for the conservation of mangroves. For conserving the existing one, 87.5% marked rank-1 and remaining 12.5% marked rank-2. For the planting of saplings, 6.25% chose as rank-1, 75% chose as rank-2 and the remaining 18.75% chose as rank-3. The last option in conservation and management is that giving awareness to local community, rank-1 labelled by 6.25%, rank-2 labelled by 12.5% and the remaining 81.25% labelled as rank-3. Most people liked to conserve the existing mangroves.

Table: 4.37 Reasons for the interest of stakeholders to involve in conservation activities

Sl.No.	Particulars	Rank 1	Rank 2	Rank 3
1.	Conserve existing one	14(87.5)	2(12.5%)	-
2.	Planting saplings	1(6.25%)	12(75%)	3(18.75%)
3.	Give awareness to local community	1(6.25%)	2(12.5%)	13(81.25%)

Note: Figures in parentheses indicate % to row total

4.8 ANALYSIS OF SOCIO-ECONOMIC SURVEY - KALLAI

The socio-economic survey was conducted at Kallai and a total of 58 households have been surveyed (Questionnaire is given as Appendix-I). The socio-economic studies were conducted to understand the demographic details such as standard of living, family details, income, fishing details like crafts and gears used, investment, operating cost, fishing days, expenditure pattern, indebtedness etc. The total population from the 58 households is 342.

4.8.1 Respondents occupational status

Respondents are those who respond to the questions that are asked for the socio-economic analysis. Regarding the occupational status (Table 4.38), only about 14% of the respondents depend on fishing and allied sectors. 43% of the respondents are involved in labour work such as construction work, agricultural fieldwork, head load labourers,*etc.* and 2% of respondents are teachers. The remaining respondents are involved in business (10%), employed abroad (3%), teachers (2%), drivers (7%) and physicians (2%) as their primary occupation.

Table 4.38. Primary occupation of the respondents at Kallai

<i>Primary Occupation</i>	<i>No.</i>	<i>% to total</i>
Fishermen	8	14
Driver	4	7
Business	6	10
Employed abroad	2	3
Labour	25	43
Physician	1	2
Teacher	1	2
Unemployed	11	19
Total	58	100.00

4.8.2 Educational status of the people of Kallai

Analysis of the educational status revealed that 5.26% of the people are illiterate (due to poor living conditions) and the remaining 94.74% are educated. The literate group include children going to Kindergarten(0.29%), those attained Lower Primary(LP) education (16.37%), Upper Primary(UP) education (16.08%), High School(HS) level (13.45%), passed Secondary School Leaving Certificate(SSLC) or Matriculation level (20.47%), Higher Secondary(HSC) level (17.84%), diploma holders (0.58%), Under Graduation(UG) (3.51%), and Post-Graduation(PG) level (1.75%). The remaining 4.39% are in the pre-schooling stage. (Table 4.39)

Table 4.39. Educational status of the people of Kallai

<i>Educational status of family</i>		
Level	No.	% to total
Illiterate	18	5.26
Nursery (Kindergarten)	1	0.29
Lower Primary	56	16.37
Upper Primary	55	16.08
High School	46	13.45
SSLC passed	70	20.47
Higher Secondary	61	17.84
Diploma	2	0.58
Graduation	12	3.51
Post-graduation	6	1.75
Children prior to age of schooling	15	4.39
Total	342	100

4.8.3 Occupation of the people of Kallai

Most of them engage in various occupations according to their willingness and physical condition (Table 4.40). Fifty one per cent of the people are involved in various labour work, 5% are engaged in fishing activities, 5% of the people work as drivers, 12% are involved in business and 1% of the people act as social workers. The remaining 8% of respondents either have technical jobs or they are employed abroad (4%). Unfortunately 11% of them are unemployed youth.

Table 4.40. Occupation of the people of Kallai

<i>Family members occupation</i>	<i>No.</i>	<i>% to total</i>
Fishing	4	5
Labour	38	51
Teacher	1	1
Driver	4	5
Business	9	12
Social worker	1	1
Technical job	6	8
Abroad	3	4
Unemployed youth	8	11
Total	74	100

4.8.4 Status of family

Among the ration card holders, 43 households were holding Below Poverty Line(BPL) cards, while 13 households were possessing the Above Poverty Line(APL) cards and two of them do not possess ration cards. All of them possess anAadhaar card and Bank account. Fourteen respondents have membership in micro-finance like Kudumbasree (Self Help Group, SHG) and the remaining 44 does not possess any membership positions. About 29 samples have membership in co-operative society such as Matsyafed and other societies related to their occupational field and 29 does not have any membership. Forty three households avail the benefit of Liquefied Petroleum Gas(LPG) subsidy for the purchase of cooking gas cylinder and 15 do not avail LPG subsidy. Only 2 samples (including family members) have leadership positions such as President, Secretary, etc. in Kudumbasree (SHG), Matsyafed(Table).

