SUSTAINABILITY AND LIVELIHOOD ISSUES OF VEMBANAD ECOSYSTEM FISHERFOLK COMMUNITIES

with special reference to Muhamma and Thanneermukkom villages

Thesis submitted to

Cochin University of Science and Technology

for the award of the Degree of

Doctor of Philosophy

under

the Faculty of Social Sciences

by

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Certificate

This is to certify that the thesis entitled "SUSTAINABILITY AND LIVELIHOOD ISSUES OF VEMBANAD ECOSYSTEM FISHERFOLK COMMUNITIES WITH SPECIAL REFERENCE TO MUHAMMA AND THANNEERMUKKOM VILLAGES" is a record of bona fide research work done by Ms. Florence M A, part–time research scholar under my supervision and guidance.

The thesis is the outcome of her original work and has not formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title and is worth submitting for the award of degree of Doctor of Philosophy under the Faculty of Social Sciences of Cochin University of Science and Technology.

D. Rajasenan

Declaration

I hereby declare that the dissertation entitled "**SUSTAINABILITY AND LIVELIHOOD ISSUES OF VEMBANAD ECOSYSTEM FISHERFOLK COMMUNITIES WITH SPECIAL REFERENCE TO MUHAMMA AND THANNEERMUKKOM VILLAGES**" is a record of the bona fide research work done by me and that it has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other title of recognition.

Florence M. A.

Acknowledgement

I wish to express my hearty gratitude and deep sense of obligation to my supervisor Dr. D. Rajasenan Professor, Department of Applied Economics, Cochin University of Science and Technology for his valuable guidance, meticulous supervision, constructive comments and continuous encouragement in the accomplishment of this work.

I extend my sincere thanks all members of the faculty of the Department of Applied Economics for their encouragement.

I owe my sincere gratitude to Dr K. S. Purushan, Retired Dean, Fisheries, Kerala Agriculture University and Member Expert, Kerala State Fishermen Debt Relief Commission who infused interest in the topic and remained as a great inspiration throughout the work. I acknowledge with thanks Dr K.V. Jayachandran, Head of the Department of Fishery Biology, College of Fisheries, Kerala Agricultural University, Cochin and Dr Bejoy. S. Nandan, Associate Professor, Department of Marine Biology, Cochin University of Science and Technology, who helped me in need with intellectual sharing and providing research materials which made it possible to complete this work.

I wish to express my gratitude for the cordial support given to me by authorities and colleagues of St. Michael's college, Cherthala. I also express *my gratitude to U.G.C. for awarding me with teacher fellowship for the materialization of this work.*

I also extend my thanks to the Librarian and non teaching staff of the department of Applied Economics, Cochin University of Science and Technology.

It is a pleasure for me to thank all those who contributed their expertise for the completion of my dissertation. Among them, I remember with gratitude Dr. T. M. Jacob Associate Professor, Department of statistics, Nirmala College, Muvattupuzha, who helped me for the data analysis and Ms Glinda George for the help provided in documentation of the thesis. I recognize the support, love and tolerance of the members of my family, friends and well wishers during the course of my PhD work.

Florence M. A.

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INTRODUCTION

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1.1 Sustainable Livelihood Approach in Inland Fisheries Management

The Sustainable Livelihood Approach (SLA) is a way of thinking about the objectives, scope and priorities of development. SLA does not have a particular sectoral focus, but it can be applied to all sectors. The SLA was developed in 1980s and has been evolving since then. The idea of sustainable livelihood was first introduced by Bruntland Commission on Environment and Development set up by United Nations in 1987 and in 1992 United Nations Conference on Environment and Development (UNCED) expanded the concept as a broad goal for poverty eradication both in terms of actual poverty and vulnerability to poverty. The objective of SLA aims for more secure access and better management of natural resources, improved access to education, information technology and training.

In a broad spectrum of natural resources, wetlands are the most productive and species rich ecosystem. Wetlands are integral part of river basins or extension of sea which include wide range of habitat constituting about six percent of earth's surface. According to Ramsar convention (1971), wetlands are areas of marsh, fen, peat, land or water bodies whether natural or artificial, permanent or temporary, static or flowing, brackish or salt including areas of marine water, the depth of which at low tide not exceed six meters. They are important for maintaining the water cycle and thus they are key players in retaining water in a landscape, recharging the aquifers, controlling floods thus regulating flows in the global water system. Wetlands are also important in regulating the global climate by sequestering and releasing carbon in peat lands, estimated to cover 3-4 percent of the world's land area. Wetlands as vital ecosystem have influenced the development of human societies since historical times. Of the most important wetland ecosystem services affecting human wellbeing involve supply of water, rice and fish. Inland fisheries are of particular importance in developing countries as they are the primary source of animal protein to non coastal rural communities. These living resources are the most important food for mankind and they also provide livelihood to millions of fishing community's *inter alia* critical importance to the world's biological as well as aquatic diversity. Hence it is of crucial importance that these resources be conserved for the want satisfying capacity of both present and future generations. In this context, the sustainability of the people who depend on fisheries for their livelihood and the sustainability of fish population and the ecosystem on which it depends are equally significant.

1.2 International Perspective

World fishery production has increased more than six times since 1990. The quantity of fish destined for direct human consumption has more than tripled and now stands at 107 million tons. Globally 20 percent average per capita intake of animal protein in the form of fish is consumed by 1.5 billion people and nearly 3 billion people with 15 percent of such protein. Fish has a particular prominence in influencing consumption decision following from the mounting evidence confirming assurance of health from fish as it is a valuable source of minerals and essential fatty acids.

By landing more than 10 million tons in 2006, inland fisheries contribute to 11 percent of global capture fisheries production (FAO, 2009). Even though the amount contributed by inland fisheries is small when compared to marine fisheries, fish and other aquatic animals from inland waters have an essential place in fishery economy as it contributes significantly to the livelihoods of poor households along with food security. Inland fisheries also play a major role in the diets of both rural and urban population as it provides a valuable supplement for diversified and nutritious diets.

Worldwide about 38 million people are estimated to be involved in marine and inland small scale capture fisheries (FAO, 2004). Inland fisheries are of particular importance to the rural poor and has accounted for at least 15 percent of global employment in capture fisheries and aquaculture. Inland fisheries are closely linked to other activities such as farming, livestock rearing and fuel wood collection. As many water bodies are seasonal, occupational and geographical migration is common. Inland fisheries often provide seasonal employment for people displaced from other sectors. In these cases, fishing is not a fulltime occupation but represents one component of multi-activity livelihood strategies developed by individuals and households. Fishing appears to be an activity involving low human and financial capital though prominent but seasonal in nature strongly integrated to annual round of livelihood activities. The diversity of species and ecosystem creates a variety of livelihood niches that different groups can occupy and that are not commercially viable for large operators. This reason may be attributed for the non availability of accurate figures in inland fisheries employment status. Inland fisheries are almost small scale, with landing made at many dispersed sites where records are not kept and fish is consumed mainly for subsistence purpose.

The most important contribution of small scale fisheries to poverty alleviation through role in poverty prevention should be recognized at the present day world. In developing countries, it is noted that fishing and related activities have not generated high economic returns but instead have helped a large majority of households to sustain their livelihoods and have prevented them from falling deeper into deprivation. In Cambodia, about sixty percent of total human consumption of animal protein is obtained from the Tonle Sap fishery alone (MRC, 1997). In Africa inland fisheries at Malawi provides 70-75 percent of the total animal protein of both urban and rural low income families (FAO, 1996). It is observed that in situations of economically or institutionally restricted access to other capital or production factors, the relatively easy and free access to fishing grounds allows poor people to rely more on the local common resources to obtain the goods and services they need to sustain their livelihoods. Inland fisheries are particularly important in this context.

Fresh water inland fisheries are increasingly threatened worldwide. Inland fisheries are found in a wide diversity of complex often fragile ecosystems such as lakes, rivers, reservoirs, ponds and wetlands. Many systems vary in size with season and from year to year. Key problems identified as threats to the livelihood users are loss of habitat, exotic species introduction and translocation and over fishing. Inappropriate fishing practices and diseases through aquaculture have adversely affected local stocks. Many species are now vulnerable, endangered or extinct. Water removal for irrigation and human consumption, deforestation, run off of agricultural chemicals, all reduce water quality and quantity. Dams and flood protection schemes have changed seasonal water flows and obstructed fish migration. The multi-use, multi-user characteristic is a key factor greatly affecting the livelihood of fishing communities through increasing competition for water and coastal resources.

1.3 Asian Scenario

Asia predominates in capture fisheries and aquaculture production with China the leading nation worldwide. More than two thirds of total inland capture fish comes from Asia. Asian continent is the home for about 65 percent of world's fishers and they are framed as the poorest of the poor. The countries in Asia fall within the top 20 inland capture production but paradoxically rank low in the human development indices. This comparison underlines the need to sustain inland fisheries in the countries where inland capture is relatively important in its own right, where inland capture contribute significantly to food security and where levels of human development are lowest.

Given the high population growth in developing countries especially in Asia, the per capita annual fish consumption in these countries is worth noting. Projection for demand indicates rising aggregate consumption for all developing Asian countries (The world Fish Centre, 2005). This has led to wider exploitation of inland fisheries worldwide, but with most in Asia. Apart from resource exploitation, environmental stresses are particularly severe in Asian watersheds. This causes concern because they correspond to the most important areas of inland fish production which is having a close link to the food security. It is proved that inland fish supply contributes to high quality and cheap animal protein crucial to the balance of diets in marginally food secure communities. This food security is highly threatened due to risks from contaminants in fish due to human activities in the coastal zone that deliver sewage, solid waste, refuse, sediments, dust, pesticides and oil hydrocarbons to rivers estuaries and coastal areas. The pressure on inland waters is also multiple in nature because inland water habitats are surrounded by land that has high economic value for agriculture and other activities. Inland water also provides services such as transportation, irrigation and hydroelectricity that lead to change in habitat. The traditional inland fisheries in Asia which largely depends on extensive use of natural resources at the cost of environment deterioration is now facing strong challenges. The degradation of aquatic resources and environment are major threats to existing and future potential fish production from inland waters and also food security. Sustainability has become vitally important to the future growth of this food production sub-sector.

1.4 Indian Context

India is the seventh largest country in the world with a land area of 3.3 million Km and is referred to as a sub-continent in its own right. The country also with diversified agro-climatic regions is endowed with potentially rich and varied aquatic resources. It is endowed with Exclusive Economic Zone (EEZ) of 2.02 million square kilometers, a continental shelf of 0.5 million sq Km, and a long coast line of 8119 Km with some of the richest fishing grounds in the world. The main inland fishing resources include about 1.20 million hectares Mha of brackish water area, 2.28 Mha fresh water ponds and tanks, about 1.24 Mha of reservoirs, 0.82 Mha of beels oxbow lakes and derelict water bodies, 0.24 Mha of floodplain wetlands, 0.29 Mha of estuaries, 1.65 Mha of mangroves, swamps, lagoons etc, besides about 1,91000 kilometers of rivers and canals. These resources offer immense scope for potential development of fisheries and aquaculture in India. The potential harvest has been estimated at 3.93 million tons per annum from marine resources of the Indian EEZ and 4.50 million tons from inland water bodies.

India being the second most populous country with an immense population of over one billion gives livelihood support to around 11 million people by way of fisheries. Fisheries is considered to be one of the important sectors contributing to the economic growth, livelihood support and poverty alleviation in the country. Fisheries sector plays a strategic role in food security, international trade and employment generation. With changing consumption pattern, emerging market forces and technological developments, it has assumed added importance in India and has undergone a rapid transformation from time immemorial. The development programmes for India's fisheries sector were aimed at increasing fish production, improving the welfare of fishermen, promoting export and providing food security. The first step towards developing as an industry was made in 1898 by strengthening fisheries to fight famine. After independence, it was decided in 1948 to seek foreign co-operation to create necessary infrastructure for modernizing the fisheries sector. In 1952 a tripartite technical co-operation agreement was designed between India, Norway and United Nations for fisheries development and a year later the Indo-Norwegian Project (INP) was started in Kerala. From then onwards the modernization of fisheries has been done in the coastal states in India.

The increasing role of inland fisheries in the overall fish production has been now recognized as India has the distinction of being second in respect of the global inland fish production. From the mid 1990s the fisheries production started witnessing significant change and by the year 2000, the share of inland fish production crossed half of the total fish production in the country. It seems that marine fisheries production has reached a plateau and at best it can register only marginal increase in the near future. On the other the hand, inland fish production was on constant rise. The inland fisheries in India include both capture and culture fisheries. The capture fisheries have been the major source of inland fish production till the mid 1980s. During the past one and half decades, the production of inland aquaculture fish production has increased from 0.51 to 2.38 million tons and of inland capture fisheries has declined from over 0.59 to 0.40 million tons. The percentage share of aquaculture has increased sharply from 46 to 86 percent primarily because of 4.5 fold increase in freshwater aquaculture. The share of freshwater aquaculture in total inland fish production has also increased from 28 to 66 percent. Fish production from natural waters like rivers, lakes etc followed a declining trend, primarily due to proliferation of water control structures, indiscriminate fishing and habitat degradation.

Around 70 percent of Indian population lives in villages and are dependent on multitude of activities including agriculture, farming, fishing and other allied activities for their livelihood. These communities who are dependent on inland fisheries are provided with livelihood as well as nutritional support. Freshwater fish are important for food security and most of the catch is consumed locally and forms a vital source of food and micro-nutrients. As inland fish production largely continues to feed local population rather than entering into export markets, it can be tapped as a chief and cheap source of protein rich food to overcome the nutritional imbalances of the rural poor population of our country. Moreover, fish is a good supplement to food production from land not only in its nutritional value, but also in enhancing the quantity of food availability in a populous country like India which needs different variety of food supplements to feed millions of people.

The Indian sub-continent is blessed with a wide diversity of complex ecosystems such as lakes, rivers, reservoirs, ponds and coastal wetlands with potentially rich and varied aquatic resources and these natural resources are depleting at an alarming rate. The country has lost 38 percent of its wetlands within just a decade according to a recent study conducted by SACON 1990

(Salim Ali Centre for Ornithology and Natural History). This has happened because wetlands considered as wastelands are given priority for reclamation for any kind of development projects. Biological diversity in backwaters is also fast eroding due to developmental projects that promote intensive use of resources and environment. The extensive reclamation of water bodies results in total irreparable loss of habitat. For last two decades, estuarine resources and environment in India had been intensively used for modern enterprises subject to the development of international market. Apart from state and central government enterprises, a number of new firms started modern industrial activities using estuarine resources and environments indiscriminately. The choice of a development path that sacrifices environment sustainability is primarily responsible for biodiversity loss and consequent decline in productivity. This leads to sharp decline in the earnings of local people which results in poverty. Thus coastal backwaters and inland water bodies which fast decline due to lack of care, improper management, over exploitation and lack of awareness calls for urgent intervention for sustainable management of the inland fish wealth. This can be made possible by institutionalizing community rights over protection and harvest of these natural resources.

1.5 Significance of the study and genesis of the research problem

Kerala provides wide variety of aquatic habitats like rivers, streams, swamps, lakes, ponds, estuaries and backwaters and these are considered as sites of exceptional biodiversity in the country. The estuarine wetlands of Kerala is formed of a chain of coastal, brackish, myxohaline wetlands, lakes, lagoons, mudflats, tidal marshes and mangrove swamps. These backwaters stretches that lie parallel to the coastline extending to over 350 Km exert profound influence on the coastal fisheries as they are the nursery and breeding grounds of coastal fish and shellfish species. These estuarine species possess rich renewable organic resources that enhance and sustain coastal productivity. The high productivity of the coastal seas of Kerala is linked to the chain of coastal backwater systems that lie parallel to the coastline and open to the coastal seas through azhis and pozhis.

In the ecosystem concept, it is well understood that a conducive environment and balanced equilibrium are factors important for sustainable fisheries and its exploitation. It is also understood that these ecosystem are also complex and ecologically delicately balanced systems, thus even without drastic direct interventions, they can be severely disrupted. Unfortunately estuarine ecosystem in Kerala, the most critical component of the coastal environment which sustains millions of people is subject to disastrous degradation.

The Vembanad wetland ecosystem a Ramsar site is a massive coastal wetland ecosystem, covering an area of 24,000 ha and contributes over 50 percent of the total area of backwaters in the state. This ecosystem has several functions and economic values. The lake's total surface area is spread across three central districts of Kerala, viz., Ernakulum in the north, Kottayam in the east and Alappuzha in the south. It is the lifeline of the area. Nearly 1.6 million people live on the banks of the lake. This wetland and the surrounding area together form a socio - ecological system supporting the life of the people who live in the villages situated on its banks. A transitional ecotone between sea and land, Vembanad Lake is highly productive environment providing feeding, spawning and rearing areas for a very large proportion of commercial fish and shell fish. It supports rich fishery resources such as a variety of fin fish, shell fish, several species of marine fishes and shrimps. The lake system also supports a highly productive agriculture system in Kuttanad – the 'rice bowl of Kerala'- spread over 1,100 Km sq. which is a reclaimed portion of the lake. The Vembanad wetland is also an important resource area for local livelihoods dependent on fishing and allied industries and also an important tourist destination. A large population living in the drainage basin is directly or indirectly dependent upon this wetland ecosystem for their livelihood. The lake is used for fishing, mining sand and lime shell deposits, harvesting live clams and tourism related activities. Surrounding land mass is used for rice cultivation, plantation crops, housing, tourist resorts etc. All these water based activities depend upon the environmental integrity of the Vembanad Lake and its surroundings.

The environmental conditions of the lake are in a steady decline due to both endogenous and exogenous factors and hence the wetland ecosystem and the dependent communities face serious threats to their livelihood. The endogenous factors arise from fishery sector itself such as destructive fishing practices like the adoption of fishing nets with small mesh size, fishing during high tide especially near estuarine bar mouths and use of dynamite and poison for fish catch etc. Moreover the present level of fishing pressure exerted on the available estuarine system is beyond sustainable levels. The exogenous factors responsible for threat to sustainability and livelihood of this ecosystem are unrestricted human interference for heterogeneous purposes. Hydraulic interventions in Vembanad wetland ecosystem are considered as the major human interference which ultimately had irrevocable adverse consequences on the entity of the lake. Mainly four such interventions are identified within the entire Vembanad wetland ecosystem. The first was the reclamation and creation of the Wellington Island. Then came the major reclamation and bunding works in the Kuttanad area for improving agriculture. The third intervention was the construction of the Thottapilly Spillway (1955) to divert flood waters of Achan Kovil, Pamba, Manimala, Meenachil directly to the sea. The last intervention was the Thaneermukkom barrior (1975) built to prevent salinity ingress into the Kuttanad agricultural area during summer. All the above interventions significantly altered the original flow pattern and changed the lake ecology adversely.

The commissioning of Thannermukkom barrage and its prolonged closure has seriously affected fish species diversity and population. The break in life cycle rhythms and changed ecology of the lake with high pollution has affected breeding of many species. There is reporting of extinction of a number of species. The fish population decline and consequent over fishing have been contributing to severe loss of fish and clam wealth. Prolonged closure of Thaneermukkom barrage, dredging and reclamation of large parts of the lake and associated ecological degradation are largely attributed to the decline of clam fisheries. Other interferences include sand mining from the lake, coconut husk retting, hectic backwater tourism activities and discharge from industrial effluents, pesticides, chemical fertilizers and sewage and fecal disposal. This summarises the crises in the inland fishing sector of this region. This crisis and consequent livelihood loss to fishermen are the cause of distress to fishing families here. Thus the construction of bund led to social conflicts especially between the fishermen above the barriage and Kuttanad farmers. In this context the impact of Thanneermukkom barrage on the ecology and the fishery resources of the lake deserve special mention. Revival of fish population and its diversity are the only alternative to strengthen the livelihoods of this fishing community. Along with this feasible strategies for employment generation and the possible trade off between productivity and income levels of present generation and biological sustainability objectives requires serious attention with alternative development purposes for this community. At the same time Management of wetlands cannot be addressed at Government level alone rather it requires the participation of all stakeholders concerned. The challenge therefore is to conserve the wetland ecosystem along with their rich biodiversity while providing sustained economic benefits to the community dependent upon these resources for their livelihood. Protection of this wetland through appropriate measure to arrest degradation and there by conserving the lake for future generation is the need of the hour. The present study is an attempt to focus on sustainable livelihood approach for this ecosystem communities through co-management technique giving due importance both for stakeholders and the state for solving these problems.

1.6 Objectives of the study

The main objective of the study is to work out a new framework of fishing rights and appropriate technology for the management and governance of the ecosystem area for the dependent community. Specific objectives are:

1) To identify the reasons for the declining biodiversity and consequent impact on sustainability and livelihood of traditional fisherfolk.
2) To assess the present socio-cultural, economic and health status of these ecosystem Communities based on the empirical evidence to devolve alternate livelihood strategy for their sustenance
3) To suggest alternate production methods for sustainable use of the ecosystem.
4) To develop a suitable management policy by incorporating all the stakeholders in the system.

1.7 Context and Background of the Study Area

The coastal belt connected with a wide network of inland water bodies, Alappuzha has the requisite natural endowments for emerging as a leading fish producing district in the state. The estimated fisherfolk population of Kerala is 11.114 lakh which include 8.558 lakh in the marine sector and 2.556 lakh in the inland sector. Alappuzha district stands first in the number of fisherfolk with a population of 1.19 lakh. Out of this total fisherfolk population of the district the number of inland fisherfolk is 66091. These figures are according to the Kerala Marine Fisheries Statistics and Kerala Inland Fisheries Statistics of 2007. Out of the state's inland fisherfolk population of 249105, the percentage share of inland fisherfolk of the Alappuzha district is 26 percent and the percentage share of inland fisherfolk to total fisherfolk population of the district is 56 percent. These census facts itself proves the importance of the need for studying the livelihood and sustainability of the inland fisherfolk of the district of Alappuzha. The district of Alappuzha consist of 29 marine fishing villages and 24 inland fishing villages out of the total of 222 marine and 113 inland fishing villages of the state of Kerala.

Connected to the Western Ghats, through six riverine systems viz., Periyar, Moovattupuzha, Meenachil, Manimala, Pampa, Achankovil that brings in water and sediments to the Arabian sea, that brings in tidal influence and seasonal salinity, the deltaic upper reaches of these wetlands, the Kuttanad has been a high fertile tract of land suited for rice cultivation from very early days. Being in confluence with the coastal influence, this vast estuarine expanse has also been favored nursery areas for the rich coastal fisheries. In effect agriculture and fisheries have been the two most important attributes of these wetlands. Just as Kuttanad is described as 'rice bowl' of Kerala, Vembanad wetlands have been acclaimed as the 'The inland fish basket' of the state. By virtue of nature's bounty, the district of Alappuzha is having the chance of supporting bulk part of Kuttanad a highly complex topography with a part of Vembanad Lake, the largest of estuaries of the West Coast of India. With its unique wetland ecosystem, the Kuttanad region and Vembanad lake hand in hand could play a crucial role in the development of inland fisheries sector of the district and the state as this region is an ideal habitat and breeding ground for a wide variety of fresh water and brackish water fish species. Despite its natural advantages, the inland fishing sector in this region is on a brink of severe crisis.

The region is ecologically significant owing to vanishing mangrove patches and an important site for resident and migratory water foul. Horadandia attukorali, an endangered fish species listed in IUCN red data book is reported only from Pathiramanal Island in Vembanad Lake. Based on the rich biodiversity and socio-economic importance, Vembanad lake was declared as a Ramsar site, a wetland of international importance in November 2002. Vembanad Lake along with adjacent kol lands is the Ramsar site in India and supports third largest wintering water foul population of the country. It is also one of the 15 mangrove areas that have been identified by the Ministry of Environment and Forests (MOEF) for intensive conservation and management.

The Vembanad Lake spanning between latitude $9^{0}28^{!}$ And $10^{0}10^{!}$ North and longitude $76^{0}13^{!}$ And $76^{0}31^{!}$ East is the biggest among the 30 backwaters in the state. It extends to a length of 96.5 Km from Azhikode in the north to Alappuzha town in the south. The lake north of Aroor is situated in the erstwhile Cochin state and is generally referred to as Cochin back waters. The southern portion from Aroor to Alappuzha is more commonly referred to as Vembanad Lake and lies in the erstwhile Travancore state. The lake is narrow and sinuous in the north while much broader to a maximum width of 14.5 Kms in the south. In its length of over 96 Kms running parallel to the sea from Azhikode to Alappuzha, the lake is mainly connected to the sea at two places Azhikode and Kochi. Seasonal intrusion is also experienced through the Thottappilly spillway situated 20 Kms south of Alappuzha. A small connection controlled through the spillway exist at Andhakaranazhi in Cherthala Thaluk about 25 Kms north of Alappuzha town. In the Vembanad, the construction of a salinity barrier at Thannermukkom and its ineffective operation has affected the system. This barrier was constructed at in a narrower part of Vembanad in order to ingress of salinity into the polders of Kuttanad during summer season. The area of the south of Thannermukkom barrage is 13,224 ha and to the north of it is 23,500 ha. It is a complex system encompassing estuary, lagoons, marshes and mangroves with intricate network of natural and manmade channels. The biological and economic importance of Vembanad and interconnected backwaters are to be viewed and assessed in this context.

1.8 Methodology

Based on the background and context of the study area two inland fishery villages –Muhamma and Thannermukkom coming under the jurisdiction of Kanjikuzhi block panchayat are selected for the purpose of the study. The selection of these two particular villages are based on certain variables such as the traditional craft-gear combination, species of fish, geographical coverage, the seasonal and temporary shift of gears, resource depletion due to unsustainable fishing and environmental degradation and methods for conservation of resources. The Thanneermukkom and Muhamma fishing villages are having a fisher population of 2739 and 2526 respectively (Panchayat Level Statistics, 2006). The inland fishermen population percentage of these selected villages to the total inland fishermen population of the district is 4 and 3.8 respectively.

Characterizing the biological loss in Vembanad Lake and its subsequent impact on the sustainability and livelihood of dependent fisherfolk community, a multidisciplinary approach is followed. As the process of degradation has been affected by natural and socio economic forces, two sets of data base, one based on natural process and the other coming under the socio- economic domain have been used. The data used to identify the natural process of degradation have been collected from secondary studies and there exist a large body of literature on various natural and physical process of Vembanad lake through the scientific enquiries conducted by research institutions like Kumarakom Research Centre of Kerala Agriculture University, Central Inland Fisheries Research Institute (CIFRI), The Centre for Earth Science Studies (CESS), National Engineering Environmental Research Institute (NEERI) and School of Marine Sciences of Cochin University.

The data on economic and social factors influencing the sustainability and livelihood issues of the inland fisherfolk community has been collected from primary sources. A sample size of 250 respondents has been surveyed for the proposed study. The study area of the two selected fishing villages was confined to 10 locations. As the sustainability issue varies from location to location, each location is bringing about some staggering realities. To bring out the live sustainability issues confronted by the fisherfolk population residing very near to the banks of the lake, a number of 25 households living in cluster were selected from each location for an in-depth study. In order to identify and select these locations for their peculiarities a pilot survey was conducted all along these locations followed by a focus interview and interview with senior fishermen. The focused interview in each location and interview with senior fishermen exposed the specialties and environmental issues encountered by that location. This knowledge was a pre-requisite for the detailed survey later conducted and also for the analysis of the surveyed facts as far as this study is concerned. The locations selected are shown in figure 1.1 given below:

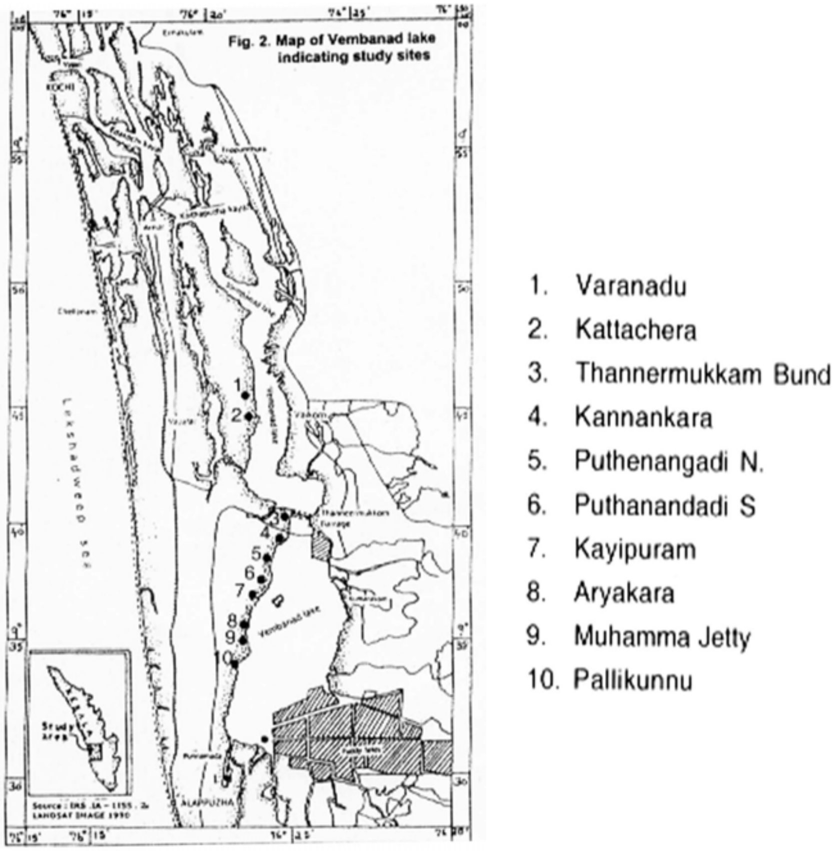


Figure 1.1 Map of Vembanad lake indicating study locations

Data were also collected from local grama panchayat, local matsyfed office, government institutions departments, social organizations like the Dhevara Sabha of the study area. A number of political leaders and social activists were interviewed to get additional information on the issues examined in the study. The multistage sampling framework is given in figure 1.2.

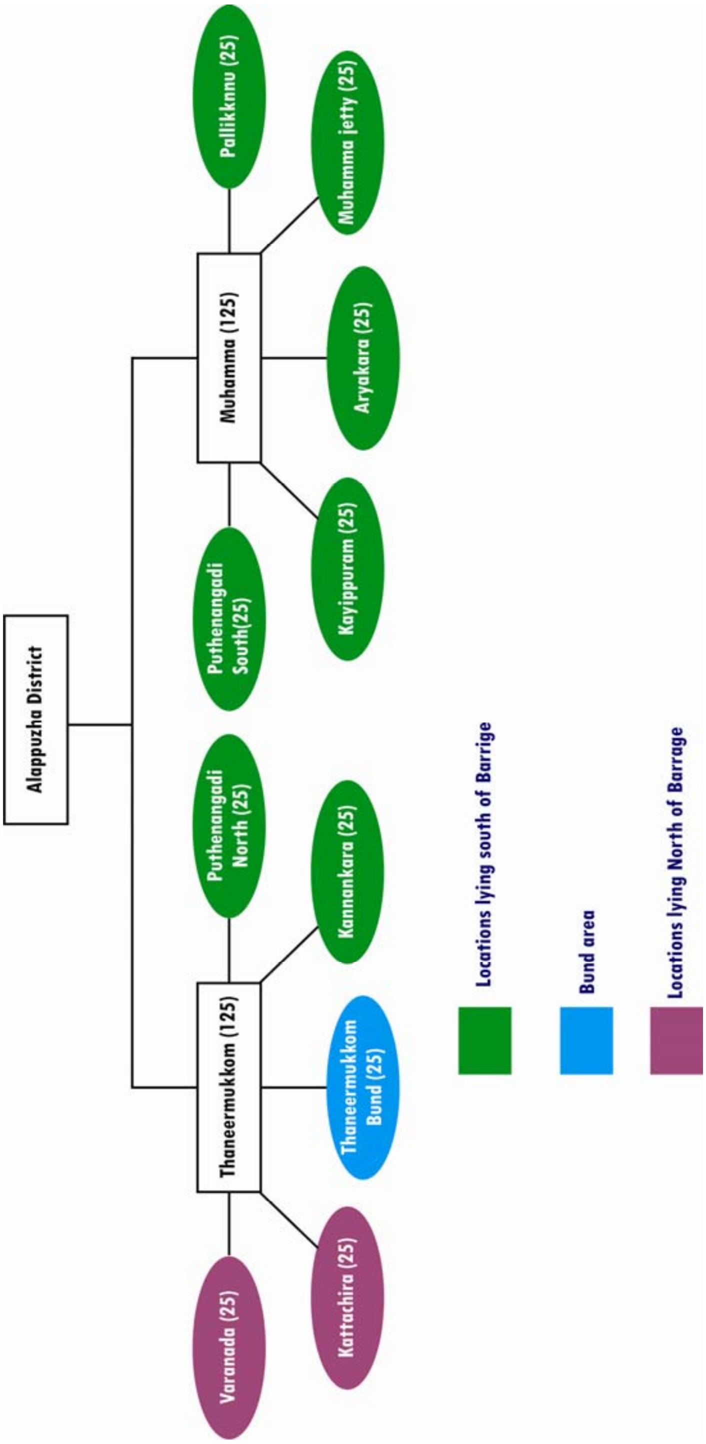


Fig 1.2 Multistage Sampling Framework

The data collected were tabulated on the basis of demographic characteristics, socio economic, institutional and health dimensions and verification of assets were done using Sustainable Livelihood Approach (SLA). The data analysis has been made using following statistical methods.

1. Chi- Square test and t test
2. Theil Index
3. Foster Welfare Function
4. Atkinson Index
5. Multi Dimensional Scaling
6. Sustainability Index

Theil Index is used to explain how certain groups contribute a certain amount of inequality to the whole. In this study, Theil index helps to analyze the poverty in each location by measuring the amount of inequality existing in different locations. Foster Welfare Function is the application of Theil Index, which is used to find out the relative inequality of the income distribution within a group. Atkinson Index explicitly incorporates normative judgments about social welfare. To deal with sustainability issues, multidimensional scaling technique and sustainability index has been used. Secondary data for the study were collected from magazines, journals, published articles, news papers, published thesis, unpublished data from research institutions, internet sources etc.

1.9 Limitation of the Study

The importance of the study lies in placing biodiversity of Vembanad lake and ecosystem as the central theme of regional development as it is closely connected with the sustainability and livelihood issues of the concerned ecosystem dependent community, the traditional inland fisherfolk. Even though this wetland and the surrounding area together form a Socio-Ecological System (SES) and lake is the lifeline for the villages on its banks there is no proper wetland data base in relation to this wetland ecosystem for monitoring and assessing changes to biodiversity values and ecological services. Thus it is not possible to evaluate biodiversity changes occurring in the area as a continuous process for a particular time period. As the statistical reports published by the central as well as the state governments with regard to inland fisheries are inadequate to substantiate data for the study, it could not explore many aspects regarding landings at species wise and district wise or a continuous assessment which is easily possible as far as marine fisheries is concerned. However, the study had taken utmost care and effort to correlate various primary and secondary information on the various facets of biodiversity degradation and its impact on the dependent community, which in turn could help to expose the incredible truth about Vembanad with suggestions and entreaties to save it from eternal damnation.

1.10 Scheme of Study

The study is designed through six chapters. The first chapter includes introduction, international, regional and national approach on inland fisheries, significance of the study and genesis of the research problem, objectives of the study, background and context of study area, methodology and source of data and limitation of the study. The second chapter deals with the evolution of property rights, sustainable livelihood approaches and frameworks for effective natural resource management. The third chapter is an overview of the fishery based wetland ecosystems in Kerala with special emphasis on sustainability and livelihood issues of traditional inland fisherfolk depending on it. The issues on this particular aspect are discussed on the basis of social, cultural, political and economic background giving due weightage to environmental problems. The fourth chapter discusses the socio-economic aspects based on demographic characteristics, employment pattern, asset and investment structure, income and employment of respondent households of the study area Thanneermukkom and Muhamma inland fishing villages of Alappuzha district. The fifth chapter discusses the livelihood issues and sustainability problems of the respondent households relating to current perceptions of key environmental challenges, ways and means for conservation and enhancement of fishery resources etc. An attempt is also made to find out an alternative employment opportunity through occupational mobility for the livelihood security of the younger and future generations. The sixth chapter highlights the major conclusions of the study encompassing policy recommendations for solving the problems identified through this study.

Chapter 2

EVOLUTION OF PROPERTY RIGHTS AND SUSTAINABLE LIVELIHOOD APPROACHES – A THEORETICAL REVIEW

Contents

Chapter two outlines the conceptual framework on the dependence of the poor on resource base, poverty assessment and sustainable livelihood issues. A brief review of existing literature is made to help for the exploration of this avenue of study. This chapter also reviews the survival strategies adopted by artisanal fishing communities to access social, cultural, political and institutional assets to sustain their livelihoods.

2.1 Natural Resources and Environmental Concerns

The earth's natural systems are the key to build an environmentally stable society. The environment in the form of natural resources which provides energy and materials is being used to produce goods and services to satisfy human needs. Traditional usage confines the term natural resource as the one which is useful to mankind under feasible technological, economic and social circumstances. The classification of natural resources as renewable and exhaustible depends on its rate of regeneration. For some renewable resources, the continuation and volume of their flow depend crucially on humans. Over harvesting reduces the stock of some renewable resources like fish which in turn reduces the rate of natural regeneration of the fish population. For other renewable resource such as solar energy, the amount consumed by one generation does not reduce the amount consumed available to the generations that follow. In the case of exhaustible resources, it will be depleted as long as the extraction rate is positive. Since exhaustible resources are created by geological processes with geological time spans they can be regarded as fixed in quantity, although the total quantity available may not be known. As an exhaustible resource is limited in quantity and is not producible and the extraction and sale of a unit today involves an opportunity cost. As long as natural resources are available in unlimited quantities, there is no environmental concern. Environmental issue starts with the transformation of environmental goods into economic goods. The abuse of environmental resources has transformed environmental resources into economic goods through a reversal in the supply demand relationship of environmental quality. Greater economic activity inevitably leads to environmental degradation and ultimately to possible economic and ecological collapse. Shafif (1994) views that rising income leads to greater of environmental degradation and poor are often the most exposed and vulnerable to the health and productivity losses associated with a degraded environment. Panayotou (1993) suggests the idea that conditions may deteriorate before they improve. He suggests that environmental degradation at first rises, and then falls as economic development proceeds. The inverted U shape of environmental Kuzent's curve explains the relationship between environmental quality and development. For more precision, the relationship between inequality of income distribution and economic development is shown as follows. Environmental pressure increases up to a point as income goes after the turning point, environmental quality improves as income keeps rising (Kuznet, 1955, 1963). It is observed that shifting of pollution intensive production to poor countries with lower environmental standards accounts for a significant part of improvements in some environmental quality indicators that occur in developing countries (Grossman and Krueger, 1994).

Economic growth is considered as the necessary means to the end of greater human welfare and a pre-requisite for the good life. But measurement of economic growth in terms of output of goods and services is considered deficient as it does not take into account the external cost of environmental pollution. The United Nation Conference on Environment and Development (The Earth Summit) at Rio de Janeiro in June 1992 gave due weightage to the issue of potential conflict between economic growth and maintenance of environmental quality. Short lived individuals make decisions which have long lasting effects on factor productivity and environment. In connection with this issue an Overlapping Generation Model of Growth and Environment is put forward by John and Peccheino (1994). According to this model pollution is generated by consumption activities and is only partially internalized as the current generation considers the impact of pollution as its own welfare but not on the welfare to future generations. In this model, the economy is characterized by declining environmental quality when consumption levels are low, but given sufficient returns to environmental maintenance, environmental quality recovers and may improve absolutely with economic growth. This model provides a theoretical explanation of observed correlations between environmental quality and income, whereby economic growth is associated first with decline, then with improvements in environmental quality.

J Curve for abatement explains the extent to which development reduces the carrying capacity of the environment which implies that the abatement effort must increase at an increasing rate to offset the effects of growth on pollution. When a given capital stock is achieved, the expenditure on pollution abatement is zero until development has created enough environmental damage to meet expenditure on abatement. Two sets of factors contribute to early and rapid increase in abatement. On technology side, there is high marginal effectiveness of abatement and on the demand side, rapidly declining marginal utility of consumption and rapidly rising marginal concern over mounting pollution levels (Seldon and Song, 1998).

To improve environmental quality, it is better to interlink resource extraction and environmental cost on society. The inclusion of environmental cost results in higher resource price which tend to lower along with maintaining its quality. According to Titenberg (1998), the direct relationship between environmental cost and resource extraction confirms that environmental and natural resource decisions are intimately interlinked.

2.2 The Poor and Environmental Degradation

Natural resources remain integral to the livelihoods of billions in developing countries providing food, fuels, water biodiversity, raw materials and spiritual fulfillment (Rasmus, 2010). The poor make extensive use of goods collected from land or water over which no individual has exclusive rights over resources (Jodha, 1986). Natural resources play a key role as a subsistence source of last resort in times of economic decline and when other food supplies are constrained, environmental income forms the basic of rural livelihood which is being compartmentalized under two heads, wild income and agricultural income. On an average the environmental income accounts for roughly two thirds of household income for the rural poor and sustaining environmental income implies better ecosystem management which is translated to higher productivity and ultimately to higher income (Vedeld et al., 2004). It has been suggested that rural households depend quite heavily on freely provided environmental goods and services to sustain their welfare through the provision of both productive inputs and consumption goods. There is also a substantial gap in quantitative understanding of rural households, economic relationship between rural households and environmental resources (Cavendish, 2000; Fisher, 2004; Das Gupta, 1993).

Environment income is the direct benefit people obtain form biodiversity and their environment. In times of crisis, during drought and economic recessions, even those households not normally reliant on environmental income can turn to wild products as a last resort. Ecosystem then serve the additional function of social safety nets ensuring families against absolute poverty and starvation. The importance of environmental income to the poor can be judged at different scales. It is estimated that 90 percent of world's billion poor are living on $ 1 per day or less depend on forest for at least some of their income (World Resources 2000-01). Environmental income is also important not only for common sources of income for the impoverished, but are major contributors to the economies of many nations. It is observed that the rich commonly derive more environmental income is absolute terms than the poor do. This generally reflects the fact that they have greater utility to exploit what ecosystem can provide (Narain et al., 2005).

Population is an important source of development but also a major source of environmental degradation when it exceeds threshold limits of the support systems. Population impacts on the environment is primary through the use of natural resources and production of wastes and is associated with environmental stresses like loss of biodiversity, air and water pollution and increases pressure on arable land (Sharma, 2007). Growing population poses some serious environmental threats. More people means less forest, water, soil and other natural resource (World Population Data Sheet, 2007).

Population is theorized as a key drawing force along with economic activity, technology, political and economic institution and attitudes and beliefs (Stern, 1993). The relationship between population, human welfare and environmental impacts is formulated by IAPT model which postulates the environmental impact (I) is the product of population (P), percapita affluence (A) and (T), the level of technology (Ehrlicich and Ehrlicich, 1990). This equation is an effort to describe the overall impact of humanity on the environment. The equation makes clear that slowing population growth is a key part of any strategy to reduce humanity's impact on the environment. This could be better explained by adding that even if precapita income resource consumption (A) declined or technologies (T) improved enough to reduce the environmental impact (I) of humanity by 10 percent the gain would be wiped out in less than a decade because world population P is growing at over one percent per year (Green, 1992; UNFPA, 1991; Subedi, 1996; Enrilchi and Holdren, 1971). As the percapita consumption of resources is expected to increase as living standards rise, protecting the environment requires more efficient production technologies, less waste and ultimately a stable population size (Upadhyay and Robey, 1999; Vitousek et al., 1997). The Simulation projection model (S/P) is used to project environmental impacts under various scenarios of population and economic growth which provide the basis for determining the effect of population and economic growth. In this model, resource demand or pollution generation is estimated as a function of percapita income. Projection of population and income is used to estimate future resource demand or pollution (Herzog and Ridker, 1972).

Mostly poor could be charged with over exploitation and consequent degradation of natural resources. Because of faster rate of growth of population and their dependence on the natural resources due to compulsions of poverty coupled with high subjective discount rate, the poor are blamed of for their responsibility of resource degradation (Vyas, 2003). Higher population densities means increased reliance on natural resources, as well as environmental impacts such as human and solid waste disposal and emission to air and water. But this aspect does not imply that population density necessarily cause pressure on the natural environment. It depends on what the natural resources can carry and how the natural resource is used by the inhabitants. People who live in coastal regions suffers the cumulative burden of environmental stress from the activities due to the over crowding of the coast and from upstream and inland development. As coastal communities grow, sewage can become a threat to local water treatment and much of the sewage is dumped without being treated (Creel, 2003). In developing countries more than 90 percent of waste water and 70 percent of industrial wastes are discharged in coastal waters without being treated. The United Nations Environment Programme estimate that South Asian Waters are at the highest risk of pollution as 825 million people in the region do not have basic sanitation services (Jasuja, 2002).