Table 4.41 Status of the family at Kallai

<i>Possession of Ration card</i>		<i>Possession of AADHAR CARD</i>		<i>Having BANK ACCOUNT</i>		<i>Member of MICRO FINANCE group</i>		<i>Membershi p in COOPERA TIVEs</i>		<i>Availing LPG SUBSIDY</i>		<i>LEADERSH IP</i>	
APL	13	YES	58	YES	58	YES	14	YES	29	YES	43	YES	2
BPL	43	NO	0	NO	0	NO	44	NO	29	NO	15	NO	56
NOT POS SESS ING	2												

4.8.5 Housing status

Fortunately, most of them have their own houses with basic amenities and the required household materials. About twelve family reside in a rental house and they do not possess their own landholdings. Housing pattern or type of house is considered as one of the indicators of the standard of living of the households. The households having Reinforced Cement Concrete(RCC) houses or concrete houses are considered as well to do households and those living in tiled houses have a medium level of standard of living. Those who reside in Katcha houses or thatched houses are considered as very poor. 65.5% of people are residing in RCC or concrete houses which indicates that most of the people lead a high standard of living. And the remaining 34.5%of respondents reside in tiled houses indicating that they lead a medium status in their standard of living. No one resides in Katcha or thatched houses. They belong to the lower strata in the standard of living. In the context of the area of houses, all houses are constructed according to their necessity and income. The area of 38% of houses are between 500 to 800sq. ft., while 50% have 800 to 1000 sq. ft. and another 12% of houses are less than 500 sq. ft. in area. (Table 4.42)

Table 4.42 House ownership status and type of housing of the residents at Kallai

<i>OWNERSHIP</i>		<i>% to total</i>	<i>TYPE</i>		<i>% to total</i>	<i>AREA (sq.ft.)</i>		<i>% to total</i>
RENT	12	21	THATCHED	0	0	<500	7	12
OWN	46	79	TILED	20	34.5	500-800	22	38
			CONCRETE	38	65.5	800-1000	29	50

4.8.6 Land status

Landholding of 47 samples (81%) are with title deed, but the remaining 11 samples (19%) are without title-deed. Eleven per cent of the respondents do not possess their own land. Sixty four percent of the respondents have less than

5cents and 14% have 6 to 10 cents of land. Two percent have 11 to 25 cents and the remaining 2% of families have more than 50 cents (Table 4.43).

Table 4.43. Details of landholdings of the local communities at Kallai

<i>TITLE DEED</i>		<i>% to total</i>	<i>AREA (cents)</i>		<i>% to total</i>
With title deed	47	81%	0	11	19
Without title deed	11	19%	<5	37	64
			6 to 10	8	14
			11 to 25	1	2
			26-50	0	0
			>50	1	2

4.8.6 Family status

There are two types of families: the joint and nuclear family (Table 4.44); 53% of the samples are joint families and the remaining 27% of the samples are nuclear families. Fifty percent of families are big comprising of 4 to 6 persons and family size of 19% is small comprising of 1 to 3 persons and the remaining 31% are large comprising of 7 to 10 family members.

Table 4.44. Type of family and family size at Kallai

<i>Family type</i>	<i>No.</i>	<i>% to total</i>	<i>Family size</i>		<i>% to total</i>
JOINT	31	53	1 to 3 (small)	11	19
NUCLEAR	27	47	4 to 6 (big)	29	50
			7 to 10 (large)	18	31

4.8.7 Fishery status

In Kallai, some of the people depend on fishery sector for their livelihood. According to the survey, 4 persons have fully owned crafts.(Table 4.45)

Table 4.45. Number of fisherman possess crafts (ownership)

Crafts	Fully owned	4
	Partially owned	0

4.8.8 Loan and financial survey

Out of 58 samples, 26 were taking a loan from financial institutions to fulfill their needs. Nearly 45% of respondents are borrowers. Surveys have shown that people avail loan for various purposes including investment in fishery sector(buying crafts,gears and other components needed for fishing), buying new vehicle, for housing(house construction, house maintenance), for education, for personal needs(marriage, purchase of home appliances). About 8% of people avail loan for investment in fishery sector and 12%for personal needs, while 4% avail loan for purchase of vehicle and for educational purposes. The remaining 73% take the loan for housing (Table 4.46)