For many of the 1.1 billion people living in severe poverty, nature is a daily life line, an asset for those with few other material means. Income from ecosystem which is called as environmental income act as a stepping stone in the economic empowerment of the rural poor. This requires that the poor manage ecosystems so that they support stable productivity overtime. Productive ecosystem are the sustainable income stream from the nature. But for poor to tap that income, they must be able to reap the benefits of their good stewardship. Unfortunately the poor are rarely in such a position of power over natural resources. This happens so because of an array of government failures. Lack of legal ownership and access to ecosystem, political marginalization and exclusion from the decisions that affect how these ecosystems are managed. Making governance friendly to the poor means tackling issues of property rights, access to information, institutional transparency and fairness in sharing the costs and benefits of resource management. For this purpose a strict environmental policy is advocated by Porter hypothesis. According to Porter (1991), strict environment regulation can reduce efficiency and encourage innovations that help to improve commercial competitiveness. The hypothesis suggests that strict environmental regulation triggers the discovery and introduction of cleaner technologies and environmental improvements, the innovation effect making production process more efficient. This hypothesis indicates that if there is an environmental policy that govern, the use of resources will be with utmost sustainability and this can result in the growth of economy and regulation of resource depletion. Thus it brings a double dividend that environmental policy improves both environment and competition (Wagner, 2003).

2.3 Poverty, Dependence on Fishery Resource Base and Sustainability

The concept of poverty is multidimensional. It covers not only levels of income and consumption, but also health and education, vulnerability and risk and marginalization and exclusion of poor from main stream society (Dev, 2005). Sen (1981) in his approach launched a new concept 'entitlement' while redefining poverty. According to him, people's command over food does not simply depend on its production and availability in the market but is also governed by a range of social, economic, cultural and political factors. He ascribes that poverty must be seen as deprivation of basic capacities than merely lowness of incomes. Poverty results from the inadequacy of command over resources needed to generate socially determined basic capabilities where as capability deprivation is more general and may be caused by host of factors (Kakwani and Son, 2006). According to the World Development Report of World Bank (2001), poverty is pronounced deprivation in well being. Das Gupta (2003) describes poverty as a concept that is fundamentally linked to lack of well being. Poverty index perspectives have refocused the concept of poverty as a human condition that reflects failures in many dimensions of human life – hunger, unemployment, homelessness, illness and health care, powerlessness and victimization and social injustice. According to Human Poverty Index (HPI), poverty is the deprivation side of human development (UNDP, 2006). Townsend (1974) redefined poverty as not just a failure to meet minimum nutrition or subsistence levels, but rather as a failure to keep up with the standards prevalent in a given society. The approaches to poverty aim to measure it objectively in terms of expenditure, income or some other quantitatively defined indicator. It is also observed that poverty is also a subjective experience and that participatory research methods offer the best means of assessing poverty and capturing what people themselves identify as its principle dimension and indicators (Chambers, 1989; Chamber and Conway, 1992). Poverty is also measured or understood in terms of true income and ownership of limited capital assets. Poverty is a human condition characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of adequate standards of living and other civil, cultural, economic, political and social rights (UN Committee on Social, Economic and Cultural Rights, 2001).

Scale and nature of poverty is assessed in different ways by different studies. They are government failure and lack of innovation, lack of access to assets, lack of growth and redistribution of income (ADB, 2004; Duncan and Pollard, 2002; De soto, 2000; Dagdeviren et al., 2002). To overcome these problems which causes poverty and to lift the poor into mainstream development, social development which includes social, economic, cultural and spiritual aspects of living is to be considered through empowering people by transforming institutions (Sachs, 2005; World Bank, 2005a; DFID, 2006; Pound et al., 2003).

Poverty in fisheries is mainly related to the natural factors-fishing resources and its associated exploitation levels. Bane (2003) interprets the relationship between fisheries and poverty specifically that fishermen are poor because they are fishermen. Fishermen are considered as the poorest of the poor due to the endogenous and exogenous origin of poverty in fishery. The endogenous causes of poverty is related to low level of natural resources and common property nature conditions and exogenous issue of poverty in the fishery is based on the economic concept of low opportunity income which means that alternative incomes are usually low for those in the fisheries sector (Gorden, 1954; Copes, 1989). Resource dependency in the fisheries sector is severe among artisanal fishing communities and also the concomitant poverty. Fishing communities face unique challenges to social and economic stability as they rely on one particular natural resource for income and employment and they are often characterized as economically impoverished and politically marginal (Baily and Pomeroy, 1996).

The key way to reduce poverty among fishing dependent people is decreasing people's vulnerability and marginalization without putting additional pressure on fully or over exploited fishery resources. This will increase their incentives and capacity to participate in resource management. Vulnerability is understood in terms of their livelihood systems to these risks and limited access to cope with and adapt to them. Vulnerability assessment offers a framework for policy measures that focus on social aspects including poverty reduction, diversification of livelihoods, protection of common property and strengthening of collective action (Obrein et al., 2004). While poverty and vulnerability are considered as end results of policy failures of various kinds, marginalization or social exclusion is conceived as resulting from negative social and power relations with others. The marginalized are excluded from political, social and economic opportunities engaged by other citizens (DFID, 2005a). Sustainable livelihood approach is useful for addressing the multiple dimension of poverty with an emphasis on asset upon which livelihoods are built including non-material assets such as education, good health and access to social support networks.

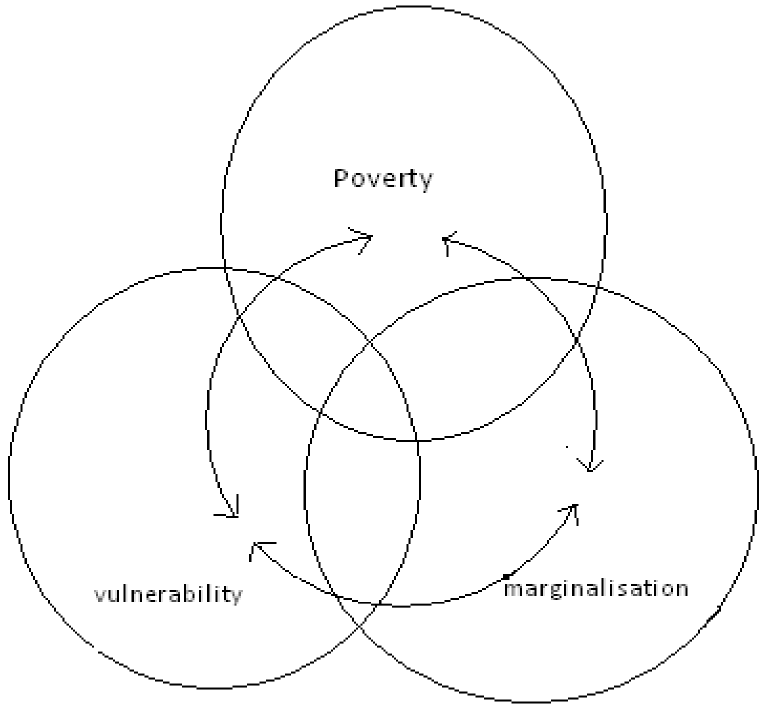


Figure 2.1 Sustainable Livelihood Frameworks

Source: DFID, 2005

Vulnerability and relative degrees of vulnerability is assessed by Risk sensitivity adaptive capacity and process of social exclusion or marginalization is assessed through an understanding of the exercise of power. While the concept of poverty, vulnerability and social exclusion are related and as they overlap, the definition of these concepts suggest different entry points for development. The causes of poverty that are rooted in inequality of power are addressed through Social Exclusion Framework given in figure 2.1 (DFID, 2005b). Accordingly social exclusion describes a process by which certain groups are systematically disadvantaged because they are discriminated against on the basis of their ethnicity, race, religion, sexual orientation, caste, descent, gender, age, disability, HIV status, migrant status or where by they live. The conceptual framework thus highlights the importance of putting prejudice and discrimination at the centre of social exclusion analysis and understanding who is socially excluded and how. The discrimination is transmitted through institutions and behaviour both formal and informal leading to exclusion outcomes in poverty and at political, economic and social levels. Social exclusion is therefore both an outcome and a dynamic process often with multiple layers of discrimination compounding the impact (Gaynor and Watson, 2007). Due to continuing vulnerability and social exclusion, many fisherfolk currently lack both the incentive and capacity to claim and defend systems of access rights that aim to conserve stocks for their exclusive use.

Most of the small-scale fisheries are continuingly overfished and becoming more unsustainable. Their crisis of change in fisheries and the way in which fishing dependent societies are reacting, adapting and coping during this period is to be linked by a holistic framework for fisheries management which acknowledges the necessity of combining natural and social systems and also for the need to manage environment and resource systems for resilience (Berkes, 2003). Deb (2009) introduces a new term 'fishantry' which is being defined as a social entity with distinct socio-economic-political and cultural characteristics tuned to the complexities of small scale fishery who using simple equipments and mostly family labour capture fish and other aquatic organisms for household consumption and sale for income, work as paid laborer and or remain engaged as coerced laborers on share basis for serving the owner of production units. Unlike peasantry, fishantry as a professional entity is not a single or homogeneous entity, but a complex dynamic mix of different sub groups, forces, attitudes and responses within the apparently homogeneous community. The fishantry framework has been benefitted from the entitlement theory of Sen. The small scale fisher's low Catch Per Unit Effort (CPUE) is not only a state of fish availability decline but also emanates from a rapid decline in fishing entitlements i.e. the ability and right to fish appropriately ensure food for a family from a designated zone. The fishing resources are not only important for economic roles, rather for cultural, spiritual and communal identity of fishers. Fishing entitlements are to be linked to mortality, conservation values, functioning of the informal institutions and belief systems of the fishers. The common property resource management and community based management schemes are considered as a route for more sustainable fisheries (Ostrome, 1990; Kurian, 1998).

The relationship between poverty and property rights over natural resources is complex. Poverty can lead to a high dependence upon the consequent degradation of natural resources. Exclusion from crucial resources following changes to property rights regimes act as the main catalyst for increasing deprivation and vulnerability of poor households. The traditional resource sharing system guaranteed continued access to the most vulnerable members of the community. In this context, access to common property resources particularly of the renewable nature are of prime concern in sustainable development scenario. Poor households are often highly dependent on common property resources which include fallow fields, forests, fishing grounds, pasture lands and wetlands for their livelihood. Common Property Resources (CPRs) are a source of variety of goods including fodder, fuel, and medicinal plants etc which are important source of income for many landless poor. The common property resource which is understood as a subset of public goods are potentially subject to congestion, depletion or degradation and now its use in pushed beyond the limits of sustainable yields (Blomquist and Ostrom, 1985). Berkes et al., (1989) defined common property resources as a class of resources for which exclusion is difficult and joint use involves substractability. When there is open access, there is absence of properly rights and no individual bears the full cost of resource degradation (Hardin, 1968). Private property is the most efficient way to internalize the externalities that arise in CPR management (Demsetz, 1964; Johnson 1972; Smith, 1981; Cheung, 1970).

The common views on the classification of common property resources shared by different literature is shown in table 2.1.

Table 2.1 Classification of common property resources

Type of resource	Specifications
Open access	1) Free and open to anyone 2) Absence of well defined property 3) Access to the resource unregulated 4) Results in degradation of scarce
Private property	1) Individuals or households are assigned the rights 2) Rights include exclusion of others from using the resource 3) Regulation of the use of resource. 4) Recognised and enforced by the state.
Communal property	1) Exclusive rights assigned to a group of individuals 2) This identifiable group excludes outsiders 3) The group manage and regulate the use of resource among the members 4) Rights of equal access and use to the members of the group.
State Property	1) Rights to the resources vested exclusively in the government 2) State regulates both access and utilization.

Source: Fenny et al., 1996; Bromely, 1991; Ostrom, 1990; Wade, 1987

A decentralized collective management of CPRS by their users would be an appropriate system for overrating the tragedy of commons (Chopra et al., 1989; Ostrom et al., 1999). Collective action for natural resource management can include joint investment in buying, constructing or maintaining local infrastructure and technologies, setting and implementing rules to exploit resources, representing the group to outsiders and sharing information (Bardhan, 2000). Olson (1965) defines collective action as; collective action is where individuals undertake collective effort based on natural interests and the expectation of natural benefits.

While defining collective action, he developed the term free riding with the basic principle that the public goods are non excludable implying that nobody in the group or society can be excluded from using the good. Individuals then have an incentive to take a free ride that they will use the good without contributing to the production or management. In such a situation under CPRs, regime is inherently inefficient since individuals do not get proper incentives to act in a socially efficient way.

A person's or community's right to land and other natural resources define their natural resource tenure. Resource tenure is defined as all the ways by which people gain legitimate access to natural resources for the purpose of management, extraction, use and disposal. Legally, tenure is bundle of both rights and obligation - the right to own, hold, manage, transfer or exploit resources and land, but also the obligation not to use these in a way that harms others (Bruce, 1998; FAO, 2002). The extent to which a person can benefit from common property depends on his or her tenure security. The definition for common property tenure security describes three facets, breadth of tenure rights, assurance of rights and duration of rights (Roth et al., 1994). Breadth of rights refers to the range of rights held such as right to use and withdrawal, right to decide who may access the resource, right to decide the manner in which access and withdrawal should take place and the right to transfer ownership (Schlager and Ostrom, 1992). Assurance of rights refers to the degree of certainty people have that their tenure rights will not be violated today. Duration of rights refers to the degree of certainty people have that their tenure rights will not be violated in the future. Thus individual group members exercise their individual tenure rights most commonly use rights according to the group rules and regulations. The group itself has a set of tenure rights granted by some external power usually the state. The Padu system in Vallarpadam island, Cochin, Kerala defines the group of rights holders and resource boundaries and fishing sites and species specific (Shrimp) (Berkes and Lobe, 2004). In Padu system the right is assigned to the individual by use of lottery or rotational access. The institution provides equitable access, collective social responsibility and rules making and conflict resolution for the right holders. Accordingly the characteristics of functioning of CPRM system (Common Property Resource Management) is as follows. The group is homogenous, the resource has a defined boundary, resource appropriation is relative to provision, there is sufficient consumers in the group on how to use the resource, the group feel that it can influence rules of use, a sanction system in a place, there is transparent and accountable conflict resolution system with monitoring possible, last but not the least the group has the power to exclude other users. Baland and Platteau (1996) argue that the studies on common property resource management shows that individuals are more likely to conserve a resource when they believe that they will reap the long term benefits of conservation and restraint. As poor people who depend heavily on a limited natural resource base attach greater value to its conservation and so they develop sustainable management strategies (Reddy, 1999).

Along the edge of coastal sea in lagoons and estuaries and in the transition zones of beaches, mangroves and tidal flats, the resources are of critical concern. In most countries, these places are not owned by individuals or private entities, but are commons where the public has more or less free access and use. The necessary link between poverty and degradation of coastal resources and wetlands have been increasingly addressed in the last five to seven years by FAO, world Bank, 9th Ramsar convention and other international bodies. Wetlands provide a special case in point. Wetland resources tend to have unique property rights regimes due to their ecological characteristics namely-their multiple-resource characteristics, the indivisible nature of these resources and the seasonal and cyclical nature of different wetland resource components (Adger and Luttrell, 2000). Wetlands are used by fisherfolk, hunters, charcoal makers, pastoralists and agriculturalists under traditional resource sharing regimes at different seasons and also harbour a wide variety of flora and fauna. Ensuring compatibility along such a wide set of users poses special challenges. Conventional access rights are particularly hard to define for this system since water levels are not the same each year and pattern of flooding are erratic (Hoven, 2001). Even the most elaborate traditional arrangements are seldom extended up to stream water users and often leads to over extraction or pollution by industrial or agricultural users. This has severe consequence on downstream fisheries resources. Thus it should be recognized that the fundamental issue for capture fisheries is the allocation of scarce natural resources to alternative ends. For wetlands which contain, major inland fisheries, as population pressure and other stresses increases, the natural resources become increasingly scarce and other things being equal would become increasingly valuable. But as institutional arrangements do not exist or are inadequate for the allocation of resources, free and open access to increasingly valuable resources results inevitably in their degradation (Cunningham et al., 1985).

Lagoons and estuaries are an important component of coastal zone management programmes as they maintain exceptionally high level of biological productivity and play important ecological roles such as (1) exporting nutrients and organic materials to outside waters through tidal circulation (2) providing habitat for a number of commercially or recreationally valuable fish species and (3) serving the needs of migratory near shore and oceanic species which require shallow protected habitats for breeding. Consequently call for increased integration between coastal resources and wetlands are common in recent literature. Management of this common property is an important function of government. But it receives too low priority. It is estimated that coastal regions in a depth of six meters at low tide cover more than 1280 million hectares or approximately 13 percent of the earth's land surface (Finlayson and Davidson, 1999). The loss of this wetland has been estimated at 50 percent of the area that existed in 1900 (MEA, 2005). It is also estimated that more than half of the fish stocks are fully exploited (52 percent) and that 27 percent are either over exploited or depleted (FAO, 2009).

Coastal resources and wetlands are important for the poor around the world. Intact and functioning wetlands are the primary source of survival for many of socially and economically excluded group in the developing world (Parry et al., 2007). While coastal resources (fisheries) are often characterized by open access or lack of appropriate tenure systems, wetlands tends to be characterized by conflicts between different tenure systems (e.g. land tenure and water resource tenure). Attempts to manage wetlands generally have a poor record as different groups use wetlands for different needs. One user group has limited influence over the total use of the wetland and hence joint management arrangements are vulnerable to free riding. The establishment of protected areas for especially environmentally critical coastal and wetland areas is of course an effective way to regulate the use of vital natural resources. This does not mean that people depended on such area be cut off from a very important source of livelihood, but that their use of natural resources is clearly regulated. Protected coastal areas have a potential to attract tourists which may serve as an alternative source of livelihood instead of direct natural resource use. In case where wetlands are managed as common pool resources, state appropriation or imposition of private property rights may lead to unsustainable utilization of wetland resources or the conservation of wetlands for other purposes. The joint conclusion is that effort made to protect threatened coastal resource and wetlands should not be allowed to exert negative effects on poverty alleviation. Tenure systems and access rights have to be designed to benefit or atleast not negatively affect the poor. If resource use is restricted, alternatives must be available to the poor. One obstacle that forms part of this challenge is identifying and designing pro-poor tenure systems in that property alleviation and natural resource conservation.

2.4 Sustainable Livelihood Approaches

Sustainable livelihood Approach (SLA) depicts the multisectoral character of real life and an integrative framework which could better explain actual problems on its way to the development of a nation. Poverty being the central concern, this approach is a comprehensive and effective means of organizing the management of assets- the human, social, natural and physical or financial that poor people access to make a living (Assby , 2003). Evolved in the Bruntdland commission, the concept implies an approach to maintain or enhance resource productivity, secure ownership of and access to assets, resources and income earning activities as well as to ensure adequate stocks of food and cash to meet basic needs. This approach allows for framing policies that target development, sustainable management resources and poverty eradication simultaneously (Delhi Sustainable Development Summit, 2002).

Definition of sustainable livelihoods varies according to scale, location, management programme and focus. Livelihoods are the ways in which people make a living. Multiple strategies are used by poor households to sustain the activities to meet both the ends of life and when one or more of these strategies fail, the poverty situation worsens. The SLA takes a holistic view, identifying and building on people's existing assets, placing the people themselves at the centre of the framework (FAO, 2006; Norton and Foster, 2001). Defined by Chambers and Conwey (1992), a livelihood comprises the capabilities, assets including both material and social resources and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resource base. This was further supported by Allision and Ellis (2001), according to them a livelihood comprises natural, physical, human, financial and social capital and the activities and access to these that together determine the living gained by the individual or household. Livelihoods are sustainable when the poor are capable of coping with stresses and shocks. Livelihoods are also sustainable when they provide benefits without undermining the natural resource base on which they rely (DFID, 2006a and 2006b; UNDP, 2006; World Bank, 2005b; EC, 2004). The sustainable livelihoods framework can be applied at a range of different levels-from individual to household cluster, to extended kin grouping to village, region or even nation and poverty level is a key criterion in the assessment of livelihoods (Scoons, 1998).

It is important to have a wide conception of the resources that people needs to access in the process of composing a livelihood especially in the context when people's livelihood shift from being directly based on natural resources to a livelihood based on a range of assets, income source and product and labour market. It is noted that sustainable livelihood development is more concerned with people accumulating and using assets to improve their well being and to lift themselves out of poverty. The effectiveness and productivity of assets in supporting people's livelihood depends not only on direct asset productivity and value, but on the options, constraints and costs involved in people exercising rights to assets. The poor are able to sustain enhanced standard of living through promotion of opportunity, empowerment and security which in essence lays the foundation of Sustainable Livelihood Approach (WDR 2001-02).

By using SLA principles and tools, it is possible to design a theoretical framework to address access to assets, livelihood survival strategies and outcomes in the context of single resource dependent households of artisanal fishing communities. Sustainable livelihood is inextricably linked with the environment as the poor are both an agent and victim of environmental damage. About half of the world's poorest people live on marginal lands with no resource but to keep depleting the resources on these or to use other vulnerable areas (WRI, 2000-01). For people in coastal communities, there is near complete reliance on the fish resources (Baily, 2004). These communities through generations have acquired skills only in fishing activities and they have only limited access to political, financial and social assets. So resource dependency in the fisheries sector is severe among artisanal fishing communities. Accordingly resource dependency refers to the condition under which particular communities are heavily reliant on one type of economic activity. It is understood that those communities who depend on one single resource are plunged into problem when that particular resource is exhausted. Livelihood options of resource dependent communities are limited by many factors. Diversification is therefore critical to the sustainable livelihood strategies of the poor (Baily and Pomeroy, 1996). Diversification increases livelihood sustainability by reducing household vulnerability to seasonal stocks and trends, permitting income smoothing.

The sustainable development framework consists of five key components, Vulnerability context, livelihood assets, institution and processes, livelihood strategies and livelihood outcomes. The starting point for SLA analysis is the vulnerability context within which the poor operate. Poor people tend to be more vulnerable than the non-poor as they are more exposed and more sensitive to risk and with less adaptive capacity (FAO, 2005). Vulnerability encompasses trends, shocks and seasonality. Trends in resource market dependency, social exclusion, high population densities having no political assets place the poor households of the fishing community in a vulnerability context. Shocks such as changes in bio-physical environment, competitions for limited resources, depletion of fish stocks, changing technology, financial liability, fluctuating prices for their produce (fish landed) and weak governance increase the vulnerability context. Seasonality in migration of shoals of fishes, algal blooms mud bank formations (Chakara) monsoon storm surges and outbreak of epidemics adds to the vulnerability context of fisherfolk. The vulnerability context in which he poor is beyond their control and many also vary from one community to the other.

There is a strong link between assets and the options people posses, which in practice pursue alternative activities that generate the income levels required for survival. The asset base upon which people build their livelihoods includes a wider range of assets and their assets imply a number of components which is recognized under the economic category. Main categories of capital identified, natural capital, physical or financial capital, human capital and social capital are shown in figure 2.2.

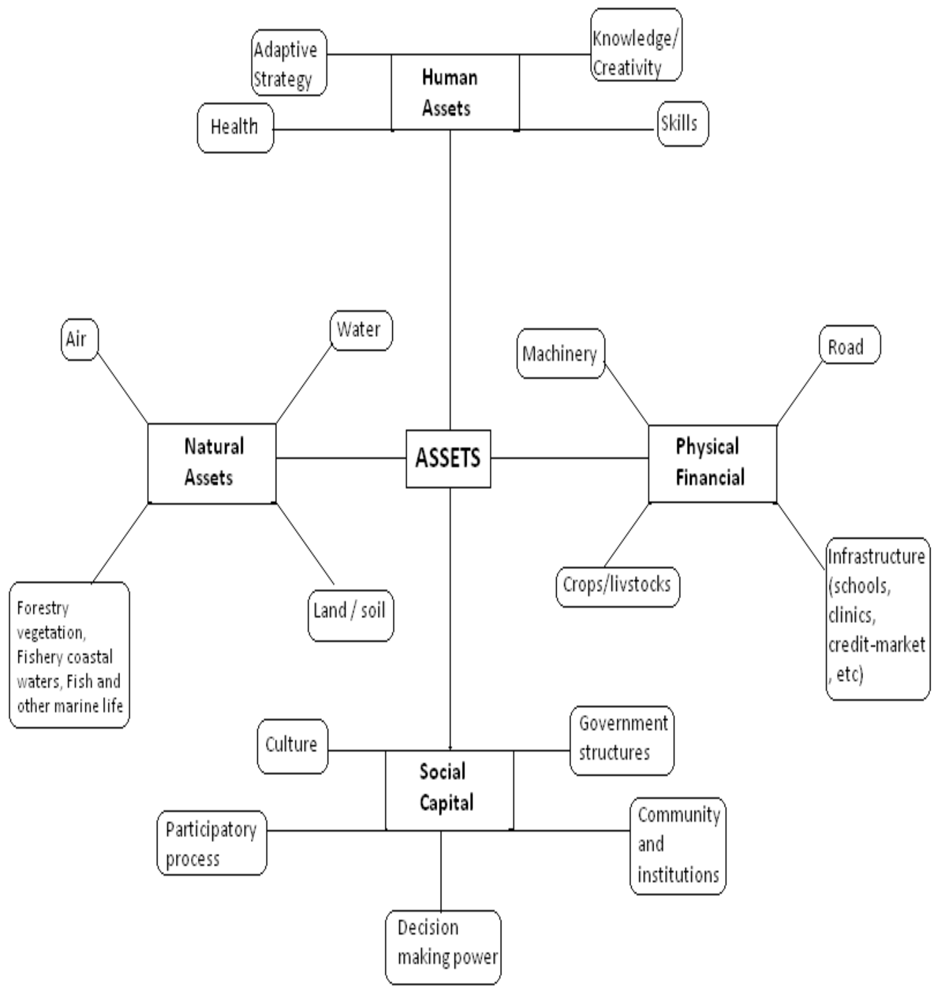


Figure 2.2 Community asset as an entry point for SLA

Source: Own formulation

Natural capital assets of fishing community are the natural resources from which benefits flow to the artisanal fishing communities and groups. They include fisheries resources themselves and their biodiversity, mangroves, plants, trees and herbs which are beneficial to the stability of coastal ecosystem, access to the seasonal benefits they have from climate and also access to community owned land the community can use. The major natural resource coming under the preview of the study is given in table 2.2.

Table 2.2 Classification of wetland based on wetland types

Wetland classes	Wetland types
Inland Wetlands	Fresh water lakes
	Fresh water Swamps, Reservoirs, large ponds
Coastal wetlands	Estuaries / Back waters, Mangrove
	Forests, kol, Kuttanad and Pokkali.
	mudflat, aquaculture pond, islets/thururtu

Source: State of the Environment Report 2007.

The best example for access to seasonal benefits due to climate is the mud bank formation in Kerala which is popularly known as 'Chakara' in Malayalam. During the south west monsoon period, when the sea is very rough, very calm sea condition prevail in the mud bank zones adjoining the shorelines. Some of the locations well known for the occurrence of mud bank are Koilandy, Njarakkal, Puthuvypu, Alappuzha and Purakkad. The land used for harbours and fish landing centers can be cited as examples for commonly used land that community can use. Another aspect of natural capital is that it can be converted into financial capital (e.g. by selling fish) into physical capital (e.g. Mangrove trees into fishing crafts) and human capital (fish for a healthy diet).

Physical/financial capital includes infrastructure tools for production and access to credit. The infrastructure that support the livelihood of artisanal fishing communities are listed as harbours and jetties, fish landing areas, gear shores, smoking kilns and ice plants. The tools for production are boats, net engines, processing equipments and ice boxes. Less obvious examples are roads, houses, schools, water supply schemes, health clinics, market places and meeting places. There are 9 major fish landing centers in Kerala. There are around 3000 crafts already in fishing operation in the inland water bodies of Kerala. The fishing gears in practice are mainly two types stationary gears such as stake nets and

Chinese dip nets and among the wandering gears 25 types of gill nets could be encountered. Apart from this, 17 varieties of seine nets and seven types of cast nets are in vogue. Financial capital not only consists of cash and savings but also access to credit and of the ability to quickly and easily converts other assets into cash. Financial capital not only consists of cash and savings but also access to credit, and this is available to the fisherfolk population of Kerala through financial agencies such as co-operative societies, local bodies, matsyafed and housing board.

Without human capital, people are unable to effectively use the other three capitals. As per the socio-Techno-Economic survey of fisherfolk in Kerala, 2004, 34.08 percent acquired primary education in inland sector followed by 25.46 percent in upper primary education. The percentage of inland fisherfolk population having post graduate education is very negligible i.e., 0.31 percent. The illiteracy level is also high of about 11.64 percent when it is compared with the literacy level of complete literate state of Kerala. As far as technical education status is concerned it is observed that among those who acquired technical education, 46.87 percent have done certificate course. 17.82 percent have obtained fisheries diploma. Support to human capital can be direct such as in the form of training in fishing skills, group organization, processing, credit and management or indirect such as through improved education and health policies which supports their fishing communities and groups or through increasing food security from fish.

Social capital is the networks and relationships which exist in communities and groups and which people make use of in their livelihoods. Social capital is very important for both social and business reasons. Social relations especially kinship ties can provide a social safety net in difficult times. In Kerala, the self help groups are playing a dominant role in providing this social safety net. Most of the fishermen community members both men and women are members in self help groups such as Kudumbasree and Ayalkootams. These social capital also facilitate business ventures by establishing trust relationships which by depending on reduces risks. Some relationships (such as pressure groups) might also help people in the artisanal fisheries to play a stronger role in guiding policy to the sector. Some social capital may be negative. Relationship of the richer and more powerful members of a community or a group may exclude the poorer or weaker members from being involved in decision or gaining access to resources. Encouraging, supporting and using the positive networks and relationships can achieve strengthening of social capital.

As there is high level of political participation and activism among ordinary people along with substantial member of leaders at all levels, Kerala's mass activism and committed cadre are able to function within a largely democratic structure. This activism is being replicated among the fisherfolk community of Kerala and thus one more type of asset political capital is to be added in this research. Political capital includes membership in political parties and participation and representation of household members in the mainstream political power structure. Most of the fishermen organizational structure set up have some sort of political affiliation and the communities are viewed as vote banks by leading political parties. Even the institutional structures constituted for these communities work as per the political backing of the governing parties and this has resulted in policy changes due to change in governments. Political assets is therefore an important component which needs further investigation.

Policies, institutions and process, according to Baumann (2000), is also a capital asset, Political capital that link an individual or a group to power structures and policy outside the locality. This framework helps to organize the extent to which the poor access and influence policies, institutions and processes. Both formal and informal institutions and organization shapes the livelihoods of individuals and households by influencing access to assets, livelihood strategies and vulnerability. Macro level policies, institutions and process influence decentralized decision making that in turn affect local livelihoods.

Livelihood strategies implies the strategies the household adapt in pursuit of income, security, health and other productive goods. It is the range and combination of activities and choices that people undertake or make to achieve their livelihood goals. The strategies could be short term, seeking opportunities with in or outside fisheries or long time, protecting local habitats, creating artificial reefs as a fish aggregation device etc. As a short term strategy poor may seek opportunities within the fisheries sector or in other sectors to escape the poverty situation (DFID, 2003; ICSF, 2003). A house hold may engage in fishing, fish processing and trade. Sometimes those involved in artisanal fisheries will have to enter into wage labor during the year because of seasonal fish strategies. When analyzing livelihood strategies, it is important to realize that those people involved in artisanal fisheries are not homogeneous group and these different groups of stakeholders sometimes have competing livelihood strategies. It is important to recognize these competitive elements and to work out approaches that generate some harmony between them.

Changes in the vulnerability context compel fishers to create new livelihood strategies within the constraint of limited assets leading to livelihood outcomes. Livelihood outcomes can be defined in the term of both what people actually achieve and what they aspire to achieve (livelihood goals). The livelihood outcomes may be positive or negative. Positive outcomes are increased incomes and improved economic conditions, increased well being, reduced vulnerability, improved food security, sustainable natural resource use, better access to assets and social transparency. The reverse direction of all these aspects results in negative livelihood outcomes. The achievement of desired livelihood outcomes is an indicator of the success of implementation of SLA.

As SLA is widely accepted as a people centered approach, there are some guiding principles behind it. According to Carswell (2002) the SL approach has some normative ideals. It is people centered, holistic, multi-level, flexible, responsive, participatory and empowering as it provides serious considerations to the needs and well being of the poor. The SLA is noted as aiming to promote development that is sustainable not just ecologically but also institutionally, socially and economically and to produce genuinely positively livelihood outcomes (Ashley and Hussein, 2000). The policies and regulations need to be directed in a pro-poor way that ensures the poorest communities are not discriminated against but instead are socially prioritized when it comes to appropriating assets. It is the primary responsibility of the government to follow an appropriate political discourse for creating an enabling environment for the poor and guide institutions towards materialization of the SL concept (Chamber and convey, 1992). SL being a holistic approach, demands the exercise of cross-scale negotiations with a variety of stakeholders as fundamental to any intervention process (Scoons, 1998). Broadly speaking, the SLA takes its principles as a practical guide for action. It focuses on the needs, capacities and aspiration of the poor and vulnerable.

A set of socio-economic indicators can be used in understanding the status of natural environment and the changes taking place there in. These socio-economic indicators are having a strong relationship with the state of the natural environment. The goal behind the building of socio-economic indicators is the communication of information about human activities and its effect on the environment. Some of the important issues in SLA framework in fisheries sector is analysed using these key indicators as shown in table 2.3. This helps to understand the actual livelihoods of people dependent on this sector.

Table 2.3 Key Socio-economic indicators for in SLA framework

Name of the indicators	Measurement	Significance or relevance
1. Human development index	Combination of life expectancy, school enrolment, adult literacy rate and per capita income.	Measures the general well being of human population. The value of index provide an indication of extent to which population depend on natural resources.
2. Collective land use management indicators	Measured in square kilometers as a percentage by region	Sustainable land use management leads to an improved appreciation of the value of land.
3. Results of secondary schools leaving certificate evaluation	Expressed as percentage	Provides a measure of quality of education. Education is critical for promoting sustainable development and improving the capacity of people to address their sustainable development.
4. Vulnerability indicator	Measured by the annual registration of vulnerable people as assessed by the emergency management unit.	Relative to annual climate variation. Instances where people cannot survive through the use of normal resources- leading to over use of natural resources.
5. Unemployment rate	Expressed as percentage of labour force which is unemployed.	Main reason for the poverty unemployed people become increasingly dependent on limited natural resources.
6. Extent of gendered inequality	Expressed as percentage of various positions.	Measures the extent to which defacto position of women is changing. Improved position of women leads to better representation in social agenda which would have positive influence on environment protection and sustainability.
7. Population pressure	Measured through a combination of population density of percentage of population dependent on agriculture.	Extent to which population is dependent on natural resources.

8. Real economic growth rate	It is the result of the increment in GDP at constant Market prices(%) minus the increment in the size of the population(%).	Basic economic growth indicator that relates the overall performances in terms of changes in total production of goals and services to the population growth rate. It measures the economic development aspects and sustainable development.
9. Human poverty index	Measures the proportion of population suffering from deprivation.	Useful tool to map the areas and group where poverty is more prevalent.
10. Rate of growth of urban population	Measures how fast the size of urban population is changing.	This index is linked to many environmental indicators such as land use change, water withdrawals and generation of solid wastes.

Source: Compiled from various UNDP Reports.

While combining all sets of indicators, it is possible to evaluate current status as well as predict development scenarios. These indicators show whether conditions are getting better or worse within the context of achieving sustainable levels of natural resource utilization. These indicators depict the relationship between human activities creating pressure, the state of natural environment providing resources and societal response including policies and programmes. This approach is employed to restore or retain balance between human activities and natural environment.

Chapter 3

AN OVERVIEW OF THE SUSTAINABILITY AND LIVELIHOOD ISSUES OF FISHER BASED COASTAL WETLAND ECOSYSTEM COMMUNITIES IN KERALA WITH SPECIAL EMPHASIZE ON VEMBANAD ECOSYSTEM

Contents

Kerala is a major Sea-front State of India, occupying about 9 percent of the coastline of the country and contributing about 22-31 percent of coastal fisheries output. The water resources of the state comprise of a coastline of 590Kms length extending from Manjeswar in the north to Poovar in the south being 14 Kms in length per 100 Km^2 of land territory and is having a continental shelf of 36, 000Km^2 and fresh water resources of 1,58,358 ha. Parallel to the coast, there is a chain of back water lagoons, interconnected with natural or artificial canals. The 41 west flowing rivers included in the 29 major river basins either reach directly or find their route through backwaters to join the Arabian Sea. Blessed with this kind of nature's bounties, Kerala possess various types of aquatic habitats which is capable of generating diversified groups of floral and faunal assemblages having immeasurable fishery significance. This has elevated Kerala in the forefront of Indian fisheries both in terms of production and per capita consumption.

3.1. Diverse Aspects of State Fisheries

Fisheries Sector plays an important role in the economy of Kerala State by contributing 3 percent of the State's economy. It provides livelihood to around 10 lakh fisherfolk population of the state contributing 3.3 percent of the state's population spread over the costal areas of the state in 222 marine fishing villages and 113 inland fishing villages. The average density of population in the coastal area is 2022 against the state average of 749 per sq Km (Report of the working group in fisheries, 2007). Fishermen of the state are the most skilled human resources who had been traditionally depended on this segment for livelihood who acquired the skill through informal education for securing the daily livelihood. Fish caters 70 percent of the animal protein food of the people belonging to all strata. The annual percapita consumption of fishers of Kerala is 27 kg/years and this is four fold when compared to national average.

The state of Kerala, not withstanding its limited geographical extent supports a rich diversity of wetland ecosystem. Physiographically, Kerala comprises of three zones viz., the low land, the midland and the high land running across the length of the state from west to east within a short distance. The altitudinal variation from west to east within a short distance (Maximum <120 Km) to over 2500 Km play a vital role in the terrain condition contributing to diversity in fauna and flora. The elevation difference influences the climate and distribution of the vegetation. Kerala endowed with three distinct ecological realms have features and properties of fresh, brackish and marine resources. The interhill basins and basins or valleys forming the lower configuration of topography in the midlands and the coastal low land belt are characterised by numerous lagoons and backwaters which constitute the major wetlands of the state. The wetlands of Kerala comprises a) the coastal wetland ecosystem such as backwaters and estuaries with the associated mangroves, Mudflats, swamps and Marshes. b) Inland ecosystem like natural fresh water lakes and swamps and c) Manmade reservoirs. The coastal wetland covers an area of 3313 Km^2 with a reticulate system of backwaters and canals. The backwaters, estuaries and lagoons such as Ashtamudi, Vembanad, Korupuzha etc. numbering about 32 comprise an area of 550 Km^2. These estuarine waterbodies are highly productive and support good fisheries as they are indispensible habitat to a variety of biologically and economically important resident and migratory aquatic fauna. Moreover, the interdependence of the adjoining marine and the estuarine zones in completion of the life cycle process of innumerable aquatic species is amply described in fishery literature. The adjoining marine coastal zone continues to be one of the most productive fishery zones in the world as the inter connected backwaters together are a unique ecosystem and habitat for about 200 resident or migratory fish and shell fish species.

Brackish water fisheries is an important driving force in the coastal environment of Kerala, though it is not a major player as in the case of the marine sector. The inland fish production from the state is estimated to the tune of 75000 to 80000 tons of which more than 60 percent is contributed from estuaries and backwaters. The fishing activities in these backwaters support about 0.2 million fisherfolk and provide full time employment to about 50000 fisherman of the state. Out of the total 50,000 inland fishermen, around 80 percent are employed in the backwaters of Kerala. Penaeid shrimps, fishes, giant prawn, mud crabs and clams are the major fishery resources of the estuaries and backwaters of Kerala.

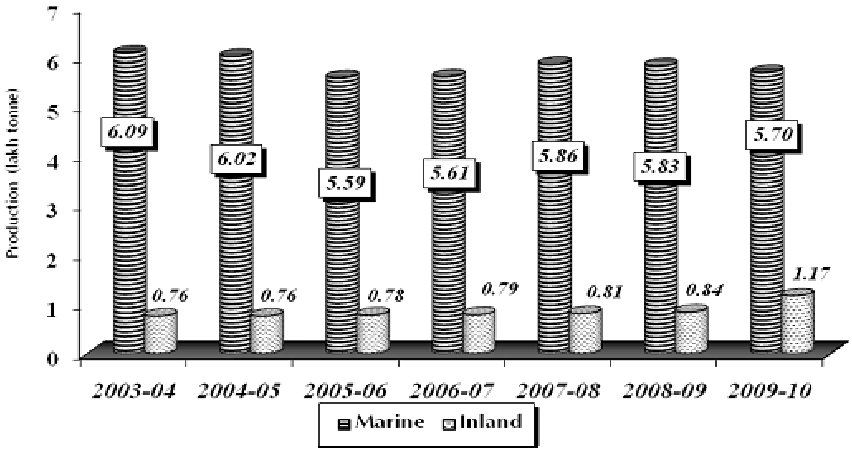
Against an estimate of about 7.5 Lakh tapable marine fishery resources approximately 5.5 - 6.0 lakh tons per annum at an average are caught by all means during the last seven years with more or less negligible fluctuations and this is shown in table 3.1.

Table 3.1 Fish Production in Kerala during last seven years (lakh tons)

Year	Marine%		Inland%		Total
2003-2004	6.09	80.91	0.76	11.09	6.85
2004-2005	6.02	88.79	0.76	11.21	6.78
2005-2006	5.59	87.76	0.78	12.24	6.37
2006-2007	5.98	88.20	0.80	11.79	6.78
2007-2008	5.86	87.86	0.81	12.14	6.67
2008-2009	5.83	87.41	0.84	12.59	6.67
2009-2010	5.70	82.97	1.17	17.03	6.87

Source: Economic Review (2010)

Figure 3.1 Fish production in Kerala (2003-04 to 2009-10)



Source: Fisheries Department, Economic Review (2010)

Though the fish production in Kerala is dominated by the marine sector, according for over 87% of net fish production, the Marine fish production of the state in Kerala appears to be stagnant and seems to have achieved saturation levels whereas the inland fish production shows signs of improvement from 1999-2000 followed by slight decline (Economic Review, 2009).

During 2007-08, Marine fish production has decreased to 5.86 Lakh tons from 5.98 lakh tons of 2006-07 and inland fish production increased slightly. During 2009-10, the marine fish production has decreased to 5.7 lakh tons from 5.83 lakh tons of 2008-09. In the inland sector 0.81 lakh tons of fish is produced which accounts for 12.14 percent of the total fish production of the state during 2007-08. During 2009-10, the share of inland fish production to the total fish production of the state was 17 percent. This implies that inland fish production sustained an increasing trend and this trend can be linked to the success story of Matsya Keralam program which is an integrated project for the development of inland fisheries and aquaculture in the state with the support of Local Self Governments. The available data indicates that further production increase from the marine source will be marginal and negligible irrespective of any method of tapping employed while at the same time there is unlimited scope to reap palatable fishes from inland water bodies which will ultimately help in partially solving the problem of food and livelihood security of the masses.

3.2 Augmenting of Inland Fish Production through Matsya Keralam Project

Matsya Keralam is an integrated project for the development of inland fisheries and aquaculture in the state with support of Local Self Governments. This project aims at increasing inland fish production from the level of 75000 tons to 2 lakh tons over a period of three years. To achieve this target, added emphasis is given for the development of inland fisheries and aquaculture for the productive utilization of inland water bodies hitherto lying by and large idle and under exploited. This project was planned and implemented in the event of stagnant trend in fish production from the marine sector due to over fishing. As the current level of exploitation of fish stocks has exceeded the Maximum Sustainable Yield (MSY) level there is only little scope for additional increase in fish production from marine fisheries. In this context development of inland fisheries and aquaculture has been identified as an alternative means of increasing fish production through this project.

The components of the proposal of the projects are programs for diversification of freshwater aquaculture in inland sector, programs for the diversification of brackish water aquaculture, programs for the development of infrastructure in inland sector, programs for the development of extension and training and programs for marketing support. The specific objectives of the Matsya Keralam project could be categorized as follows.

- To diversify aquaculture for enhancing fish production from inland freshwater/brackish water areas.
- To create new employment opportunities in rural areas through the development of inland and brackish water aquaculture.
- To increase export of fish and fish products.
- To increase percapita availability of fish.
- To develop a well designed marketing system for aquaculture products and to create new employment opportunities through value addition of aquaculture products.

All these objectives are aimed at renovation of inland fish sector which had remained unchanged in terms of production, preservation and marketing practices. A quantum jump in inland fish production was anticipated while the project was implemented and it has been observed that this has come true when the details of second phase harvest data is taken into account. Table 3.2 explains the details of second phase harvest details of Matsya Keralam project.