Table 4.46 Purpose for which loan is availed from financial institutions

LOAN		
Purpose	No.	% to total
Fishery	2	8
Vehicle	1	4
Personal	3	12
House	19	73
Education	1	4

During the survey, ranking was done to ascertain as to whom the local people contact when they are in need of money. The details were listed in ranking charts and prioritised (Table 4.47) Many of them (36%) gave rank-1(R1) for the Self Help Groups and 43% gave rank-2 (R2) for Self Help Group(SHG). About 48% gave rank-3(R3) for Private Bank. Rank-4 maximum was for Co-operative society. Rank-5 i.e. for money lender and auctioneer (59%). Rank-6 is maximum for the Public Bank. Most of the people take loans for their needs and could not repay on time.

Table 4.47 Ranking (Institutions contacted while in need of money)

RANKING(Contact when need of money)	Rank	No.	% to total
Moneylender	R1	1	2
	R2	0	0
	R3	5	9
	R4	9	16
	R5	34	59
	R6	9	16
Self Help Group	R1	21	36
	R2	25	43
	R3	10	17
	R4	2	3
	R5	0	0
	R6	0	0
Cooperative Society	R1	8	14
	R2	5	9
	R3	0	0
	R4	32	55
	R5	10	17
	R6	3	5
Private bank	R1	5	9
	R2	4	7
	R3	39	67
	R4	7	12
	R5	3	5
	R6	0	0
Public bank	R1	0	0
	R2	1	2
	R3	0	0
	R4	1	2
	R5	9	16
	R6	47	81
Auctioneer	R1	1	2
	R2	0	0
	R3	5	9
	R4	9	16
	R5	34	59
	R6	9	16

4.8.9 Income and expenditure pattern analysis

A detailed study was made to understand the annual income and expenditure pattern of various households. For understanding the expenditure pattern, the recurring costs were taken into consideration. The annual income less than Rs.50,000 is about 2% which was considered as a relatively poor income group. About 26% of samples have an annual income of about Rs.50,000 to Rs.1,00,000. Forty seven percent of people had an annual income of Rs. 1,00,000 to Rs.2,00,000, while 16% of them had an annual income of Rs.2,00,000 to Rs.3,00,000. Remaining 10% of the households had a comparatively high-income of Rs.3,00,000 to Rs.7,00,000(Table 4.48).

Among the families with an annual income of less than Rs.50,000, most of the income with an average amount of Rs.20000 was spent on food, Rs.2000 for medical needs, Rs.4000 for clothing, Rs.3000 for social obligations, Rs.1200 for fuel and Rs.3000 for other expenses,. In the case of families with an annual income of Rs.50,000 to Rs.1,00,000, an average amount of Rs.23,867 was spent on food, Rs.9,900 for medical purposes, Rs.4,636 for education, Rs.7,507 for clothing, Rs.3,627 for social obligations, Rs.1,673 for fuel and an average amount of Rs.10,067 for other purposes. In the next category of annual income i.e. Rs.1,00,000 to Rs.2,00,000, the families spent an average amount of Rs.25,926 for food, Rs.13,222 for medical purposes, Rs.9,544 for clothing, Rs.6,944 for education, Rs.13,759 for social obligations, Rs.2,144 for fuel and an average amount of Rs.13,759 for other needs. In case of families with an annual income of Rs.2,00,000 to Rs.3,00,000, an average amount of Rs.32,556 of the expenditure was made for food, Rs.16,556 for clothing, Rs.21,778 for medical requirements, Rs.7,500 for social obligations, Rs.3,144 for fuel and Rs.16,000 for other requirements. In the income category of Rs.3,00,000 to Rs.7,00,000, an average amount of Rs.30,000 was spent on food, Rs.31,667 for medical requirements, Rs.17,417 for clothing, Rs.9,167 for social obligations, Rs.19,000 for education, Rs.2,550 for fuel and an average amount of Rs.24,167 for other purposes. From the analysis, it was found that all categories of people spent more money to meet their requirement for food.