Table 3.2 Second Phase harvest details of Matsya Keralam Project

Sl.No	District	Beneficiaries	Area stocked in Ha	Harvest details (in tons)		
				Shrimp	Fin Fish(Karimeen)	Mussel
1	Thiruvananthapuram	40	6.016	3.61	2.55	0
2	Kollam	350	156.68	150.41	0	47.79
3	Pathanamthitta	0	0	0	0	0
4	Alappuzha	533	751.5	752.07	2.288	0
5	Kottayam	10	27	20.79	0	0
6	Idukki	0	0	0	0	0
7	Eranakulam	584	1118.85	1184.75	0	67.57
8	Thrissur	165	262.88	265.7	3.857	1.5
9	Palakkad	0	0	0	0	0
10	Malappuram	62	44	37.62	0	5.72
11	Kozhikode	242	77.2	84.92	0	190.77
12	Kannur	187	178.45	148.12	0.805	18.2
13	Wayanad	0	0	0	0	0
14	Kasargode	1377	18.46	147.7	0	2735.81
	TOTAL	**3550**	**2641.036**	**2795.69**	**9.5**	**3067.36**

Source**:** Economic Review (2010)

It is observed that Alappuzha and Ernakulam districts are benefited maximum out of the project in terms of beneficiaries and production levels. When the production details from Matsya Keralam project is added to total inland production details, a remarkable change in total inland fish production levels is noted. A sudden change of 0.84 lakh tons in 2008-09 to 1.17 lakh tons in 2009-10 in inland fish production brings out this fact. It is also interesting to note that though the project was implemented in 2008 as per the

Government order No G.O. (MS) No, 37/08/F and PD with project period of three years, its positive impacts are observed from second phase onwards. From this experience it is to be learned that revival of inland fisheries is possible through constant efforts.

3.3 Concatenation and Congruence of Marine and Inland Wetland Ecosystem

Marine and aquatic ecosystem are inter-connected. Many aquatic ecosystem are linked to the Ocean ecosystem through nutrient inflows that causes high productivity. A number of marine fishery resources need inland water ecosystem including estuaries and lagoons to complete this life cycles. The penaeid prawns breed in the Sea and hatch within eight to twelve hours. After attaining the post larvae stage, they move to the coastal sea and then from there to the estuarine bar mouth. They enter into the backwaters during high tide and attain full growth within three to six months. The low saline water in the estuaries or backwaters is more congenial for the growth of post larva. During this period, they perform ecdysis (shedding out shells) many times before they attain full growth. Once they attain full growth, their tendency is to go back to the deep sea.

There is very good evidence that the land of Kerala has been shaped by a geological upheaval. The Western Ghats that form the eastern boundary of the state appears to be thrown back and heaped up, as if a deluge burst through them. Marine fossils including coral reefs have been unearthed in the present midlands pointing to the fact that the sea once extended right back from the cataclysm form the basis of the extensive network of rivers, backwaters and lagoons that Criss-cross the state today. There are 41 west flowing rivers with an average length of 64 Kms each. They have their sources in the dense tropical rain forests on the Ghats. The lagoons and backwaters experience tidal effect even 50 Kms upstream since much of this land that lies below sea- level cover an estimated area of 3,55,000 ha (Government of Kerala, 1983).

The nutrients from the hills and forests are washed down with torrential monsoon rain. This accumulated silt finds its way through these water ways into littoral currents of the coastal Waters. Here during the monsoon, they lead to the formation of mud banks called Chakara. This mud bank formation in Kerala is an unique phenomenon. This phenomenon reported hitherto only from west coast of India. It occurs between Quilon and Ponnani region predominantly at Alappuzha coast. These mud banks which form strange havens of calm anchorage particularly when the sea is rough have been known to the mariners of ancient times who have visited Kerala. When these banks form they team with fish and prawns. Mud bank denotes those regions in coastal areas which posses the special property of dampening the wave action and producing areas of calm water even during the roughest monsoon. Wave energy is dampened due to dissipation of energy in the large quantity of colloidal suspension in the area. It is usually formed after a week after the monsoon sets in. Unlike the mud banks reported from other muddy coasts of the world, the Kerala mud banks do not show regular relief forming features. Their transient nature, unpredictable periodicity, calmness and turbid nature of the water column are unique. The nutrient inflow into the coastal waters stored in the mangroves or mud flats or vertically circulated through coastal upwellings are vital for sustaining the biological productivity of the coastal seas and inland reaches.

The ecological settings of a narrow strip of land interfaced with a network of rivers, lagoons and backwater flowing into the nutrient enriched coastal sea ensured plentitude of aquatic resources. This factor adds to the diversity of fishing technology. Thus the biological importance of the chain of backwater/estuaries/wetlands along with canals on the south west coast of India are of special significance as they exert profound influence on the coastal fisheries and they are the nursery and breeding grounds of coastal fish and shell fish species. These system are also net exporters of organic matters to the coastal system. Thus it is categorically proved that the high productivity of the coastal seas of Kerala is undoubtedly linked to the chain of coastal back water systems that lie parallel to the coast line and open to the coastal seas through 'azhis' and 'pozhis. Apart from this fabulous phenomenon, another important function that adds value to estuaries is its tidal actions. When salt water enters into the estuary and mixes with fresh water during high tides (veliyettam) a healthy habitat is created for various living organisms. It brings wide variety of juvenile species into the inland water body which is retained in the system until they are matured and harvested. Similarly when water recedes during low tide (veliyirakkam) a variety of pollutants and wastes are taken into the oceans. Estuaries also stabilize the coastal shore and prevents soil erosion in many ways. Another interplay between coastal ecosystem and inland wetlands can also be explained in terms of the fresh water availability. Kerala with its peaked seasonal heavy monsoon has its hydrological cycle regulated to provide fresh water round the year primarily through its evergreen forest cover in the catchment slopes. Within this forest and all the way down along the river channel up to the sea shore there are various wetland system which retain the fresh water and nutrients transported down from the Ghats and make it available to inland before it is emptied into the sea. The coastal stretch of Kerala where salinity from the sea water permeates into the ground water and soil, the near surface storage of fresh water flowing from inland in the back water and all the other coastal wetland system are essential for fresh water availability.

The importance of wetlands was clearly demonstrated by Indian Ocean Tsunami in 2004. It was noted that wetlands have provided a green barrier to protect coastlines and coastal communities who live there. There were localized and anecdotal reports from around the Indian Ocean region of how the damaging impact of the Tsunami was reduced among mangrove stands and coral reefs.

3.4 Inland Resource Potential in Kerala and its Socio-Cultural Implication on the Dependent Community

Geographically, inland fisheries have great scope in the state. The important feature of the state is the occurrence of 49 interconnected back water (kayals) with an area of 46,129 ha. The total brackish water resources of the state is estimated as 1,43,693 ha. In the inland sector, the state is endowed with a total area of about 2,26,274 ha of fresh water lakes, reservoirs, minor irrigation ponds etc. Inland fish production provides significant contribution to animal protein supplies in rural areas of the state. Most of the inland fish production is consumed locally and marketed domestically. This sector contribute to around 0.78 lakh metric tons annually accounts a net value of Rs 30,000 lakh. Above all the inland water bodies of Kerala have a paramount role in the socio-economic development of the state especially in the light of potentials for the development of aquaculture, navigation, commercial fisheries, sport fisheries, aquatic recreation and tourism.

The rivers, rivulets, streams etc originated from the western Ghats are well known for their richness of biodiversity including fresh water fish species. Altogether 210 primary fishes (excluding the marine migrants) are found in the inland water of which 53 species are endemic. Majority of these species have ornamental value also. The estuaries and brackish water fisheries resources comprised of 150 species of fishes, 6 species of shrimps, 4 species of crabs,6 species of palaemonid prawns and 4 species of mollusc. The fishes comprised of about 40 true resident estuarine species which are available in these water bodies round the year while the marine migrants numbering around 70 are migratory to the water body during post and pre monsoon months and contribute to more than 30 percent of the landings. Apart from these resources, the state is having 53 reservoirs belonging to small medium and large with a total water spread of 42890 ha. The majority of the reservoirs are under the administrative control of Kerala Electricity Board or the Forest Department. Scientific aquaculture is done only in ten reservoirs. These managed small reservoirs registered a production of 350 kg/ha/annum. This implies that in Kerala the inland aquaculture has not attained the status as a major fish producing system. Kerala is the least developed inland aquaculture states in India. Most of the inland aquaculture activities in the state could be regarded as rural aquaculture.

The local fishing practices and resource management practices are based on local ecological knowledge of fishermen. In back waters of Kerala, the catch structure and period are closely associated with the lunar tides. Large tides are experienced in the earth's oceans. When the sun and the moon are lined up with the earth at new and full moon phases of moon, they are called spring tides. The amount of enhancement in earth's tides is about the same whether the sun and moon are lined up on opposite sides of the earth (full lunar phase) or on the same side (new lunar phase). The fishermen refer to this period as the 'Thakkam' and it is during this period that they get good catch of both prawns and fishes. In inland sector only non-motorized traditional type of vessels are operated. Plank built canoes and dug out canoes are the common crafts. Catamarans were occasionally operated in the Paravoor back waters of the Kollam district. Cast netting, gill netting, crab trapping, dive fishing, clam fishing, oyster fishing, line fishing etc are practiced with these crafts. Other fishing gears used are drag nets, stake nets and Chinese nets. Based on a survey conducted by fisheries department during 1985-96, there were 8834 stake nets and 1915 Chinese dip nets in operation in the back waters and estuaries of Kerala. It is observed that the fishing methods of brackish water bodies and estuaries are incredibly complex and among the various categories about the three forth of the landings are registered from the stationary nets. Between the two types of fixed nets, stake nets account for more than 50 percent of the landings.

The fish production from the state is stabilized around 6.75 lakh tons, the share of marine landings being 6 lakh tons and from that of inland water bodies is only meager around 0.75 lakh. This figure regarding inland fisheries have shown a remarkable increase in recent years. It observed that, in the national context, production from aquaculture is now contributing around 53 percent of the total fish production. But the contribution from inland fisheries and aquaculture to the total fish production in the state is only 10 percent. Hardly less than 25 percent of the water bodies capable for aquaculture available in the state are currently utilized for various aquaculture activities. The following district wise details of brackish water shown by table 3.3 points to this lacuna.

Table 3.3 District wise details if brackish water area suitable for aqua culture in Kerala (including back water and canals)

Name of District	Total Area (ha)	Area developed (ha)	Area available for future development	% of unused area
Kasarkode	3248	14	3234	99.0
Kannur	5944	737	5207	91.4
Kozhikodu	4162	41	4121	97.7
Malappuram	1766	1	1795	99.9
Thrissur	4272	1012	3260	76.3
Ernakulam	16213	11067	5146	31.7
Kottayam	4327	53	4274	97.1
Alappuzha	15223	1380	13843	66.8
Kollam	8604	570	8034	90.4
Thiruvanathapuram	1424	nil	1424	100
Total	65,213	14,875	50,338	77.2

Source: Success story of Matsya Keralam First Phase(2009)

The district wise details shows that only Ernakulam and Alappuzha districts are utilizing at least more than 60 percent and 30 percent for aquaculture purposes respectively. More than 77 percent of brackish water area which are left unused can be brought under the fold of shrimp farming by organizing farmers groups/co-operatives and by extending training and financial support. But this inland fish production potential has to be tapped properly in a sustainable manner. For this diversification of aquaculture is the need of the time. The cultivation of high value fresh water prawns simultaneous with the paddy would make the culture system more sustainable, eco-friendly and economical where ever it is possible.

The influence of inland water bodies, backwater and sea coast are mutually complementing ecosystem. The state in endowed with a significant wealth of inland capture and culture fishery resources. The inland capture fisheries consist of estuarine fisheries and fresh water fisheries. The capture fishery occurs in the estuarine region, the extensive backwater areas, running half way of the state from the south and the connected paddy fields, while the culture fisheries is seen in rivers, reservoirs and ponds. Though Kerala blessed with these natural resources congenial for increased inland fish production, it is understood that the contribution of inland fishery to marine fishery of the state is negligible when compared with the all India level. A comparison of national level marine and inland fish production and state level marine and inland fish production reveals this fact. Fish production in India during past 7 years (2000-07) given in the table 3.4 clearly indicate a sudden upsurge in inland fish production. This can be attributed to the increasing performance of inland aquaculture in the country.

Table 3.4 Marine and inland fish production in India (000 tons)

Year	Marine	Percentage	Inland	Percentage	Total
2000-01	2811	49.70	2845	50.30	5656
2001-02	2830	47.52	3126	52.48	5956
2002-03	2990	48.23	3210	51.77	6200
2003-04	2941	45.96	3458	54.04	6399
2004-05	2778	44.07	3526	55.93	6304
2005-06	2810	42.78	3760	57.22	6570
2006-07	3000	43.67	3869	56.33	6869

Source: Economic Review (2007)

From the year 2000-01 onwards share of inland fish production has remained above 50 percent of the total fish production and marine fish production registers a declining trend. It is to be noted that India ranks third in the total fish production and second in the fresh water fish production in the world. The country could bag these top positions as a result of increase in inland fish production.

Table 3.5 Inland fish production of Kerala and India during 2000-2007(000 tons)

Year	Kerala	India	% share of Kerala
2000-2001	85.23#	2844.83*	2.99
2001-2002	78.04#	3126.18*	2.49
2002-2003	75.04#	3209.86*	2.34
2003-2004	76.28#	3458.00*	2.21
2004-2005	76.45#	3526.00*	2.17
2005-2006	77.98#	3760.00*	2.07
2006-2007	79.11#	3869.00*	2.04

Source: ICAR and Economic Review (2007) - # : Economic review, * : ICAR.

The inland fish production of Kerala and India during 2000-07 is given by table 3.5. The production of inland fish production in the country during 2006-07 was 3.9 million tons placing the country as the second largest producer of inland fish. From the above table it is clear that the percentage share of Kerala in inland fish production has gone down in successive years when compared with the all India inland fish production figures. It is to be noted that when the share of inland fish production of the country to the total fish production is around 50 percent, contribution of Kerala's inland fish production to India's inland fish production is only around 2 percent.

Table 3.6 Inland fish production in Kerala from 1980-1981 to 2006-2007 and trends in production and value changes.

Year	Quantity(in M.T)	% change in Quantity	Value(Rs 10 Lakhs)	% change in Value
1980-81	25526		1092.91	
1981-82	26059	2.1	1301.6	19.1
1982-83	26385	1.3	1403.59	7.8
1983-84	27240	3.2	1480.68	5.5
1984-85	27617	1.4	1567.6	5.9
1985-86	28578	3.5	1779.13	13.5
1986-87	28194	-1.3	2177.09	22.4
1987-88	26932	-4.5	2423.74	11.3
1988-89	33312	23.7	4880.09	101.3
1989-90	36342	9.1	5828.68	19.4
1990-91	40365	11.1	7584.91	30.1
1991-92	42390	5	9138.78	20.5
1993-94	45482	7.3	9719.71	6.4
1994- 95	48192	6	13094.3	34.7
1995-96	49586	2.7	14346.8	9.6
1996-97	52105	5.1	15274.1	6.5
1997-98	58215	11.7	17019	11.4
1998-99	65855	13.1	24711	45.2
1999-00	74130	12.6	30755.3	24.5
2000-01	85234	15	29995.2	-2.5
2001-02	78039	-8.4	28867	-3.8
2002-03	75036	-3.8	30014	4
2003-04	76279	1.7	31890.2	6.3
2004-05	76451	0.2	59851.5	87.7
2005-06	77980	2	60415.5	1
2006-07	79647	2.1	67658.2	11.9

Source: Kerala Inland Fisheries Statistics (2007)

Table 3.6 shows records for the past twenty five years of inland fish production and this data reveals some interesting facts. During the period from 1981 to 1988 there is downward and upward trends in growth rate in inland fish production with erratic fluctuations. But there is a remarkable increase of growth rate of 23.7 percent during the period of 1989 -90 which was only 4.5 percent during the just proceeding year. But the next decade (1991-2000) production trend shows a better performance than the preceding decade. In value terms there is exceptional increase in the growth rate of 101.3 percent and 87.7 percent during the period 1989-90 and 2004-05.

As per the latest records production of prawns have gone down to 16.54 percent and 14.87 in 2008-09 and 2009-10 respectively which was above 20 percent up to the year 2007-08. This deviation is production fall is attributed due to delayed rainfall and increased temperature during the breading season of this species by fisheries scientists. The delayed and declined rainfall have resulted in delayed breeding and declined production of prawns. It is also to be noted that climate change is one of the reasons for this change. Biodiversity loss and unsustainable fishing practices also can be attributed as reason for this production fall. The species wise change also depicts that all the important species have shown a downwards trend during the period 2008-09 and 2009-10 whereas the total increase in inland fish production is due to increase in the production level of inland species which has been categorized as others. Next to prawns, Tilapia is having the second highest production percentage in all the years as this species are produced as part of culture fisheries and it has been included in the stock enhancement programs. The production of Etroplus shows an erratic fluctuation during the above referred production period. Table 3.7 shows inland fish landing species wise for 10 years.

Table 3.7 Inland fish landing species wise for 10 years (in tons)

sl.no	Species	1999-2000	%	2000-01	%	2001-02	%	2002-03	%	2003-04	%	2004-05	%	2005-06	%	2006-07	%	2007-08	%	2008-09	%	2009-10	%
1	Prawns	16459	22.2	18315	21.5	16388	21	16178	21.6	16136	20.35	16334	26	14812	19	16114	20	16455	20	17026	16.54	17367	14.87
2	Etroplus	4860	6.56	4963	5.8	6998	9	4394	5.9	4510	5.69	4458	6	4626	6	4644	6	4721	6	4870	4.74	4858	4.16
3	Murrels	4996	6.2	4600	5.4	4306	5.5	4460	5.9	3657	4.61	4133	5	4287	6	4299	5	4370	6	4509	4.38	4544	3.89
4	Tilapia	8510	11.48	8336	9.8	6868	8.8	7449	9.9	7739	9.76	7490	10	7965	10	8157	10	8288	10	8548	8.31	8440	7.22
5	Catfish	4816	6.5	5276	6.2	4517	5.8	4367	5.8	4359	5.5	4740	6	4922	6	4940	6	5022	6	5182	5.04	5211	4.46
6	Jewfish	3054	4.12	3078	3.6	2426	3.1	2677	3.6	2795	3.53	2765	4	2871	4	2883	3	2931	4	3024	2.99	2994	2.56
7	Others	31835	42.94	40666	47.7	36536	46.8	35511	47.3	40083	50.56	36531	48	38497	49	38610	50	39254	48	59683	58.03	73422	62.84
	Total	74130	100	83234	100	78039	100	75036	100	79279	100	76451	100	77980	100	79647	100	811041	100	102842	100	116836	100

Source: Compiled from various reports Economic Review

The human settlement pattern in Kerala became very dense on an average of 750/Km^2 on the land is criss-crossed with water. Under the physiographic condition of Kerala, the population density has tended to increase towards the coastal region. Even the unstable coastline has not detoured large human settlements in close proximity to the sea. Out of the total area of 38,863 sq Km of Kerala. 3,355 sq Km falls in the coastal area supporting a population of 4,228 per sq Km as compared to the average urban density of 2,907 in the state. The coastal rural population density 1700 is far above from the state average rural population density of 603 (Censes data, 2001). This extremely high density population have been able to survive so far because of the productivity of the coastal wetlands and the freshwater they made available. The rich biodiversity available here not only supported the primary needs of the people but commercial activities also proliferated. Among them the main activity being a more decentralized commodity exchanges networking between fish producers and fish consumers. All the religious group including Hindus are fish consumers though the Hindus in most other parts of India are strict vegetarians. The ecological setting of the state is mainly responsible in shaping food preferences. Fish has thus become a culturally important and indispensible part of the diet of Keralites. With rice as the main source of carbohydrate, fish is an indispensable component of food intake of the people of the state. The traditional agriculture known as pokkali cropping system is a rice shrimp rotational cropping system and as these pokkali fields are highly productive coastal wetland ecosystem which produces enormous quantity of special variety of paddy and palatable shrimp and fish depending on season. Adjoining the 590 Km long coast line there are 26000 ha saline paddy (pokkali) fields and a wide continental shelf encompassing 39,139Km^2 included in the aquatic resources map of Kerala (Purushan, 1986 and 2007). Hence extensive land use changes happened along the coast of Kerala is redesigning practically the entire natural landscape into cultural landscape (Sathish, 2005). This pattern of human settlement and land use pattern overall Kerala and particularly in coastal ecosystem has resulted in development activities like construction of huge buildings, roads, railways and other infra structure and township development ultimately destroying biodiversity in wetland areas. Apart from this unplanned development and economic activities for supporting the needs of increasing population, the arrangements of proper disposal of sewage and salvage from the settlement are far from adequate. Only about one seventh of the population has access to sanitary modes of disposal of waste. The quantum of pollution caused by direct/indirect discharge of untreated sewage into any water body is alarming. The major impact both primary and secondary on the marine and coastal environment of Kerala are environmental degradation, reduced ecosystem functioning, loss of habitats, depletion of fish stocks, loss of biodiversity, loss of water spread area etc. Wetlands, mangroves, mud banks, beaches ,estuaries and cliffs which form important habitats of marine and coastal environmental are in various stage of degradation. The loss of mangroves has directly affected the fish diversity as well as avifaunal diversity as mangroves are the most affected ones throughout the coastal reaches of Kerala from south to north. Moreover the estuaries and the back water which once occupied an area of 2426 Km^2 have now shrunken to 625 Km^2 due to serious alternations during the past 150 years through reclamation for agriculture and human settlement. The environmental degradation resulting from large scale reclamation of wetland, unscrupulous methods of waste disposal etc. have harnessed the bio- resources including fisheries at an alarming rate. From all these conceptions it is clear that Kerala faces multitude of issues related to their coastal zone. In a nutshell these issues can be presented as lack of coastal landward space due to natural geomorphology, pressure due to very high coastal population density, presence of number of ecologically sensitive areas such as tributaries, creeks, backwater and mangroves and to the top of it all the pressures from development activities. Kerala's largest backwater Vembanad exemplifies a clear-cut example of ecological destruction due to constant pressure as a result of unplanned economic development activities. This region accounts for nearly one fourth of the total water area used for fish culture, accommodate more than one-third of the inland fishermen's households and active inland fishermen in the state. Despite its natural advantages, the inland fishing sector in this region is on the brink of severe crisis owing to different reasons - reclamations, encroachments, over fishing, banned fishing gears, practices like water poisoning, use of explosives and electrocution, creation of water barriers and resultant degeneration of the ecosystem, water pollution due to the discharge of household and industrial waste, accumulation of pesticides and fertilizers residue in water bodies. All these reasons have emerged out of the human settlement and land use pattern in this region. This has happened primarily due to the multitude of livelihood activities including agriculture, fishing, tourism, inland navigation, coir retting, live shell collection, shrimp/crab farming and sand mining. The commercial nature of many of these activities leads to an uncontrolled resource use and pose grave threats to the ecosystem.

As this ecosystem is facing a large number of ecological problems due to anthropogenic pressures leading to loss of bio-diversity and productivity, causing serious implications to the communities that are dependent on the socio- ecological system, it is highly significant to evaluate the diverse threats to fish diversity in the ecosystem specifically. A detailed enquiry into several aspects of Vembanad ecosystem is likely to depict the past and present picture and future predictions of this ecosystem.

3.5 Origin and legendary of Vembanad Lake

Vembanad Lake is said to have originated around 5000 to 6000 years ago during the post glacial era when most of the world's coastal systems took shape. However, according to the geologists, the Lake attained its present configuration in the 4th century A.D, The system was primarily a marine environment bound by an alluvial bar parallel to the coast line and interrupted by the Arabian Sea at intervals. As a result of the catastrophic deluge that took place in 1341 A.D, parts of Alappuzha and Ernakulum districts including number of islands thus separated into a distinct water body from the sea with connecting channels at Thottappally, Andhakaranazhi and Cochin. During this period the river Periyar emptying at Kodungalloor took a diversion through Varapuzha and opened into Cochin Channel, giving rise to a number of islands lying scattered in the backwaters by the deposition of the alluvium in its course. This transformation from the original marine environment into an estuarine environment is evident by the large quantities of typically marine shells deposited in the Vembanad region. The place of pride among the Kerala backwater goes to the ever blue Vembanad Lake.

Vembanad is having a glorious past which has been evolved through both history and myth. The lake has taken its name from the ancient kingdom of Vempolinad which split itself into the principalities of Vadakkumkur and Thekkumkur. The holy river Pampa was flowing through Vempolinad. As a result of geographical changes, Vempolinad was sunk to the interior part of the earth. Along with this a portion of the river Pampa was also sunk with Vembanad. The Vembanad Lake is formed out of these geological changes.

Beneath the lake, there is a portion which people call it as 'kappal chal' and this has been considered as a continuation of Pampa.

3.6 The Present Status of Vembanad Lake

Based on the rich biodiversity and socio economic importance, Vembanad along with adjacent Kollands was declared as a Ramsar site, a wetland of international importance (Ramsar Convention, 2002). Vembanad Kol wetland and its ten associated drainage basins are characterized by continuous chain of back waters. This wetland supports rich diversity of water birds, fishes, aquatic plants and other life forms. Lake supports a population of more than 20,000 water fowls in India during the winter months.

The lake helps to contain flood waters and saves thickly populated areas from submersion, recharges coastal aquifers, filters and flushes out pollutants, facilitates inland navigation and wetland tourism. The system supports unique cultural traditions, water centered social institutions and life styles. Acting as a carbon bomb, this wetland can play a significant role in reducing the dreadful impacts of climate change.

As far as fish diversity is concerned, 150 species of fishes belonging to 100 genera under 56 families are identified from Vembanad lake. The lake is also renounced for its live clam resources and sub-fossil deposits. The soft organically rich sedimentary substratum of the inshore region is an ideal habitat of shrimps. Vembanad serves as a habitat for variety of fin-fish, shell fish and nursery of several species of aquatic life. Many fish species depend on this wetland for food, spawning and nursery. Horabagrus brachysoma, popularly known as yellow cat fish, a cultivable species is now endangered. The species has recorded a sharp decline in its catch and is now restricted to the riverine environs of the Vembanad wetland. Giant sea pike (Sphyraena Jello), pearl spot popularly known as Kareemeen(Etroplus suratenias), the Grey Mullet (Mugil cephalus), dusky finned bulley (Pracanthrus hamrar), Milk fish (Channa Chanos), fresh water catfishes etc. are some of the few species found in the ecosystem. The estuarine zone plays an important role in the life cycle of many shrimp species and the entire Vembanad wetland acts as nursery for important shrimps like Panaeus Indicus, P.Monodon, Metapenaeus dobsoni, M.Monoceros, M.Affinis, Macrobrachium rosenbergii. According to Kurup et al., (1993) the annual landings of fisheries accounts for 60.8 percent fishes forming 34.8 percent, crabs with 2.5 percent and palaemonid prawns with 1.8 percent. The major fish groups constituting the fishery are croakers, glassy perch lets, pearl spot, mullets, cat fishes, gerrads, estuarine sprat and halbeaks. Among the total landings of the shrimps, 74.2 percent was accounted by Metapenaeus dobsoni while the share of penaeus indicus was 14.8 percent and that of M.Monoceros was 10.3 percent. Among the Palaemonids, M.rosenbergii accounted for 70 percent of the landing (129 tons) while the share of M.idella was only 21 percent. The data on species composition and their occurrence and abundance in the Vembanad Lake reveals that most of them are either of marine origin or has a close affinity with the Marine species. Majority of the fish either immigrants regularly or perform short range movements from the inshore areas of Arabian Sea into the lake or back depending on the conditions prevailing in the lake. Fishes which are undergoing regular migration from the adjoining sea or rivers are designated as migrants. Some of the fish species enter the lake accidently and they are termed as vagrants. Those fish species which are perennially present in the lake are termed as residents of which most of them constitute the stock of permanent lake fishery resources. The regular occurrence of the post-monsoons period and during the entire non-monsoon seasons, these fishes are found to be flourishing in the mouth and lower reaches of the estuary and constitutes a thriving fishery. Based on the availability and biomass of plankton and benthos during the non-monsoon period and the regular occurrences of marine migratory fishes in the lake, it may be presumed that the lake ward migration of these fishes is mainly for utilizing this highly dynamic productive area as their feeding ground. The distribution and abundance of fishes in the Vembanad lake is mainly dependent on salinity and annual floods (Kurup and Samuel, 1980). Salinity was found to be the most fluctuating one and it has direct bearing on the occurrence and abundance of fish species in the lake. Majority of fish species showed maximum occurrence during the high saline periods in Vembanad Lake. During monsoon there is decline in diversity and abundance of different species which is recovered during the period of rapidly increasing salinity.

As regards the fishing gears and methods employed in Lake Fishery, there are some diverse aspects. The different types of fishing gears and their methods of operation in the Vembanad Lake are classified in table 3.8.

Table 3.8 Classification of fishing gear and fishing methods of the Vembanad Lake

Seine nets	Gill nets		Fixed nets		Drag nets	Line fishing	Miscellaneous method
Valli vala	Set gill net	Drift gill net	Dip or life net	Fixed bag net	Cycle Vala	Hand line	Hand picking
Thirutha vala	Koori vala	loop vala	chinese dip net (kamba vala or Cheena vala)	Oonni vala	Falling net	Long line with baited hook	Changala Payikkal
Paithu vala		Ozhukkuvala			Cast net (Veesu Vala)		Trap fishing
Neria vala		Murasu Vala					
Chemmeen vala		Karimeen Vala					
Mandu vala							
Peru vala							

Source: Own formulation

Diversified fishing gears and methods are employed in Vembanad Lake and they are variously designed to suit the local conditions and the availability of different fishes in the lake. Some of the gears are very selective and are designed for particular species whereas most of them take multi-species catches. The gears operated in different sectors of the lake are different since the fishes inhabiting various parts of lake are distinctly varied. It is also noticed that different terminology are used for the same type of nets in different sectors of the lake. Kurup et al., (1993) reported that two stationary gears such as stake nets and Chinese dip nets accounted for 72.5 percent of the landings from Vembanad lake, the former contributing to 53 percent (3827 tons) and 19.4 percent from the latter (1393 tons). Among wandering gears, 25 types of gill nets could be encountered which contribute to 730 tons which form 19 percent of the landing from this water body. The seine net fishery of this waterbody comprised of 17 varieties which land 697 tons (7.6 percent) while seven types of cast nets land 252 tons which contribute to 3.4 percent of the landing. There are about 35 types of indigenous fishing practices being carried out in this brackish waterbody with as well as without fishing implements and the share from this type of fishing is 119 tons (1.6 percent) in Vembanad back waters (Report of the working group on fisheries, 2007). These facts and figures implies that the fishing methods of this brackish water body are incredibly complex and among the various categories about three fourth of the landings are registered from the stationery nets. Between the two types of fixed nets, stake nets accounts for more than 50 percent of the landings.

3.7 Ecological Issues that has Affected the Fishery of Vembanad Lake

The major human intervention affecting the ecology of Vembanad Lake started with the construction of the Thannermukkom bund. In 1952, initial studies were presented for a comprehensive Kuttanad Development Scheme to boost agricultural production in the area and the studies by Vaidyanathan (1952) proposed a bund construction at Thanneermukkom and Thottappally to arrest salt water intrusion. The above report also visualized the probable adverse effect on environment. Though the Thottappally spillway was intended to relieve flooding problem, the floods were only partially evacuated as the spill way channel was not constructed to the size required. With the commissioning of Thannermukkom salinity barriers in 1976, the salinity intrusion into the upstream region has been totally arrested and this has facilitated Puncha cropping of about 43,000 ha. However there have been unfortunate side effects on the aquatic environment and on fisheries. The regulator split the estuarine system north south into a predominantly fresh water lake to the South and a brackish lagoon on the north. As agriculture and fisheries are linked by their common use of water in the region, at times the agricultural need for fresh water comes into conflict with the fisheries requirement for saline or brackish waters. The disruption of the Physical and biological continuity of the lake with the coastal waters resulted in rapid decline in fish yield and species diversity. The fisherfolk in the area have suffered the most because of dwindling catches as requirements for agriculture has been given prime importance rather than fisheries. The bunding of shallow parts of the lagoon into Padasekharams to enable paddy cultivation during the early dry season which started a century ago is another form of human intervention. The Padasekhrams created in this manner cover an area of 55,000 hectares. The permanent but submersible bunds constructed around the padasekharam as protection from flooding and the roads constructed in the name of development fragmented the wetland ecosystem into tiny units disrupting the natural hydrological balance.

The Vembanad estuary received affluent from chemical and engineering industries food and drug manufacturing industries and also from paper, rayon, rubber textiles and plywood industries. It is estimated that nearly 260 mld of such industrial effluents reach the estuary from the industrial belt of greater Kochi. Indiscriminate application of pesticides, discharge of industrial effluents, lack of adequate sanitation facilities together with the closure of the barrier have aggravated the water pollution problems of Vembanad.

The agricultural developments have resulted in the input of large quantities of agrochemical and pesticides in the Wetland bodies of Kerala especially in Vembanad Lake. The introduction of high yielding paddy varieties in Kuttanad area has produced not only a dramatic increase in rice yields but also a greater pest problem and application of pesticides has gone up from 3 to 4 times per cropping season. When water is pumped out of the paddy fields these toxic substances are washed into the waterways and this had resulted in incidental fish kills. DDE, DDT and very low concentration of Dieldrin, Endrain and Endosulfan were found in the black clam samples from the lake and canals (Kurup, 1992). The Cochin Shipyard and Port are also releasing sizable quantities of Waste oil, paints, metals and paint scrapings. The traditional retting practices in coir sector of the area also exert pressure on the system. Another source of pollution of Vembanad lake is the domestic sewage generated in the urban areas of Alappuzha and Kochi city alone generates about 2550 million/day of waste water that enters the lake directly. De-oxygenation of waterbodies, deposition of organics in sediments and input of substantial load of metals are the principal processes in the wetland due to the sewage discharge. These are highly destructive and irreversible and cause drastic changes in the abundance and diversity of benthic organisms and fishes. The fish population is also subject to microbial contamination which makes it unacceptable for consumption. The high nutrient content associated with sewage is attributed as one of the main causative factors for the high rate of eutrophication in the lake. Exorbitant growth of aquatic plants when exceeds the supporting capacity of the environment leads to dead plant settlement down and results in siltation and shallowing of the water body. Due to the bacterial decomposition of plant debris there is reduction of oxygen in the ecosystem. This will have adverse effects on aquatic organisms.

Authorized and unauthorized sand mining is common in all areas of Vembanad Wetland System. The uncontrolled mining of shells from the lake is also posing a threat to the ecosystem. Large scale industrial mining of shells which take place in the lake for the white shells is done using mechanized drudgers. The white shells are mined for the Travancore Cements Ltd. Since the mechanical mining creates large pits, it has many environmental implications depleting the resource base quickly. Shrinkage of Vembanad lake to 37 percent (13224 ha) of its original area (36329 ha) as a result of land reclamation has been the most environmental consequence. The depth of the Vembanad Lake has been reduced by 40-50 percent in all zones except between Aroor and Wellington Island and Cochin Port Zone. The water carrying capacity of the system has been reduced to an abysmal 0.6 Km^3 with a decline of 78 percent. Another impact is due to the development of water way. Deepening of the channel by dredging is an activity which affects environment through biological changes in both terrestrial and aquatic flora due to the regular barrage operation. The high pollution in upstream areas of Pampa, Achankovil and Periyar rivers due to human interventions also affect the Vembanad backwater system negatively as these rivers ultimately drain to it. The cascading effect of upstream pollution and domestic sewage on the ecology of the lagoon is significant with very high fecal coliform counts of even up to 38,000 per 100 ml sample and high value up to 1, 30,000 fecal coli per 100 ml in small stagnant channels of Kuttanad against the range between 500 and 5000 being generally found in the river water samples. All these polluting agents have resulted in blanketing the lake with highly nutrient rich, acidic, sand dominated sediments. Metal accumulation is found high in these sediments. Sediment organic matter can be a source of recycled nutrients for water column productivity when it degrades. Owing to low nutrient build up, the standing crop of plankton remains extremely poor resulting in low fish production. Reduction is fish production finally affects the livelihood of fisherfolk who depends on the lake due to dwindling catches. The fishes inhibiting the water body are facing reproductive hazards, growth retardation, morphological abnormalities etc. apart from total destruction of eggs and larvae. Fish shoals entering the highly polluted zone cannot tolerate the cumulative effects of pollution which results in their immediate death. The out break of Epizootic Ulcerative Syndrome (EUS) in 1991 and its recurrence now at varied intensities could be looked upon as the after effect of high level polluting agents. The threat posed by activities of most of the stakeholders on the health of Vembanad ecosystem is severe and dangerous to levels exceeding the carrying capacity of the system.

3.8 Fishing Methods and Practices Affecting the Resource Base and Sustainability of Fisheries of Vembanad Lake

The backwaters of Kerala face excessive unauthorized and indiscriminate fishing pressure along with illegal and detrimental fishing practices. Fishing by explosives and poisoning, electro fishing and light fishing etc. are wide spread in the backwaters. The Vembanad backwaters are subjected to high fishing pressures exerted by the unusual increase in the number of fixed and wandering gears. The areas where shrimp juveniles become concentrated are prone to heavy fishing pressures due to the prolific nature of stake nets and their indiscriminate operation. Since these nets are used mainly to catch prawns which have a high value, every effort is made to increase the catch by reducing the mesh size, thus resulting in the depletion of stocks. Kurup et al., (1989) reported the incidence of size overfishing in Poovalan and Naren inhibiting the downstream regions of the Vembanad backwaters. A study conducted at the Central Institute of Fisheries Technology showed that the three species caught in the stake nets i.e. Metapenaeus dobsoni, Metapenaeus monoceros and Penaeus indices have a model length less than the size at first maturity. The Percentage of immature prawns landed by stake nets is 88.3 percent, 94.7 percent and 82.7 percent respectively for these three species. These figures indicate that huge quantities of juveniles are removed by stake nets thereby reducing the stock. Stake nets are also operated during high tide period which is locally known as "Ettamkettal" or "Tharachu Kettal". As this backwater is heavily infested with stake nets, there is major exploitation of juvenile stocks of commercially important species. The statutory permitted minimum mesh size of the cod end of nets is 20mm. But none of the nets comply with this and majority operates with cod end mesh sizes below 8mm. Over the past 15 years, increased fishing pressure in both marine and estuarine prawns was observed. The sub adults were caught by stake nets and post larvae were filtered and used as a seed for farming. Sub adult prawns are caught from inshore and coastal areas on their way back to breeding ground in deeper part of the sea. This is the reason for the massive destruction of juvenile stocks. The level of exploitation of juveniles causes severe threat to the fishery resources not only in this backwater system, but also in the coastal waters of Kerala. The historic data on catches of prawn shows that there is decline in catch per unit effort accompanied by reduction in the size of the prawns in the catches. Using catch information of average stake net catches/year, it is estimated that around 1119 to 3732 tons of illegal shrimps and fish are landed by these stake nets within this backwater. The present scale of unregulated fishery in the backwater could be gauged from the quantity of young shrimps being caught at various points by the filtration fishery (Chemmen Kettu) (Kalwar et al., 1984). Almost 90 percent of the 1727 stake nets are engaged in illegal fishing as majority of these nets do not follow the distance and mesh size requirements as well as illegal operation of nets during high tide. Removal of illegal stake and Chinese dip nets by the Fisheries Department has been met with stiff resistance by fishers in backwaters so in recent years no action has been taken on illegal nets in operation. Thomson (2003) shows that there are more illegal nets (Stake and Chinese dip nets) than the licensed nets. Indiscriminate intervention through this fishing pressure on the estuarine environment is disturbing the migration of juvenile prawn and also hampering the eco balance of the natural resources. The stock M.Rosenbergii a true denizen of Kuttanad and locally known as Kuttanad Konchu has also been subjected to serious stress and threat due to over fishing.

Apart from fish and crustacean resources in the lake, immense quantity of live clams and sub fossil white clam form a major resource of the lake. As the demand for live and dead shells increased due to the establishing of industries based on shell as raw materials, the white shells are exploited regularly from the lake intensively. There is marked depletion on the number of live clams due to over fishery in some part of clam beds of backwaters. The average size of clam diminished and undersized clam in large number are removed from the backwaters. This type of exploitation has badly affected the traditional live clam fishery. The traditional fishermen feel that due to dredging considerable damage is done to live clams and consequent deposition of silt prevent recolonization and growth of clams. Increased and indiscriminate fishing practices resulting in spat settlement of clams and mass removal of undersized clams affects the livelihood of clam fishers.

Operation of madavala on the petti and para pumping system in polders of Kuttanad prior to the annual punja rice season is yet another destructive fishing practice that brings about indiscriminate destruction of all sorts of fish species. The massive trapping and netting of spawned stocks with the onset of monsoons, clandestine introduction of exotics such as African cat fish, clarias, garipineus, red pirhana etc. are other threats to fish biodiversity in this water body. These exotic species and their intrusion in the natural waters are a matter of grave concern as the biodiversity of fish wealth is under threat due to the competition of such fishes with the indigenous fauna for food and habitat. With the boom of backwater tourism, the demand for Karimeen, the high valued food fish in Vembanad Lake is on the increase. Since the most valuable species are generally exploited to the maximum the fishery of this species is further subject to increasing pressures. This is evident from the decline in average size of this species in catches.

The general shallowness and protected nature of the backwater system permit the fishermen to do fishing throughout the year. Major fishing activities in the lake during night fetch the fishermen more catches. But fishing without any interval at least during the breeding season ultimately results in complete exhaustion of stocks. Even though the use of fishing gears that leads, to mass destruction and premature catching of inland fish are legally banned, such practices continue out of livelihood pressure. One of the reasons for this pressure is due to decline in available fishable area because of massive reclamation of lake. In a bid to maintain the size of the daily catch local fishermen work overtime and use more sophisticated nets and gears. Owing to all these overfishing practices the productivity of fishing grounds have decreased dramatically. Research by the CUSAT School of Marine Sciences has found a direct link between depletion of backwaters and the decline in estuarine fishing resources arising from alteration to the ecology where estuarine dependent penaeid shrimps catches early made up the bulk of Kerala's shrimp catches earlier. Marine species have almost totally replaced there in the last two decades.

The major reason for the unsustainable fishery outcome is the common property nature of the fishery, each of many fishers who have access to same stock has every reason to grasp a large share of the potential yield as possible lest the resources can offer. Declining catches often act as an incentive for fishers to increase their individual fishing effort, thus escalating resource depletion (Rajasenan, 2005). The traditional fishermen who depend on these stocks belong to the most economically backward communities and their standard of living depends mainly on the earnings from fisheries sector. Thus stagnation in their production levels that depends on the depleted stocks again worsens their living standard. Effective measures to regulate the number of fishing crafts and gears and promotion and use of proper gears and nets are necessary to protect the interest of impoverished community. For this, meaningful interventions are necessary to ensure sustainable development and governance of estuaries. These interventions have to be integrated with the policy making processes of the government. A detailed enquiry into inland fishery policy of the state is to be taken into account for further policy formulation.

3.9 Institutional Arrangements in Inland Fishery Sector of Kerala

Institutionalization of backwater fishery of Kerala dates back to 400 years with the origination of stake net fishing in Aroor-Arookkutty area. The Deevara community was given exclusive right to operate stake nets by the king. The Agricultural Department of Travancore king was entrusted with the duty of formulation and enforcement of law. A well formulated local village hierarchy was established to regulate stake nets. These institutions survived till India enacted the Indian Fisheries Act in 1897. The rules and orders made under the Indian Fisheries Act 1897 and Travancore Fisheries Act 1950 contained the laws relating to inland fisheries of Kerala. Both the Acts comprises provisions for prohibiting the use of dynamites and poison in all waters and making such an Act punishable under Indian Fisheries Act. Other important provisions common to are those that empower the state to make rules prohibiting or regulating the erection and use of fixed engines, dimensions and kinds of net to be used and mode of using them. These acts also laid down the regulations to be followed by fishermen using gears that are fixed. The government prohibits nets with measures having a cod end less than 20 mm mainly to protect the very young ones. Fishing in government waters using either a fixed net or a free net requires license from the government. Licenses are to be issued only to people who are genuine and active fishermen. Fixed nets are not to be operated at the mouth of the river. Some other rules in subsequent events are as follows.

- Regulation of fishing with fixed engines(Stake Nets, Chinese's Nets etc.)1973.
- Issue of fishing License Rules 1974.

- Regulation of prawn fishing in private Water Rules 1974.
- Rules for Management and control of Fishermen and Fisheries in government water rules,1974.
- The Kerala Protection of River Banks and Regulation of Removal of Sand Rules, 2002.
- The Inland Fishermen Act (1984)-to create a sense of awareness about the preservation of

  wetlands among the people in general and also among the Panchayat level functionaries.

Observing a phenomenal increase in the number of Chinese and stake nets, the Expert Committee headed by A.G. Kalwar in the year 1985 recommended reduction in the number of fixed engines to half of the number existed then. The Coastal Regulation Zone (CRZ) Notification 1991 Provides regulation of all activities with in the coastal regions. The demarcation of CRZ areas are the coastal stretches of seas, bays, estuarine, creeks, rivers and backwaters which are influenced by tidal action (in the land word side) upto 500 metres from the high tide line and the land between the low tide line and high tide line. In response to the government of India CRZ Notification and supreme court Judgment, the government of Kerala prepared Coastal Zone Management plan. Because of the special features and circumstance of the state like the limited land availability and high population density, it was decided through an amendment that distance from the HTL along the creeks, rivers and backwaters which is less for the purpose of regulation. All the Mudflats, the marshy surroundings and the mangrove ecosystem have been classified as CRZ-1. A buffer zone of 50m distance belt around them will be maintained even if the width of the creek, back waters and river is less than 50

m. Reclamation was not permitted nor there were any construction or land reclaims after February 1991. It was also observed that the estuaries and backwaters of Kerala which once occupied an area of 2426 sq Km have now Shrunken to 625 sq Km due to the serious alternation during the past 150 years through reclamation for agriculture and human settlement. With the introduction of CRZ, these areas have been classified in to CRZ -1 where such activities are permitted. With the strict enforcement of CRZ since 1996, backed by the Supreme Court verdict, further reclamation was not allowed in coastal villages. Supreme court of India also proclaimed a land mark judgments that no aquaculture practices should be carried out within CRZ other than the traditional or improved traditional practices. The judgment restrict the conduct of semi intensive and intensive prawn or fish farming in the CRZ area. A National Aquaculture authority constituted in 1997 on the basis of directive of the Supreme Court became responsible for regulating the development of aquaculture in the coastal zone. A state level Aquaculture Authority has been constituted with the secretary, Department of Fisheries, Government of Kerala as the chairman following the directions in the Aquaculture Authority Notification. This is supported by district level aquaculture authorities which are chaired by the respective District Collectors.

The new fisheries policy of 1994 accorded fish production the status of agriculture to make it eligible for all assistance/subsides recommended for agriculture. The policy also envisaged the formulation of an Aquarian Reform with the objective of ensuring ownership rights of fishing implements exclusively to real fishermen. The state government through the Department of Fisheries has been actively involved in fisheries management. The state has also floated cooperative organisations like Matsyafed under fisheries Department to address fishery problems. The primary functions of these formal organisation and management institution were to define a change in boundaries, regulate access, decide appropriate levels of harvest, introduce incentives and penalties and enforce and monitor those rules to ensure socially acceptable outcomes and benefit to communities. But the existing provisions of all these laws relating to inland fisheries operations are inadequate and hence there is need to have unified legislation applicable to the entire land area of the state. For this purpose the Aquarian Reforms Committee (2000) headed by K. Ravindran was constituted by the Kerala government. The committee in its report stated that the state government shall adopt and implement some basic reforms in the Fisheries sector for securing the livelihood and occupation of bonafide traditional and artisanal fisherfolk. The objective of such an enactment was to protect the waterbodies and to conserve the natural fisheries resources at sustainable level to ensure the rights of traditional/ artisanal fisherfolk for occupation and livelihood in the fisheries sector to establish a regular marketing Systems in Kerala and to ensure availability of appropriate quality and quantity of fishes to consumers in the State . Other objectives of the enactment were to bestow legally the right of fishing in the inland and territorial waters exclusively to the traditional/artisanal fisherfolk. Thus the Act formed which may be called as Kerala Aquarian (Fisheries)Reforms Act -2008 is to enact a comprehensive legislation for bringing certain basic reforms in the management of the fisheries sector of the state. Kerala Ulnadan fishery Bill 2010 (Inland Fisher Bill) is intended to codify separate laws for inland fishing existing in Malabar and Travancore - Cochin areas. Reforming the existing laws in a scientific manner, the Bill envisages the development, procreation, protection and care of fish wealth in the inland waterbodies. It also aims at promoting scientific fishing, job protection, preventing encroachments of lakes and solving environmental problems.

The state government has also implemented many centrally sponsored schemes. Brackish Water Fish Farmers Development Agencies (BFFDA) and the state government together has already established BFFDA' s in six district working on a regional basis. Under the state government initiative, Agency for the Development of Aquaculture in Kerala (ADAK) has also started functioning to help prawn farmers in adopting scientific farming methods by extending technical and financial services. The state government has also implemented the centrally sponsored scheme of setting up of prawn hatcheries for timely supply of quality prawn seeds at reasonable rates. Of late the government of Kerala has also launched a project under the name Matsya Keralam as an integrated project for the development of inland fisheries and aquaculture with the support of local self governments in the year 2008. This project is implemented in the state in line with the norms of centrally sponsored scheme on Inland Fisheries and Aquaculture. Assistance is provided in the form of subsidy for identified activities to individual beneficiary, self help group, women group and fishermen societies etc as per the approved norms. As part of research the regional Agricultural Research Centre at Kumarakam started in 1972 under Kerala Agricultural University has evolved schemes like fish ranching, cage culture and pen culture with the financial assistance of state government and I.C.A.R. for enriching the fish wealth of Vembanad lake. Swaminathan Commission Report (2007) has come out with strong recommendations for ecological regeneration of Kuttanad region and Vembanad Lake. The Commission emphasis the need for modernization of the operation of Thannermukkom barrage to manage salinity and minimize ecological decay which is possible through simplifying the administration of operation of Thannermukkom barrage using standardized parameters that it will be placed in auto management mode with least bureaucratic interferences and subjective decision making. It has suggested that Thannermukkom barrage operation should be with minimum shutdown period with analysis of its impact on fishery and water quality. This massive thought provoking report approved by Government of India with full financial support, implemented by the Government of Kerala if effectively works out could bring back both restoration of fish diversity and restoration of lake ecology.

The Padu system in Vallarpadam Island, Cochin in the state has been noted as an informal institution for upholding the rights of a group of fishers which is caste specific, gear specific and species specific. The institution functions in providing equitable access, collective social responsibility and rule making and conflict resolution. All the fishers in this institution are Hindus and members of the same caste Dheevara who operates stake nets for the species shrimp of three types- Metapenaeus dobsoni, M monoceros and Paeneus Indicus. Padu uses a lottery system for allocation of access to fishing locations to ensure equal opportunity to prime fishing locations. The group of right holders known an Sangham (society or association) organize the functioning of the institution. These Sanghams are not formally recognised by the state Fisheries Department but they are registered with the state registrars office at High Court. They have a set of rules for governing their operations.

Even in the wake of all these institutional arrangements, the resource users of the ecosystem are motivated by economic rather than resource conservationist considerations. The major reason for this situation is the multi- user characteristic of the estuarine system. To put the issue in proper perspective, the characteristics of the users under state management are to be examined. Involving the users in the management of resource along with institutional change is needed as estuarine fisheries faces problems that are within and outside the fisheries sector. The state and communities have to play the important roles for the conservation of the resources and the fishermen should be in a position to organize themselves to make a resonance during policy formulations.

Chapter 4

THE SUSTAINABLE LIVELIHOOD ASPIRATIONS OF FISHING COMMUNITIES OF TWO INLAND FISHING VILLAGES - MUHAMMA AND THANNEERMUKKOM USING THE SL ANALYSIS

Contents

The two inland fishing villages Muhamma and Thanneermukkom are situated on the bank of Vembanad Lake which is a massive and vibrant coastal wetland ecosystem. This ecosystem stretches to over 24, 000 ha in area and contributes to over 50 percent of total area of backwaters (Kayals) in the state of Kerala. The traditional fishing communities of the two villages Muhamma and Thanneermukkom are mainly involved in traditional and subsistence activities that are also referred to as fish workers. Fish workers in this analysis means all men and women involved in or dependent upon fisheries and aquatic resources for their livelihood. This categorization is not restricted to those in the harvesting sub-sector. It includes those involved in processing, storage, transportation and retailing. It is fully acknowledged that this covers a very diverse group of people with extremely different needs, wants and capacities.

A verification of different types of asset holdings of the sample population is done, as access to resources enhances the ability of people to secure a livelihood and the sustainability of it however depends on the kind and extent of assets that they have. The livelihood asset holdings include natural assets, financial assets, physical assets, social assets, human assets and institutional assets. The main objective of this analysis is to lay down a sustainable livelihood framework to help understand SLA and to understand the actual livelihoods of the sample population dependent on traditional fishing. The framework consists of five components.

- The vulnerability context
- The livelihood assets
- The transforming structures and processes which affects their lives
- The livelihood strategies the sample population adopt
- The outcomes they achieve or aspire to

The framework provides a checklist of important issues and shows how these links to each other. It also draws attention to core influences and processes. It also emphasizes the multiple interactions between the various factors that affect livelihood.

The vulnerability context is very important in this analysis because it has a direct impact on the life of sample population. Some elements of the vulnerability are outside the control of government and fish workers e.g. seasonal availability of fish. But others such as declining fish resources and conflict between groups of fish workers can be addressed. The vulnerability context is the group of factors operating in the external environment in which people exist which may affect their susceptibility to poverty. The livelihood people adopt and the livelihood outcomes they aspire to are greatly affected by the vulnerability context. There are three key areas that broadly summarize the factors contributing to vulnerability context. They are trends, shocks and seasonality.

4.1 The Major Factor that Contributes to the Vulnerability Context of the Study Area

Over the past several decades the unrestricted human interference for the heterogeneous purposes had irrevocable adverse consequences on the entity of the Vembanad Lake itself. The most significant eventuality among these activities was the commissioning of Thanneermukkom barrage across the lake in 1976. This has destroyed the continuity of the ecosystem prohibiting the sharing of its physical and biological entity between both the sectors. In effect an area of 69 Km^2 of brackish water lying south of Thannermukkom had been ecologically cut off from the rest of the backwaters. The major environmental factor that influenced the fishery of the lake due to this barrage construction was salinity which showed significant spatial and temporal variations. The operation of the salinity barrier played a crucial role in these changes. Naturally higher salinity values were characteristic to the northern locations (0.06 to 5.966 ppt) close to the barrage. As expected, freshwater conditions prevailed in zones close to the riverine discharges at Punnamada, Rani Kayal, Pallathuruthiyar and Kaipuzhayaar (0.06 to 1.48 ppt). During the year 1999-2000, the highest salinity values in locations just north of the barrage was only 5.96 ppt observed during April whereas the maximum value at Thanneermukkom zone just south of the barrage was 4.31 ppt for the same month. Several studies conducted in this lake shows that there is an alarming decline of the species of fish. The reason for this alarming decline is attributed to the operation of the salinity barrier by obstructing the downstream migration of the berried females and the reverse migration of the post larvae from their breeding grounds during January to May. The date of opening of the barrage appears to be critical factor that determine the fishery of species in the lake. The relatively higher catches of the species from immediately north of the barrage indicate an apparent shift in the breeding ground of the species downstream the lake, probably due to the changes in the salinity gradient. Though the barrage at Thanneermukkom was constructed to protect the low lying paddy fields from the tidal salt water ingress during November to May to raise two crops of paddy in an area of 6,000 ha south of barrage, its faulty designing and partial implementation had brought all the misfortunes. The most discernible among them was a virtual stagnation of water mass in the Southern sector and its adjoining canals and waterways during the summer, resulting in serious pollution and health hazards in the area. On the other hand barrage sluices were unable to negotiate the monsoon rush from the four major rivers and as a result there were frequent floods during the monsoon bringing enormous misery to the people of Kuttanad. The sector that got cut off during the summer experienced a transformation from the estuarine phase to an almost freshwater phase resulting in a rapid decline in fish yield and the shrinkage in the species spectrum. The riverine or the estuarine species that essentially required a sojourn into the estuary or vice-versa faced a fall in their population size. The marine migratory and the resident estuarine species were restricted to the north of the barrage. The replacement of the estuarine species of the sector by the sweet water species was not adequate to compensate the loss to the fishery.

It is at this juncture the vulnerability context is having its importance as this factor bears a direct impact on the life of the traditional fisherfolk who depends on the fishery resources of Vembanad Lake for their livelihood. Apart from seasonal nature of vulnerability the fisherfolk used to suffer, this particular ecosystem community started suffering of year round vulnerability due to the declining stocks, declining access to markets and increasing poverty which is the ultimate result of the commissioning of the above said barrage and its ecological impacts. Though the construction of barrage is the starting point of vulnerability factors, several other factors both fishery and non fishery also so far further aggravated the vulnerability context.

4.2 Examination of Characteristics of Sample Population Based on Demographic Features

Examination of characteristics of sample population of the fishermen is important to conduct the analysis within a framework that takes into account the relationship between different variables.

4.2.1 The role of religion and caste based categorization of sample population

The analysis begins with the role of religion and caste. It is assumed that resource users belonging to the traditional communities would be more knowledgeable about resource conservation rules. Caste based fishers have developed folk taxonomies about the salient natural features such as water, colour, waves, winds, depth, currents etc. through decades of their learning actions. The extent of family engagement in fishing activities which is also associated with the religion and caste of traditional communities is shown in table 4.1.

Table 4.1 Caste wise location wise categorization of sample population

	Caste		
Location	**OBC**	**OEC**	**Total**
1	0	25	25
2	25	0	25
3	0	25	25
4	0	25	25
5	0	25	25
6	21	4	25
7	0	25	25
8	10	15	25
9	0	25	25
10	0	25	25
Total	**56(22.4)**	**194(77.6)**	**250(100)**

Source: Field survey

The whole sample population of the study area belongs to one particular religion Hindu of which 77.6 percent of the sample population belongs to Dheevara community and 22.4 percent belongs to Ezhava community. The Dheevara community comes under the categorization of Other Eligible Caste (OEC) and Ezhava community comes under Other Backward Community (OBC). This implies that the sample population of fishermen community belongs to socially and economically backward strata of the society. The location wise classification of caste brings some interesting facts. It is observed that in six locations (loc 1, 3, 4, 5, 7, 9, 10), only Dheevara community is involved in fishing. In location 2, 8 only Ezhava community is engaged in fishing. The old generation of fishing community opined that in the earlier periods of fishing, only Dheevara community was engaged in fishing. Other castes were not ready to take up this occupation as their livelihood.

Later on the prospects of clam shell collection and processing gave way for the Ezhava community to enter the field of fishing. The respondents of Ezhava community were of the opinion that they do not face any communal rivalry from Dheevara community as resource users of the estuary. They also observed that the Dheevara community allows them to participate in activities of issues connected with resource users. It is also observed that the members of Dheevara community of the sample population is having a strong affiliation towards their state level community based organization Akhila Kerala Dheevara Sabha and a strong local unit functions in the study area. The local unit is having a strong organizational structure as all the members of the community are members of this local unit. The organizers of the local unit of the Akhila Kerala Dheevara Sabha were not active during earlier periods, but now they are actively taking up issues concerned with resource use and organize different types of campaigns against issues which cause hurdles for their livelihood.

4.2.2 Comparison of the age group of the sample population with the state age group data of inland fishermen population

Table 4.2.1 Age group of Male and Female sample population

	Male			Female		
Age Group	**Frequency**	**Percent**	**Cumulative%**	**Frequency**	**Percent**	**Cumulative%**
Lessthan18	137	25.70	25.70	134	26.02	26.02
19-24	68	12.76	38.46	62	12.04	38.06
25-44	154	28.89	67.35	170	33.01	71.07
45-59	136	25.52	92.87	103	20.00	91.07
Above 59	38	7.13	100.00	46	8.93	100.00
Total	**533**	**100.00**		**515**	**100.00**	

Source: Field survey

Table 4.2.2 Age group of state inland fisherfolk population

State data						
Age Group	**Male**	**Percentage**	**Cumulative%**	**Female**	**Percentage**	**Cumulative%**
Less than18	29601	23.25	23.25	30195	24.32	24.32
19-24	21567	16.94	40.19	19283	15.53	39.85
25-44	42398	33.30	73.49	41159	33.15	72.99
45-59	24875	19.54	93.03	23208	18.69	91.68
Above 59	8869	6.97	100.00	10327	8.32	100.00
Total	**127310**	**100.00**		**124172**	**100.00**	

Source: Socio techno economic survey of fisherfolk in Kerala (2004)

Table 4.2.3 Comparison of age group of surveyed and state population

	Male		**Female**	
Age group	**Survey**	**State**	**Survey**	**State**
Less than 18	137	29601	134	30195
19-24	68	21567	62	19283
25-44	154	42398	170	41159
45-59	136	24875	103	23208
Above 59	38	8869	46	10327

Source: Field survey and socio techno economic survey of fisherfolk in Kerala (2004)

	Male	**Female**
Chi-square	19.673	5.345
Degree of freedom	4	4
Critical value	9.49	9.49

Computed from table 4.2.3

The tables 4.2.1, 4.2.2 and 4.2.3 shows the comparison of the age group of the sample population with their state counter parts. When χ^2 test is applied, the age group structure of male and female population brings some interesting insights. As far as the male population is concerned, as the calculated value is greater than critical value (19.673 > 9.49), it is observed that there is significant difference between survey region and state regarding proportion of male in different age group. But when the age group of female population of the surveyed area is compared with that of state data, it is interesting to note that the proportion of females at different age groups are similar to the state pattern as the calculated value is less than the table value as per the χ^2 test. The percentage of the age group between the age of 18 and 59 of males in the surveyed area is 67.17 whereas it is 65.05 among the females. The state data show a minor difference as it is 69.78 for males, but it is exactly the same among females which is 65.05. This observation highlights the fact that a good percentage of the population sample could be considered as working age category. The male and female age group percentage coming under less than 18 age group is 25.70 and 26.02, which is higher than state data being referred as 23.25 and 24.32 respectively.

4.2.3 Dependency ratio of the sample population

A nation's dependency ratio is the ratio of the dependent population to the working age population. The demographic burden is supposed to be shouldered by those who are economically active. In this analysis, dependency ratio refers to the number of actually working and not working as this ratio is more precise to find out the actual demographic burden. Table 4.3 represents the dependency ratio of the sample population.

Table 4.3 Dependency ratio of the family members of the sample population

Age	Number
Below-15	189 (57.27)
Student Category between the age group of 15 to 22 who does not work	63 (19.09)
Mentally and physically handicapped	5 (1.51)
Above 65	48 (14.55)
Unable to work due to health reasons	25 (7.58)
Total	**330 (100%)**

Source: Field survey

- Figures in the bracket represent percentage

The burden of non-working population on working population explains the concept of dependency ratio. It is observed from the survey that people up to the age of 65 except those who have been identified under dependency category are going for some sort of work. Out of the total sample population of 1048, 689 are considered as working population though the actually working family members both in fishery and non fishery sector is 608. The rest 81 family members here are women engaged in domestic activities alone. Although they are not earning in monetary terms, they somehow contribute to the family in physical terms. Thus the percentage of dependence of non working sample population is 47.89. The student category between the age group of 15 to 22 is also included in the dependent category because it is found from the survey that as parents give due importance for their education, they do not compel them to work. The parents expressed their willingness to work too hard even by sacrificing their health to educate their children because they do not want their children to return back to the traditional employment of fishing. They are of the opinion that education is the only asset they can hand over to their children. It is also observed that the old age group in the sample population get due respect and care from their family members and they are satisfied of their love and affection they enjoy. This implies that the family attachments are having importance among these communities.

4.2.4 Nature of the family

Now-a-days there is a tendency towards downsizing the nature of family. People prefer nuclear family system rather than joint family system.

Table 4.4 Nature of family – nuclear or joint

Number of members	Frequency	Percent	Cumulative percent
2	20	8	8
3	48	19.2	27.2
4	107	42.8	70
5	47	18.8	88.8
6	23	9.2	98
7	4	1.6	99.6
8	1	0.4	100

Source: Field survey

Table 4.4 shows the nature of the family. It is observed from the survey that 42.8 percent of sample population comprises of four family members followed by 18.8 percent having 5 family members. Only 2 percent of the sample population is having 7 to 8 members in their family. As 88.8 percent of sample population is having members up to 5, it is implied that the sample population of the study area also prefers nuclear family system. This tendency towards family size is an empirical evidence for the successful implementation of the family planning programmes laid down by the government.

4.2.5 Age wise sex wise marital status of the family members of the sample population

The sex ratio shown by the sample population is not in tune with the state's sex ratio. As per the reported census data of 2011, the state sex ratio is 1084. But the males out number females in the sample population as 51.04 percent are males and 48.96 are females.

Table 4.5 Age wise – Sex wise Marital Status of sample population

	Age Group						
	Marital Status	**Below 18**	**18-25**	**25-35**	**35-55**	**Above 55**	**Total**
Male	Married	0	15 (30)	90 (90)	185 (97.37)	56 (100)	**346 (64.92)**
	Unmarried	137 (100)	35 (70)	8 (8)	4 (2.1)	0	**184 (34.52)**
	Divorced	0	0	0	0	0	**0**
	Separated	0	0	2 (2)	1 (.53)	0	**3 (.56)**
	Total	**137 (100)**	**50 (100)**	**100 (100)**	**190 (100)**	**56 (100)**	**533**
Female	Married	2 (1.49)	40 (65.57)	70 (63.64)	166 (97.64)	37 (92.5)	**315 (61.17)**
	Unmarried	132 (98.51)	21 (34.43)	39 (35.45)	2 (1.18)	0	**194 (37.66)**
	Widowed	0	0	1 (.91)	2 (1.18)	3 (7.5)	**6 (1.17)**
	Total	**134 (100)**	**61 (100)**	**110 (100)**	**170 (100)**	**40 (100)**	**515**

Source: Field survey

The age wise sex wise marital status of sample population is given by table 4.5. The marital status among the male and female sample population between the age group of 25-35 gives a dismal picture. It is observed that 90 percent of the sample male population within this age group is married whereas the percentage of married female sample population of this age group is only 63.64. 35.45 percent of females who remain unmarried in this age group point hands to an unexpected situation in the society when compared with the very high percentage of married males of the same age group. Most of the parents of the daughters expressed their woes about alarming dowry rates demanded. This type of marital status of women shows that girl child is becoming a burden of the family. This situation in future may lead to a missing girl child tendency. When the marital status of the whole male and female sample population is taken into consideration, it is observed that 64.92 percent of the males and 61.17 percent of the females are married. It is interesting to note that the percentages of divorced, separated and widowed cases are very negligible. This implies that there is a very good family bond and relationship among the members of respondent families.

4.3 Sustainable Livelihood Situation Analysis, Entry Points, Effects and Impacts on the Sample Population

The following livelihood analysis now verifies the different forms of assets held by the sample population. The livelihood assets considered for the purpose of analysis are human capital, physical capital, social capital, financial capital and natural capital.

4.3.1 Human capital position of the sample population

Human capital also known as indigenous knowledge capital is the total capability embodied in individuals that reflects the stock of individually possessed knowledge, experience, competencies, education and skills that help them increase personal, economic and social well being. An examination of human capital is especially important for rural fishing because fishing operations inevitably entail a broad mix of knowledge covering traditional navigation and people skills as well as a thorough understanding of fish behaviour, ecosystem attributes and risk management. Knowledge base contributes significantly in the decision making process adopted by fishers for maximizing their harvests. The human capital asset structure of the sample population evaluated here are their educational status, the work structure and pattern of the health issues which ultimately affects their ability to work and the income and expenditure which is being determined by their work pattern which could also explain their reasons for poverty and vulnerability conditions.

a) Comparison of the sex wise educational status of the sample population with the state data

Literacy and education are the hallmark of Kerala's social advancement. The educational status of the sample population of the surveyed area is compared with the educational levels of inland fishing population of the state using the χ^2 test.

Table 4.6 Sex wise educational status of state and sample population.

	Male			Female			Total		
Category	N	Percentage	State	N	Percentage	State	N	Percentage	State
Illiterate	13	2.66	12.94	24	5.08	15.47	37	3.85	14.16
Literate	6	1.23	33.83	9	1.91	33.74	15	1.56	33.78
primary	134	27.40	28.30	131	27.75	24.56	265	27.58	26.50
Secondary	188	38.45	18.91	171	36.23	19.28	359	37.36	19.08
H S	110	22.49	4.41	107	22.67	4.87	217	22.58	4.83
Degree	11	2.25	1.30	15	3.18	1.60	26	2.71	1.45
PG	2	0.41	0.17	4	0.85	0.27	6	0.62	0.22
Technical	25	5.11	0.15	11	2.33	0.22	36	3.75	0.18
Total	489	100.00	100.00	472	100.00	100.00	961	100.00	100.00

Source: Field survey and socio techno economic survey of fisherfolk in Kerala, (2004)

Chi Square test

	Male	Female	Total
Chi Square value	299.17	140.414	193.5
Degree freedom	7	7	7
Table value	14.07	14.07	14.07

Computed from table 4.6

Sex wise educational status of state and sample population is given in Table 4.6. The educational pattern of the sample village population is in no way similar to state pattern. The educational qualification of male and female sample population of the study area reveals some fascinating results. As far as the sample male population is concerned, the calculated value of χ^2 299.17 is greater than the tabled value 14.07. Regarding the educational qualification of female population, the calculated value χ^2 140.41 is greater than the tabled value of 14.07. The educational level of the inland fisherfolk sample population also depicts the same pattern as the calculated value of χ^2 is 193.5 which are greater than the tabled value 14.07. The sex wise comparison of the data in particular and that of fisherfolk in general regarding the educational levels promises a better future for the sample population of the study area as the χ^2 results shows that the education levels of both males and females separately and fisherfolk considered together are higher than that of the state pattern. It is observed that the fisherfolk of the area are interested in acquiring higher education. During the survey it is observed that the parents are having more eagerness in educating their children and they showed no discrimination against educating a girl child. In all categories, the females have kept same level of educational achievements when compared to their male counterparts. The parents of the professional student category have even indebted their assets to meet the educational expenses of these students. The attainment of higher level of education by the sample population than that of their state counter parts implies that the sample populations have effectively utilized the lump sum grant provided by the state for the educational needs of the fisherfolk students. The male and female sample populations of the study area possess secondary education level of 38.45 percent and 36.23 percent respectively. Even though the educational levels of sample population is greater than that of state data, the percentage of degree, post graduate and technically qualified category comes to only 7 percent. This reveals the fact that the community needs more economic and social support both from government and non government organizations to acquire higher levels of education as present days are more competitive in the field of education. As it is observed that no student has specialized in courses in fisheries even at higher secondary levels, lack of vocational courses in fishery related subjects is a drawback of the study area. Giving due importance to courses such as aquaculture and industrial fisheries could pave way for improving skill training and specialization of modern techniques of sustainable fishing. Diversification towards such courses could be started from higher secondary levels onwards.

b) Work structure and pattern of the sample population

The fisherfolk of the study area are mainly targeting on the potentials of the fishery wealth from the estuary. The fishing wealth available in the estuary is highly diverse and seasonal and its availability is mainly dependent on ecosystem functions. Thus it is important to have a wide conception of the resources that people need to access in the processing of composing a livelihood perhaps especially in the context of where people's livelihoods shift from being directly based on natural resources to livelihood based on a range of assets, income source and products and labour market. This is related to the ability of a particular combination of livelihood strategies to create gainful employment for a certain portion of the year. This may be on or off fisheries, part of wage labour system or some other traditional or nontraditional activities. As far as fishing and non fishing activities are concerned, mainly three classifications on some aspects of employment are taken into account. As different location from the study area is specially selected for the study, a location wise fishing occupation categorization is done to identify the varying nature and pattern of occupation in each location and this is given in table 4.7.

Table 4.7 Location wise fishing occupation categorization

Fishing occupation	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9	Loc 10	Total
Owner worker	28 (39.44)	30 (60)	35 (52.24)	20 (47.62)	18 (47.37)	9 (54.29)	19 (67.86)	23 (63.89)	16 (34.78)	15 (30)	223 (48.16)
Owner only	1 (1.42)	2 (4)	3 (4.48)	0	0	0	6 (21.43)	0	1 (2.17)	0	13 (2.81)
Worker only	6 (22.53)	18 (36)	2 (2.98)	3 (7.14)	3 (7.89)	6 (17.14)	0	3 (8.33)	6 (13.04)	5 (10)	62 (13.39)
Middlemen trader cum wholesaler and retailer	0	0	4 (5.97)	1 (2.38)	1 (12.63)	0	0	1 (2.78)	1 (2.18)	0	8 (1.71)
Vendor	26 (36.62)	0	23 (34.33)	18 (42.86)	16 (42.11)	10 (28.57)	3 (10.71)	9 (25)	22 (47.83)	30 (60)	157 (33.91)
Total	71 (15.33)	50 (10.79)	67 (14.47)	42 (9.07)	38 (8.21)	35 (7.56)	28 (6.05)	36 (7.78)	46 (9.94)	50 (10.79)	463 (100)

Source: Field survev

- Figures in the bracket category wise represent percentages of column total.

Out of the total sample working population of 608, 76.2 percent are engaged in fishing and allied activities which are being categorized as owner workers, owners only, workers only, middlemen traders and vendors. Out of the total working category the owner workers and vendors together constitute 82.07 percent. The vendors who constitute 33.91 percent are exclusively the women category. The worker only category comes to about 13.39 percent. This is because of purchasing of craft and gear is not a heavy investment as far as inland fishing is concerned. The worker category specified in the analysis does not work under an owner, but they hire the craft for rent per month at the rate of 300 to 500 depending upon the seasonal variation of the availability of the catch. As the catches are dwindling day by day, the role of middlemen traders is also decreasing. This is being empirically proved by the very negligible percentage of middlemen trader which comes to about 1.73 percent. The vendor categories who are exclusively women disperse off to distant places for fish vending. Some of them travel to other districts such as Ernakulam and Kottayam to sell their fish. They also opined that they do have some special preference to selected areas and the households in that area are their regular customers. The fish vendors expressed their concern about dwindling catches as this affects their livelihood. They opined that in order to please their customers they now-a-days depend on fish markets where marine fishes are available as there is lack of regular availability of freshwater fishes. Out of these vendors, some are only clam meat vendors. The percentage of owner only category is very negligible i.e. 2.81 because lending of crafts fetches them very few incomes.

As far as location wise specification is concerned, some variations are observed. In location 2 there are no vendors. This is because of the caste wise representation in the fishing category. As the location is dominated by Ezhava Community, the women do not go for fish vending. Out of the 8 middle men trader cum wholesaler, 50 percent are residing in location 3 as it is a turning junction to many important routes. Fish sale mostly takes place in this location as many outsiders passing the way regularly purchase fish from this particular junction. The worker only category is highest in percentage in location 2 as most of them are not traditional fishermen. As Ezhava Community dominates in this location, the worker only category often opt only clam collection rather than fishing. As referred earlier they depend on rented crafts.

c) Location wise fishing activity categorization

Fishing activity in this analysis implies the direct activities taking place in the estuary such as fish catch and clam collection. The fishing activity categorization is highlighted to the changes that occurred in fishing activity directly in the lake due to various reasons. Table 4.8 shows this categorization and this brings out the importance of clam collection and the problem and prospects associated with it.

Table 4.8 Location wise fishing activity Categorization

Fishing activity	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9	Loc 10	Total
A	16.67 10 21.28	0	30 18 47.37	5 3 11.12	3.33 2 8.69	10 6 21.43	8.33 5 25	11.67 7 25.93	6.67 4 15.38	8.33 5 25	**60** **19.61**
B	13.71 17 36.18	35.48 44 88	4.03 5 13.16	9.68 12 44.44	8.87 11 47.83	8.06 10 35.71	4.84 6 30	3.23 4 14.81	7.26 9 34.62	4.84 6 30	**124** **40.52**
C	16.39 20 42.55	4.92 6 12	12.29 15 39.47	9.84 12 44.44	8.9 10 43.48	9.84 12 42.86	7.38 9 45	13.11 16 59.26	10.66 13 50	7.38 9 45	**122** **39.87**
Total	**15.36** **47**	**16.34** **50**	**12.42** **38**	**8.82** **27**	**7.52** **23**	**9.15** **28**	**6.54** **20**	**8.82** **27**	**8.49** **26**	**6.54** **20**	**306**

Source: Field survey

Blue colour represents percentage of fishing activity in each locations column wise.

Green colour represents percentage of location wise fishing activity row wise.

- A – Fish catch
- B – Clam collection
- C – Both fish catch and clam collections

Percentage of sample population directly engaged in fish harvesting and clam collection comes to about 66.09 percent out of the total sample population related to fishing occupation. It is observed that out of the total sample populations who are engaged in fish harvesting and clam collection in the lake, the percentage of clam collection group is the highest (40.52). It also shows that fish catch only has lost its fervor as the percentage is only 19.61. Engaging in both fish catch and clam collection have become the livelihood activity of the sample population because of variations in income due to dwindling fish catches and also the problems associated with marketing of black shells separated from clam. Clubbing of these two activities is the alternative to overcome these issues. The fisherfolk are of the opinion that fish catch alone or clam collection alone could not fetch the income for their sustenance.

The percentage of sample population engaged in fishing activities fish catch, clam collection and both activities together constitutes 44.12 in the location 1, 2 and 3 together whereas it is distributionally less in all the other seven locations. Lowering down of catches due to sustainability issues has resulted in this situation in all the rest of the seven locations which is identified as south of barrage. The Southern portion of the Thanneermukkom barrage has been pointed out as the most disturbed area for both ecological and environmental reasons. The percentage of clam collectors is highest in location 2 due to the caste wise denomination of the sample population in the study area. As the Ezhava community dominate location 2, they are mainly engaged in clam collection alone which comes to 88 percent. It is also noted that none of the fish workers in location 2 is engaged in fish catch alone. This implies that they are not traditional fish workers. An important change that has occurred in the study area is that those who were wholly depending on fish catch only earlier have also shifted to clam collection activity due to non availability of fish because of resource depletion taking place in the area. Those sample population engaged in clam collection could not end up their work just by bringing the catch to the landing areas. Once the collected clam is brought home or landed, it is a tedious job to process the clam to separate into shells and meat. The processing of clam is a family endeavor as this needs various stages of processing. Those who go for clam collection starts their work early in the morning at 5^{o} clock and they reach back home by 11^{0} clocks in the forenoon. Once the collected clam is brought to the shore, it is to be boiled in big vessels for long hours. Some of the sample populations do this process nearby the landing area whereas some others carry their loads to their house either as head load or in trolleys.

In locations 6, 9 and 10, some common facility has been utilized by the processors. Many respondents expressed their deep concern about loosing of their opportunities for processing. Boiling for long hours of the clam is a time consuming process. The boiling process continues for about 2 to 3 hours depending upon the quantity of clam. After this constant boiling, the meat comes out of the shell and then starts the process of filtering using a big filter which needs the effort of two persons. The process of filtering separates the meat from the shell. The price of meat depends upon the size of the clam available. Both meat and shell are valuable products. The big size shell and meat fetches more price than the small size. By around 2.30 pm in the afternoon, meat is ready for marketing. Different forms of marketing are prevailing in the area both in the case of fish landed and processed clam meat. The shells fetch more income than meat. There is an institutional set up to market the shells available in the whole study area. The processed meat is either carried by women fish vendors to distant places or sold to wholesalers and petty traders collects them from the households and sells to wholesalers. Sometimes the households themselves takes the meat directly to wholesalers in order to avoid middlemen exploitation. The clam collecting and processing workers category opined that as the size of the clam gets reduced day by day, the price for meat and shell is also declining. The availability of the resource have been also been affected due to varying reasons. Those who are engaged in fish catching only are of the opinion that the availability of fish has come down to a very low quantity that there is no fish to sell. Some of those who stick on fish catch alone opined that they are not shifting to clam collection due to their health reasons.

d) Non-fishing Activity categorization

Fishing being a seasonal occupation based on vagaries of nature, naturally the family members of the fisherfolk depend on non-fishing sources of income. Diversity into non-fishing livelihoods and the ability of the sample population to adopt coping mechanisms through diversification in non-fishing livelihoods seems to be largely attributable to the factors such as the geographical as well as traditional importance of activities such as coconut husk retting and related occupation prevailing in the study area

Table 4.9 No. of respondent family members having non- fishing activity –activity wise - sex wise

Non-Fishing activity	Male	Female	Total
Wage employment in coir related activity	16 (40)	46 (43.81)	**62 (42.75)**
Self employed in the coir	12 (30)	58 (55.24)	**70 (48.28)**
Salaried	10 (25)	1 (.95)	**11 (7.59)**
professional	2	0	**2 (1.38)**
Total	**40**	**105**	**145**

Source: Field survey

It is clear from table 4.9 that out of the total sample working population, 23.85 percent are relying non fishing activities such as coir related occupations. Shifting to non fishing activities other than coir is very less as it comes to 8.97 percent only. Coir related activities acquire more prominence in the study area as the brackish water bodies and the nearby wetlands are congenial for soaking coconut husks. It is observed that 91 percent of the sample populations who depend on non fishing activities are relying upon coir related occupations. From the organizational point of view, the coir fiber is produced under four systems of production namely (a) contract basis (b) directly by households in their sheds (c) by capitalists having mechanized factories and (d) by coir co-operative societies. Spinning of coir-yarn is the next important stage of production in this industry. This activity is more prominent is the study area. Small sheds are attached to many of the houses of the respondents. Major two activities taking place in these sheds are spinning and weaving of coir yarn. Weaving of coir floor mat products is the final stage of the process in the traditional coir industry. The women in the coir sector are engaged in spinning where as men are engaged in weaving process. These activities in coir sector are considered as a self employment. Men and women are also involved in wage employment in the coir related activities. Women go to small scale factories for spinning and men go far weaving to small factories attached to the residence and big coir factories. Out of the 91 percent of sample population who are engaged in coir related activities, 48.28 percent are engaged in self employment. It is also noted that in this sample population engaged in coir related activities, female work participation rate is very high as women constitute the major proportion of 78.79. Out of the 91 percent, 40 percent of the women who are engaged in self employed activities opined that they could manage their domestic work along with spinning of coir. Though the study area is well known for hectic tourism activities, it is interesting to note that no traditional fisherman has turned to tourism related activities. It has also been noted that 25 percent of the male non-fishing working population who are classified as salaried group are employed in Mc Dowell liquor manufacturing company. This implies that the company has taken a strategy of giving employment to local people thereby overcoming the pollution related issues raised against the company by local people.

e) Qualities that describes the skills of fishermen

Knowledge-practice-belief complex (Berkes, 2008) can be viewed as specific human capital as skill, knowledge and experience of fishers are utilized as a means of production. Fisheries combine a set of observations and underlying principles prior to making a decision for fishing. The FAO Advisory Committee on Fisheries has highlighted the potential usefulness of local and traditional knowledge in fisheries from the broader ecosystem framework and for the development of appropriate resource conservation methods (FAO, 2000). The livelihoods of fishers are impacted by the success of the techniques they follow for fish aggregation and their access rights to certain location in certain periods. It is widely agreed by fishers that certain phenomena occur with precise regularity during different cycles of lunar months and the associated tidal pattern. For example fishers know that prawns migrate (walk in fisher's term) through rivers and estuaries under camourflage of the new moon darkness to avoid predators. Fishers also agree that in a given lunar month the tidal height and force during full moon is slightly stronger than that of new moon. Seasonal abundance of fish, fishing sites i.e. fishing areas traditionally known to and identified by fishers is a valuable tool for artisanal fishery management. In this analysis an attempt is made to assess the qualities that describe the skills of fishermen by ranking effectively the perceptions of fishermen regarding their fishing skills. Out of the 250 fishermen respondent households 249 have revealed their perceptions regarding their skills based on a rank order preference and as shown in table 4.10.

Table 4.10 Ranking of respondents regarding the qualities that describes the skills of fishermen.

Skills	Number	Mean Rank
Good at locating fishing Grounds	249	2.26
Very Brave	249	2.59
Can fish in only sea or can fish at all fishing sites	249	2.55
Can use all type of Gears	249	2.61

Source: Field survey

It is observed from the data that, the skill good at locating fishing grounds is getting the lowest value (2.26) which means highest preference according to the perceptions given by the fishermen. The skill can use all type of gears gets the highest value, which shows lowest preference implies that though the inland fisheries sector still retains its pre-historic gear with manual operations, the skill in use of multiple gears mainly in compliance with the hydrological patterns and seasonality, geographical locations and species life cycle of the fish poses a hard task for the respondent fisherfolk.

f) Health profile and status of the sample population

For improved livelihoods, there must be focus on good health. Improved health conditions contribute to stronger and more energetic workers, lengthens the working life span, increases cognitive skills and reduces the number of days lost due to illness. This is a clear enhancement of human capital that leads to greater output and increased flows of earning. Here the attempt is to find out the health problems of sample population in general and the clam collecting and processing workers in particular.

Table 4.11 Number of respondent family members of the sample population affected by deadly and contagious diseases

Diseases affected	Household members
Cancer	12 (11.53)
Jaundice	18 (17.31)
Cholera	30 (28.85)
Skin disease	44 (42.31)
Total	**104(9.9)***

Source: Field survey

* Percentage of total population affected by contagious and deadly diseases.

It is clear from table 4.11 that out of the total sample population of 1048, 9.9 percent are affected by contagious and deadly diseases. 11.53 percent of the disease affected population suffers due to cancer. These cancer patients were identified from location 1, 2 and 3. 42.31 percent of the disease affected sample population suffers due to recurring skin diseases. Waterborne diseases both cholera and jaundice were prevalent among the people during the survey. It was also fatal to observe that the outbreak of contagious disease Chicken Guinea has affected the life of the people of the surveyed area and had claimed many deaths from these locations. The entire sample population retorted in one voice that the stranded water due to construction of barrage and accruing of pollutants of the estuary is the basic reason for the outbreak of both water borne and contagious diseases in the locality. The public opinion is that the levels of pollution have reached to the extreme that the tanker lorries are emptying the septic tank waste sneaked from distant towns to the estuary. They expressed their incapability to resist to this activity as these tanker lorries cunningly empty the waste to estuary just by putting the hose from the tanker lorry to the estuary. By the time the local people identify the attempt, the drivers escape with the vehicles. Apart from this type of pollution, there are several polluting agents such as coir factory, houseboats, emission from the Mc Dowell Company etc. There is possibility for contamination of ground water of this locality due to the high level pollution of the estuary. Due to this pathetic situation, the people of these locations are always prone to various types of contagious diseases. Recent research also suggests that the degree of income inequality in society may be related to the health status of the population.

Table 4.12 Number of respondent family members engaged in clam collection and processing affected due to health problem.

Age	Back pain	Shoulder pain	Both back pain & shoulder pain	Total
15-25	0	(6.67) 3 (60)	(4) 2 (40)	**(3.7) 5**
25-35	(12.5) 5 (29.4)	(17.78) 8 (47.05)	(8) 2 (23.54)	**(12.59) 17**
35-45	(22.5) 9 (33.33)	(26.67) 12 (44.44)	(12) 6 (22.23)	**(20) 27**
45-55	(50) 2 (33.33)	(35.56) 16 (26.67)	(48) 24 (40)	**(44.54) 60**
55 and above	(15) 6 (23.08)	(13.33) 6 (23.08)	(28) 4 (53.85)	**(19.26)26**
Total	**40 (29.63)**	**45 (33.33)**	**50 (37.03)**	**135 * (54.88)**

Source: Field survey

* This represents the affected number of members engaged in clam collections of the respondent families due to health problems.

Red colour represents percentage of clam workers affected by different health problems at each age group row wise.

Blue colour represents different health problems of clam workers at different ages column wise.

In table 4.12, out of the 306 fishermen who are categorized in fishing activity, 124 which come to 40.52 percent are clam collectors only and 246 which comes to 80.39 percent is a sum total of clam collectors alone and both fish catch and collecting category. According to the perception of the respondent fisherfolk, in earlier times, there was a situation where fishing was more profitable than clam collection. This was because fish resources were available at larger quantity while clam meat and shell was less priced. But now the situation has changed that availability of fish has much affected due to resource depletion. Though the clam meat fetches only low income, the shell separated from meat brings them better income. This situation has brought most of those who were engaged only in fish catch into the clam collection activity. But most of the clam collectors looked to be very tired and aged. When they were asked about their ill health, they opined that clam collection is a tiresome work that it affects their health very badly. The clam collectors start their work early in the morning. After reaching the spot where clam is available, with their tools, they have to load their crafts. They have to stay in the water for long hours in a bended position to collect the clam. After collecting clam, it is a hard task to lift the clams collected in a big net type bag with a long stick attached to it. They opened that the weight of clams lifted comes to about 75 Kgs to 100 Kgs each time. 54.9 percent clam collectors suffers of different health problems such as back pain and shoulder pain. The reasons they sight for these health problems is their long stay for hours in bended position in the water and lifting up of the heavily weighed collected clams for loading into the crafts. It is observed that the age group between 35 and 55 are more affected due to health problems as 72.5 percent of clam collectors are having back pain and 62.5 percent are having shoulder pains. 60 percent of clam collectors have both back pain and shoulder pain between this age group. Above the age of 55, the clam collectors having both shoulder pain and back pain as 53.8 percent are effected. 63.7 percent of the clam collectors are affected by back pain, shoulder pain and both shoulder and back pain whose age group is above 45. This implies that at younger age they can withstand due to good health, but as age passes by, various health problems starts crippling. Accordingly they reported that they could not regularly go for clam collection, because after two or three day's continuous work, they are unable to do the work due to severe body pain. This affects their income levels as they have to spend a good part of their income for medicine. They opined that they stick on to clam collection as they have no other alternatives.