Income and Expenditure Analysis

Table 4.48. Income and expenditure pattern

Annual Income (Rs.)	Class	Sample size	% to total	Expenditure pattern(avg.)							
				Food (Rs)	Fuel (Rs)	Rent (Rs)	Clothing (Rs)	Education (Rs)	Medical (Rs)	Social (Rs)	Others (Rs)
<50,000	Very low	1	2	20,000	1,200	0	4,000	0	2,000	3,000	15,000
50,000-1,00,000	Low	15	26	23,867	1,673	44,667	7,507	4,636	9,900	3,627	10,067
1,00,000-2,00,000	Medium	27	47	25,926	2,144	72,000	9,544	6,944	13,222	6,296	13,759
2,00,000-3,00,000	High	9	16	32,555.56	3,144.44	1,08,000	16,555.56	7,666.667	21,777.78	7,500	16,000
3,00,000-7,00,000	Very high	6	10	30,000.0	2,550	0	17,416.67	19,000	31,666.67	9,166.667	24,166.67

4.8.9 Impacts affect coastal environment and mangrove ecosystem – Kallai

Kallai being an important wood trade centre, storing wooden logs in the river might lead to decomposition and pollution of the river as a gradual process. Cleaning and restoration programmes were undertaken in this river by Kozhikode Corporation. The mangrove ecosystems are prone to die back owing to diverse natural and anthropogenic activities. The sand bar formation in the estuary was found to hinder the passage of water to the pneumatophores and the sand grains would obstruct the lenticels, thereby affecting the passage of air through the pneumatophores, gradually leading to the death of mangrove vegetation. Also, dumping of waste in the mangrove region, often completely masking the mangrove ecosystem (Syamjith and Ramani, 2014). The major issues faced by the local residents of Kallai region are pollution, sand bar formation, garbage dumping, declined fish catch, reduction in clam and mussel population and unemployment. Kallai river is in the “Red zone” list of National Green Tribunal (2019 Report). According to this report, the Kallai river belongs to the priority V category and the report states that the Biological Oxygen Demand (BOD) level is 4.5mg/L in Kallai.

4.8.10 General Analysis

Kallai is a small town on the banks of Kallai river. The local community is educated at basic level to Post-Graduate level. The residents were directly or indirectly dependent on mangroves for their livelihood. But its utility has been ignored by the inhabitants due to lack of awareness, lower household income and poor livelihood condition. Majority of people have an occupation to meet their various basic needs. They are involved in different occupations based on their educational status. They are aware about the social and political conditions of society, possess ration card, Aadhaar card, bank account and less number have membership in various micro-finance, co-operative. Local communities give priority to family relationships and maintain a strong bond within the community. They join their hands together for many local issues. Most of them possess their landholdings, except for some who are landless. The number of

people who avail loans is more; they take loan mainly for housing purposes.. Majority borrow money from co-operative bank which is the first priority. According to the income, most of them are categorized under the middle class. Very few come under the extremely low and extreme high-class people. Generally, the attitude of the people was not well supportive and helpful. They did not show not much interest during the survey, in answering the questionnaire.

4.9 VALUATION OF PROVISIONAL SERVICES

For the valuation of provisional services such as timber, fish, which contributes to the market products, direct market value was applied. The main benefit of this valuation method is that the market data are readily available and robust. At the same time it has limitations; it is limited to those ecosystem services for which a market exists.

4.9.1 Valuation of Provisional services Kolavipalam (Iringal)

Kolavipalam is a coastal village and most of the people depend on the coastal ecosystem for their livelihood. About 1,221 fishermen are found in this village and out of these 518 are male and 703 are females. Here female communities are more active in the fisheries sector. According to the records, there are 1058 registered fishermen of whom 453 are males and 605 are females. 285 active fisherman are recorded in this coastal village and of this only 185 are legally registered fishermen. About 45 males and 8 females are active involved as fish vendors. The local communities are also involved in fishing-related occupation such as drying, value addition *etc.* and about 24 individuals are engaged in these activities.

Details about the fishing boats were collected (Table 4.49). Four types of boats were found namely inboard vallam(1), Fibreglass boat(6), Cheruyanangal [small boats](35){Figure in brackets implies the number}. Various gears are operated in fishing activities such as ring seine, drift net, gill net *etc.* Engine capacity varies in different types of crafts.