4.3.2 Financial capital position of the sample population

The DFID livelihood programme defines financial capital as the financial resources that are available to people and which provide them with different livelihood options. Financial capital is the financial resources which people use to achieve their livelihood strategies. It consists of cash savings, access to credit and the ability to quickly and easily convert other assets into cash. Financial capital is the most versatile of assets as it can be converted fairly easily access into most other types of assets. It can be used for direct achievement of livelihood outcomes. Fishers consider financial capital as the most powerful capital. Obviously in the context of financial capital, a minimum flow of monthly income is important for all families, with the corollary being that fishers falling below the economic equilibrium with extremely low levels of income do critically risk not only nutritional deprivation, but also their familial and social standing. The major financial assets noted during the survey among the sample population are savings and credit and its accessibility.

Table 4.13 Savings position of the sample households

Amount	No. of households	Percentage
>2000	49	19.6
2000-4000	91	36.4
4000-6000	37	14.8
<6000	47	18.8
No savings	26	10.4
Total	**250**	**100**

Source: Field survey

Savings position of the sample households is given in 4.13. It is observed from the survey that the major chunk of the sample population of 89.6 percent is having savings though it is a petty amount. Of this 36.4 percent of sample population is having a savings range between 2000 and 4000. This tendency shows the willingness to save of the sample population. The low amount of savings shows that their capacity to save is low as their income is low. It is also found that as major portion of their income is spent on food and non food items, only small part of their income is set apart for savings.

Table 4.14 Source of savings of the sample households

Source	No. of households	Percentage
Bank	3	1.2
Co-operative societies	5	2
Chitties/Kuries	6	2.4
Post office	10	4
Kudumbasree/Ayalkoottam	175	70
Co-op banks & SHG	20	8
Chitties & SHG	5	2
No savings	26	10.4
Total	**250**	**100**

Source: Field survey

A thrive for saving is also a result of motivation from the part of financial agencies who encourage savings by attractive packages. It is clear from table 4.14 that in the study area, there is multitude of banking and non- banking institutions to promote savings. Out of the 250 households of sample population, 70 percent is having savings with SHGs alone and 10 percent is having savings in SHGs, co-operative banks, chitties and kuries. The savings promoted by 'Kudumbasree' for woman and 'Ayalkoottam' for men both of which comes under the common head SHG points out two positive factors. 89.29 percent of the sample households are participants of SHGs and these SHGs are the major motive force for saving behind this community. It is also implied that these petty savings of the SHGs which are accounted in the nearby nationalized banks known as micro savings becomes the major form of bank's source of savings. In effect it is observed that this poor community's money has also now paved the way for economic development of the country.

Table 4.15 Loan position of the sample house holds

Amount	No. of Households	Percentage
<5000	15	6
5000-10000	125	50
10000-20000	35	14
20000-50000	14	5.6
>50000	11	4.4
No sharing	50	20
Total	**250**	**100**

Source: Field survey

Table 4.15 shows that 80 percent of the sample population is trapped in debt. Of this 80 percent, 50 percent are having a debt of amount ranging between 5000 and 10000. The sample household who have loans opined that the recent non availability of fish and high cost of living along with increased burden of medical expenses had led them to avail loans.

In table 4.16, out of the 200 households who have loans, 70 percent of them have availed it from SHGs as it is the easiest channel to take loans compared to other financial agencies. The highest percentage of loan that is 51.5 percent is spent for purchase of production equipments and the sample households have availed it mainly from SHG's where the SHG loans for the purchase of production equipments comes to about 64.29 percent out of its share of 70 percent to the total loans. Out of the total loans of 103 numbers for purchase of production equipments, 90 whose percentage share is 87.38 are from SHG's.

Table 4.16 Source of loan and purpose of borrowing of the sample households.

	Purpose					
Source	**House construction and maintenance**	**To buy productive Assets**	**To meet medical expenses**	**Marriage expenses**	**Educational expenses**	**Total**
Bank	(8.57) 3 (60)	(1.94) 2 (40)	0	0	0	**2 (2.5)**
Co-operative Bank	(45.71) 16 (64)	(8.74) 9 (36)	0	0	0	**25 (12.5)**
Chities/Curies	(8.57) 3 (37.5)	**0**	**0**	(29.41) 5 (62.5)	**0**	**8 (4)**
Gold Loan	(2.86) 1 (50)	0	(4) 1 (50)	0	0	**2 (1)**
Money Lenders	0	(1.94) 2 (12.5)	(32) 8 (50)	(35.29) 6 (37.5)	0	**16 (8)**
Friends& Relatives	(5.71) 2 (50)	0	(4) 1 (25)	(5.89) 1 (25)	0	**4 (2)**
SHGS	(28.58) 10 (7)	(87.38) 90 (64.29)	(60) 15 (10.71)	(29.41) 5 (3.57)	20 (14.29)	**140 (70)**
Total	**35 (17.5)**	**103 (51.5)**	**25 (12.5)**	**17 (8.5)**	**20 (10)**	**200**

Source: Field survey

Blue represents percentage of sources for different loan purposes column wise.

Green represents percentage of purposes for which loan has availed from each source row wise.

As co-operative banks come with a loan percentage of 12.5, it comes in second place in the provider group. This is due to the establishment of good many numbers of co-operative societies in the study area. The role of SHG as a financial intermediary and the spread of co-operative society movement among the rural poor in the study area has resulted in decreased role of money lenders which comes to only about 8 percent of the total loans. Loans availed for house construction and maintenance comes in the second place as the people are more aware of a need for a safe house rather than a temporary setting. Out of the total loans, the percentage share of loans for construction and maintenance of houses is 17.5 percent. Loans for medical expenses comes to third position as it is observed that a good number of sample populations suffer due to many health problems. As their income is not sufficient to meet the expenses for the medical care, they are compelled to take loans to meet the higher cost on medical expenses. Strengthening of financial capital can be done by improving access to credit, supporting the development of savings and loan groups, developing business management skills and increasing access to natural capital that can be exchanged for financial capital.

4.3.3 Physical capital position of the sample population

The DFID Livelihood Programme defines physical capital as the store of human-made material resources comprising manufactured capital and basic infrastructure like houses, drinking water, sanitation, equipment, community facilities etc. which have a bearing on healthy living conditions, economic production system, productive working days, health, overall well being and social dignity. The physical capital among the fishing communities are broadly divided into fishing and non fishing capital assets. The non- fishing physical capital includes ownership of land, houses and availability of drinking water facility. Of direct fisheries importance to artisanal fishing communities and groups is infrastructure such as harbors and jetties, fish land areas. Tools for production includes crafts, nets, ice boxes and processing equipments.

a) Land possession pattern of the sample households

The most visible aspect of the poor quality of life of fishing communities is their rather huddled settlement pattern which is very unlike the dispersed settlement structure of agrarian communities. The major cause of crowding is to be found in the land holding patterns. In a state where every household is entitled to a piece of homestead plot (as per the Kerala State House Stead Act) varying between 2 and 10 cents, the data as per the year 1979 indicates that as many as 16 percent of households in fishing villages does not possess even their own homestead plot.

Table 4.17 shows the distribution of the land among the sample population. The homestead plot distribution is also similar to the state distribution of land as the possession of land among the sample households varies between 2 cents and 10 cents. 79.92 percent of the sample households have land between the ranges of 2 to 10 cents. 22.49 percent of house holds possess 10 cents of land followed by 18.47 percent possessing 5 cents of land. When the land distribution of sample population is compared with the land distribution of the inland population of the state, it is found that the possession of land between the range of 0-5 cents, both by the 37.49 and 37.45 which is almost similar. But the possession of land by the sample population between the ranges of 6-10 cents is 42.17 where as it is only 37.06 at the state level. In the sample population no one possesses land above 50 cents whereas 2.07 percent possess land above 50 as per the state data of inland population.

Table 4.17 Distribution of land among the sample population

Cent	Frequency	Valid Percent	Cumulative Percent
2	2	0.80321285	0.803212851
3	20	8.03212851	8.835341365
4	26	10.4417671	19.27710843
5	46	18.4738956	37.75100402
6	19	7.63052209	45.3815261
7	13	5.22088353	50.60240964
8	10	4.01606426	54.6184739
9	7	2.81124498	57.42971888
10	56	22.4899598	79.91967871
11	1	0.40160643	80.32128514
12	8	3.21285141	83.53413655
13	3	1.20481928	84.73895582
14	4	1.6064257	86.34538153
15	11	4.41767068	90.76305221
16	4	1.6064257	92.36947791
18	1	0.40160643	92.77108434
19	3	1.20481928	93.97590361
20	5	2.00803213	95.98393574
22	2	0.80321285	96.78714859
25	3	1.20481928	97.99196787
27	1	0.40160643	98.3935743
28	1	0.40160643	98.79518072
30	1	0.40160643	99.19678715
43	1	0.40160643	99.59839357
50	1	0.40160643	100

Source: Field survey

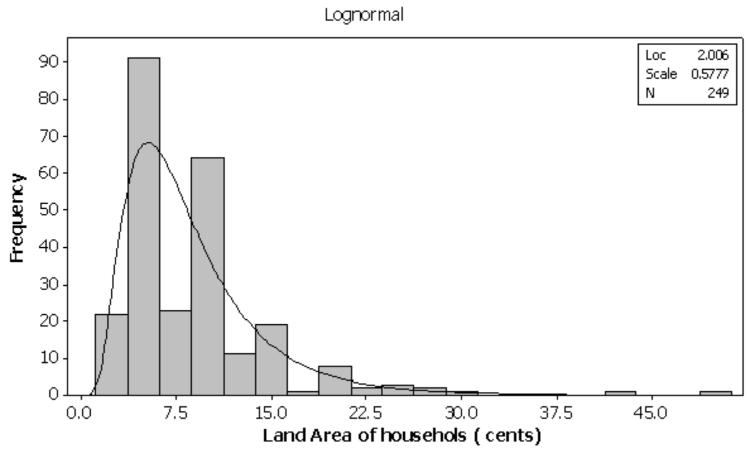


Figure 4.1 Histogram of Land Area

In figure 4.4, the histogram of land area explains a positive skewness in the distribution of land among the sample population. Positive skewness of the curve shows that the curve is distorted on the right side. Here it is implied that the land distribution, of the sample population is thrown to the right side of the curve and the positive skewness brings out the fact that, out of the total sample population, majority of them are having land more than 7.5 cents.

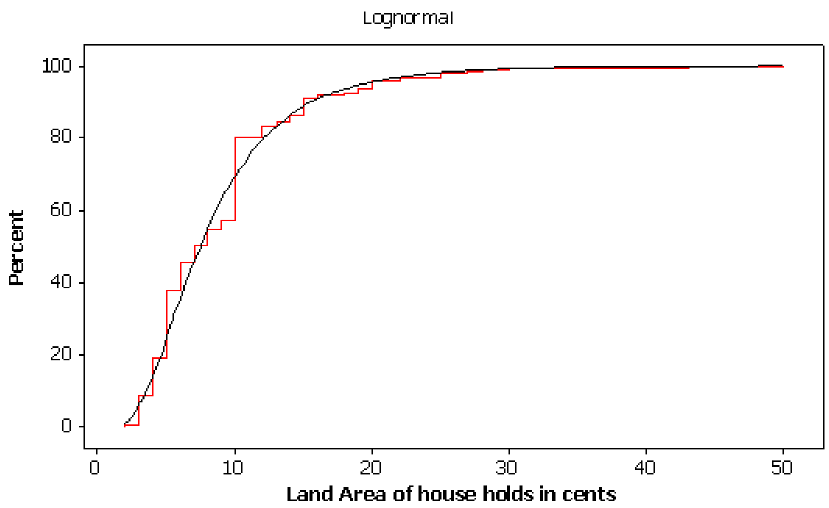


Figure 4.2 Empirical CDF of Land Area

In the figure 4.5, the cumulative distribution function of land area explains that 79.92 percent of sample population enjoys the possession of only up to 10 cents of land, whereas 20 percent sample population enjoys possession of more than 10 cents of land.

b) Ownership of houses by the sample population

There are several governments housing programmes undertaken in the fishing villages. The pace of this development had improved since 1985 following the availability of numerous schemes as part of plan programmes and assistance through Matsyafed. The task of providing permanent housing for all fishing families is still a daunting task. Even though the conditions of the inland fishing communities are better when compared to the poor housing and habitat conditions of marine fishing communities, construction of pucca houses for a good number of the sample population is more important. All the households in the sample population own a house. Here an attempt is made to verify the type of structure of houses, roof type, floor type and kitchen type. Electrification and latrine facility is also taken into account.

c) Type of structure of the houses of the sample population

Tables 4.18, 4.19, 4.20 and 4.21 shows the type of structure of the houses of sample population. Pucca houses come to only 32.8 percent whereas 53.2 percent are semi pucca houses. Though the percentage of thatched houses is less which is only 1.6 percent, the percentage of tiled, tinned and asbestos roofed houses is 94.8 percent. 98.4 percent of the floors are either cemented or tiled. 92.4 have common kitchen whereas 7.6 percent have separate kitchen. By separate kitchen, it is meant that a shed made separate out of main building.

Table 4.18 Type of Structure

	Frequency	Percent
Temporary Shed	7	2.8
Kutcha	28	11.2
Semi Pucca	133	53.2
Pucca	82	32.8
Total	**250**	**100.0**

Source: Field survey

Table 4.19 Roof Type

	Frequency	Percent
Thatched	4	1.6
Tiled/Tinned/Asbestoses	237	94.8
Concrete	9	3.6
Total	**250**	**100.0**

Source: Field survey

Table 4.20 Floor Type

	Frequency	Percent
Mud	4	1.6
Stone /Tile/Cement	246	98.4
Total	**250**	**100.0**

Source: Field survey

Table 4.21 Kitchen Type

	Frequency	Percent
Separate Kitchen	19	7.6
Common Kitchen	231	92.4
Total	**250**	**100.0**

Source: Field survey

d) Electrification status of sample household

Table 4.22 Electrification

	Frequency	Percent
Yes	236	94.4
No	14	5.6
Total	**250**	**100.0**

Source: Field survey

In table 4.22, 94.4 percent of the houses are electrified. Rural electrification programme has resulted in high number of electrified houses in the area.

e) Latrine facility of the sample households

Table 4.23 Latrine Facility

	Frequency	Percent
Water Sealed	20	8.0
Bore hole	219	87.6
Open pit	3	1.2
No latrine	8	3.2
Total	**250**	**100.0**

Source: Field survey

In table 4.23, 87 percent of households have bore whole type latrine. Only 8 percent is having water sealed septic tanks. Bore holes and open pits are unhygienic sanitary facilities for the surveyed area as it is a wetland ecosystem. These wetlands store and regulate the flow of water within the system. Most wetlands store water derived from surface runoff and from ground water. More over by water table level, they protect ground water and water resources from salt water intrusion. Thus wetlands play a crucial role in improving the quality of water. The bore holes and open pits pollute the underground water as the faecal waste penetrates into underground water which ultimately results in water borne diseases like cholera, jaundice etc.

f) Availability of drinking water for the sample population

The quality of environment improves substantially due to better hygiene, awareness on sanitation and good quality of water availability. The water supply and its availability are analyzed in the study as water scarcity is identified as an important reason for the deplorable quality of life of the fishing communities.

Table 4.24 Source of drinking water for the sample households

Source of drinking water	No. of Households	Percentage
Open Well	20	8
Bore Well	30	12
Public Water	50	20
Neighbours Well or Pond	150	60
Total	**250**	**100**

Source: Field survey

Source of drinking water for sample households is given in table 4.24. 60 percent of the sample population who depends on neighbors well and pond expressed their anguish towards the administrative authorities and political parties who had assured them of provisioning of safe drinking water. They also opined that they are prone to many water born diseases during the summer season due to the change in the water quality parameter. It is also observed during the survey that both the panchayats have not taken any measures to provide the rain water harvesting tanks to the sample households, though construction of rain water harvesting tanks has become a massive programme at the state level. The sample households who extremely suffer due to water scarcity opined that even though they want to construct rain water harvesting tank, lack of funds makes them unable to construct it.

Table 4.25 Distance of the households from the source of drinking water

Distance from the source in KM	No of Households	Percentage
0.5	45	18
1	50	20
1.5	125	50
2	30	12
Total	**250**	**100**

Source: Field survey

In table 4.25, 50 percent of the sample populations have to cover a distance of 1.5 Km from their destination to have access for safe drinking water. The womenfolk who are busily engaged in household work and different occupations lamented over their fate to walk for miles to have a pot of drinking water. 12 percent of the sample households have to carry water for about 2Kms. The women folk of the sample households opined that if there is public source of water taps at a calculated distance, they could spare the time they spent for fetching water for some useful purposes. If every household are able to get water within a walking distance of 250 meters, they could escape from the burden of water scarcity and long hours of walking. Many of the households opined their willingness to provide a common space for the construction of a common water harvesting tank if proper support is given by the Panchayat.

g) Fishing assets as physical capital for the sample households

The production equipments of fishing mainly crafts and gears have evolved through a historical process of adaptation to the ecosystem available.

They play an important role as physical capital. When resource permits improvements in fishing crafts and gears, it improves the livelihood of traditional fish folk.

Table 4.26 Craft-gear-price combinations of the sample households

	N	Percentage	Mean	
			Sample Mean	Sample std deviation
Price Craft	184	73.6	6827.45	456.273
Price Gear	115	46	3100.43	195.388
Price-other equipments	128	51.2	1821.09	40.522

Source: Field survey

The craft-gear-price combinations of this sample households is given in table 4.26. 73.6 percent of the sample households have their own crafts whose mean price is 6827.45. Only 46 percent of the sample households have their own gears. This percentage is low compared to the percentage ownership of crafts, as this fishing operation is a joint venture of two people. As gear is costly and always needs maintenance, buying of gears is a burden for every fishermen. Thus in this joint venture, some of the households own crafts and some others possess only gears. Other equipments include the vessels for clam boiling, possession of ice box, iron made pipe for burning the fire for clam boiling and aluminum vessels of fisher women folk for the house to house selling of fish and clam meat.

Physical capital can be enhanced through both direct provision and improvement in access to the infrastructure. It can also be improved by increasing financial capital which can be converted into physical capital.

4.3.4 Social capital position of the sample population

Social capital is the networks and relationships which exist in communities and groups which people make use of in their livelihoods. Social capital is very important for both social and business reasons. Social relations can provide a social safety net in difficult times. It can also facilitate business by establishing trust relationships which can be depended on thus reducing risk. Given the turbulent nature of dependence on a fluctuating resource, for fishers, social capital is very important source of stability.

Here the very basis of this particular capital is the maintenance of societal relationship and values that connect individuals into a functional layer social group. From the view point of sustainable livelihoods, social capital captures the idea that upholding the values of social norms, bonds, attitudes, responsibilities, a culture of reciprocity and natural trust and collective action embedded in societal relations and institutional arrangements serve up important roles.

Table 4.27 Categorization of family members according to their membership in different social organization-sex wise

Membership	No. of Males between the age of 18-60	No of females between the age of 18-60	Total
One Organization	(25.42) 75 (40.54)	(74.58) 220	295 (72.84)
Two Organization	60 (32.43)	0	60 (14.81)
Three organization	50 (27.03)	0	50 (12.35)
Total	**185 (46.72)#**	**220 (57.74)$**	**405 (52)***

Source: Field survey

*- It represents the percentage of membership of respondent family members in different social organizations.

Represents percentage of female membership to total females of the age group of 18 – 60.

$ represents percentage of male membership to total males of the age group of 18 – 60.

Blue represents percentage of male female membership in different social organization column wise.

Green represents percentage of male female membership to total membership.

Table 4.27 shows the categorization of family members according to their membership in different social organization-sex wise. It is observed that the surveyed area is a platform for various social and cultural organizations. It is also noted that the respondents in the surveyed area are members in various organizations. 46.72 percent males of the sample population are members in either of the three organizations. All the females are members of one particular organization. 46.72 percent and 57.74 percent of males and females are members of various social and cultural organizations out of the total sample population whose age category is between18 - 60.

Table 4.28 Type of social organization and membership of family members sex wise – status wise

Organization	Ordinary member male	Executive Member Male	Ordinary member Female	Executive Member Female	Total
SHGS	(22.58) 70 (46.67)	(6.45) 20 (57.14)	(61.29) 190	(9.68) 30	**310** **(76.54)**
Political Organization	(88.89) 40 (26.67)	(11.11) 5 (14.29)	0	0	**45** **(11.11)**
Sports and arts	(80) 40 (26.67)	(20) 10 (28.57)	0	0	**50** **(12.35)**
Total	**(37.04)** **150**	**(8.64)** **35**	**(46.91)** **190**	**(7.41)** **30**	**405**

Source: Field survey

Blue colour represents percentage of male female membership in different organizations in column wise.

Green colour represents percentage of male female membership in each organization in row wise.

In table 2.28, out of the sample population in the study area whose age group ranges between 18 - 60, whose numbers comes to about 777, 52 percent are members in mainly three organizations. Here an attempt is made to categorize the membership both sex wise and based on the nature of membership-ordinary or executive. Out of the total membership of 405, 76.54 percent belongs to the organizational set up of SHGs. It is also observed that the women participation rate is higher (70.97 percent), when compared with male participation rate (29.03 percent) in SHGs. The executive membership of women i.e. 30 among 220 female members show that the women are capable of holding positions now a days. The women oriented SHG which is popularly known as Kudumbasree is an innovative poverty eradication programme which had its origin in 7 wards of Alappuzha town in 1993. The implementation of poverty alleviation programmes with community participation in Alappuzha won laurels from the United Nations. Alappuzha received 'We the people 50 communities' award initiated in commemoration of the 50th anniversary of the United Nations. Alappuzha being the beginning spot of Kudumbasree programme, the surveyed area also shows its tremendous effects in carrying out the Kudumbasree activities. The executive memberships of SHGs including president and secretary not only ensure the smooth functioning of the groups in terms of needs, finalization of activities and their implementation and follow up, but also serve as a medium of integration with the concerned Area Development Society (ADS) in which the NHG is federated. The executive members of about 8 Kudumbasree groups were satisfied with the functioning of their groups. All these groups have good backing from local self government of the study area. The office bears of each group are able to conduct a range of programmes with specific objectives such as awareness and education programmes on female empowerment and entrepreneurship programmes. This inculcates not only a sense of female empowerment among the members in each unit, but also helps to promote economic independence. It has been noted in the savings and credit position of the household, SHG plays an active role as a savings and credit promoting agency. In the weekly meetings of the neighborhood groups the meager savings of the women members are collected and distributed back through the sanction of loans. This facility increases poor women's accessibility to small loans. These weekly meetings also provide a social platform for poor women to express their concerns, discuss their problem and search for better opportunities. This get together have generated a self respect, self reliance and feeling of unity among the members of the SHGs. It is also observed that none of the female, respondents in the study area are members in political organization. At the same time, out of the total representation of male memberships in different organization, 26.67 percent are members in political organizations. Though this political representation has been categorized under social capital, it can also be defined as political capital which is an endogenous asset that holds the power to connect an individual or group to higher power structure and policy instruments outside the domain of own territory (Baumaan, 2000). For fishing communities, active participation in socio-political institutions and empowerment as a strategy is more concerned with access rights, entitlement, socio economic capacity building and raising consciousness about proper management of environment and resources. In the case of common property resource management, community empowerment can be stimulated through co-management, as it involves the excluded, disenfranchised and sometimes alienated user groups and stakeholders into the management decision making process by rearranging power and responsibility. It is widely recognized that the enabling process of community empowerment is a pre-condition for and outcome of fisheries co-management efforts.

4.4 Access to Social Security Benefits by the Respondent Households of the Surveyed Area

Providing social security is not seen merely as a measure to solve temporary economic insecurity. It seeks to address the problem of chronic poverty. These measures are envisaged as public provisioning to the vulnerable, thereby empowering them into the private pursuit of a livelihood. Social security is achieved when deprivation or vulnerability is reduced or removed as a result of using social means, thereby making lives and livelihood more secure in this process. These social means are also termed as public action and include measures taken at the level of state, the community or the family.

This analysis is confined to the social security schemes specific to the types of benefits enjoyed by the respondent households and sources of these benefits and this is shown in table 2.49.

Table 4.29 Source and type of social security benefits accessed by the respondent households

Type of benefit	Panchayath	Matsyafed	Total
Housing	20 (10.26)	63 (49.21)	**83 (25.69)**
Toilet	45 (23.08)	-	**45 (13.94)**
Well	5 (2.56)	-	**5 (1.55)**
Fishing Equipment	125 (64.10)	40 (31.25)	**165 (51.08)**
Old Age Pension	-	25 (19.53)	**25 (7.74)**
Total	**195 (60.37)**	**128 (39.63)**	**323**

Source: Field survey

Figures in the bracket represent percentage

Though most of the social security schemes are implemented by Matsyaboard and Matsyafed such as savings cum relief scheme, scheme for housing, electrification of homes and schemes to provide sanitation, dispensaries, fisheries, schools, training centers and educational grants, it has been found that out of the total social security benefits of 323 numbers received by 154 households, only 128(39.63 percent) is contributed by

Matsyafed. Out of this 103 benefits, 63(49.21 percent) is for housing, 40 (31.25 percent) for the purchase of fishing equipments and 25 (19.53 percent) as old age pension for fish workers. Though the number of the aged eligible for pension for fish workers comes to about 48 in numbers as per the dependency ratio verified, only 25(52.1 percent) is enjoying the benefit of old age pension. The reason cited by many of the old aged fish workers for not getting the benefit is as follows. Some of them were unaware of this benefit and thus they did not join the Matsyafed when it was started. Some others complained that when they approached the Matsyafed for the membership, they were asked to clear the pending subscription for long years that has accrued to be a huge amount which was unaffordable for them to pay to the Matsyafed. Out of the 195 benefits (60.37 percent) accrued through Panchayats, the highest percentage of 64.1 goes for fishing equipments. This is because in one particular Panchayat of the surveyed area, Muhamma, all the fish workers were distributed fishing equipments. The other types of benefits such as housing, toilet, wells etc. were made available to respondent households by the Panchayat mainly due to the active functioning of neighborhood groups formed at the grass root level-Kudumbasree as this is a common platform for finding out the deserving beneficiaries and recommending them for the benefit provided by panchayath.

Table 4.30 Number of respondent households who availed several types of social security benefits

Number of Benefits	Number of Households
One benefit	33 (21.43)
Two benefits	45 (29.22)
Three benefits	76 (49.35)
Total	**154 (61.6)***

Source: Field survey

*- Represents percentage of respondent households who have availed several types of social security benefits.

It is observed from table 4.30 that some of the respondent households enjoy two or three social security benefits at a time, whereas some families are left out of any of these benefits. Though 154 (61.6 percent) households enjoy social security benefits provided by both Panchayath and Matsyafed, it is a fact that the same group of respondents i.e. 121 (78.57 percent) out of the 154 enjoy multiplicity of benefits. Those respondent households who do not enjoy any of these social security benefits accuse that those who have political influence and hold in Panchayaths reaps the maximum benefits from the authorities. But there is a general opinion that the active participation in neighbourhood groups of SHGs makes way for obtaining maximum benefits. The responses of the executive members of SHGs on this issue are also noticeable. The involvement and regular attendance of respondent households in the weekly meetings of Ayalkoottam paved the way for acquiring these advantages for some respondents where as the non participating respondent households do not harvest these benefits due to their long abstinence. It has been observed that though a number of social security measures are in vogue in the state of Kerala among the marine fish workers, it is not much benefited by the inland fisherfolk community.

4.5 An Enquiry into the Policies, Institutions and Processes Supporting Sustainable Livelihood of Respondent Households

For successful fisheries management, there must be a good institutional framework to permit decentralized management and co-management measures and community based resource management. The responsibilities of various institutions that affect fishing communities, their fulfillment of these functions and the reasons for failure is to be checked up.

Initially in the state of Kerala, the Fisheries Department was the sole agency engaged in the implementation of social security benefits for fishermen. Later newly formed agencies like the Kerala Fishermen's Welfare Corporation, Kerala State Co-operative Federation for Fisheries Development commonly known as Matsyafed and the Kerala fishermen's Welfare Fund Board known as Matsya board and the Kerala Fishermen's Welfare Fund have also entered the arena for supplementing the social security initiatives.

A glance at the institutional support and policies worked out in the surveyed area depicts a mixed response. The Village level society at the primary level known under the name fishermen welfare society registered under the Kerala State Welfare Societies Act is situated at Thannermukkom Panchayat. This welfare society caters to the needs of the fishworkers of the surveyed area including both the panchayat, Muhamma and Thannermukkom. There was also a Primary Fisherwomen Development Co-operative Society at Thannermukkom which is not functioning now exemplifies an institutional failure. A welfare fund board is functioning at Thannermukkom whose jurisdiction is from Aroor to southern end of Alappuzha district to Kuppapuram the northern end. The fishermen and allied workers of the study area are the beneficiaries of this welfare fund coming under the purview of this particular branch of the office. The benefits enjoyed by the fisherfolk and allied workers are as follows. The fishermen and allied workers who have joined as members in the Welfare fund whose annual subscription is Rs 100/- and Rs 240/- enjoy a pension of Rs 75 and Rs 120 respectively after 60 years of age. A Marriage fund constituted grants an amount of Rs 1500 for the marriage of two daughters of the beneficiaries. Apart from this, there is also assistance for sterilization of Rs 500 and provision of maternity benefit of Rs 750 for the delivery of two children. There is an insurance coverage of Rs 1, 00,000 for death occurring during fishing time and Rs 500 for temporary disability to work once in six months. Assistance of Rs 15000/- is provided as medical expense for treatment of diseases like cancer, heart attack, paralysis and tumor. An amount of Rs. 5000/- is granted in case of normal death. The office also issues certificate for the eligibility for educational scholarship of the children of these members. The owners of the craft have to remit Rs 60/- per craft annually. The total numbers of crafts registered in the study area are 600 in numbers in this office. Out of the total sample population of 1048, 463 persons were identified as fishermen and allied workers. Out of this 463, 360 (77.75 percent) are members of welfare fund Board. The reasons stated by those who stay out of this benefit scheme are given as follows. Those who want to join the welfare fund have to clear these arrears from the year of commencing the scheme. As the scheme was started in 1986, those who want to join the scheme have to remit an amount upto Rs 1000 according to their age. The respondents who have not joined the scheme are reluctant to clear this amount of arrears due to their financial problems. In the sample population, the number of respondents coming above of the age of 60 is 80. Out of this only 46(57.5 percent) are eligible for old age pension benefit Scheme. The rest of the sample population whose age is above 60 does not enjoy this benefit either because they never joined the scheme or they were above the age of 55 which is the cut off age to join the scheme, when the scheme was started. It was understood from the interaction with old age respondents that they were kept aloof from the scheme due to the lack of appropriate administrative measures. They also expressed their desire to be included in the scheme by amending the rules in accordance with their pathetic conditions.

As clam collection and processing is included as a major fishing activity of the study area, the sale and purchase of the clam shells white and black is an important business of the locality. This purchase and sale is legally permitted through the primary co-operative societies functioning in the study area whose membership is exclusively given only to clam workers. But as clam workers are also fish workers, the membership cannot be isolated as mentioned. Thus clam collectors who are also fish workers are members in the societies. There are three co-operative societies in the study area located at Aryakkara, Muhamma and Pallikkunnu. These three Co-operative societies are supposed to purchase only from its members. But those who are not members sell their shells to these societies with the help of the members. The working procedures for all the three co-operative societies are somewhat similar though some differences are found out while interacting with the secretaries of their societies. The co-operative society located at Arayakkara deals with white shells whereas the other two societies deal with black shells. As the process of purchase and selling of white and black shells is dealt through these societies, the state government receives a good amount as sales tax. The process of the purchase of shells is described as follows. After separating the meat from the shells, the clam collectors leave off the shells in their premises. The co-operative societies have made arrangements to measure heap of shells. Each Society is having temporary members of staff for measurement of shells. The common rode of measure for shells is locally called 'Patta' which can measure 20 kg of shells. The society purchases shells at the rate of Rs. 21.80 per patta. But the members are given only Rs 19 per patta at the time of purchase and Rs. 2.80Ps is held with the society for disbursing the same to the members under different schemes. Out of this Rs 2.80Ps, 50Ps is compulsory deposit of members known as thrift, 95Ps as Onam bonus, 20Ps as collection bonus, 10Ps as gratuity, 5Ps as provident fund, 55Ps as festival allowance and 45Ps as education fund. Once a person becomes member by paying membership fee of Rs 57, he is eligible to enjoy all benefit schemes of the society. Apart from the above mentioned disbursement, the societies have certain welfare programmes for members from common fund. Rs. 243 is given as medical allowance during the monsoon season. Due to heavy rain, as calm collection and processing not possible, 3kg of rice is supplied for each 100 Patta shells of members based on their total sale of the year to the society. The members are also given a personal loan Rs 2000/- based on the security of two other members. The members are also given their sale price in advance as and when needed. The Co-operative societies sell the purchased shells to the local industries at the rate of Rs 25 per Patta. The societies have to pay sales tax of 4 percent to government and royalty to the department of geology and mining at the rate of Rs 45 per ton. The shells are utilized as inputs for industries like poultry, medicine, cement, cotton, bleach, etc. There is some hue and cry by the members regarding the measurement of shells. They complain that the workers sent by the societies to measure are not accurate in measuring the shells. But when the problem was discussed with the authorities of the societies, they opined that this complaint was not genuine. Their justification against this complaint is as follows. There is a practice of purchasers of the society seldom going directly and measuring the shells without the assistance of the workers of the society. These Purchasers due to the shortage of the shells do not strictly stick on correct measurement. Instead of 20kg, they are satisfied with 16 or 17 kg per patta while measuring and members are also pleased with this measurement as they could save upto 4 kg per patta. The members prefer this type of measurement rather than the worker of the societies dealing with measurement and thus they raise this issue. The authorities of these societies opine that such foul plays have resulted in a hitch between the members and society. The members of the committee who represents these societies stated that as there exists certain level of competition between these three societies based on different political affiliations, many constraints are faced by the societies from the apex offices and state officials as and when there is an administrative change. Thus strong emphasis should be placed on empowering the poor to enable them to participate in the institutional processes and on linking communities to a wide range of government programmes and social and economic opportunities. There should be substantial flexibility for local communities to prioritize project interventions and include viable non fishery activities. Thought needs to go into identifying trends and institutional changes that attempt to respond to the needs of the rural poor - a central pillar of the SL approach. Improved processes can be achieved through improved relationships between different institutions.

4.6 Income and Expenditure Pattern of the Sample Population- Citing Causes for Poverty and Vulnerability Condition

The poverty level is a key criterion in the assessment of livelihoods. Poverty is an ever increasing haunting presence a grim reality that thousands of fishers are forced to cope with day in and day out. For fishing community, poverty is multi dimensional with cross scale connection to resource base, social, economic, institutional, political, governance, geographical, environmental and cultural roots. It covers not only levels of income and consumption, but also health and education, vulnerability and risk and marginalization and exclusion of the poor from mainstream society. Poor people have to struggle against five interlinking disadvantages which trap them in deprivation, poverty itself, physical weakness, isolation, vulnerability and powerlessness. Resource dependent communities face unique challenges to social and economic stability because of their reliance on a particular natural resource for income and employment. Such communities are often characterized as economically impoverished and politically marginal. The notion of livelihood cuts across what has been perceived as two opposite views on the nature of poverty. At one pole are those approaches to poverty that aims to measure it objectively in terms of expenditure income or some other quantitatively defined indicator. At the other pole, the approaches aim to see poverty through the eyes of the poor, arguing that it is as much a subjective experience as it is an objective state. Income, expenditure and the experienced quality of life are all implicit in the notion of livelihood.

Income inequality metrics or income distribution metrics are techniques used by economists to measure the distribution of income among the members of the society. Income is also considered as the basis of evaluating poverty. The ten locations selected for study characterizes certain specialties which ultimately results in variation to their income contribution. The annual mean income of the each cluster of twenty five families from each location is calculated to find out the inequality within the subgroups and also to verify that which group contributes what level of inequality to the whole. In orders to explain the intensity of inequality among the traditional fisherfolk of the study area and to verify the intergroup disparity in income distribution, mainly three indices are used. They are Theil index, Foster's welfare function and Atkinson's index.

Theil index is an interesting measure of inequality proposed by Theil in 1967 is the weighted sum of inequality within subgroups. This index helps to explain how certain groups contribute a certain amount of inequality to the whole. Theil Index is just weighted geometric average of the income relatives if there is no inequality, index value is zero and if there is perfect inequality index value is one. There is actually a much better reason for using Theil index of inequality. It is an index that allows decomposing changes in income inequality into the changes of inequality within sub groups and the changes in inequality between groups.

Theil Index $T = \sum_{i=1}^{N} \left(\frac{x_i}{\sum_{j=1}^{N} xj} - \ln\frac{x_i}{\bar{x}}\right)$

x_i is the income of the i^{th} person

$\bar{x}$ is the mean income

N is the number of people.

The first term inside the sum can be considered as individual's share of aggregate income. Second term is that person's income relative to the mean. If everyone has the same income, the index is zero. If one person has all the income, then the index is ln N.

The Theil index is derived from Shannon's measure of information entropy (Shannon, 1948). Entropy implies that some disorder or instability. There is always a tendency to for all the variables be in an order. T being the Theil index and S being the Shannon's measure,

$T = \ln N - S$

S is the probability of an event occurring. This implies that a rupee drawn at random from the population come from a specific individual. It is the individual's share of aggregate income. Decomposability of Theil index is the weighted sum of inequality within subgroups. If the population is divided into M certain sub groups and S^k is the income share of group K, Tk is the Theil index for that subgroup and $\bar{X}^k$ is the average of income in group k. Then Theil index is

$$T = \sum_{k=1}^{M} S^k \; T_k + \sum_{i=1}^{M} S^k \; \ln \frac{\bar{X}^k}{\bar{x}}$$

This implies that certain sub groups contributes certain amount of inequality to the whole.

The second index used in the analysis is foster's welfare function which is considered here as the application of Theil index.

In economics a social welfare function

$W = y_1 + y_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots y_n$

Where W is the social welfare, y_i income of the individual among n in the society without regard to how incomes are distributed in the society. According to Sen (1973) welfare is a function of income and inequality.

Foster (1985) has computed welfare which is known as Foster Welfare Function.

W = income (1- inequality)

Where income is the average income of a measured group and inequality is the relative inequality of the income distribution within that group.

The third index used to measure income inequality is the Atkinson index. This is one of the few inequality measures that explicitly incorporate normative judgments about social welfare (Atkinson, 1970). This index is derived by calculating the so called equity- sensitive average income (Y_e) which is defined as the level of per capita income which if enjoyed by everybody would make total welfare exactly equal to the total welfare generated by the actual income distribution. The equity-sensitive -average income is given by

$$y_e = \sum\left(y_{i}{}_{i=1}^{n} . y_i{}^{1-e}\right)^{1/(1-e)}$$

Where y_i is the proportion of total income earned by the i^{th} group and is the inequality aversion Parameter. The parameter e reflects the strength of society's preference for equality and can take values ranging from zero to infinity. When e>o, there is a social preference for equality (or aversion to inequality). As e rises, society attaches more weight to income transfers at the lower end of the distribution and less weight to transfers at the top. Typically used values of e include 0.5 and 2.

The Atkinson index (A) is then given by

$A = 1\text{-}y_e/\mu$

Where μ is the actual mean income. The more equal the income distributions, the closer the y_e will be to μ and lower the value of the Atkinson index. For any income distribution the value of A lies between 0 and 1. Obviously there is no single "best" measure of income inequality. Some measures are bottom sensitive than others is more strongly correlated to the extent of poverty. The measures perform differently under various types of income transfers.

Table 4.31 Theil Index, Forster Welfare Function and Atkinson Index for poverty analysis for 10 locations

	Income					Percapita Income				
Location	Mean	SE	Theil Index	Fosters Welfare Function	Atkinson Index	Mean	SE	Theil Index	Fosters Welfare Function	Atkinson Index
1	25780	1456.70	0.035	24893.30763	0.034394584	6432.867	400.463	0.044	6155.957215	0.04304604
2	24448	1189.48	0.0275	23784.84024	0.027125317	6437.981	336.4937	0.0313	6239.593115	0.03081523
3	23488	1199.99	0.0261	22882.89418	0.025762339	5774	405.7875	0.0535	5473.208903	0.05209406
4	23708	1053.47	0.0214	23206.03894	0.021172645	5805	311.6571	0.0339	5611.508707	0.03333183
5	23180	599.81	0.0081	22993.00037	0.008067283	6208.8	453.4101	0.0586	5855.419488	0.05691607
6	20932	766.20	0.0143	20634.80243	0.014198241	5833.667	246.9098	0.0205	5715.293966	0.0202913
7	25160	1011.40	0.0189	24688.94152	0.018722515	6482.767	367.9124	0.0381	6240.41929	0.03738333
8	23164	552.14	0.0067	23009.31996	0.006677605	6277.476	287.1804	0.0251	6121.872533	0.02478761
9	25446	489.32	0.0044	25334.28356	0.004390334	6364.019	238.8522	0.017	6256.745136	0.01685632
10	23976	658.19	0.0089	23763.56036	0.008860512	6544.4	385.6854	0.04	6287.790406	0.03921056

Source: Field survey

Table 4.31 shows indices foe poverty analysis. As the study takes into consideration 10 locations out of the two villages and as each location comprises the cluster of 25 households whose annual aggregate income is calculated, it is very important to find out contribution of each group's inequality to the whole sample population. Using the above mentioned formula for Theil index, the weighted sum of inequality within sub groups is calculated. Inequality within the study area is the sum of each location's income relative to the entire study area. The sample population is divided into 10 subgroups and S^1 is the income share of group I where S is the Shannon's measure. T is the Theil index for 10 subgroups and $\bar{X}^1$ average income in the group I the theil index is

$$T = \sum_{K=1}^{10} S^1 \; T_1 \; + \; \sum_{K=1}^{10} S^1 \ln \frac{\bar{x}^1}{\bar{x}}$$

This implies that 25 households in each location contribute certain amount of inequality to the whole sample of 250 households. This share of inequality by each group describes the decomposability property of Theil index

At the same time the formula

$$T = \sum_{i=1}^{N} \left(\frac{x_i}{\sum_{j=1}^{N} xj} \, . \; \ln \frac{x_i}{\bar{x}} \right)$$

Can be in the study written as

$$T = \sum_{i=1}^{250} \left(\frac{x_i}{\sum_{j=1}^{250} xj} \, . \; \ln \frac{x_i}{\bar{x}} \right)$$

Where xi is the income of the i^{th} person $\bar{x}$ is the mean income of 250 households and N, the number of households which is 250. The first term inside the sum is considered as the individual's household's share of aggregate income and the second term is that of household's income relative to the mean.

In the study area, out of the 10 location, each comprising of 25 households, the annual mean income is calculated for each 25 households. According to Theil index no inequality among households if index value is zero which implies that all persons have the same income. On the other hand if the Theil index value is 1, there is perfect inequality. The limit of inequality depends upon the size of the sample population.

Here it is noted that the value of that index shows that there is inequality in income distribution among the 250 households as the value of the Theil index is not zero. It is observed that the most nearest value of the Theil index to zero is obtained by location 9. Location 9 is having the least inequality among the ten locations and location 1 is having the highest inequality as it is farther away from 0 when compared with other locations.

Foster's welfare function - The social welfare of society is taken to be related to the income of the poorest person without regard for the income of the others. It is the relative inequality of the income distribution within a group. It is observed from the data that the location 9 is having the highest welfare situation as the value of Foster's welfare function is highest among the ten locations. Location 6 is having the lowest welfare situation as the value of Foster's welfare function is the lowest.

Pigou-Dalton transfer principle is egalitarian in the sense that any transfer from a poorer to a richer person must be seen as an increase in inequality and regarded as worsening. But Atkinson suggested that given income transfer should have the greatest effect at the lower end of the distribution. A transfer sensitivity inequality measure is one which must regard such a favorable composite transfer as inequality reducing.

Evaluation of poverty is a necessary pre-requisite in this analysis. This evaluation includes mainly two steps:

1. Identification to identify the poor among the total population in the community.
2. Aggregation - the diverse characterization of the poor would have to be put together to arrive at an assessment of the level of aggregate poverty in that community.