Table 4.49. Details about the fishing boats

Sl. No.	Type of boat	No. of boats	Gear operated	Engine capacity
1.	Inboard Vallam	1	Ring seine	Very high capacity engines
2.	Plywood Vallam	45	Paachuvala	2 HP, 2.5 HP, 4 HP, 6 HP, 9.9 HP
3.	Fibreglass boat	6	OonnuVala	2.5 HP
4.	CheruYanangal (small boats)	35	Drift gill net	No engine

The total value from auctioning of fish at Kolavipalam fish landing centre during April-2018 to March-2019 was Rs.12,39,500. Average auction price at landing centre ranged from Rs.100 to Rs.150 per kilogram and the total availability of fish catch was found to be 8,258 kg. It is seen that the month of January-2019 got the highest benefit from the fishery with about 2746 kg of fishes caught, fetching a revenue of Rs.4,12,000. Fishing was least in June and July because of the adverse weather condition such as intense monsoon and trawl ban. In July 2018, the fish catch was only 200kg with revenue of Rs.30,000. The fish catch in June 2018 was slightly higher (316kg) with revenue of Rs.47,500.(Table: 4.50)

Table 4.50 Month-wise value of fishes (landing centre price) from auctioning during 2018-19: Kolavipalam

Months	Quantity (kg)	Value of fish landed (Rs.)
April 2018	646	97,000
May 2018	380	57,000
June 2018	316	47,500
July 2018	200	30,000
August 2018	333	50,000
September 2018	546	82,000
October 2018	440	66,000
November 2018	966	1,45,000
December 2018	793	1,19,000
January 2019	2,746	4,12,000
February 2019	386	58,000
March 2019	506	76,000
Grand Total	8258	12,39,500

The shells of clams (bivalves) were collected and marketed by the local people to the various industries. The shells are collected using a special net and the gathered shells are heaped near the beach and are sold to the traders who come from different states to be used in the manufacture of white cement, poultry feed etc. In these, there were ten to twelve stakeholders in this region were involved in the month of June and July (rainy season). On an average, these people are engaged in shell collection process for about 45 days. The collected shells are quantified in terms of baskets which they call as “*Paattas*.” And one *paatta* is approximately equal to 40kg and it is sold to the traders for Rs.80/*paatta*. On an average, 7 to 8 baskets were collected by each individual per day. From the sale of shells, a revenue of Rs.86,400 were obtained per year. The total value obtained from provisional services is Rs.13,25,900 only from fisheries.

4.9.2 Valuation of provisional services of Kallai

Chakkumkadavu is the landing centre at the bar mouth of Kallai river. A total of 670 fishermen and 130 individuals depend on fisheries and allied sector. Crafts and gears found in this region are comparatively high.

The total value from fishes at Kallai fish market during April-2018 to March-2019 was about Rs.71,51,000. Average market price ranged from Rs.100 to Rs.150 per kilogram. The total quantity of fish available was 204 kg/day on an average. The highest fish catch was obtained in the month of January 2019 (305 kg) with a revenue of Rs.11,89,500 (Table 4.51). There was no fishing in the month of June and July because of the adverse weather conditions and trawl ban. The lowest quantity of fish caught was in the month of May 2018 (105 kg), while the highest caught was in September 2018 (471 kg).

Table 4.51 Month-wise value of fishes landed in Chakkumkadavu during 2018-19

Month	Quantity(kg/day)	Amount(Rs.)
Apr 2018	159	5,96,250
May' 18	105	4,09,500
June' 18	0	0
July' 18	0	0
August' 18	262	5,50,200
September' 18	471	11,77,500
October' 18	139	3,47,500
November'18	230	5,52,000
December' 18	218	5,66,800
January 2019	305	11,89,500
February' 19	175	6,03,750
March' 19	386	11,58,000
Grand Total		71,51,000

SUMMARY AND CONCLUSION

CHAPTER -5

SUMMARY AND CONCLUSION

- The study area namely Kolavipalam and Kallai mangrove wetland in Kozhikode district has an estimated area of 2.5ha and 10ha respectively, according to the survey of Divisional Forest Office, Kozhikode.
- The biodiversity of the Kolavipalam encompasses 10 species of true mangroves, 10 species of mangrove associates, 19 species of crustaceans, 37 species of molluscs, 3 species of mudskippers, 48 species of fishes, 3 species of snakes and 64 species of avian fauna.
- 49% of the respondents in Kolavipalam are willing to pay for the conservation of mangroves and the value emerged from this was Rs.1,351.
- Among the 51% of respondents who were not willing to pay for the conservation, 18% were willing to act as volunteers and also to serve as labourer in the conservation activities and 21% of them were also willing to provide support for the awareness programmes.
- Survey at Kolavipalam revealed that most of the local community are well aware about the importance of mangroves and are willing to conserve this critical habitat through payment basis as well as through voluntary conservation activities.
- Various issues faced by the local community at Kolavipalam are illegal sand mining, beach erosion, partially or fully destructed seawall, sand accretion, sand bar formation, fish gap erosion, dwindling rate of turtle nesting, declined fish catch, migration of fishes into the deeper ocean, vanishing of various ichthyofauna species, dumping of wastes in the mangrove areas.
- The biodiversity documentation of Kallai mangrove wetland revealed the presence of 5 species of true mangroves, 4 species of mangrove