The identification exercise is primarily one of choosing a poverty line income below which people are counted as poor. The aggregation exercise would consist in this case of choosing a way of ranking communities with different vectors of individual incomes of choosing a functional form that makes different income vectors into a numerical index of aggregate poverty. The identification of the level of income at which people can be cogently described as poor may well depend on the pattern of affluence and deprivation that others experience and this can be affected by both mean income and the actual distribution around the mean. The sensitivity of the poverty standard to the pattern of distribution relates to taking a relative view of poverty. The extent to which a person falls behind other individuals can be checked only with the detailed pattern of distribution - not just the mean income.

Atkinson explains that the equally distributed equivalent income of a given distribution of a total income if enjoyed by everybody would make total welfare exactly equal to the total welfare generated by the actual income distribution. y_e being equally distributed equivalent income and μ the mean income, the more equal the distribution, the closer will be y_e to μ. If income is equally distributed then y_e is equal to μ and the value of Atkinson's index will be zero. The more the unequal distribution, the more will be the difference between y_e and μ and depending upon this relationship the value of Atkinson's index will lay between 1 and 0. Value of A closer to 0 means more equal is the distribution and vice versa. From the data it is clear that the value of location 9 is closer to 0 and hence more equal is the distribution in location 9 and as the value of location 1 is farther from 0 or closer to 1, the more unequal the distribution in location 1.

As there is a reporting bias in income, an alternative monetary measure that can be used as an indicator of the living standard is the consumption expenditure. More over consumption expenditure is considered to be more appropriate and relevant than income for the fact that actual consumption expenditure is more closely related to a person's well being and that it is not affected by seasonal fluctuation in income. It may also come from earnings from assets, debt and dis-savings. To adjust the difference in needs among households, per capita consumption expenditure is taken as the measure of standard of living. For more precision in the measurement of poverty, the interval plot for per capita income, per capita expenditure is taken into account. The statement on per capita income and per capita expenditure is calculated for a period of three months from March to May. This has been taken as reference period as this period is considered moderately as a part of peak season for inland fishing in the study area. It is also observed that the seasonality nature of fishing has been partly lost due to the ecological cutting of the lake into fresh water and saline water to the south of and north of the lake due to construction of the Thanneermukkom barrage. From the perceptions of the respondents, and through detailed enquiry on the expenditure and income pattern of the households during the period, it was a hard task to accurately take an income - expenditure statement of the respondent households.

Reasons for not fishing on some days

Missing of fishing days can be attributed as one of the main causes of low income or the income gap of the respondent families. Lipton (1993) argues that 200 days per year should be considered as a minimum employment period for rural livelihood. However fishers consider that at least a working period of 275-300 days per year would suffice for full filling there basic necessities. But from various study reports and from responses of the surveyed households, it is clear that around 162 fishing days are only available for fishing in Vembanad lake. But the number of actual fishing days has gone down from 162 fishing days due to various reasons. The identified reasons are ranked by the respondent fisherfolk according to their preferences.

Table 4.32 Reasons for not fishing on some days out of the available fishing days of 162

Reasons	Number	Mean rank
Poor catcher recently	249	2.6
Bad weather condition	249	3.11
Obligatory village meetings	249	3.26
Repairs/Manufactures	249	2.73
No craft available	249	3.3

Source: Field survey

Table 4.32 shows the reasons for not fishing on some days and the data reveals that poor catches recently is the basic reason for not fishing on some days, as this reason has attained lowest value which implies the highest preference of respondent fisherfolk. Most of them opine that they have lost interest in fishing due to the deplorable condition of falling down of catches up to the level of non availability of fish even for their domestic use. Non availability of craft gets the least importance as this reason attains the highest value. As buying of craft and gear is a small investment for inland fisherfolk it does not pose much problem and non availability affects only a small proportion of respondent fisherfolk who often depends on rental crafts. Household level coping strategies or mechanisms which involves some implicit principles or self provisioning action are to be chosen under this stress situation of unusual loss of fishing days for the survival and well being of the respondent households.

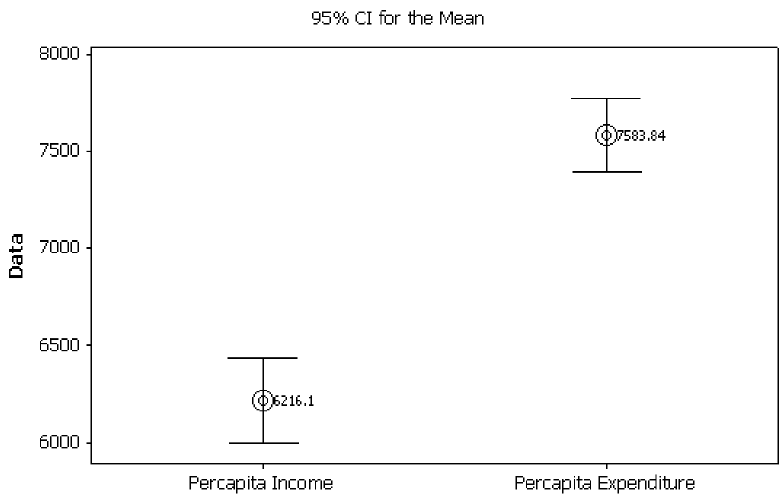


Figure 4.3 Interval plot of per capita income - per capita expenditure

In the figure 4.3, it is noted that mean income is Rs. 6216.1 and mean expenditure is Rs. 7583.84 with 95 percent confidence interval. The mean per capita income varies between Rs. 6800 and Rs.7800 and the mean per capita expenditure varies between Rs 6000 and Rs 6500. The standard error 110.17561 for income and 95.71824 for expenditure shows that within group, variation of income is much more than expenditure. The two-sample t test is used to compare between the means of per capita income and per capita expenditure. Here the null hypothesis tested is Ho: $\mu_{pcI} = \mu_{pcx}$. But it is found that mean expenditure (7583.84) is more than mean income (6216.1) at 95 percent confidence interval for mean. Since P value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis is accepted that there is significant difference between mean income and mean expenditure. The respondent families are unable to meet their requirements. This situation implies that to meet the income gap, the respondent families should approach alternative income earning activities or they have to work hard to cover the excess expenditure than their income. But the respondent families are of the opinion that fishing is no more an alternative income source to fill this income gap as the prospects from fishing is going on declining. At the same time, they are also perplexed over the issue of finding other alternative income sources.

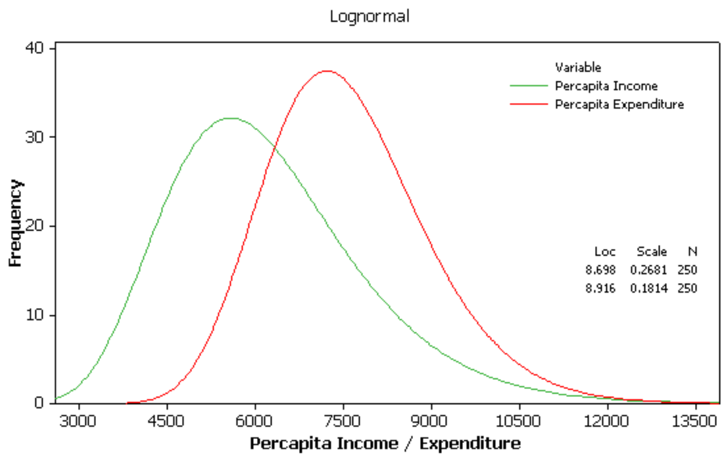


Figure 4.4 Log Distribution of Percapita Income and Percapita Expenditure

To make the income and expenditure variable amenable for robust data analysis, here the log of per capita income and expenditure are taken. From the figure 4.4 it is clear that both the log per capita income and log per capita expenditure curve depicts normal distribution.

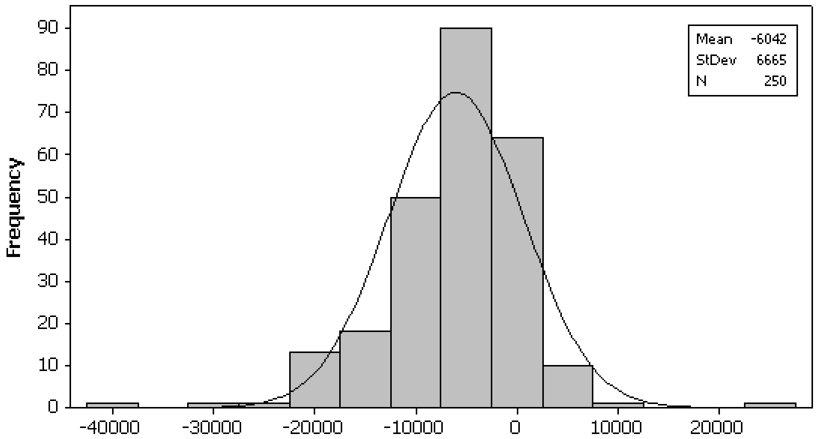


Figure 4.5 Histogram of Difference between income and Expenditure

Figure 4.5 explains the income expenditure gap. It is also normally distributed and this implies that expenditure is always greater than income.

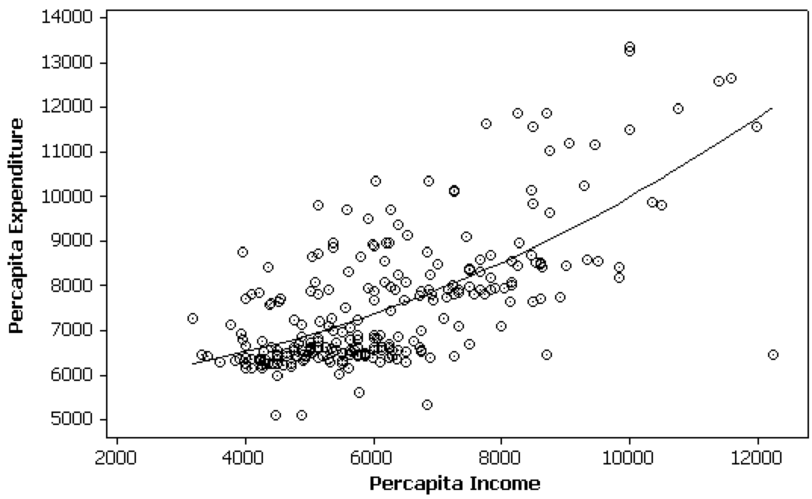


Figure 4.6 Scatter plot of per capita Expenditure Vs per capita Income

The figure 4.6 indicates that when the income increases, expenditure also increases. Since there is higher concentration of population in the lower end, it can be concluded that low income low expenditure group are more than high income high expenditure group. The scatter plot implies that below the line, as income of the respondent family's increases, expenditure decreases and above the line as income of the respondent family's decreases, expenditure decreases.

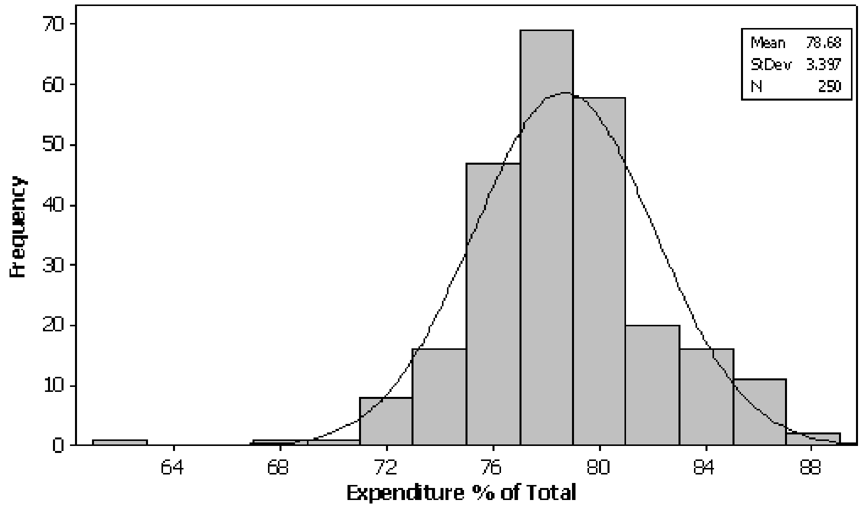


Figure 4.7 Histogram of Expenditure for food

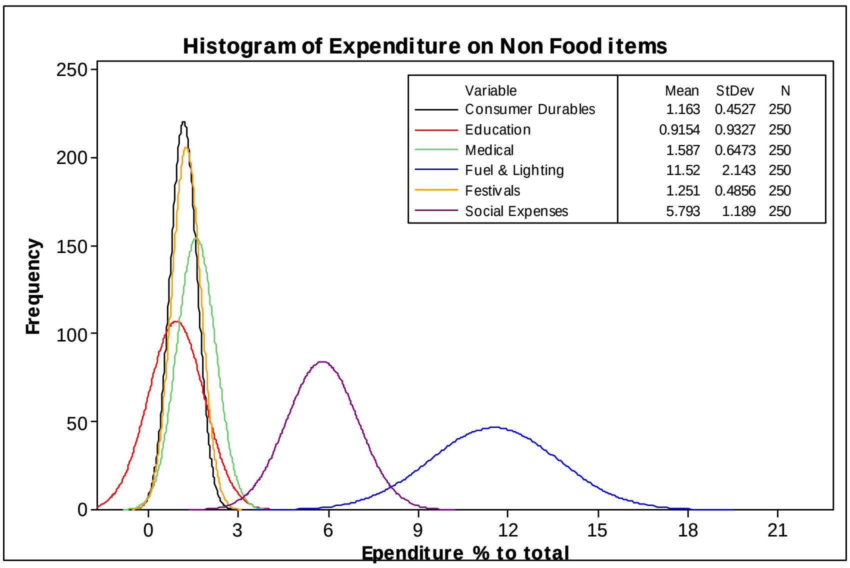


Figure 4.8 Histogram of Expenditure on Non Food item

The figure 4.7 and 4.8 gives some clues on the expenditure pattern of respondent families. 78.68 percent of the expenditure of the respondent families goes for food and the rest on other variables. The histogram of expenditure on non food items brings out some interesting facts. 11.52 percent spent for fuel and lighting which forms the highest percent among non food items. This proportion is high as those respondent families who are engaged in clam processing are in need of lot of fuel for boiling of clam to separate the meet and shell. Most of the respondent families are engaged in this activity and hence there is high proportion of fuel expenditure. Expenditure on education is low as the students of the respondent families get fisheries grant provided by the state government. The second highest proportion on non food items is incurred for social expenses. During the survey it was observed that most of the respondent families were forced to spend for social expenses such as marriage, death ceremonies etc as this has become a social custom. At the same time they also agree that though the social expenses are high, social gatherings are an opportunity for socialization and mutual help among the members of the community. These social expenses often become a blessing for those poor families which are not able to find sources for meeting the expenses in connection with the ceremonies taking place in their families.

Chapter 5

AN ENQUIRY INTO NATURAL CAPITAL, ENVIRONMENTAL VULNERABILITY AND CONFLICTING INTERESTS AND ISSUES

Contents

Natural capital usually comprises nature's environment, goods and ecosystem services and is essential for economic activities and for sustaining all forms of life. Availability of and access to natural resources is directly related to livelihood functions and the sustainable use of the resources can be translated into source of wages. It is also implied that if resources are sustainably used and that habitats are protected and rehabilitated can increase the benefits from natural capital and the right to benefit from resources transferred to the resources users themselves. At the same time the overuse and depletion of this natural capital inevitably leads to non availability of other capital forms financial, physical and human. Decline to the availability of fish due to biodiversity loss results in loss of financial capital as income from selling of fish declines and as the financial capital declines, physical capital also declines which is made out of financial capital. Human capital also suffers a setback due to the declining fish catches due to non availability of fish for healthy diet. At this juncture, SLA is highly useful technique for assessing inland fisheries as a natural capital as the resources is usually under threat from a multitude of factors. This approach allows understanding quickly the area and the threats to the fishery and conflicts between different stakeholders. This section examines the role of natural capital in the livelihood of the fishers.

Ekins(2003) summarizes how natural capital provides four classes of fundamental environmental functions (1) source functions (providing fish for consumption) (2) Sink functions (accumulation of upland wastes) (3) Life support function and (4) Human welfare functions. To understand about these functions the diverse livelihood natural capital available and its sustainable use are to be discussed in detail.

5.1 Loss of Fish Diversity

The fish population decline and consequent overfishing have been contributing to severe loss of fish and clam wealth. It has been estimated that over the last 30 years, fish diversity has come down from 150 to 36 species and fish catch has declined from 1, 60,000 tons to 7,200 tons in 1989 and to as low as 687 tons in 2000-01. Black clam, *Villorita Cyprinoides* and sub-fossils of dead white clam are other aquatic rich sources in Vembanad Lake. Annual landings of black clam are reported to have plummeted from 27,000 tons on 1968 to 11652 tons during the mid 80’s. The fishery of the giant fresh water prawn experienced a sharp decline. The catch of the species in the lake has declined from over 300 tons in the 60’s to less than 100 tons in the 90’s.

During the pilot survey, while discussing with traditional fisherfolk and leaders of fishermen organization, 17 major reason were identified as the major causes of above mentioned resources depletion. During the household survey these seventeen reason were given to the respondents to pick one by one to be identified by them and to be ranked by order suitably fitting to their location.

As each location had some specialty according to the pilot survey this was a necessary step to assign the weightage of each and every reason for all the 10 locations. The perceptions about resource depletion of each respondent were ranked carefully and analyzed using multi dimensional scaling. A direct ranking method was used asking the respondents to rate the reasons from 1 for most preferred to 17 for least preferred of all the 17 objects.

The general perception on all these 17 reasons shared by the 250 respondent fishermen is to be discussed in detail before analyzing it with the statistical tool Multidimensional Scaling. Here each reason is discussed in detail to find out how each one results in loss of fish diversity and clam production of Vembanad lake in general which ultimately leads to the livelihood issues of concerned fisherfolk community. The complexities of these issues have also been supported and substantiated by various scientific reports published by different agencies and researchers.

(1) Climate - If Vembanad is in healthy intact condition, it can greatly contribute to increase the resilience to impact of climate change. Its capacity to store and gradually release water makes this wetland a vital life line in periods of excessive droughts. Unfortunately the Vembanad wetland is degrading faster as extensive water and land remodeling efforts have taken place in Vembanad Lake which has drastically changed the lake. Water and landscapes are altering natural habitats of many terrestrial and aquatic fauna and flora. This tendency significantly amplifies the harms that changes bring to nature and people. This is because the poorest communities are primarily depending on the resources and services that Vembanad wetlands provide. The respondent fisherfolk are of the opinion that apart from other reasons the delayed and declined monsoon affects the availability of fish and prawns. The spawning of clams and prawns mainly takes place during the season June to October every year in

the estuary. The delayed Monsoon has resulted in delayed breeding of these species thus resulting in lower catches compared to the previous years. The excessive rainfall is also having some negative effects. This results in low salinity of the estuarine system which affects the growing periods of different species of fish. The post larvae which arrive the backwater can tolerate a wide range of salinity and hence invade the best feeding grounds even those with moderate salinity for rapid growth. As they grow bigger in size they become more sensitive to low salinities and hence are forced to descend into more favorable downstream region. The maximum growth rate in penaeid prawns is associated with optimal saline and food condition.

(2) Overfishing - The stock of various fishery resources of backwaters and estuaries are under strong threat of overfishing and this acts as a major contributing factor in the depletion of principal species of commercial importance in the lake. It is estimated that on an annual average basis, about 7000 tons of juveniles of penaeid prawns are indiscriminately filtered from Vembanad lake of which the contribution of penaeus indicus alone is around 245 million numbers. The reason for overfishing is cited as follows by respondent fishers. The commercial selling of juvenile prawns to the farmers for depositing in Pokkali field by indiscriminately catching from the estuary during the month of November and January is a usual phenomenon. During the operation, around 190 another type of juvenile prawn and fish are destructed. Size overfishing which implies reduction in the size group contributing to commercial fishery. In Vembanad Lake, the size contributing to fishery of penaeus indicus was 120-140mm in 1980. However in 1990 it has declined to 60-80 mm. Recruitment overfishing which means indiscriminate exploitation of spawner population during the spawning season and the consequent effect on recruitment. Ecosystem overfishing is another type based

on the qualitative and quantitative changes noticed in the exploited stock of fin fish and shell fish and due to this a steady decline is noticed in the commercially important species which is not compensated by the increase in biomass of desirable species. Another opinion regarding fishing pressure is that as the catches have declined to below sustainable levels, most of the fisherfolk have now concentrated on clam collection as an alternative to fishing. But this has increased the pressure on the sustainable levels of clam production also.

(3) Unsustainable fishing - The old group among the respondent fisherfolk expressed their grave concern over some unethical fishing practices among the young generation who keep away fishing principles craving for more money. They pointed out some of the unsustainable practices using chemical and herbal poisons, use of insecticides as poison, dynamiting, electric fishing and use of small meshed fishing gears. In Vembanad backwater, the number of stake nets in operation is enumerated as 3862 of which 30 percent are unauthorized, 90 percent of the stake nets have a code end mesh size less than 8 mm (Kurup, 1993). As there is no restriction regarding the mesh size of the stake nets the young and juvenile fish and prawns are caught indiscriminately. Stake nets which are mostly seen proximal to the bar mouth regions is seen inimical to the brackish water fishery because they indiscriminately filter out the incoming prawn larvae and fish fingerlings irrespective of their size. The respondent fisherfolk described about 8 types of seine nets mainly known as Valli Vala, Pattu Kanni Vala, Paithu Vala, Neria Vala, Chemmeen Vala, Mandu Vala and Peru Vala. Respondent fishers opined that fishing using seine nets which have 2 Km length and 500 meter width and 10 mm mesh size surely depletes fishing resources on a large scale.

(4) Barrage at Thannermukkom- The regulator across the lake at Thannermukkom divides the estuarine system north-south into a predominantly a fresh water lake to the south and a brackish lagoon on the north. The scientific findings regarding the environmental factor that Influence the fishery of the lake is salinity variation in spatial and temporal aspects due to the operation of the barrage. The estimates of the fishery production also show some dismal facts. The annual landings of 838 tons were recorded during 1999-2000 and 687 tons during 2000-01 in northern side. For the same period, the total landings exclusively from the lake south of the barrage were 584 and 507 respectively (Padmakumar et al., 2002). In detailed discussion with the respondent fisherfolk, it was possible to go through many complex issues which have arisen locally within the fishing communities. The respondent fisherfolk who live south of barrage (location 4,5,6,7,8,9,10) complained that some fishermen living nearby the bund are engaged in illegal fishing with the help of shutter operators and police officials. By night time few shutters of the bund are lifted to a certain height, that they could get good catch of fish and prawns which rushes to pass through the opened up shutters. Such operations fetches them a very good income. To bring out the fuming issues regarding the seasonal operation of the barrage at Thannermukkom, certain facts and figures along with some historical events are to be taken into consideration. Consequent to an unanticipated flood in 1949, the then agriculture minister of the state decided to find a mechanism to prevent the damage to the paddy crops in the reclaimed vast fields in Kuttanad area encompassing the Vembanad Lake. As part of this strategy a bund extending to 4500 feet in length with 93 shutters was planned at Thannermukkom, 24 Km north of Alappuzha town. This was to prevent the saline water incursion to the 6000 ha in area of low lying paddy fields in the southern sector of the lake so that a second crop of paddy

also could be raised in these fields. But the problem started as the project was implemented only partially. Only 62 shutters were erected at the west and east ends of the barrage. The central portion was filled with earth. The shutters were to prevent the salinity incursion to the southern sector during high tides of November-December months and were never intended to be closed permanently. But in effect due to practical problems in opening and closing the shutters, the barrage remained closed permanently for about six month from November-December to April-May. But this closure has destroyed the continuity of the ecosystem prohibiting the sharing of its physical and biological identity between the sectors and this faulty intervention has brought a lot of misfortunes on the livelihood of the fisherfolk community depending on this ecosystem. The early 1990s saw the mobilization of fisherfolk against the seasonal closing of this salinity barrage. The conflicts are the results of the twin process of environmental degradation of the bio-physical system and social marginalization of sections of people directly depended on the lake for their livelihoods. The marginalized traditional fishermen used agitation as a tactic of protest and also used covert tactics like putting physical obstruction to the full closing to the barrier. The constant pressure building by fishermen empowered through mobilization led to the formation of a committee led by the district collector with representation from affected sections. This was succeeded by series of negotiation, were the fishermen representatives used the research results from the academia that suggested the environmental degradation and need for rationalization of operation of the barrage. They could also mobilize the opinions of environmentalists to further their cause in the negotiation forums. Fisherfolk accelerated their protests demanding for a permanent opening of barrage. This led to the appointment of a commission of enquiry under a reputed scientist that suggested timely operation of the barrage as originally suggested in the design. Government accepted this report and every effort are made for the timely operation of the barrage. However the sustainability of this resolution of the conflict depends on the continuity and institutionalization of the process, including continued effective involvement by the state machinery. There is also a conflict of interest between revenue administrations on the two sides of the lake and also between the department of agriculture and fisheries centered on the operation of the barrage. The respective district collectors, MLAs, and MPs on the different sides of the lake try to represent and pursue the interest of their dominant constituencies. The department of the agriculture highlights the farmer interests, the department of fisheries stands for the issues of fishermen and the department of irrigation which is in charge of closure and opening of the barrage is always in dilemma between the issues of fishers and farmers. The local unit of the Dheevarasabha who is in the forefront of agitation against the closing of the bund affirms that whenever there is a timely opening of the bund as an after effect of agitation, the catch for the next year is good. But they feel it very difficult to organize these agitations every year for their livelihood as this is a time consuming and costly affair. The respondent fisherfolk also opine that the politicians are taking a tricky stand on the issue to bag the votes. Another issue pointed out by the fisherfolk is that the shutter operators of the barrage gets tips from houseboat operators and motor boats for lifting up the shutters for crossing the barrage. As the month from December to May is the period of hectic back water tourism, these operators are also longing for closed shutters during this period expecting tips.

(5) Fertilizers and pesticides - Indiscriminate application of pesticides and discharge of industrial effluent have aggravated the water pollution problems of Kuttanad and Vembanad Lake. The agriculture developments have resulted in the

input due to large quantities of agro-chemicals and pesticides in the Vembanad Lake. A critical examination of the pattern of pesticide application in Kuttanad reveals the extent of damage that has been taking place in the water body. The introduction of high yielding paddy varieties in the Kuttanad area has produced not only a dramatic increase in rice yield but also a greater pest problem and application of pesticides has gone up from 3 to 4 times per cropping season. When water is pumped out of the paddy fields, these toxic substances are washed into water ways and this has resulted in incidental fish killing. Ten types of pesticides are regularly used in Kuttanad. Although use of DDT has been banned in Kuttanad for agriculture purposes, the pesticides and its derivatives DDE and DDD are found in the black clam from the lake and canals. The application of fertilizers and bio degradation of organic waste has also led to the enrichment of nitrogen in the lake waters. As regards industrial pollution, about 108 major and minor industrial units are functioning in Kuttanad region and daily discharge of these factories is of the order of 33,000 cum. The respondent fisherfolk opine that these pesticides and fertilizers are the active killers of fish and shell fish.

(6) Oil spillage- Numerous oil tankers, travel and tourist boats and house boats plying on the back waters are the major sources of pollution. The aromatic hydrocarbons like benzene, toluene, etc associated with oil and lubricants are acute poisons to the aquatic organism. Especially in back waters as the area of oil spillage from these motorized boats are spreading in a limited area compared to that of marine ecosystem the intensity of pollution is much higher. It is also scientifically proved that the impact of Petroleum Hydro Carbons (PHC) is found mostly in the form of unburned fuel and oil and the tarry nature of these residues adheres to the respiratory system of aquatic organisms. Many of the respondent fishers are of the

opinion that sometimes the fish consumers complain about the taste of oil for fish.

(7) Backwater tourism - The sudden development of back water tourism in the form of houseboats, motor boats, speed launches and of late raw boats or country crafts is considered as an income earning economic activity to a particular group who has entered in to tourism with a new dimension. But there has emerged complex issues affecting the livelihood of fisherfolk in connection with this tourism business. The respondent fisherfolk list out the problems as follows.

As around 350 house boats, 400 motorized tourist boats and a few speed launches ply in the region the fishing community have lost their control and freedom over the water body in many respect. They complain that disposal of plastic waste like bottles and carry bags from houseboats is a common scene. The fishers get all these non-biodegradable wastes in their nets instead of fish. As the houseboats and other tourist boats operate with motorized engines, the oil spillage had affected the quality and taste of fish. The high horse power engines used by the house boats create noise pollution which affects the breeding conditions of the fish and prawns. The women folk of the respondent families are totally dissatisfied with the backwater tourism as they have lost their freedom to wash their clothes and bath in the lake. It is also observed that the faecal waste from the house boats is also disposed to the lake. Though the government has brought regulations to use tanks to collect faecal waste and to be disposed only in treatment plants built at Kumarakam, most of the house boats though uses the tank empties it into the lake itself as they have to run a long distance for this process from their destination point. This has increased the rate of coliform bacteria in the lake water.

(8) Dredging - The Vembanad lake is well known for its abundance of molluscs especially black clam Villorita Cyprinoids. The black clam breed in

colonies of thousands, the spat move in thousands by the celiary actions and settle down layers after layers in suitable habitat which has a particular composition of mud and sand (reported to be 60 percent and 40 percent respectively) and availability of sunlight in the medium. Such spots where the spat settles are known as clam beds which have a particular role in the ecosystem. This is the scientific basis of the clam production. Turning to the social aspects of black clam production, it is understood that this is an important food source and an economically useful resources since the fishing communities make use of them for meat and shell and is used for the manufacture of various by - products such as white cement and lime. In addition to the presence of black clam in live condition, significant quantities of sub fossil deposits of the shell of this species are found in the Vembanad Lake. The local communities refer to the live specimen as Karutha kakka (black clam) and the fossils as Velutha kakka (white clam). The traditional method employed for clam collection is by manually scooping the bottom with hand nets, the shells in the net then washed and hand picked and stored in country canoe. The white clams are also collected in the same manner. The respondent fisherfolk opine that this is totally an environment friendly practice which sustains the lives of thousands of people. The Travancore Cement Limited (TCL), a state public sector under taking located at Nattakam, Kottayam district in Kerala uses the fossil clam shells dredged from the deposits in the Vembanad Lake for production of white cement. In a year the TCL requires about 40,000 tons of clam shells which they dredge from various locations in the Vembanad Lake as per the permit given to them by the government. The company uses mechanical dredging which scoops the bottom and sub surface up to several meters to collect shell deposit. The depth of dredging according to TCL is about 5 to 6 meters from the water surface, in practice it goes between 6 to 12 meters. The respondent fisherfolk observes that the materials dredged out contain a large fraction of mud and other unwarranted debris is removed. The mud thus collected from the bottom is thrown on the surface on either side which settles over the bottom where young clams grow. This obviously smothers the baby clams and hinders their growth by burying under the muddy cover. This process also affects the fish resources of the area. The respondent fisherfolk object the dredging mainly because it affects their livelihood as it not only depletes the present clam resource, but affects its growth by disturbing the ecosystem making the area unsuitable for spat settling, an important event in the life cycle of the clams. Apart from this large scale dredging, there are mini dredging units which uses engine of 250 horse power and it penetrates up to the depth of 6 to 7 feets. Though this type of dredging is also done by non fisher group, they claim that they are also fisher group and they use this method for their livelihood. It is also noted that there is a conflict between the traditional fisherfolk who fully depend on artisanal methods for clam collection and those using mini dredgers for lime shell dredging. The respondent fisherfolk accuse that those using mini dredges are working not for livelihood purposes, but they are dredging on behalf of some lobbies for commercial utilization of lime shells.

(9) Coconut husk retting - Coconut husk retting is one of the acute sources of pollutions which convert this wetland ecosystem into a curious and complex ecosystem of micro aerobic and anaerobic properties. Large scale reclamation of this water area due to the dumping of the husk, coir pith and related materials is a very serious threat. According to the Water Pollution Act of 1974, dumping of bundle of fiber in back waters is legally prohibited. But the respondent fisherfolk argues that the house owners on the bank of the lake get a good amount for allowing safe dumping of the bundle in the water front area of their houses. Studies conducted by Gopalan et al., (1983) had shown that Vembanad estuary which had an area of 36,500 ha in the last century has

undergone manmade shrinkage at an alarming rate due to various reasons including coconut husk retting leading to an area of only 23,350 ha of the estuary at present. Studies conducted by Shetty (1965) in the Vembanad Lake have reported on the pollution problem arising from retting activity and its effect on the fishery resources of the region. It is observed that around 247 hectares of Vembanad Lake is used for retting 157 million lakhs coconut hunks. Organic pollutants, high amount H_2S and low dissolved oxygen levels are the most outstanding environment alteration occurring in the retting zones. Followed by this the deterioration in water quality and the consequent damage to the aquatic organisms are found to be serious particularly during pre-monsoon period (February-May) when this backwater is cut off from the sea. The respondent fisher men were of the opinion that the pollution from retting activity has seriously affected their economy. They are alarmed at the indiscriminate use of backwater for the retting of coconut husks grabbing vast areas of fishable water bodies and killing the precious and naturally sustainable resources. According to fishermen organizations, retting has reached a level of being the greatest threat to the capture fisheries in the estuarine area.

(10) Distillery waste - In Kerala, Mc Dowell is the only distillery producing spirit from the molasses. The distillery effluent is sent out along with large quantity of water into a by canal of Vembanad Lake. Scientific studies have proved that production of spirit is high level amount of oxygen consuming process. The local people living in the vicinity of the company complained that they are prone to many diseases, allergy, asthma and skin due to the large scale emission of smoke during the production of liquor. The household items and metal things are worn out fast. The respondent fisherfolk specifically complained about the impact of effluent discharge openly into the lake on aquatic life. Many of the respondent fisherfolk have shared their personal experience regarding the pollution. They say

that when they go down the water for clam collection, they experience many health problems like itching of skin and eye. They complain that when the company discharges the effluents, water nearby the area appears to be red colour. The hot discharge which is acidic in nature results in the breaking up of premature live clam shells and these broken clam meat and shells are of no use. Apart from this the fish and prawns also looses its aquatic atmosphere for sustenance due to very low oxygen level. But local fisherfolk have resorted to many methods of struggles against this open discharge. Though company has set up a treatment plant, the local people still complain that the effluents are still discharged to the lake itself as using treatment plant is a costly process. The companies have installed it just to satisfy people and to overcome the legal barriers connected with pollution problems. The company management has also taken some policy measures by way of providing employment for local people to get the local support in emergencies arising due to agitations. These measures to certain extent have helped the company to continue their operation without much discontent from local people. Still fisherfolk on the whole are totally dissatisfied on these aspects and they have moved to court to get justice on this issue.

(11) Coir factory - The coir factories located in and around the rural and sub-urban areas of Alappuzha district functions as an economic booster. But at the same time it also acts as an environment pollutant of the area. These coir factories which use various chemicals as bleaches and dies for the production of finished coir products were in practice of discharging the effluents in the nearby areas of the factories. It was found that the underground water of nearby wells and ponds were polluted due to these pollutants. Due to the objections from the local people, these factories started discharging these effluents to farther areas using tanker lorries at night time. But it was also noticed by the residents of these areas and was objected. The

respondent fisherfolk accused that these coir factories have found Vembanad Lake as an outlet to dispose these effluents by carrying using tanker lorries by night. The vehicles carrying these effluents just park in nearby non-residential bund area by mid night and within minutes these effluents are let out through hose into the Vembanad Lake.

(12) Depletion of mangroves - According to the fisherfolk, mangroves play a motherly role for fish and shrimps. They describe the relationship between mangroves and fish sustainability as an umbilical code relationship of mother and child. Available reports suggest that the penaeid prawns and fish such as pearls spot, mullets, sea bass and shrimps such as Kara, Naren, Thelly etc. take their shelter in mangrove sanctuaries. The total area of mangrove forest in Alappuzha district is 90 hectares. The respondent fisherfolk accused that the activities including construction for resort tourism, land reclamation for construction of houses, agriculture and aquaculture have led to massive destruction of the fragile ecosystem. Scientific studies also show that the population of birds like Oriental Darter, Egrets and Herons in the Vembanad wetlands are on the decline as most of the mangroves have been destroyed in the name of tourism and development.

(13) Excessive weed growth - The low salinity in Vembanad Lake and increased discharge of organic waste and fertilizer residues into water bodies are promoting eutrophication. It is observed that infestation of floating aquatic weeds in the lake is a major threat affecting the fishing and fishery wealth. The weeds pushed out from the paddy fields from Kuttanad at the time of preparing for Mundakam crop contribute to heavy infestation of the water hyacinth. The respondent fisherfolk accused that the rowing of crafts are laborious and casting of nets are impossible due to heavy weed infestation in the water body. Alien invasive species like water hyacinth is densely spreading

over upper reaches of water body, canals and drains contributing to further pollution of water preventing water navigation, especially through canals which the fisherfolk use to row their craft to the nearby living areas. But they also opined that in some wards of the Muhamma Panchayat, the members of the wards have taken special interest in deepening of canals and scooping of aquatic weeds by implementing schemes of panchayat, there by helping the fisherfolk to overcome the difficulties due to the weed infestation. The fisherfolk also complained that these aquatic weeds provide a breeding ground for mosquitoes and other vectors causing health hazards to them. Some of the respondent fisherfolk expressed their anxiety over snake bite while fishing as some virulent types of water snakes are being found inside these aquatic weeds. From their observation, fisherfolk gave a brief account on the nature of weed growth and its multiplicity.

The weed pushed out of one cent of paddy field in Kuttanad which reaches Vembanad Lake grows faster and covers an area of one hectare within fourteen days. This multiplicity continues at a faster rate that within few days most of the area of the lake gets covered by aquatic weeds. This situation results in lack of oxygen supply and sun light to the underneath area of the lake which is an essential condition for aquatic productivity. Ultimately when salinity increases, these aquatic weeds get decayed goes beneath the lake producing noxious gases.

(14) Shrinkage due to reclamation - The available reports suggest that the total area of Vembanad Lake was 44, 000 ha in the beginning of 19th century while in the 20th century it was reduced to 21,000 ha which implies that the lake has reduced to less than half the total area within just a century. This fact itself brings out the bewildering realities of human intervention on the

ecology of the lake. Table 5.1 is a fact finding report for 150 years on reclamation of Vembanad for various purposes.

Table 5.1 Details of area reclaimed from Vembanad Lake during 1834-2004 for various activities

Period	Area reclaimed (in hectares)	Percentage reclaimed	Purpose
1834 - 1903	2226.72	6.185	agriculture
1912 - 1931	5253.15	14.592	do
1941 - 1950	1325	3.68	do
till 1970	5100	14.166	paddy cum shrimp culture
1970 - 1984	800	2.222	do
1900 - 1984	1500	4.166	housing, agriculture etc
1975	6900	19.166	ecologically du to bunding at Thaneermukkom
1980 - 2004	350	0.972	super tanker berth/Goshree etc
Total	**23454.87**	**65.149**	

Source: Kurup(2006)

The respondent fisherfolk are of the opinion that the indiscriminate reclamation done either as part of various developmental schemes of central and state governments or undertaken by private parties illegally has virtually resulted in the reduction of nursery ground of shrimps and considerably altered the physical features of estuary such as tidal flow, water circulation, current flow which collectively affected the fishery wealth.

(15) Resorts - On the banks of the lake in both the villages Thannermukkom and Muhamma, a number of resorts have been established with star facilities. The resort tourism has affected the life of fisherfolk to a large extent. The respondent

fisherfolk who live nearby these resorts say that they have lost their peaceful living atmosphere. There are also various other issues connected to fishing activities due to the emergence of resort tourism. The resort owners have built huge walls around the resorts stretching for long kilometers which have ultimately resulted in forbidding many of the services accessed by the fisherfolk from lake. The land owners other than resort owners also have separated their land by compound walls which lies adjacent to the lake. As the price of the land have shoot up due to resort and tourism, the landlords who on friendly terms had given the fisherfolk a free access on their land for fishing activities are now reluctant to do so fearing of a declaration of right by them. The banks of the lake were used by fisherfolk for various fishing activities such as boiling of collected clam shells, casting of nets from the banks of the lake and for the anchorage of their fishing crafts. But all these facilities are almost lost for them. The clam shells collected by fisherfolk are now to be carried to their house sites either by trolley or by head load for further processing. They also carry their crafts and gears by the same way especially during rough seasons. A few respondent fisherfolk expressed their gratitude towards those resort owners who have allowed a small portion of their land area for clam processing. At the same time some resort owners have complained about the emission of smoke and smell while boiling of clam shells. The fisherfolk complained that these resort owners have built their compound walls on the foundation laid down by the department of irrigation. The concerned panchayats which are the legal authority to prohibit building up of compound walls on these foundation stones keep silence due to some hidden agenda. These resort owners also have encroached waterfront area of the lake besides the resort for the constructing launching centers and jetties for the safe launching of tourists from houseboats and motorboats. The respondent fisherfolk said that these resort owners were very friendly with them when they started the construction of buildings, but once they got established, they keep aloof from them. The garbage disposed from resort is also thrown to the lake. These respondent fisherfolk who have shore as their landed property are not ready to sell it even if resort owners offers high price. It was found that two of the respondent families who sold their land to the resort owners on the promise that they will be given better land were cheated. They had offered them job in the resorts, money for building house, water supply and clear cut-3 meter path to their house. But after shifting to the new residence, these promises are not yet fulfilled.

(16) Sand mining - The unbridled sand mining rampant in the lake have brought major changes in the ecology. Sand extraction mainly takes place in the mouth of estuary and canals. The respondent fisherfolk have expressed their grave concern on this issue. They agreed that a group of fisherfolk themselves have turned to this type of activity which is highly detrimental to the fishery wealth. They say that the fisherfolk have resorted to these activities due to the declined catches. Before decades, they used to get large quantity of fish and even though the price was less the quantity they used to get compensated it. But now even though the price of the fish has increased, as they get only very small quantity, they could fetch only very low income. But sand mining using the country crafts brings very high income to those who are indulged in it. A craft full of sand a day brings up to Rs.3000 as this extracted sand is having very high demand for building construction and land filling. Fisherfolk say that sand bed is an important component for healthy fishery life and clam production. Sand mining results in dwindling fishery wealth and even endangerment of many endemic and endangered fish species of the lake.

(17) Bird attack- Water birds are on the top of the food chain of Vembanad wetland ecosystem. The region has high population of the water birds

and a good number of them are migratory in nature. According to a report of Vembanad water bird count from 2006 onwards, it is reported that there in 22 percent increase in Cormorants on an average and a total number of 2480 were counted in 2009 and this figure is third highest peak in nine years history of Vembanad waterbird count. In 2010 the total number has doubled from that of the 2009 count. In 2009, a total number of 1067 Little Cormorants were counted which went up to three times to 3759 in 2010. This species showed considerable variation in its winter population in the region in the last decade and the population of this particular species is increasing. The respondent fisherfolk complained about the large scale attack of the species of bird Cormorants (which is called as Neerkakka). This bird goes deep into the water and picks live fishes and off spring with their long beak. They cite mainly two reasons for this problem. One is the change in migratory pattern of bird species. The scientific proof based on bird count also support this line of argument. Another reason is that due to decreasing trend in rice cultivation these species might have lost its opportunity of getting food grains from the paddy fields. This might have resulted in diverting of these birds to the lake in search of fish. The underlying nature of this behaviour is attributed to climate change that is happening globally which ultimately affects local aspects.

Now the seventeen reasons identified as sustainability issues affecting the livelihood of fisherfolk in 10 locations are represented by Multi Dimensional Scaling (MDS) technique, a way of representing subjective attributes in objective scales. The central MDS output takes the form of a set of scatter plot in which the axes are the underlying dimensions and the points are the respondent's opinion. The objective of MDS is to array points in multidimensional space such that the distances separating points physically on the scatter plots reflect as closely as possible the subjective distances obtained by surveying subjects. Distance between preferences is the fundamental measurement concept in MDS which is also called as similarity, dissimilarity or proximity. Here MDS can be used to measure the correlation metrics treating correlation as a type of similarity measure which implies higher the correlation of two variables, the closer they will be located in the map created by MDS. The objects also called variables or stimuli are the opinions of fisherfolk and the subjects are those respondent fisherfolk doing the comparing. Stress is a goodness of fit measure for MDS models. The smaller the stress, the better the fit. Higher the stress for the solution, the less reliable the location of objects in MDS space and hence less reliable the interpretation. Squared correlation index (RSQ) is simply the squared correlation of the input distances with the scaled p-space distances using MDS coordinates. RSQ reflects the proportion of variance of the input distance data accounted for the scaled data or vice versa. Based on these terms and concepts, the main assumption in MDS is as follows. Stimuli can be described by values along a set of dimensions that places these stimuli as points in a multidimensional space and that the similarity between stimuli is inversely related to the distances of the corresponding points in the multidimensional space.