associates, 19 species of crustaceans, 37 species of molluscs, 3 species of mudskippers, 48 species of fishes, 3 species of snakes and 50 species of avian fauna.

- 40% of the respondents in Kallai were willing to pay for the conservation of mangroves, and the value emerged from this was Rs.362.
- Among the 60% of respondents who were not willing to pay for the conservation of mangroves, 22% were willing to act as volunteers or serve as labourers in the conservation activities and also ensured to provide support for the awareness programmes.
- Survey conducted with the local community of Kallai has shown that most of the local community are not well aware about the importance of mangroves and they are not willing to conserve this critical habitat through payment basis as well as through voluntary conservation activities.
- Various issues faced by the local community of Kallai are sand bar formation, dumping of wastes in the mangrove areas and pollution.
- Kallai river is in the “Red zone” list of National Green Tribunal (2019 Report).
- Valuation of Provisional services

Table 5.1 Estimated value of provisional services in the study area

Sl.No.	Provisional services	Kolavipalam (Rs.)	Kallai (Rs.)
1	Fishing	12,39,500	71,51,000
2	Collection of dead shells	86,400	NIL
	Total	13,25,900	71,51,000

- Ramsar Mission states conservation and the wise use of wetlands through local and national actions and international cooperation is essential towards achieving sustainable development throughout the world.

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APPENDIX-I

**B.Sc. - M.Sc. Integrated Programme of Miss. Supriya Baburaj M
(Admission No. 2014-20-108)**

**Academy of Climate Change Education and Research (ACCER),
Kerala Agricultural University, Vellanikkara, Thrissur, Kerala – 680656**

**Project Title: Valuation of ecosystem services of selected mangrove wetlands
of Kozhikode district, Kerala**

Schedule-1: Primary data collection

**Assessment of socio-economic status of stakeholders in Kolavipalam
(Iringal), Kerala**

Name of the village	:
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1. Name of the respondent (with address) :
2. Primary occupation :
3. Secondary occupation :
4. Educational status of the respondent : Illiterate/LP/UP/HS/ 10+2/Diploma/
Degree/PG
5. 5a. Details of family:

Relation	Age	Educational status	Occupation	Average Monthly Income

- 5b. Possession of ration card : APL / BPL
Aadhaar Card : Yes / No
Bank Account : Yes / No

- Membership in cooperatives : Yes / No
 Membership in micro-finance : Yes/ No
 Any leadership position : Yes / No
 LPG Subsidy : Yes / No
 6. Family type : (Nuclear /Joint)

7. Land (√)

a. With title deed /without title deed / Govt. land

b. Area ----- cents

8. House a. Own/rented

b. Thatched/Tiled/Concrete

d. Area :sqft

e. Distance from landing center /sea shore:

f. Electrified : Yes/ No

g. If Yes monthly bill : Rs

h. Latrine : Yes / No

i. Source of drinking water : Public tap/Public well/Own well

j. Cooking fuel : wood/gas/electricity

k.Home appliance: TV/Radio/Fridge/VCR/tape recorder/camera/mixer

9. Details of Ownership: (indicate Primary and Secondary Occupation)

Name	Occupational Status (Primary/Secondary)	Annual Revenue (Rs.)
1. Craft – Gear		
2. Land		
3. Animal Husbandry		
4. Business Establishments		
5.Others (Specify)		

10. Ownership of means of production: Crafts(*if the stakeholder is a fisherman*)

Crafts

Crafts	Number	Ownership		If partial details (% share)
		Full (No.&Cost Rs.)	Partial (No.&Cost Rs.)	