Now a major task while using MDS technique is to find out the underlying dimensions and the paramount criterion for selecting optimal should be interpretability. Dimensions are item attributes that seem to order the item in the map along a continuum. The underlying dimensions are thought to explain the perceived similarity between items. The dimensions underlying in the identified sustainability issues of the livelihood of fisherfolk can be attributed as sustainability issues generated within the ecosystem

(Dimension 1) and sustainability issues generated outside the ecosystem (Dimension 2). More specifically out of the 17 sustainability issues identified, the reason such as climate, overfishing, unsustainable fishing, barrage at Thanneermukkom, dredging, depletion of mangroves, excessive weed growth, shrinkage due to reclamation and sand mining from the lake comes within the purview of dimension 1 which is attributed as issues generated with in the ecosystem. The reason such as fertilizers and pesticides, oil spillage, back water tourism, coconut husk retting, distillery waste, coir factory, resorts and birds attack comes within the purview of dimension 2 attributed as sustainability issues generated outside the ecosystem. Based on these underlying dimensions for all the ten locations, MDS provides a visual representation of the pattern of proximities among these set of opinions of fisherfolk. Here MDS plots opinion on the map such that the opinion perceived to be very similar to each other are placed near each other on the map and those opinions which are perceived to be very different from each other are placed far away from each other on the map. The interpretation of the resulting dimension takes place outside the technique. Additional information is introduced to decide why object are located in their relative position. The location of the objects themselves suggests dimensional interpretation

Location wise analysis of Multi Dimensional Scaling

As the sustainability issues relating to fisherfolk vary from one location to another the opinion of the fisherfolk regarding these issues is ranked in different order in different locations. A cluster of 25 respondents represents a location and that the 10 locations each represented by a cluster of these 25 respondents faces the sustainability issues in different order in all the 10 locations. A location wise analysis brought to light some interesting observations.

Coding of sustainability issues faced by the fisherfolk as represented in the map

LP1 – Climate

LP2 – Overfishing

LP3 – Unsustainable fishing

LP4 – Barrage at Thaneermukkom

LP5 – Fertilizers and pesticides

LP6 – Oilspilage

LP7 – Backwater tourism

LP8 – Drudging

LP9 – Coconut husk retting

LP10 – Distillery waste

LP11 – Coir factory

LP12 – Depletion of mangroves

LP13 – Excessive weed growth

LP14 – Shrinkage due to reclamation

LP15 – Resorts

LP16 – Sand mining from lake

LP17 – Bird attack

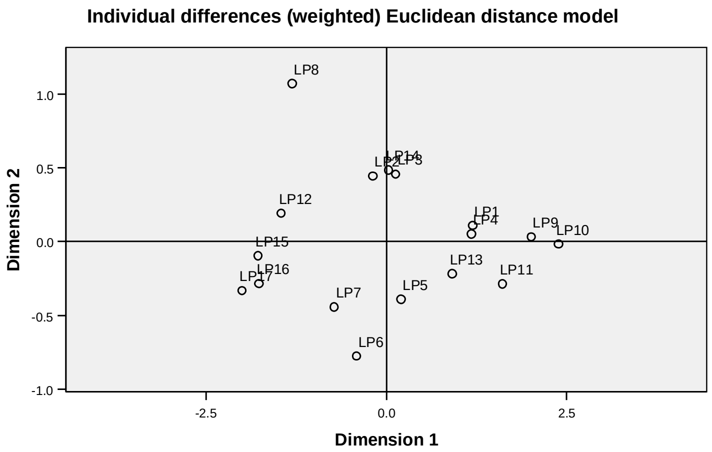


Figure 5.1 Derived Stimulus Configurations in Location 1

```
For matrix
  Stress    =   .04870
  RSQ       =  .99015
```

Table 5.2 Configuration derived in 2 dimensions (Location 1) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	1.1957	0.1086
2	LP2	-0.1887	0.4445
3	LP3	0.1274	0.4568
4	LP4	1.1776	0.052
5	LP5	0.2026	-0.3907
6	LP6	-0.4152	-0.7755
7	LP7	-0.7265	-0.4436
8	LP8	-1.306	1.0709
9	LP9	2.006	0.0328
10	LP10	2.3864	-0.0167
11	LP11	1.6077	-0.2868
12	LP12	-1.459	0.192
13	LP13	0.912	-0.2179
14	LP14	0.0291	0.4849
15	LP15	-1.7803	-0.0954
16	LP16	-1.7669	-0.2844
17	LP17	-2.0019	-0.3315

Figure 5.1 is based on an MDS analysis of 25 respondent's opinions regarding 17 sustainability issues affecting their livelihood. The two dimensional MDS configuration represents the input data relationships where dimensions separate the sustainability issues on the basis of issues generated outside the ecosystem and issues generated within the ecosystem. The joint space of ideal points in quadrant 1 and 2 shows some indication of similarity of opinions of respondents. The issues LP2, LP3 and LP14 appears to be one set of very similar issues and LP1 and LP4, LP9 and LP10 are another sets of very similar issues. Broadly speaking stress is a goodness of fit measures for MDS model and smaller the stress, better the explanation. The stress value less than 0.1 is tolerable and <0.15 is unacceptable. Squared correlation index R^2 (RSQ) is simply the squared correlation of the input distances with the scaled p-space distances using MDS co-ordinates. RSQ reflects the proportion of variance of the input distance data accounted for by the scaled data or vice versa. This is a common fit measure with RSQ>.6 is considered acceptable fit. In location1 the stress value .04870 is considered as an excellent one and the RSQ value. 99015 are considered as a better fit.

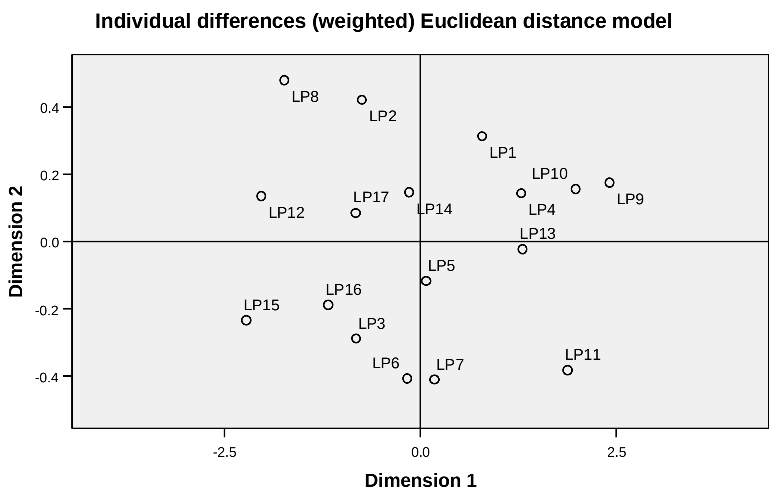


Figure 5.2 Derived Stimulus Configurations in Location 2

```
For matrix
    Stress =   .04739
  RSQ = .99160
```

Table 5.3 Configuration derived in 2 dimensions (location 2) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.7840	0.3131
2	LP2	-0.7473	0.4208
3	LP3	-0.8215	-0.2885
4	LP4	1.2845	0.1433
5	LP5	0.0710	-0.1178
6	LP6	-0.1720	-0.4072
7	LP7	0.1775	-0.4103
8	LP8	-1.7386	0.4793
9	LP9	2.4118	0.1746
10	LP10	1.9803	0.1562
11	LP11	1.8758	-0.3829
12	LP12	-2.0331	0.1346
13	LP13	1.3010	-0.0232
14	LP14	-0.1469	0.1459
15	LP15	-2.2236	-0.2344
16	LP16	-1.1776	-0.1885
17	LP17	-0.8255	0.0849

In figure 5.2, most of the sustainability issues are generated within the system in quadrant 1 and 4. As the location 2 is the next close location to the distillery situated nearby and as this location is prone to pollution due to coconut husk retting, the sustainability issues LP9 and LP10 appears to be the most similar set of issues of the location. The issues LP6 and LP7 are also very similar problems as backwater tourism and oil spillage are connected issues. The issues LP4 and LP13 are also similar issues, the basic issue behind this similarity being the reason that closure of barrage at Thanneermukkom and associated salinity problem being the underlying reason behind excessive weed growth. In table 5.3, the stress value being .04739 is an excellent value and RSQ value of .99160 is a better fit.

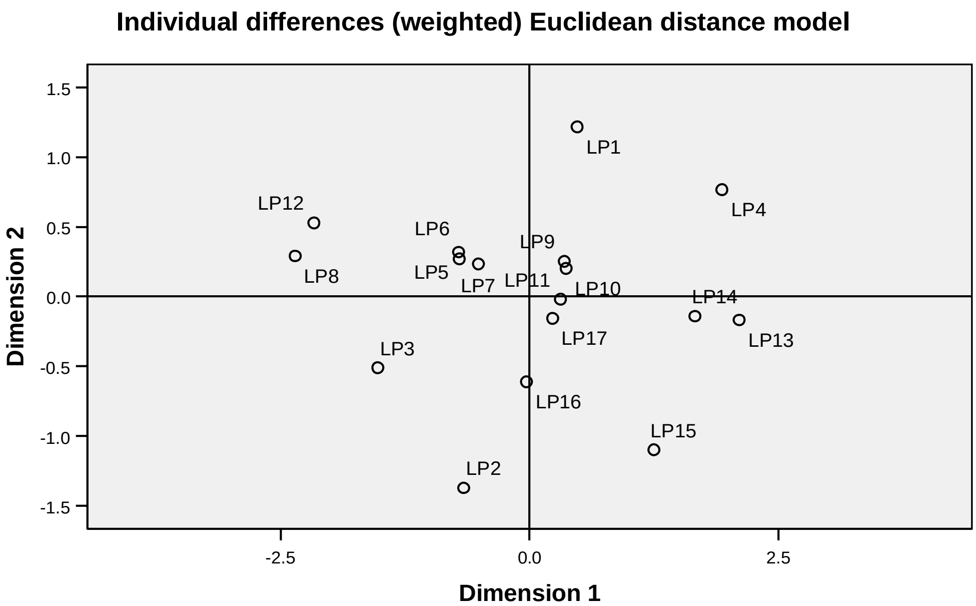


Figure5.3 Derived Stimulus Configuration in Location 3

```
For matrix
    Stress =   .09368      RSQ =.96008
```

Table 5.4 Configuration derived in 2 dimensions(Location 3) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.4781	1.2168
2	LP2	-0.6633	-1.3728
3	LP3	-1.5280	-0.5106
4	LP4	1.9336	0.7658
5	LP5	-0.7140	0.3194
6	LP6	-0.7053	0.2693
7	LP7	-0.5154	0.2339
8	LP8	-2.3570	0.2912
9	LP9	0.3492	0.2532
10	LP10	0.3645	0.2025
11	LP11	0.3113	-0.0206
12	LP12	-2.1673	0.5291
13	LP13	2.1063	-0.1676
14	LP14	1.6625	-0.1415
15	LP15	1.2477	-1.1008
16	LP16	-0.0324	-0.6110
17	LP17	0.2295	-0.1564

Location 3 being the barrage erected area; many issues are very subtle in this location as shown in figure 5.3. It is interesting to note that most of the issues which is being generated outside the system lies close to the origin in all the four quadrants (LP5, LP6, LP7, LP9, LP10, LP11 and LP17). Here the most similar issues are LP5 and LP6 and LP9 and LP11. According to table 5.4 the stress value .09368 is good and RSR value .96008 is better fit.

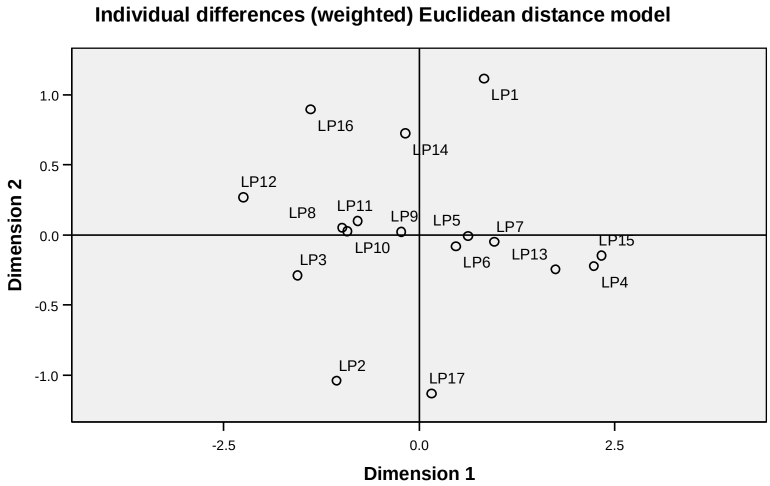


Figure 5.4 Derived Stimulus Configurations in Location 4

```
For matrix
    Stress =.08853      RSQ =.96438
```

Table 5.5 Configuration derived in 2 dimensions(Location 4) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.8288	1.1160
2	LP2	-1.0557	-1.0385
3	LP3	-1.5556	-0.2877
4	LP4	2.2337	-0.2212
5	LP5	0.6242	-0.0065
6	LP6	0.4683	-0.0815
7	LP7	0.9618	-0.0483
8	LP8	-0.9862	0.0518
9	LP9	-0.2285	0.0230
10	LP10	-0.9207	0.0260
11	LP11	-0.787	0.0993
12	LP12	-2.2502	0.2688
13	LP13	1.7437	-0.2449
14	LP14	-0.1762	0.7256
15	LP15	2.3309	-0.1466
16	LP16	-1.3888	0.8962
17	LP17	0.1577	-1.1315

Location 4 being a tourist spot faces several issues within and outside the system. The sustainability issues LP8, LP11, LP3, LP9, LP10, LP5, LP6, LP7, LP13 lies close to the origin and LP12, LP4 and LP15 lies almost nearby the origin in the figure 5.4. It is observed that in this location, some indications of preference heterogeneity is noted by the fact that there is a mixing up of ideal points of issues within and outside the system. LP5 and LP6 and LP9 and LP11 are the most similar problems in this location. The stress value here .08853 which is exceptionally good and RSQ is .96438 which is a better fit in table 5.5.

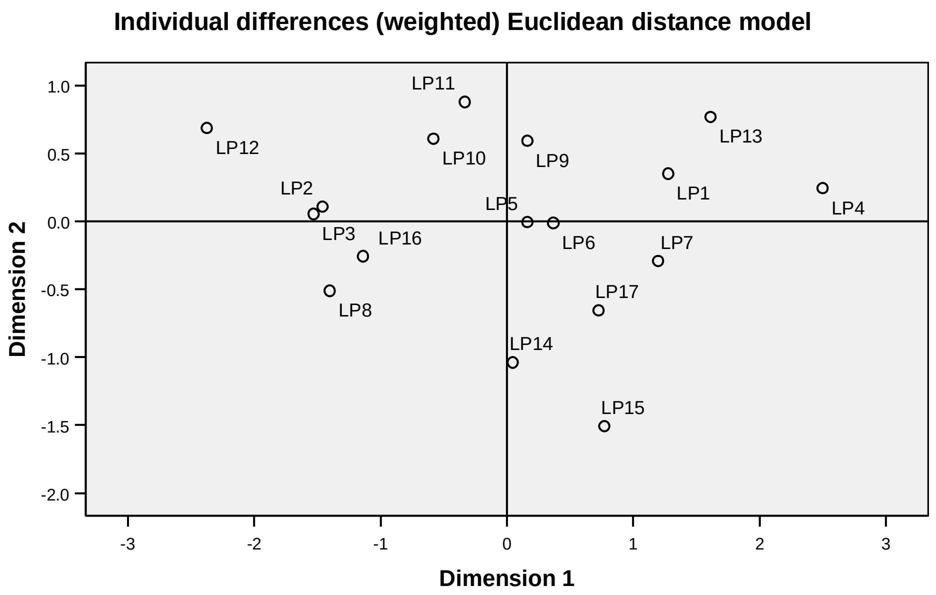


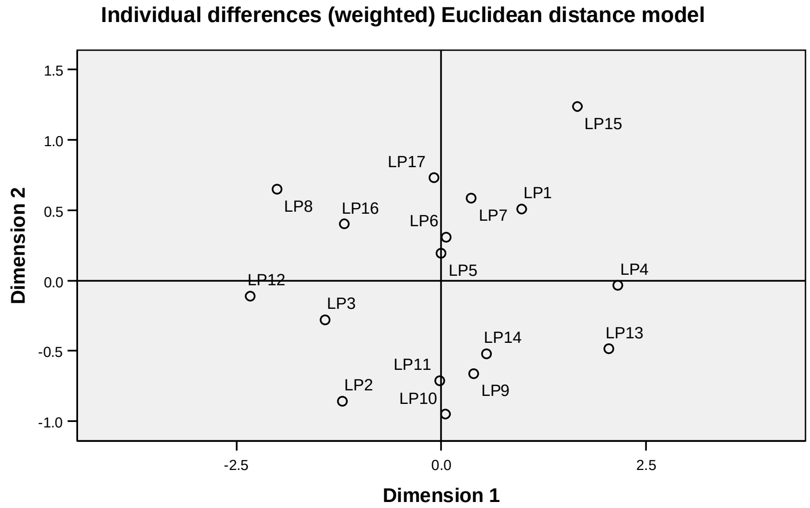
Figure 5.5 Derived Stimulus Configuration in Location 5

```
For matrix
    Stress =   .11159      RSQ =  .93914
```

Table 5.6 Configuration derived in 2 dimensions (Location 5) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	1.276	0.3499
2	LP2	-1.4599	0.1075
3	LP3	-1.5316	0.0536
4	LP4	2.5007	0.2435
5	LP5	0.1619	-0.0058
6	LP6	0.3675	-0.0125
7	LP7	1.1978	-0.2918
8	LP8	-1.4019	-0.5117
9	LP9	0.1608	0.592
10	LP10	-0.5802	0.607
11	LP11	-0.3336	0.8775
12	LP12	-2.3751	0.6851
13	LP13	1.6122	0.7677
14	LP14	0.0457	-1.0391
15	LP15	0.7724	-1.5077
16	LP16	-1.1392	-0.2581
17	LP17	0.7265	-0.6569

In the figure 5.5, the sustainability issues are laying distributed in all the quadrants. LP2 and LP3 are the most similar issues and then come next as LP5 and LP6. LP15 is lying further away from both the dimension which implies that the ill effects of resorts are less pronounced in this location. The stress value.11159 is acceptable and RSQ .93914 is a better fit according to table 5.6.



Figures 5.6 Derived Stimulus Configuration in Location 6

```
For matrix
    Stress =   .11891      RSQ = .93252
```

Table 5.7 Configuration derived in 2 dimensions (Location 6)

Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.9774	0.5083
2	LP2	-1.2042	-0.8577
3	LP3	-1.4183	-0.2792
4	LP4	2.1569	-0.035
5	LP5	-0.0027	0.1926
6	LP6	0.0608	0.3080
7	LP7	0.3637	0.5840
8	LP8	-2.0064	0.6484
9	LP9	0.3935	-0.6629
10	LP10	0.0481	-0.9498
11	LP11	-0.0179	-0.7108
12	LP12	-2.3284	-0.1100
13	LP13	2.0412	-0.4852
14	LP14	0.5524	-0.5207
15	LP15	1.6578	1.2383
16	LP16	-1.1845	0.4015
17	LP17	-0.0894	0.7301

LP5 and LP6 are the most similar points in figure 5.6. LP14 and LP9 are also ideal similar points as the shrinkage of ecosystem due to reclamation and coconut husk retting are interconnected. As the problems due to establishment of resorts are less, LP15 is lying farther away from both the dimensions. It is also observed that the points representing the sustainability issues are distributed farther away from the origin. The stress value .11891 is acceptable and RSQ .93252 is a better fit according to table 5.7.

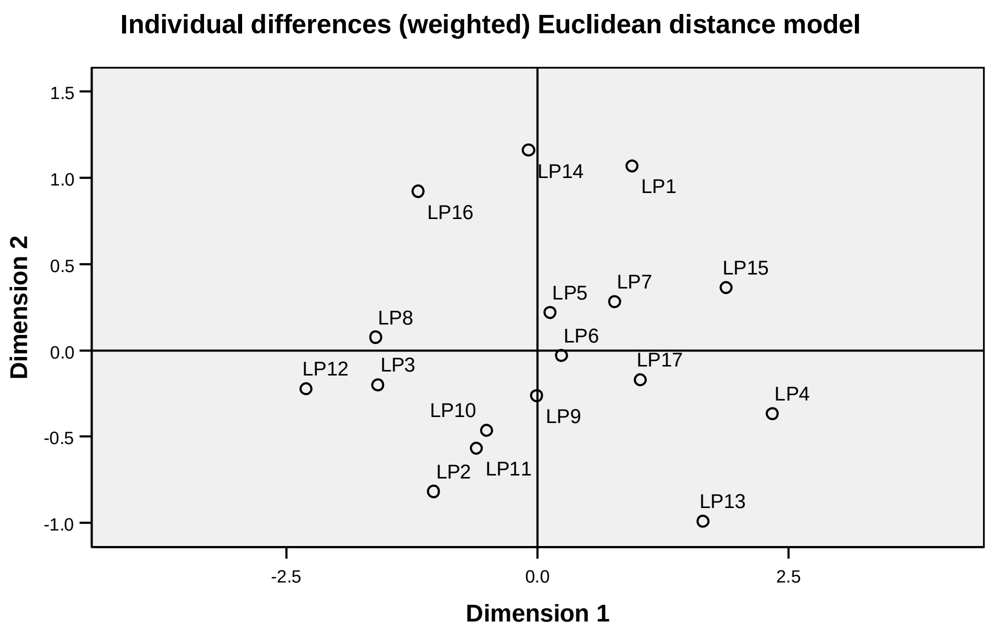


Figure 5. 7 Derived Stimulus Configuration in Location 7

```
For matrix
   Stress =   .08242      RSQ = .9670
```

Table 5.8 Configuration derived in 2 dimensions (Location 7) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.9416	1.0693
2	LP2	-1.0349	-0.8184
3	LP3	-1.5903	-0.2009
4	LP4	2.3392	-0.3669
5	LP5	0.1249	0.2206
6	LP6	0.2362	-0.0296
7	LP7	0.7665	0.2827
8	LP8	-1.6144	0.0760
9	LP9	-0.0079	-0.2624
10	LP10	-0.5092	-0.4642
11	LP11	-0.6112	-0.5670
12	LP12	-2.3062	-0.2235
13	LP13	1.6464	-0.9916
14	LP14	-0.0907	1.1610
15	LP15	1.8767	0.3642
16	LP16	-1.1895	0.9219
17	LP17	1.0229	-0.1714

Most of the sustainability issues generated both outside and within the system lies in quadrant 1 and 2in figure 5.7. LP10 and LP11 are the most similar issues identified by the respondents. Then comes the issues LP8 and LP3 as it is observed that the dredging has negatively affected fishing which ultimately results in unsustainable fishing. LP5 and LP6 also have been similarly considered reasons as respondents find both these reasons as polluting agents coming from outside the system. LP6 and LP7 are also closer points as oil spillage is the after effect of backwater tourism. The stress value obtained here is .08242 and the RSQ is .96704 which is a better fit according to table 5.8.

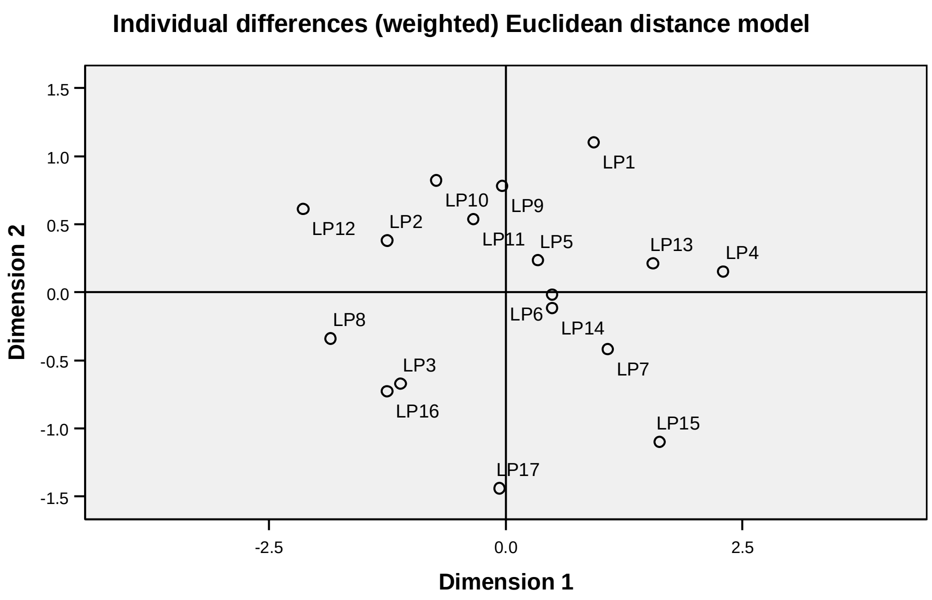


Figure 5.8 Derived Stimulus Configuration in Location 8

```
For matrix
    Stress =.09710      RSQ =.95012
```

Table 5.9 Configuration derived in 2 dimensions (Location 8) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	0.9301	1.1015
2	LP2	-1.2533	0.3801
3	LP3	-1.1121	-0.6713
4	LP4	2.2977	0.1531
5	LP5	0.3369	0.2349
6	LP6	0.4909	-0.0166
7	LP7	1.0764	-0.4178
8	LP8	-1.8529	-0.3406
9	LP9	-0.0393	0.7796
10	LP10	-0.7348	0.8215
11	LP11	-0.3433	0.5366
12	LP12	-2.1404	0.6115
13	LP13	1.5540	0.2111
14	LP14	0.4906	-0.1165
15	LP15	1.6228	-1.0992
16	LP16	-1.2549	-0.7274
17	LP17	-0.0685	-1.4404

In figure 5.8 the issues LP6 and LP14 and LP3 and LP16 are the most similar points pointed out based on preference data which are fitted in the spatial map derived from perception data. As Aryakkara is comprised of many resorts and as houseboat tourism is more pronounced in this spot due to resort tourism, many of the waterfront lake area have been reclaimed by the resort owners and the respondents have pointed out these issues due to their serious concern about this activity of private parties. It is observed from this spacial spacing that oil spillage due to backwater tourism and shrinkage due to the reclamation for tourism activities are closely associated. LP3 and LP16 are also other similar issues as sand mining from the lake negatively impacts the sustainability of fish population ultimately leading to unsustainable fisheries. The stress value obtained from location 8 is .09710 and the RSQ is .95012 which is a better fit according to table 5.9.

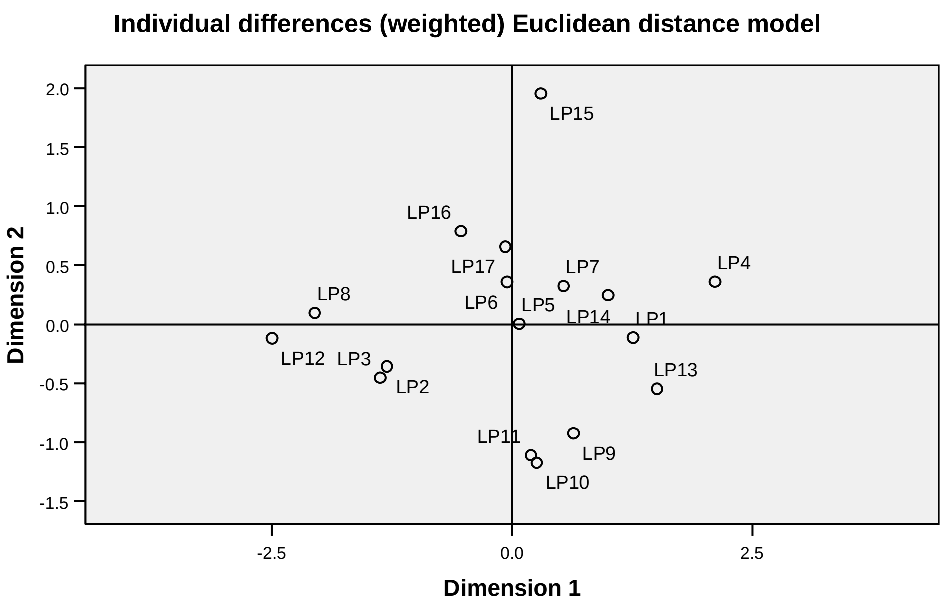


Figure 5.9 Derived Stimulus Configuration in Location 9

```
For matrix
    Stress =   .12385      RSQ =  .92298
```

Table 5.10 Configuration derived in 2 dimensions (Location 9) Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	1.2607	-0.1128
2	LP2	-1.3033	-0.3566
3	LP3	-1.3733	-0.4534
4	LP4	2.1129	0.3601
5	LP5	0.0743	0.0045
6	LP6	-0.0515	0.3593
7	LP7	0.5359	0.3247
8	LP8	-2.0554	0.0972
9	LP9	0.6391	-0.9236
10	LP10	0.2568	-1.1730
11	LP11	0.1970	-1.1093
12	LP12	-2.4988	-0.1184
13	LP13	1.5096	-0.5473
14	LP14	0.9987	0.2465
15	LP15	0.2996	1.9550
16	LP16	-0.5319	0.7892
17	LP17	-0.0705	0.6577

LP3 and LP2 and LP11 and LP10 are the most closely related similar points in figure 5.9. Over fishing and unsustainable fishing generated within the system have some close association as methods of unsustainable fishing and fishing pressure are related. The respondents of the area place their preferences for pollution of the lake by highlighting the issues such as distillery wastes and coir factory as the most polluting agents which is generated outside the system. The particular location comprises of a large number of small and big coir factories. The issues LP1, LP14, LP7, LP8, LP17, LP5, LP16 which comes from within and outside the ecosystem lies close to the origin depicting the fact that the respondents have strongly expressed their views on these aspects. The stress value obtained for this location .12385 is acceptable and the RSQ .92298 is a better fit according to table 5.10.

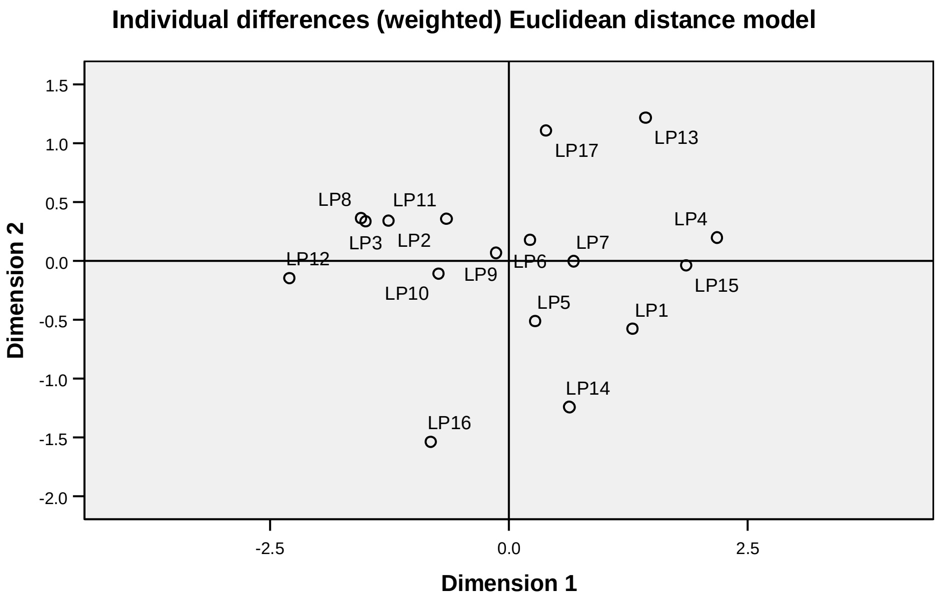


Figure 5.10 Derived Stimulus Configuration in Location 10

```
For matrix
    Stress =   .09568      RSQ = .95337
```

Table 5.11 Configuration derived in 2 dimensions(Location 10)

Stimulus Coordinates

		Dimensions	
Stimulus Number	**Stimulus Name**	**1**	**2**
1	LP1	1.2941	-0.5758
2	LP2	-1.2602	0.3398
3	LP3	-1.4996	0.3356
4	LP4	2.1781	0.1972
5	LP5	0.2743	-0.5125
6	LP6	0.2211	0.1768
7	LP7	0.6780	-0.0024
8	LP8	-1.5483	0.3625
9	LP9	-0.1351	0.0681
10	LP10	-0.7367	-0.1080
11	LP11	-0.6537	0.3573
12	LP12	-2.2981	-0.1458
13	LP13	1.4310	1.2153
14	LP14	0.6329	-1.2411
15	LP15	1.8536	-0.0370
16	LP16	-0.8188	-1.5357
17	LP17	0.3874	1.1057

In the figure 5.10, most numbers of sustainability issues is lying in quadrant 1 and 4 which are generated both within and outside the ecosystem. The issues LP3 and LP8 are the most similar points as dredging ultimately results in unsustainable fishing. LP2 and LP3 are the next closer points as there are also similar reasons for fast depletion of fish population. LP5, LP7, LP6 and LP9 are the issues generated outside the system which the respondent fisherfolk pointed out as strong polluting agents of the area. LP5 (Fertilizers and pesticides) affects the area severely because the location is close to Perumthuruthukari in Kuttanad region where there is intensive rice cultivation. This implies that the fertilizers and pesticides used for paddy cultivation first reaches this location leading to many sustainability issues. An excellent stress value of .09568 and RSQ of .95337 obtained for this location according to table 5.11.

Using this MDS technique it is possible to represent the opinion as stimulus points and respondents as ideal points in the same attribute space. The representation implies that different respondents could perceive the same stimuli differently as well as occupy positions in the space that is perceived. Here there are three situations logically (1) The stimuli are perceived differently but common ideal points exists (2) Respondent individuals exhibit similar perceptions but possess different ideal point positions and (3) Neither stimulus perception nor ideal point position is common over individual respondents. The common view in application of MDS is that moving of opinions towards some region in the space that has a high concentration of ideal points and attempting to move the ideal points themselves towards its opinions.

5.2 Tourism Related Problems Affecting the Sustainability and Livelihood Issues of the Fisherfolk Community

The tourism activity had its origin with the starting of Nehru Memorial Boat Race Trophy in the year 1952 which is still going on with pomp and splendor. The Vembanad Lake attained its position in tourism map in the early 80s. The reason behind sudden spurt of Kerala backwater tourism especially in Vembanad Lake may be due to a setback to water tourism in Kashmir because of extreme militant activities. The bird sanctuary at Kumarakom, an island known as 'Pathira Manal' is the important tourist spots of this area. Activities in connection with tourism resorts, houseboat cruise and tourist motor boats has lead to an economic evolution marketing the tourism facilities to thousands of domestic and foreign tourist visiting Vembanad lake every year. Expansion of tourism also includes farm families and unique farming processes which helps broader integration of water tourism with farm tourism. The advent of tourism has its socio-economic impact on various fields. This socio-economic impact is having a mixed response on the population depending the area for their livelihood. Some of the economic impacts are as follows. The value of land has increased several folds. More employment opportunities with higher wages emerged in construction sector as a large number of resorts and hotels came into existence. Some of the local people got employment opportunities in houseboats. The social impacts of tourism development emerged are as follows. Land used for agriculture purposes were converted as resorts. Increase in the number of resorts on the bank of Vembanad has hampered the employment opportunity of traditional fisherfolk who are engaged in fish catching and clam collection. As the number of houseboats, speed boats and tourist motor boats has increased to very large number, the fisherfolk started complaining about tearing of their gears. The privacy of the womenfolk has been lost who uses the bank of Vembanad for bathing and washing their clothes due to this backwater tourism. It is also alleged that the houseboats are being used for illegal anti-social activities. Apart from these problems a number of ecological issues have cropped up. The resort owners who have the ownership of the lion share of banks of Vembanad by felling patches of mangrove forests for direct viewing of the lake by the tourists, have destructed the richness and diversity of this productive ecosystem. This has resulted in the loss of natural fish sanctuaries. Vembanad Bird Court 2009-10 shows that there is a reduction in water birds which are on the top of food chain of this wetland ecosystem by 10.9 percent compared to the previous years. The large disposal of garbage from hotels and resorts and faecal waste from houseboats has increased the coliform bacteria to an uncontrollable level. Table 5.12 shows the location wise problems faced by the respondent fisherfolk due to hectic tourism activities.

Table 5.12 Number of respondent families affected by tourism related problems – Location Wise

Location	1	2	3	4	5	6	7	8	9	10	Total
Problems											
Plastic Wastes	2 (8)	3 (12)	10 (40)	20 (80)	18 (72)	21 (84)	18 (72)	17 (68)	22 (88)	23 (92)	153 (16.6)
Loss of anchorage facility	0	0	4 (16)	12 (48)	10 (40)	8 (32)	6 (24)	12 (48)	20 (80)	0	72 (28.8)
Loss of clam processing facility	0	0	5 (20)	15 (60)	8 (32)	5 (20)	15 (60)	16 (24)	4 (16)	4 (16)	75 (30)
Direct view of lake due to Resort tourism	0	0	3 (12)	20 (80)	20 (80)	22 (88)	20 (80)	18 (72)	25 (100)	15 (60)	143 (57.2)
Peaceful atmospheric lost	0	0	2 (8)	23 (92)	19 (76)	21 (84)	17 (68)	18 (72)	21 (84)	22 (88)	143 (57.2)

Source: Field survey

Figures in the brackets represent percentages

It is observed from the table that all the locations are affected by tourism related problems one way or the other. Except two locations (1 and 2) all the other locations face all the problems related. The intensity of the problems varies location wise at varying degrees of percentages. 100 percent of respondent families in location 9 (Muhamma Jetty) have lost their direct view of the lake due to construction of resorts and big walls all along the bank of Vembanad. The problem of getting plastic wastes while casting of nets during fishing is more prominent is location 4, 6, 9 and 10. The grave concern over the loss of peaceful atmosphere for living is expressed by respondent families in the location 4, 6, 9 and 10. This implies that the impact of resort and houseboat tourism is more pronounced in these locations. Though the location 3, 4, 5, 6, 7, 8 and 9 faces all the five problems, location 9(Muhamma Jetty) faces these problems with highest intensity. Though the clam collectors have lost their facility to process the clam on them banks of the lake, as the Muhamma Panchayat has provided them a common place to process the clam collected, only 16 percent of the respondent families are affected due to loss of processing facility. As far as the whole sample of respondent families are concerned, 61.6 percent are affected due to plastic wastes during different fishing operations, 57.2 percent have lost direct view of the lake due to resort tourism and 57.2 have lost peaceful atmosphere of their surrounding area where they live.

5.3 Sustainability Index

A review of the present status of sustainability of Kerala inland fisheries and Vembanad ecosystem- Backwater fishing is one of the major economic activities of the rural coastal communities. In the inland Wetlands, fishing is mainly an alternative income generating activity. The current level of inland (including backwater and estuaries) fish production of Kerala is to the quantum of about 75000 tons/year. The population engaged in this sector in Kerala is currently 2, 51,482 of which 41,223 are active fishermen. Penaeid shrimps, giant prawns and crabs and clams are the major fishery resources of the estuaries and backwater of Kerala. Among the various estuaries and backwaters of Kerala, Vembanad and Ashtamudi lakes are highly productive and accounts for 60 percent of fish landings. Over exploitation of fishery resources along with highly degrading environmental factors have affected the very existence of this wetland ecosystem and livelihood of dependent fisherfolk community. This has been supported by the fact that Vembanad which was producing 16,000 tons of fishery could now produce only 7200 tons. The contribution of income of the fishermen who depend on these resources comes to about one fifth of the state average. This reason behind these issues can be traced out as the lack of importance in the planning process and less attention paid to inland fisheries when compared to the development programmes worked out in marine sector. This condition has to be viewed and assessed in a situation where global fisheries have attained a ten percent growth rate. The present livelihood alternatives are not adequate to support the households even at subsistence levels and this call forth for the more viable alternative livelihoods by working out a defending sustainability mechanism of the system. To do so an attempt is made to access the present sustainability status of inland fishery sector of the state.

Table 5.13 A Preliminary assessment of the sustainability of Kerala inland fishery sector.

I Economic Sustainability Indicators

Economic Sustainability Indicators			Ratio	Range	Comment on the indicator	
Inland fishery sector production	2000-01	2006-07				
Contribution of inland fish production to all India inland fish production (in %)	2.99	2.04	0.682	1- α	Very low (below the critical level)	
Contribution of inland fish production to total fish production in Kerala (in %)	13.08	12.36	0.945	1- α	Very low (below the critical level)	
Contribution of inland fishing to marine fishing production (%) in Kerala	15.04	14.1	0.938	1- α	Very low (below the critical level)	
Inland fishery production changes in Kerala (in metric tons)	85234	79110	0.928	1- α	Very low (below the critical level)	
			Ratio	**Range**	**Comment on the indicator**	
Inland fishermen population changes inland	2002-03	2006-07				
Inland fishermen population in Kerala	249105	255639	1.026	1-infinity	Promising	
Inland fishermen population in Alappuzha	65440	67170	1.026	1-infinity	Promising	
Active fishermen changes in Kerala	43529	41905	0.963	1-infinity	Very low (below the critical level)	
Active fishermen population in Alappuzha	10696	8786	0.821	1-infinity	Very low (below the critical level)	
% of active fishermen population to fishermen population in Kerala (inland)	17.47	16.5	0.944	1-infinity	Very low (below the critical level)	
% of active fishermen population to fishermen population in Alappuzha (inland)	16.34	13.16	0.85	1-infinity	Very low (below the critical level)	
Sustainable fishing capacity	**Recommended**	**Actual**	**Surplus**	**Ration**	**Optimum**	**Commend of the indicator**
Fishing crafts in Kerala backwaters	10000	38000	28000	0.263	0	Far exceeds the limit
Fixed engines in Kerala	5374	10749	5375	0.5	0	Far exceeds the limit
Stake net capacity in Vembanad lake	2703	3862	1159	0.3	0	Far exceeds the limit
Chinese dip nets in Vembanad lake	1692	4823	3131	0.649	0	Far exceeds the limit

II Community or Social Sustainability indicators Livelihood alternative and community dependence

			Ratio	The critical minimum	Comment on the indicator
Total	Fishing Occupation	Non fishing occupation			
608	463	145	0.313	0.5	Very low (Far below the criteria)
Total	Fishing Skill	Non fishing skills			
306	245	61	0.248	0.5	Very low (Far below the criteria)
Total	Education below SSLC	Education above SSLC			
961	893	68	0.076	1	Very low (Far below the critical minimum)

Gender Equity

Sex Ratio	Kerala	Total Fishermen Community	Ratio	The Critical Minimum	Comments
	1084	910.74	0.84	1	Very low (Far below the critical minimum)
Sex Ratio	Kerala	Marine fisherman community	Ratio	The critical Minimum	
	1084	895.71	0.826	1	"
	Kerala	Inland fisher men community	Ratio	The critical Minimum	
	1058	961.8	0.887	1	"
Sex Ratio	Alappuzha	Marine fisher men community	Ratio	The critical Minimum	
	1079	912.8	0.846	1	"
	Alappuzha	Inland fishermen community	Ratio	The critical minimum	
	1079	958.4	0.888	1	"
Sex ratio of sample population	Alappuzha	Sample population community	Ratio	The critical Minimum	
	1079	968.9	0.898	1	"

Gender equity in decision making	Total	Women do not have equal decision making power	Women have equal decision making power	Ratio	The critical minimum	Comment very low(Far below the critical minimum)
	498	328	170	0.518	1	

Source:

a) Inland Fisheries Statistics of Kerala, 2007 Department of Fisheries, Government of Kerala.
b) Report of the working group on Fisheries Submitted to State Planning Board, 2007, Government of Kerala.
c) Kalawar Committee, 1984
d) Department of Fisheries, Government of Kerala, 1996
e) Survey Data
f) Kurup, 2006

As far as economic sustainability is concerned, only the changes in inland fishermen population in Kerala and Alappuzha district shows promising trends. Taking into consideration the production trends of inland fishery, it is observed from table 5.13 that there is a declining trend in contribution of inland fish production to all India level, contribution of inland fish production to total fish production in Kerala, contribution of inland fish production to marine fishery production etc. Though the inland fishermen population changes both in Kerala and Alappuzha district, shows promising trends, the active fishermen changes for the same period shows a declining trend. As the employment status of fishermen community is calculated on the basis of trend in the number of active fishermen, the declining trends in active inland fishermen population both at state and district level implies that, the employment situation in inland fishery sector is not acceptable. In inland fisheries as the possibilities of active fishermen to be employed in allied activities of processing and marketing etc at large scale is less, there is only limited scope for employment generation in allied activities. This problem could be identified as a major reason for lower employment status and lower income generation in this sector. High fishing pressure due to unusual increase in fleets in operation is hampering the eco balance of the natural resources and this situation demands an immediate action. The Kalwar Committee appointed by the government of Kerala as early as in 1985 has also recommended reducing the fixed engine at least to half its numbers. All the indicators under fleet capacity have far exceeded the sustainability limits. On the whole, the present situation depicts the failure of the state in implementing various rules and regulations imposed for backwater fisheries management. This scenario necessitates a deeper understanding of the state regulation of back water fisheries management. Along with this, strict vigil and effective enforcement of appropriate legal measures are highly essential to reduce the excessive fishing pressure exerted on the stock of estuarine shrimps and fishes. As most of the economic sustainability indicators show a negative trend, the inland fishery situation of the state of Kerala in general and that of Vembanad Lake in particular exhibits a degrading situation.