Gears

Gears	Number	Ownership		If partial details (% share)
		Full (No.& Cost Rs.)	Partial (No.& Cost Rs.)	
Cast net				
Gill net				
Ring seine				
Shore seine				
Hooks and lines				

11. Other components (used in fishing vessels)(*if the stakeholder is a fisherman*)

Item	Number	Cost (Rs.)
Mobile phone		
Radio		
GPS		
Compass		
SONAR		
Life jackets		
Lanterns		
Others		

12a) Average operating cost pertrip (*if the stakeholder is a fisherman*)

Item	Quantity/trip	Rate/unit	Total cost
1. Diesel			
2. Starter oil (Rs.)			
2. Ice			
3. Food /provisions			
4. Jetty rent			
5. Wages (provided to labourers)			
6. Auction charges			
7. Water charges			
8. Net/Engine repairs			
9. Other expenses			
Total operating cost			

12 b) Annual Fixed cost(*if the stakeholder is a fisherman*)

Item	Cost (Rs.)
1. Cost of craft	
2. Cost of gear (s)	
3. Engine	
4. License fee	
5. Others	

13. Average gross revenue per trip(*if the stakeholder is a fisherman*)

Fishing months	Average quantity	Average revenue (Rs.)
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

14. Fishing Pattern Number of fishing days per annum(✓ the appropriate)

(a) 360 days b) 250-360 c) 200-250 days d) 150-200 e)less than 100 days)

	Castnet	Gillnet	Ring seine	Hooks & Lines
Annual number of fishing days				

15. Alternative Livelihood Options during the lean fishing seasons:

Labourer / Farming / Skilled jobs / petty business / others (specify)

16. a) Income

a) Average earnings / wages per day of stakeholder :

b) Average total earnings of the family (monthly) :

16.b) Expenditure pattern

Average investment made in

(i) Fisheries :

(ii) Agriculture :

(iii) Livestock :

(iv) Business :

(iv) Others (Specify) :

Sl.No.	Items	Annual expenditure (Rs.)
1	Food	
2	Fuel (Fire wood / cooking gas)	
3	House rent	
4	Clothing	
5	Education	
6	Medical expenses	
7	Social obligations	
8	Others	

17. Indebtedness position

Purpose of loan	Amount (Rs)	Source	Interest (%)	Balance outstanding (Rs.)

18. When in need of money, whom do you contact? (Rank)

Cooperative society	
Nationalized Bank	
Private bank	
Money lender	
Auctioneer/ Fish Merchant	

19. General observation :

APPENDIX-II

**B.Sc. - M.Sc. Integrated Programme of Miss. Supriya Baburaj M
(Admission No. 2014-20-108)**

**Academy of Climate Change Education and Research (ACCER),
Kerala Agricultural University, Vellanikkara, Thrissur, Kerala – 680656**

**Project Title: Valuation of ecosystem services of selected mangrove wetlands
of Kozhikode district, Kerala**

Schedule-1: Primary data collection

WILLINGNESS TO PAY

Are you willing to pay for the conservation activity of mangroves?

Response	Put a tick mark for suitable option
Yes	
No	

PAYMENT LADDER

Sl.No.	Amount	One time	Installment			Total
			Weekly	Monthly	Yearly	
1	0					
2	10					
3	50					
4	100					
5	500					
6	1000					
7	2000					
8	5000					
9	10000					
10	25000					
11	50000					
Grand Total						

Reasons for Willingness to Pay

Sl.No	Particulars	SA	A	N	D	SD
1	Because I am more aware about mangroves					
2	It is my moral duty to protect mangroves					
3	Conservation is better for nature sustainability					
4	Reasonable amount (affordable)					
5	Concerned about degradation					

***SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree**

Reasons for not willing to Pay

Sl.No	Particulars	SA	A	N	D	SD
1	I have no spare income but would otherwise contribute					
2	I donot believe that the system would bring changes					
3	It is the Government's responsibility					
4	I feel that environmental protection of mangroves is unimportant					
5	The user should pay					
6	I fail to understand the question					
7	We cannot place a monetary value on biodiversity					
8	I would rather have the current situation than pay more					
9	I believe that this improvement will take place without my contribution					

*SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

If not paying

Sl.No	Particulars	Response
1	Act as volunteer in conservation activity of mangrove	
2	Involve as labourer	
3	Organise and provide support to awareness programmes	

Time spent for conservation

Daily/Monthly

Specify how many hours

Monthly average -

Ranking of goods and services provided by mangroves:

Goods/ Services	Importance				
	Highly relevant	Moderately relevant	Less relevant	No decision	Not relevant
1. Carbon sequestration					
2. Ground water recharging					
3. Water quality maintenance					
4. Shoreline protection					
5. Sedimentation					
6. Reduce Green House Effect					
7. Protection from Tsunami/cyclone/flood					
8. Reducing soil erosion					
9. Protecting from UV-B radiation					
10. Protection against sea-level rise					
11. Nutrient sink					
12. Nursery ground for fishes					
13. Roosting place for birds					
14. Fish wealth					
15. Source of medicine					
16. Source of food					
17. Source of fodder					
18. Source of fuelwood					
19. Source of honey					
20. Source of tannin					
21. Source of manure/biofertilizer					
22. Source of materials for thatching roofs, mats & baskets					

CURRENT STATUS

1. Current status of mangroves in your area

<i>Status</i>	<i>Response</i>
Improving	
No change	
Depleting	

Reason for answer

2. Is there any destruction activity in your area?

Response	Put a tick mark for suitable option
Yes	
No	

Reasons

Sl.No	Particulars	Rank
1	Climate change	
2	Forest fire	
3	Destruction of mangroves for alternate uses	
4	Cutting for tourism promotion	
5	Large-scale exploitation of mangrove trees for fuelwood and fodder	

3. If mangroves in your locality are completely extinct, what do you think it effects your life and locality?

Response	Put a tick mark for suitable option
Yes	
No	

4. Are you willing to take part in better conservation activity and management?

Response	Put tick mark
Highly interested	
Moderately interested	
Not interested	

5. If you are interested, what are your proceeding actions

Sl.No	Particulars	Rank 1	Rank 2	Rank 3
1	Conserve existing one			
2	Planting saplings			
3	Give awareness to local community			

6. What about the status of turtle nesting in your coast? (in recent years) (√)
(Only applicable to Kolavipalam)

Response	Put tick mark
Highly interested	
Moderately interested	
Not interested	

**VALUATION OF ECOSYSTEM SERVICES OF SELECTED MANGROVE
WETLANDS OF KOZHIKODE DISTRICT, KERALA**

By

SUPRIYA, BABURAJ.M

(2014 - 20 - 108)

ABSTRACT OF THE THESIS

**Submitted in partial fulfillment of the
requirements for the degree of**

B.Sc. – M.Sc. (Integrated) Climate Change Adaptation

Faculty of Agriculture

Kerala Agricultural University



ACADEMY OF CLIMATE CHANGE EDUCATION AND RESEARCH

VELLANIKKARA, THRISSUR – 680 656

KERALA, INDIA

2020

ABSTRACT

Mangroves are highly productive ecosystems, have special adaptations to thrive in saline conditions. The mangrove wetlands are important ecosystems that render numerous ecosystem services. The major objectives of the study were to identify the various provisional ecosystem goods and services and assess the present value of the provisional services of Kallai and Kolavipalam mangrove wetlands in the Kozhikode district of Kerala. Kolavipalam (11°56'54"N, 75°59'14"E) are known for their lush growth of mangroves and the breeding ground of Olive ridley turtles. Kallai (11°14'292"N, 75°47'203"E) was one of the most important centres in the world for timber business and lost its past glory of mangroves due to faulty land use. This work briefly examines the role of economic valuation information (includes Willingness To Pay {WTP}) to argue for the conservation of mangroves. Economic information is valuable to decision-makers for implementing management strategies for the sustainable and wise use of this ecosystem. To determine the marginal changes that happen in the in-situ values of mangrove resources, one needs to understand not only the ecological dynamics of the system but also the link between human activities and their impacts on the goods and services provided by the ecosystem, in addition to their economic value. In this backdrop, a study entitled "Valuation of ecosystem services of selected mangrove wetlands of Kozhikode district, Kerala" was undertaken during 2018-19. The direct market price method was used to assess the valuation of provisional services like fishery, raw materials, etc. Also, primary and secondary data were used for biodiversity documentation, socio-economic studies, WTP studies and to identify the various issues faced by the local community. Value estimated from the provisional services is 13,25,900 INR and 71,51,000 INR for Kolavipalam and Kallai respectively. The willingness of people to pay for conservation of mangrove ecosystem was also estimated through interviews with the stakeholders and an annual average WTP value of

1,351 INR and 362 INR were recorded for Kolavipalam and Kallai respectively. The various goods and services provided by the mangroves were ranked based on the perception of the local community; besides, a checklist of the diversity of mangroves and the associated faunal assemblages such as have been prepared. The results of the present study would be useful to plan suitable management measures for the conservation and sustainable use of the mangrove wetlands of Kolavipalam and Kallai.