Livelihood alternatives or community dependence indicators show that even though the resource has been over exploited in terms of high fishing pressure, destructive fishing methods and overfishing, the surveyed fishermen communities have high dependence on this over exploited resource base. This implies that lack of livelihood alternatives among this community compels them to stick on this sector, that many of the commercially important species are exploited beyond the sustainable levels, thus leading to their endangerment in most of their place of inhabitation. With the intensification of fishing during the onset of South West monsoon, the spawners are indiscriminately exploited thus hampering their recruitment and regeneration. As far as the education level is concerned the sample populations is far below the critical minimum, which indicates the marginalization of the community from the mainstream of the state educational level.

Gender being a social constructs and as gender is culture, the well being of a community corresponds to its gender status. As far the inland fishery sector of the state, Alappuzha district, as well as the sample population is concerned a detailed analysis of the sex ratio which reveals the gender equity index points out to some dismal facts. The gender equity indicator of this sector is very low in terms of sex ratio. As far as the equal decision making power of women are concerned, it is to be noted that, even though the ratio is low, it has come up to this level, as the same number of women who have equal decision making power at home are either ordinary members or work in executive position in SHGs. Though the sex ratio of the state is favorable to women the same is unfavorable to inland fishery sector at state, district and sample population level which implies that there is lower health status of both elder women and female children. Females have a higher chance of getting risk from water-borne and sanitation related diseases and are more prone to health risk in the fishing region compared with rest of Kerala. This situation arises from the fact that there is gender inequality in their allocation of food and thus females cannot meet all their nutritional requirements. Sometimes women are voluntarily sharing their part of meals to rest of their family members in times of shortages. The empirical analysis of female to male ratio here indicates that the fisherfolk communities have gender bias in their population unlike the rest in Kerala resulting in female deprivations in this community.

Ecological Sustainability Indicators

Table 5.14 Changes in species wise inland fish production in Kerala

Fish Species production changes in quantity in metric	1999-2000	2009-2010	Ratio	Range	Comment
Prawns	16459	17367	1.055	1-α	Promising
Eutroplus	4860	4858	.999	1-α	Below the critical minimum
Murrells	4996	4544	.909	1-α	Below the critical minimum
Tilapia	8510	8440	0.992	1-α	Below the critical minimum
Catfish	4816	5211	1.08	1-α	Promising
Jew Fish	3054	2994	0.980	1-α	Below the critical minimum
Others	31835	73422	2.31	1-α	Promising

Production changes in fish and clam resources of Vembanad Lake

	1989-1990	2000-2001	Ratio	The critical minimum	Comment
Fish catch changes	7200 t	687t	0.1	1	Very below far below the critical minimum
Kuttanad Attukonju Macrobrachium (Rosenbergii)	1967	2002	Ratio	The critical minimum	Comment
Catch changes	429t	27t	0.06	1	Very below far below the critical minimum
Lime Shell Production changes	1992-93	1997-98	Ratio	The critical minimum	Comment
White shell	104591 t	85314 t	0.82	1	Very low
Black shell	30773 t	29384 t	0.96	1	Very low
Total	135364 t	114698 t	0.85	1	Very low

Exploitation of spawner Stock

Exploitation of spanner stock	Recommended	Actual	Surplus	Ratio	Optimum	Comment
Exploitation of berried Macro Brachium rosen bergii (at Vembanad)	0	30 tons	30	1	0	Far exceeded the limit
Shrimp post larvae and juveniles caught at Vembanadu	0	7000 tons	7000	1	0	Far exceeded the limit

Fish Species Change in Vembanad Lake

Fish diversity changes	1989	2009	Ratio	Range	Comment
Reduction in fish species	150	65	0.433	1	Very low

Sector wise analysis of bird count

Reduction in number of birds	1993	2010	Ratio	Range	Comment
Bird count from ten sites of Vembanad Wetland	36498	27493	0.753	1	Very low
Vembanad Lake	25196	6713	0.266	1	Very low
Thanneermukkom Bund	1421	286	0.201	1	Very low

Other Ecological issues associated with Vembanad Kerala

Count of faecal coliform at different sites	Recommended by WHO	Actual	Surplus	Ratio	Optimum	Comment
Upstream region	350 faecal coliform per 100ml water	15000 per 100ml	14650	0.977	0	Far exceeds the limit
Small stagnant channels of Kuttanad	"	130000 per 100 ml water	129650	0.997	0	"
Alleppey channels station	"	38000 per 100ml	37650	0.991	0	"
From water samples of Vembadnad lake	"	31000 per 100 ml water	30650	0.989	0	"
Water carrying capacity of the lake	Beginning of 20th century	1985	Ratio	Range	Comment	
	$2.449Km^3$	$0.559Km^3$	0.245	1	Very low	
Coconut husk retting area of the lake	Recommended	Actual	Surplus	Ratio	Optimum	Comment
Area of lake under retting	0	247 ha	247	1	0	Far exceeded the limit

Source:

a) State of the environment Report, Kerala 2005

b) Report of the participatory Fish Resource Survey of Vembanad Lake Kerala (2009).

c) Fish Count (2009) published by ATREE Community Environmental Resource Centre.

d) Preliminary Bird Survey Nest Keri Peechi (1993).

e) Vembanad Water bird count 2009-2010. Report Department of Forests and Wildlife, Government of Kerala.

The term ecological sustainability depicts a situation where stocks and species are maintained at that levels which do not foreclose future options and maintain and enhance the capacity and quality of ecosystem and environment. This situation can best be compared to an action of drawing of interest from a bank account, but leaving the principal intact to ensure the same future interest payment in subsequent years. For the fishers, the issue of ecosystem health and availability of fishery resources is not merely a concern of biodiversity; rather it is more importantly an issue of livelihood security. Loss of harvestable fish means poor income from fishing leading to the desperate fishing and prolonged fishing time. The ratio of undersized fish to total catches is usually very high in a multi species multi gear fishery and the large scale mortality of larval and juveniles of fish and shell fish is detrimental for the fishery in the long run.

As far as Kerala is concerned, the insensitive treatment of the fragile ecology of the state in general and coastal ecosystem in particular in pursuit of modern developments has contributed gravely to its destruction, leading to serve resource depletion. Some recent studies conducted by the state also recognize this crucial situation. A latest study on poverty and Environment nexus jointly by Asian Development Bank (ADB) and Centre for Earth Science Studies (CESS) put this more explicitly. The coastal zone of Kerala is affected by the sea erosion, destruction of mangroves, shrinkage of wetlands, loss of cultivable land, water pollution, and decline/stagnation of fish catch, species reduction and biodiversity loss (ADB and CESS, 2003).

While considering the level of ecosystem understanding, it is observed from table 5.14 that all the respondent fisherfolk have clear cut ideas and opinion about the ecosystem changes taking place which vehemently affects their sustainability and livelihoods. The Field survey details itself supports this aspect. Most of the sustainability issues have been elicited by the respondent fishermen during the period of investigation. Ecological sustainability relating to species wise changes in inland fish production in Kerala is analyzed in detail in the beginning of this session. Out of the six important inland fish species, only the production of two species shows promising trend here. As far as the production changes from fish, prawn and clam resources of Vembanad Lake are concerned, there is devastating declining trend. Regarding the fish diversity changes, the number of species has declined from 150 in 1989 to 65 in 2009 as per the Report of the participatory Fish Resource Survey of Vembanad Lake published by ATREE. Water birds are broadly defined as 'birds ecologically dependent on Wetlands (Wetlands International, 2006) and these water birds are one of the most obvious indicators of the richness and diversity of these productive ecosystems. Being a Wetland, Vembanad Region needs to be assessed in the context of water bird population changes to evaluate the ecological sustainability of the region. The Vembanad water bird count 2009-10 shows that the water birds have declined when the bird count taken from ten sites of Vembanad Wetland, Vembanad lake and Thannermukkom bund are compared with the Preliminary Bird Survey conducted by Nest Keri Peechi (1993). The exploitation of spawner stock exploitation such as berried macro brachium rosenbergii and shrimp post larvae and juveniles caught at Vembanad is a primordial sin to the fisheries management. If these stocks were allowed to grow till they attain the harvestable size, the production of shrimps from backwaters and inshore coastal belts of Kerala would have been increased 2-3 times. Disappearance of mangroves is another ecological consequence of modern developments in coastal areas which has affected the sustainability of fishery ecosystem as they provided breeding grounds for a variety of estuarine fish species such as ('Karimeen') Etroplus suratensis and prawns. The rate of mangrove depletion depicts a large scale declining trend. According to Chand Bhasha (1991) the mangrove expands was 700 Km^2 and as per the latest survey by FSI (2005) (Forest Survey of India), it has come down to 80Km^2. Sediment accumulation has reduced the mean depth of the Vembanad Lake and this has affected the fishery sector of the area. This fact have been supported by the average depth of the lake during 1980 and 2008 which was 6.7 and 4.2 respectively which implies that this declining trend have created serious imbalances in the ecosystem functions of backwater in recent years. Shell fish such as clams, oyster etc filter upto 25 gallons of water per day while feeding, thereby can concentrate bacteria leading to human health. The high level faecal coliform levels leads to high level of bacterial pollution resulting in human health threat which may ultimately end up shell fish harvesting. Water samples from different sites of Vembanad show extreme values of count of faecal coliform as per the report of pollution control board and also according to a study on water quality of Vembanad Lake (Harikumar et al., 2007). As per the available data, the water carrying capacity of the lake has been reduced to 0.559Km^3 in 1985 which was 2.449Km^3 in the beginning of the 20th century. According to the study conducted by different scientists who have made research in the field of impact of retting on the aquatic ecosystems, retting activity in the backwaters has affected the very existence of prized fishery resources. Mass mortality of fishes due to intense pollution from anoxia coupled with sulphide and other organic pollutants could be observed from the retting zones of the backwaters particularly during the dry and stagnant pre-monsoon period. The retting of coconut husk has resulted in formation of black layer of organic matter and this has spoiled the nursery ground of some of the commercially important fishes like mullets, pearl spots and milk fishes inhabiting the area. All these evidence observed from retting zones establishes the fact that the retting activity in the unique backwater system of Kerala is a major ecological threat to the biological productivity and biodiversity of these zones. This implies that pollution from retting activity has seriously affected the economy of the poor fishermen that retting has reached a level of being the greatest threat to capture fishermen in the estuaries of Kerala. According to Bejoy Nandan (2004), 247 ha of backwaters area are used for retting activity and the present status of pollution from retting recommends no retting in backwaters.

In order to enhance fish production, there is dire need for integration of inland fisheries, aquaculture and agriculture. Fishery resources may be further augmented through ranching of high value and high utility fishes and prawns and undertaking targeted conservation of important species. The high dependence of rural people on these resources and the huge potential that sustainable management of these resources offers for national development is such that conservation of biodiversity must also address sustainable livelihoods. Strengthening the capacity of local communities by providing common and social infrastructure for promotion of cage or pen fishery, fish integration in paddy fields, fish culture in water bodies like ponds and development model for home stead fishery are proposed to enhance the income from fishery. Specific programs from promoting specific fishery habitats particularly for economically important native species is to be taken up and the fishing community also may follow a code of conduct for responsible fishery exploitation on the basis of guidelines already available. This strategy of promoting sustainable livelihoods based on these resources alone cannot protect the fishermen community who by their nature of their exclusive dependence on capture fishery and declining stocks, have been pushed to the edge of survival. To overcome the hardships of these community, efforts should be taken for providing socio-economic well being by promoting alternative and additional employment/income generation, developing community independence, gender equity, and equal decision making power for women etc.

5.4 Revival of Fishery Based Livelihoods of Respondent Fisherfolk of Vembanad Ecosystem–Alternatives Developed

In the context that the endemic fishery resources are stretched to its upper limits of tolerance by manmade interferences, over exploitation, poor natural recruitment and habitat alternation, the suggested strategies identified are intensified stocking of natural and manmade water bodies known under the name open ranching, habitat improvement and open water culture and protected sanctuaries. Integrated fish farming techniques and farming system models tested and developed during the past decades can also be utilized at the farm and community level.

Open ranching – Ranching implies the production of seeds of commercially important species of fish in hatcheries and depositing the same into open waters. Restoration breeding supported by captive breeding is a valid management tool that can substantially enhance fish production in open waters. In the context of the phenomenal decline of macrobrachium rosenbergii, a true denizer of Kuttanad and locally known as Kuttanad Konchu, owing to the reduction in natural recruitment, sustained ranching program of seeds of prawns is suggested to enhance and rehabitat this fishery. This fishery was known to have provided a lucrative fishery in Vembanad Lake and its confluent rivers during 1950s and early 1960s. Studies conducted by Kerala Agricultural University have shown that release of hatchery reared seeds of giant prawns to open Lake Situation is a viable strategy to improve and enhance fishery. Table 5.5 gives the ranching details conducted by ADAK in Alappuzha District.

Table 5.15 Report of ADAK on ranching in Alappuzha District – Public Water Stocking of Fish

Year of Stocking	Number of fish seeds stocked	Number of prawns seeds stocked	Total
2004-2005	-	8000	8000
2005-2006	37200	-	37200
2006-2007	-	-	-
2007-2008	50000	175000(prawn) 900000(Shrimp)	11250 00

Source: Unpublished report of ADAK

The growth performance of ranched individuals and their rapid recruitment in the exploited fisheries indicate the perceptible advantages of such stocking programs on resource conservation. As there is non availability of reliable data on the growth performance of these ranched individuals, there is a limitation in explaining the advantages of such stocking.

Open water fish culture - Culture of commercially important fishes in enclosures in open water bodies is the most accepted strategy that ensures high production by optimal utilization of natural productivity of such waters but will also promote parallel enhancement of resident fisheries (Welcomme and Bartley, 1998). Vembanad Lake shows that by promoting enclosure fish culture, pressure on natural fisheries can be reduced considerably. Vembanad Lake has shown that enclosure fish culture can play a significant role in augmenting yield from capture fishery. The endemic fish E-suratensis (Pearl spot) has been demonstrated to be most suitable for this system and they can grow to marketable size 230g in 6-7 months and fetch high value. This cage culture concept is an ideal alternative to protect the biodiversity through and eco friendly approach. It is also a low volume high density food production system ideal for small scale farmers. Its low capital input and minimal operation cost ultimately leads to sustainable fish production. These advantages of this system imply the need for accepting cage culture as a livelihood opportunity by poor inland fishers. But adequate caution shall be taken to ensure that these farming strategies do not exceed the carrying capacity of the wetland system. Cage carrying capacity is depending on the water quality in the open water that the carrying capacity is increased beyond the natural purification capacity of receiving waters. Water quality will deteriorate and eventually this might affect the production. Sustainable fish culture methods are possible only with active participation of fisher community.

Protected Sanctuaries - In the context that as the endemic fishery resources are affected by poor natural recruitment and habitat recruitment mainly caused by the grave loss of mangrove swamps due to wide spread destruction of it, which was once the natural breeding nurseries for fish and prawn, an alternative suggested strategy for conservation to protect biodiversity rich region is to develop protected sanctuaries. Fishery recruitment and production of endemic fish species can be enhanced by providing stimulated breeding habitats. The experiences in the development of a designated 'Fish Sanctuary' for recruitment promotion of the endemic fish ' Etroplus Suratensis' in the open Vembanad lake at Kumarakom (Padmakumar et al., 2003) indicates this possibility. The development of a We A variety of artificial nest and substrates deposited in the lake floor in the engineered fish sanctuary has been found to provide meeting surfaces for pearl spot, the commercial fish species of the lake. This protected fish sanctuary is the first of its kind in the country established in open Vembanad Lake at Kumarakom on experimental bases. Half split coconut shells, large boulders of laterite blocks, specially designed coconut concrete tetra pods and coconut piles were used as paaru and reefs simulating breeding habitats for fish in the open lake sanctuary. Fish population studies in the engineered fish sanctuary indicate that fishes utilize the protected sanctuary habitats and the deposited substrate materials for breeding. The increased fishery recruitment and yield of fish almost six fold in the sanctuary zone during the succeeding seasons indicate that such attempts are viable strategies for conservation of endemic lake fish. The co-operation of the local fishermen communities and their participation is an essential factor for the development of this engineered habitat. The protected sanctuaries were also set up by the lake protection forum with financial and technical aid from ATREE (Asoka Trust for Ecology and Environment). Community Environment Resource Centre, Kaipuram, Pallikkunnu and Anjuthaikal in Kerala now boast of fish sanctuaries or 'Matsyathavalam'. These sanctuaries have also been established to ensure the continued presence of fish dependent species such as Otters and Cormorants as well as benefit native fishermen. Anyway effective partnership and linkage by close involvement by the local interests have to go a long way to ensure protection of the resources and environment.

Ornamental fish culture - Ornamental fish culture is becoming an increasingly lucrative business and this offers new income generation opportunities in Kuttanad region with group based enterprise building.

5.5 Non Fishery Based Livelihood Alternatives for the Respondent Households

a) Role of Self Help Groups (SHGs) in providing livelihood activities for the respondent households

Within Kerala, poverty reduction has been uneven to a large part owing to ecological factors. One such ecologically handicapped area is Kanjikkuzhy where both the two Villages Muhamma and Thanneermukkom coming under the purview of study belong to. The major occupation in the area being fishing, Coir Production and Copra production, there is scope for promoting alternative and additional employment/enterprise income generating activities for the people. It is possible with the full involvement of the existing decentralized people's organizations of Panchayaths, neighbourhood groups and self help groups with a special focus on women members of the SHGs.

Considering the geographical importance of the area, there is an opportunity for developing a group of products with backward linkages- the most dynamic component of this process being the agro-fishery products to be marketed outside the region and therefore need to be branded and be of uniform quality. The major products line can be as follows.

Fish products-Fish pickles Readymade curries, dry fish, fish soup powder, cut and cleaned ready to cook fish to be sold through cold storages.

Mussels products-Pickles, mussel soup powder, cleaned and ready to cook mussels to be sold through cold storages.

Vegetables – Pickles, Vegetables in bran, Marinated and dried vegetables, soup powders.

Fruits - Jams, squashes, fruits in syrup, cashew apple juice.

Catering Units specialized in traditional preparation, Fresh Vegetable stalls selling organic vegetables in the neighboring towns.

Another product group categorized is the coir related products from the exporting firm in the region itself. The coir industry today is organized in small scale weaving units who subcontract orders from exporters through middlemen. The development of the product line is possible through upgrading of hand spinning of coir yarns to modern motorized wheel spinning. For this purpose, micro production units of two or three spinning wheels each may be set up and linked to specific small scale weaving units. Common facility centers also be set up to supply fiber to the spinning units.

Apart from this, a wide range of product lines from coconut based agro industries can be developed. They are coconut cream, which is the processed milk extracted from fresh natural coconuts, desiccated coconuts, vinegar made from coconut water etc.

All these income generating employment activities can be easily co-ordinated by the SHGs of the area. Now the Panchayats have started many new schemes for utilizing the fallow lands in rural areas for group farming for vegetable growing, paddy cultivation, herbal medicinal plants growing etc by paying rent for the suitable land identified under this scheme. The members of the SHGs could actively get involved in these activities and they are able to get gainful employment up to 100 days a year through Mahatma Gandhi Grameena Thozhilaldana project, a centrally sponsored scheme worked out through Panchayats mainly for cleaning of waste lands within the jurisdiction of Panchayaths. The members participating in the cleaning process gets Rs.120 per day as remuneration from this Scheme.

(b) Sustainable tourism as an alternative livelihood programme

Backwater tourism at Vembanad Lake and associated activities are growing at a rapid pace and is emerging as one of the few economic alternatives available to the people of the area. The income and employment generation potential of tourism is receiving increasing priority in policy formulations. Revenue generated in tourism is estimated at about 7.7 percent of the GDP of Kerala. It is a fact that whiles the big tourist operators, resorts and house boat owners gets the lion's share of income from tourism, the spill over to the locals is negligible. Statistics show that tourism infrastructure of the area includes 6 major hotels/resorts, about 457 medium hotels and 21 small hotels, about 350 house boats, 40 country boats and 300 motor boats and a few speed boats. The houseboat cruises along waterways during 180 days a year are reported to generate average revenue of 108 crores/year. It is reported that this tourism venture can provide employment to about 2000 persons for 180 days a year. The potential for employment categorization includes the posts like guards, guides, caterers, boat crew and naturalists. But it is ironic that the employment opportunity in the tourism sector is not favorable to the local community with more than 90 percent of the regular employees appointed in these opportunities from outside the area.

As traditional occupation like fisheries and agriculture are declining and becoming an unsustainable means of livelihood, especially for the poor, it should be ensured that the tourism industry has the responsibility to provide direct and indirect employment opportunities for these local people and contribute to the projects of priority for the well being of the community. To implement this type of tourism activities, first of all the tourism sector should be redeemed from the clutches of the so called tourism mafia and thereby making way for responsible tourism which is likely to be turned to ecotourism.

The development of ecotourism can generate employment for residential people and thereby creating a positive vested reason for the protection of the area in its natural state for all time by the local populace. The backwater tourism with the use of house boats and motor boats have done maximum damage to the lake ecology by way of emission of kerosene and disposal of faecal waste and other garbage. But it is not possible to prohibit the entire backwater tourism in this manner. The best practice that can be adopted in Vembanad Lake is that restrict the number of houseboats and motorized to a very limited number that it could avoid large scale excretion of kerosene to the lake. As an alternative to this, backwater tourism with small country boats operated manually by Village men could be promoted. This would fetch a respectable income for that fisherfolk who are well versed in rowing the country boats and who also know every nook and corner of the lake. These country boats are also able to go through even narrow canals of the lake which is not accessible to houseboats. Then Vembanad lake tourism can be protected without harm to lake ecology, as in the case of Dal lakes in Kashmir. This type of small scale tourism could be opted in fishing and peak season in tourism that they could make up their income fall from fisheries sector through tourism

As health tourism which is of recent origin attracts the tourists to our traditional Ayurvedic and Panchakarma treatment, the local people could also promote herbal garden in their premises for the supply of herbal medicines as there area is best suited for cultivation of herbal Mangroves. The modern generation of this community could also undergo for short term courses in Ayurvedic and Panchakarma treatments.

Along with the participation of the SHGs local groups be formed in specializing in making of handicrafts and in collection of antique thereby stack their purses with immense money which flows from the pockets of foreign tourists who are fond of the handicraft and antique available locally. The handicrafts could be made with locally available agro products like coconut shell, coconut fiber and fiber from plantain, sea shells, furniture etc.

All these efforts would lead to the conservation of the environment in the backdrop of overall socio-economic environment of the region. A thrust has to be given to the concepts of social obligations of tourism industry and its corporate accountability.

Chapter 6

CONCLUSION

The sustainable livelihood framework focus on the sustainable livelihoods of inland fisherfolk communities whose issues are divergent and a close watch on the empirical realities that are complex and interrelated have brought to light the impact of ecosystem degradation and resource depletion on the life of this community. As the study is intimately linked to sustainable development thoughts and practices and as it takes social, economic and environmental objectives into consideration, the study could explain the role of assets that play in determining the survival strategies. The key strategies that households in these fishing communities use to access assets and base their livelihood have been identified in this study. It also tried to identify which of the institutions, organizations and policies would help shape the livelihood outcomes of these small scale fishers. The area under the purview of the study is a multiple use local level natural resource managed by the state and it is facing several threats as vast areas being affected due to both fishery and non fishery aspects. Although this wetland is generally considered as dynamic ecosystems, where natural fluctuations are part of the system, human activities change its ecological functions. As the very bases of this natural resource have been threatened, the fishers of this ecosystem are forced to sniff around and negotiate with endogenous and exogenous forces of livelihood diversity. Thus the present study tried to explore certain economic and institutional aspects with regard to its present use and management so that appropriate institutional alternative could be enquired for the conservation of the estuary.

The Vembanad wetland ecosystems which has several functions and economic values is brought under the purview of the study as the water based activities such as fishing, clam collection and all other types of resource use depend upon the environmental integrity of the Vembanad lake and its surroundings. The study has tried to explore the major factors that contribute to the vulnerability context of the study area and has identified that the construction of Thaneermukkom barrage across the lake in 1976 and its ineffective operation has affected the ecosystem as it destroyed the continuity of the ecosystem and ultimately resulted in the total damage to the fish yield and shrinkage in species spectrum. Though this salinity barrage plays a crucial role among the vulnerability factors, several other factors has aggravated the biodiversity loss and consequent decline in productivity. As all these factors are having a direct impact on the life of the traditional fisherfolk, who depends on the fishery resources of Vembanad Lake for their livelihood, the study critically examined their livelihood dynamics within the framework of the SLA. Taking a comparative approach between two inland fishing villages of the study area – Muhamma and Thanneermukkom, a close examination of the characteristics of the sample population of fishermen brought to light how ecosystem degradation and resource depletion impacted on the households and further aggravated their poverty.

Caste is the one of the important factors that determines livelihood activities of fisherfolk communities. It is found that the whole sample population belongs to one particular religion, Hindu out of which 78 percent belongs to Dheevara community and the rest is Ezhava community who are referred as socially and economically backward group. The Dheevara community which forms the major chunk in the sample population who are more knowledgeable about resource conservation rules is well organized on the basis of caste as a strong local level unit of Akhila Kerala Dheevara Sabha functioning in the study area takes up the issues concerned with resource use. As far as the age group of the sample population is concerned, in a comparison with the state data of inland fishermen, it is observed that there is significant difference between survey region and state regarding proportion of males in different age group whereas the proportion of the females at different age group are similar to the state pattern. It is also noticed that a good percentage of the sample population belongs to the working age category. The counterparts of the working age group that is non working population comes to about 31.49 percent which is explained through a detailed categorization of dependent family members based on certain criteria. The old age group or senior citizen group which comes to about 14.55 percent are found happy, as they get due respect and care from their family members, which shows that the family attachments are having importance among theses communities. As 88.8 percent of sample population having members up to 5, it is implied that the sample population have adopted a nuclear family system. The marital status among the male and the female sample population of the age group of 25-35 displays a dismal picture regarding the marital status of the females with a percentage of 63.64 only where as the males of the same age group shows a higher percentage of married category of 90. This situation shows that the girl child is becoming a burden to the family due to high dowry rates prevailing in the society. All these demographic factors indicated in this study have clearly explained the demographic profile of the sample households and sample population.

One of the entry points into sustainable livelihood situation analysis being asset development, the study has gone through a detailed verification of different forms of assets held by the sample population. As regards the human capital position, the study made a sincere attempt to evaluate the educational status, the work structure and pattern of health issues. The educational status of the sample population when compared with the education level of state inland fisherfolk population, it was observed that it was no way similar to the state pattern. The sex wise comparison of educational status of sample population with that of state data implies that the educational levels of males and females are higher than that of the state pattern. Even though the educational levels of sample population is greater than that of state data, the percentage of degree, post graduate and technically qualified category comes to only 7 percent. It is also to be noted that there is no discrimination against educating a girl child, as the survey results show almost a similar pattern of education levels for both males and females in all the categories. It is also observed that no student has specialized in courses in fisheries even at higher secondary levels as there is lack of vocational courses in fishery related subjects in the study area.

Taking a comparative approach on the 10 different locations from two inland fishing villages selected for study, a location wise fishing occupation categorization have been done to identify the varying nature and pattern of occupation in each location. As far as fishing and non fishing activities are concerned mainly three classifications on some aspects of employment are taken into account. Out of the total sample working population, 76.2 percent are engaged in fishing and allied activities which are being categorized as owner workers, owners only, middlemen traders and vendors. Vendors are exclusively women category. The percentage of owner only category is very negligible. As the catches are dwindling day by day, the role of middlemen traders is also decreasing. Lack of regular availability of fresh water fishes has affected the livelihood of women fish vendors. To stick on to their job they depend on marine fish markets to avoid loosing of their regular customers at distant sites.

The study has also concentrated on fishing activity categorization which implies direct activities taking place in the estuary such as fish catch and clam collection. Out of the total sample population who are engaged in fish harvesting and clam collection in the lake, the percentage of clam collection group is highest (40.52), whereas the percentage of fish catch only category has come down to 19.61. This change implies that dwindling fish catches have diverted most of the fishermen to turn to clam collection activity or to both fish catch and clam collection activities. Though the respondent families are more dependent on clam collection and related activities, it is understood that collection, processing and marketing of clams is a tedious job as it involves more time and effort in earning income out of this activity.

As fishing is a seasonal occupation based on vagaries of nature, the family members of the respondent households also have to depend on non-fishing sources of income. The sample populations who depend on non-fishing livelihoods are mainly engaged in coir related activities due to the geographical as well as traditional importance of activities such as coconut husk retting and related occupation has more prominence in the study area. It is observed that 91 percent of the sample populations who depend on non-fishing activities are relying upon coir related occupations.

It is also to be noted that in this sample population engaged in coir related activities, female work participation rate in very high as women constitute the major proportion of 78.79 out of this 91 percent.

Though most of the locations selected for the study are identified for tourism related activities, it is interesting to note that no traditional fishermen have turned to tourism related activities.

Though the educational level of sample population is higher than the state inland fishermen population, only very negligible proportion of sample population 1.38 percent comes under the professional category. As the livelihoods of fishers are impacted by the success of the techniques they follow for fish aggregation and their access rights to certain locations in certain periods, the perception regarding their skills are taken into account. The highest preference according to the perception given by fishermen is for the skill, good at locating the fishing grounds. As the inland sector still retains its pre historic gear with manual operations, the skill is using multiple gears poses a hard task for the respondent fisherfolk.

As far as the health aspect of sample population is concerned, 9.9 percent are affected by contagious and deadly diseases. Waterborne diseases like Cholera and Jaundice has affected the health of the sample population due to the highly polluted stranded water south of the barrage due to the construction of the barrage. Apart from this, those people who are engaged in clam collection and associated activities are also affected due to various health problems such as back pain and shoulder pain. As clam collection and associated activities is a tire some work involving a lot of time and effort, it has affected their health very badly. These sample population have to spend a good part of their income for medical purposes due to their various health problems.

The financial capital which people use to achieve their livelihood strategies such as savings, access to credit and its accessibility of the sample households are taken into account. The saving positions of the household's portrait their willingness to save, though the amount of savings is a petty amount. The reason for their low savings is their low income. The savings promoted by SHGs is the reason behind savings by high percentage of 89.6 of households. Apart from this, the presence of multitude of banking and non banking institutions also have promoted the savings of the sample households. These sample households are also indebted as 80 percent of them have taken loans from different institutions for several purposes. The SHGs also play an active role in lending loans among these households and this has resulted in curbing the role of money lenders in this society as the percentage of loans taken from money lenders is only 8 percent. The co-operative societies also play a crucial role in reducing the role of money lenders as it comes in second place in the provider group. The physical capital being divided into fishing and non fishing capital assets, it is inferred that the home stead plot distribution is also similar to the state distribution pattern as the possession of land among the sample households varies between 2 cents and 10 cents. As the land area pattern explains a positive skewness in the distribution of land among the sample population, it is learnt that majority of the sample population possess land more than 7.5 cents. The cumulative distribution function of land area interprets that 79.92 percent of sample population enjoys land only up to 10 cents whereas 20 percent of sample population enjoys possession of more than 10 cents of land.

All the households own a house though not of a pucca type. 94.8 percent of the sample households have tiled tinned or asbestoses type of roof. 94.4 percent of houses are electrified and 87.6 percent people have bore whole type latrine. The bore whole type of latrine is highly unhygienic as it pollutes the underground water and ultimately results in water borne diseases like Cholera, Jaundice, etc. 60 percent of the sample population depends on neighborhood wells and ponds for drinking water. As only 20 percent of the people get public water, rest of the people is prone to many water borne diseases during the summer season due to the change in water quality parameter. Though they suffer due to water scarcity problems, no rain water harvesting tanks are constructed in the study area. It is also understood that a good percentage of people have to walk upto 2 Km to have access for safe drinking water, the most sufferers being the women folk who have to spend a lot of time for this purpose. As far as inland fisherfolk are concerned, the capital investment for fishing equipments is not huge and hence 73.6 percent of respondent fisherfolk have their own crafts whose mean price is 6827.45.

The surveyed area is a platform for various social and cultural organizations and both male and female members of the respondent families are members in these organizations. High female representation in these organizations is due to the role played by the SHGs (Kudumbasree) in the study area. When the membership analyzed sex-wise and based on the nature of membership, it is realized that the executive membership of female members show that women are capable of holding positions now a days. SHG, the grass root level organizational setup named kudumbasree has provided a social platform for poor women to express their concerns, discuss their problems and search for better opportunities. Though the 26.67 percent of male membership considered as social capital can also be brought under the head of political capital as this asset holds power to connect an individual or group to higher power structure and policy instruments.

From the analysis of social security schemes specific to the types of benefits enjoyed, it was found that 61.6 percent of the sample households accessed many of the social security schemes provided by the sources, panchayat and matsyafed. But it is unferstood that the same sample population enjoys the total social security benefits of 323 numbers which implies that rest of the families are left out of any of these schemes. It is also to be memorized that benefits such as housing, toilets, wells, etc were made available to respondent households by the panchayat mainly due to the active functioning of kudumbasree which could find out the deserving beneficiaries through its efforts. It is also to be noted that though a number of social security measures are in vogue in the state of Kerala among the marine fish workers, it is not much benefited by the inland fisherfolk community.

A glance at the institutional support and policies worked out portraits a detailed account of working of different institution in the surveyed area. It is understood that many of the family members of the respondent households who are also the members of the Welfare Fund Board enjoys many of the benefits provisioned by this board. The three co-operative societies working for the well being of clam workers disburse many benefits to its members through its welfare programmes. But it is learnt that all these institutional setup faces many constraints from the apex offices and state officials especially when there is administrative change and this affects the smooth functioning of these institutions.

In this analysis, poverty and inequality among the inland fishing community is examined by taking income as the basis for evaluating poverty. The intensity of inequality among the traditional fisherfolk of the study area and the verification of inter group disparity in income distribution is found out using mainly three indices – Theil index, Foster Welfare Function and Alkinson’s index. For evaluation of poverty, these approaches were used because the ten locations selected for study characterizes certain specialties which ultimately resulted in variations to their income contributions. As each location comprised a cluster of 25 households, their annual aggregate income was calculated and the contribution of each group's inequality to the whole sample population was found out. It is inferred that as the value of Theil index is not zero, there is inequality in income distribution among the 250 households. Accordingly location 9 is having the lowest inequality and location 1 is having the highest inequality. It is also observed that location 9 is having the highest welfare situation as the value of the Foster Welfare Function is highest in location 9 and location 6 is having the lowest welfare situation as its value is lowest. As the Atkinson's value is more closer to 0 in location 9, the more equal the distribution in location 9 and as the value of location 1 is farther from 0, the most unequal the distribution in location 1. These three indices have proved that there is inequality within groups, there is difference in welfare situations within groups and there is unequal distribution between the groups. The reason for low income or the income gap is attributed as the loss of fishing days due to various reasons. Though around 162 fishing days are only available for fishing in Vembanad Lake, the actual fishing days are much less due to various reasons. The basic reasons for not fishing on some days have been cited as poor catches recently.

As the actual consumption expenditure is more closely related to person's well being, household's per capita consumption expenditure is taken as the measure of standard of living. Interval plot of per capita income-per capita expenditure shows that within group variation in income is much more than expenditure and mean expenditure is more than mean income. This situation implies that respondent fisherfolk have to approach alternative income earning activities to meet this income gap. It is also inferred that both log per capita income and log per capita expenditure curve depict normal distribution. The scatter plot of per capita expenditure vs per capita income depicts that low income low expenditure groups are more than high income high expenditure group as there is higher concentration of population in the lower end. Histogram of expenditure on food and non food items reveals that, the highest spending of the respondents is on food items and among the non food items, the highest spending is on fuel and lighting as those respondent families who are engaged in clam processing are in need of lot of firewood for boiling of clams. Social expenses among this community are also high. Though high social expenses often make some financial burden sometimes, it also works as a mutual help among the members of the community.

Availability of and access to natural resources is directly related to livelihood functions. As the natural resources coming under the purview of study i.e. water, biodiversity, fish availability, flora and fauna, mangroves etc is under threat from a multitude of factors, the SLA is used to understand quickly the area and threats to fishery and conflicts between stakeholders. The diverse livelihood natural capital available and its sustainable use are discussed in detail. Fishery wealth of Vembanad species wise and quantity wise are considered in the study to assess the grave decline in these natural resources. The fish fauna of the lake comprises of 161 species belonging to 100 genera and 56 families. It has been estimated that over the last 30 years, fish diversity has come down from 150 to 65 species and fish catch has declined from 16,000 tons to 7,200 tons in 1989 and to as low as 687 tons in 2000-01.

The study has identified 17 major reasons for the grave loss of this rich biodiversity. The perceptions of the respondents together with the facts and figures substantiated by various scientific reports contributed a detailed analysis of the complexities of all the 17 reasons using Multi Dimensional Scaling technique. It has been identified that the delayed and declined monsoon has affected the availability of fish and prawns. The commercial selling of juvenile prawns to the farmers for depositing in Pokkali fields by indiscriminately catching from estuary has resulted in destruction of juvenile prawns and fish. Apart from this size overfishing, recruitment overfishing and ecosystem overfishing are also cited as reasons for decline in fish diversity. It is also realized that unsustainable fishing using unethical fishing practices, using chemicals, herbal poisons, dynamiting, electric fishing and use of small meshed fishing gears are also prevalent in the Vembanad Lake.

Barrage at Thanneermukkom has been remarked as the most destructive one influencing the fishery of the lake resulting in salinity variation in spatial and temporal aspects due to the operation of the barrage. It has been watched over that the barrage always posed conflicts between the fisherfolk and farmers regarding the opening and closing of it resulting in several agitations by fisherfolk. Indiscriminate application of pesticides and discharge of industrial affluent is identified as a major reason for water pollution problems of the lake. A critical examination of the pattern of pesticide application shows that there are instances of incidental fish killing. Though the use of DDT has been banned in Kuttanad for agriculture purposes, these pesticides and its derivatives DDE and DDD are found in the black clam from the lake and canals. As the area of oil spillage from the motorized boats are spreading in a limited area compared to that of marine ecosystem, the intensity of pollution is much higher which have ultimately resulted detection of hydrocarbons like benzenes, toluene, etc which are acute poisons to the aquatic organisms. It has been realized that the sudden development of backwater tourism in several forms have caused many problems for the fisherfolk and they have lost their control and freedom over the water body in many respects.

Black clam production is an important source of food and an economically useful resource as the fishing communities make use of them for meat and shells. It has been observed that when the mode of production changed from traditional manner to large scale mechanical dredging for the large scale and industrial use of the company Travancore Cement Limited, it has changed the ecology of the lake, making the area unsustainable for spat setting and fish production. The pollution from retting activity has also seriously affected the ecosystem and the fisherfolk are alarmed at the indiscriminate use of backwater for this purpose, as this process have resulted in killing of precious and naturally sustainable resources. According to fishermen organizations, retting has become a grave threat to the capture fisheries in the estuarine area.

Distillery waste from the Mc Dowell Company at Varanadu is discharged at large quantity to Vembanad Lake causes a number of ill effects to the locality and also to the fishery resources in the lake. The hot discharge which is acidic in nature results in the breaking up of premature living clam shells. The fisherfolk who go down the water for collection of clams face many health problems like itching of the skin and eye. The fish and prawn also looses its aquatic atmosphere for sustenance due to very low oxygen level caused due to these emissions. The coir factories working in and around the rural and sub urban areas of Alappuzha district discharges their effluents also to the Vembanad Lake and this acts as a major pollutant of the lake resulting in mass mortality of fish.

The activities including construction for resort tourism, land reclamation for constructions of houses, agriculture and aquaculture have led to massive destruction of ecosystem by large scale felling of mangrove forests. These mangrove forests had been natural sanctuaries for many species of fishes and prawns. The excessive weed growth in the lake is also a major threat affecting the fishing and fishery wealth. Excessive weed growth results in lack of oxygen supply and sunlight to the underneath area of the lake and hampers the aquatic productivity. It is also learnt that rowing of crafts are laborious and casting of nets are impossible due to heavy weed infestation. Vembanad Lake has reduced to less than half the total area within a century and this has resulted in the reduction of nursery grounds of shrimps and considerably altered the physical features of the estuary. The resort tourism has also affected the life of fisherfolk, as these huge resorts and the big walls around it stretching for long kilometers has forbidden the fishermen from many of the services they accessed from the lake. It has been realized that indiscriminate sand mining rampant in the lake have brought major changes in the lake ecology and this has resulted in dwindling fishery wealth. The uncontrolled increase in the number of particular bird cormorant which goes deep into the water to pick the live fishes and off spring has also affected the fishery wealth, as this bird with its slender neck like periscope of a submarine rests among the patch of water hyacinth in the entire stretch of the lake for catching the fish.

The Multidimensional scaling technique has provided a visual representation of the pattern of proximities among these opinions regarding 17 sustainability issues identified. Opinions are plotted on the map in such a manner that the opinion perceived to be very similar to each other are placed near other and those opinions which are perceived to be very different from each other are placed far away from each other. A location wise analysis of these sustainability issues using the MDS technique has brought out some interesting observations. In location 1 (Varanadu) overfishing, unsustainable fishing and shrinkage due to reclamation is one set of similar issues and climate, barrage at Thaneermukom, coconut husk retting and distillery waste is another set of very similar issues. In Kattachira, coconut husk retting and distillery waste are identified as the most similar issues. Another set of similar issues is barrage at Thaneermukkom and excessive weed growth. Most of the issues which are originated outside the system lie close to the origin among which the most similar issues being fertilizers and pesticides and oil spillage and coconut husk retting.

Kannankara being a tourist spot faces several issues within and outside the system. Overfishing and unsustainable fishing are identified as the most similar ones in Puthanangady north and Puthanangady south, fertilizers, pesticides and oil spillage are the most similar one. In both these locations the issue of resort is lying farther away from both the dimensions implying that ill effects of resorts are less pronounced here. Distillery waste and coir factory are the most similar issues identified in Kayipuram. Another set of similar issues being unsustainable fishing and dredging implying that dredging has negatively affected the fishing. Oil spillage and shrinkage due to reclamation and unsustainable fishing and sand mining from the lake are the most similar issues pointed in Aryakkara and this location is comprised of resorts and houseboat tourism and is being most affected by reclamation, as most of the resort owners have reclaimed the waterfront area adjacent to resorts. Unsustainable fishing and over fishing and distillery waste and coir factory are the most closely related similar points in Muhamma jetty. The issues of unsustainable fishing and dredging are identified as the most similar issues at Pallikunnu. In all the locations, the stress values obtained are either excellent or satisfactory using the MDS technique, all the opinions are represented as stimulus points and respondents as ideal points in the same attribute space.

It is to ascertain that the hectic tourism activities taking place in Vembanad Lake and on its banks either in the form of back water tourism or resort tourism has done irreparable damage to the ecosystem and also has affected the livelihood of the fisherfolk dependent on the ecosystem. The ecological issues that have affected the ecosystem remarked are felling up of patches of mangrove forests resulting in loss of natural fish sanctuaries, reduction in number of water birds which is the sign of healthy habitat and increased coliform bacteria levels in an uncontrolled manner. A number of issues affecting the livelihood of fisherfolk are also identified which is being analyzed location specific. It is understood that all the respondents are affected by tourism related problems in one way or another in all the locations but in varying degrees. The major problem highlighted are plastic waste, loss of anchorage facilities, loss of clam processing facilities, loss of direct view of the lake due to resort tourism and loss of peaceful atmosphere.

As far as economic sustainability is concerned, the changes in inland fishermen population in Kerala and Alappuzha show promising trends. But at the same time the active fishermen changes shows a declining trends. The declining trend in active inland fishermen population both at state and district level implies that the employment situation in inland fishery sector is not acceptable. It is also realized that all the indicators under fleet capacity have far exceeded the sustainability limits which depicts the failure of the state in implementing various rules and regulations imposed for back water fisheries management. The community dependence indicators show that fishermen have high dependence on the resource base even though it is overexploited. Lack of livelihood alternatives compels these fisherfolk to stick on this sector and hence there is further resource depletion. As the education level of sample population is far below the critical minimum, there is marginalization of the community from the mainstream of state education level. The gender equity index points out that the gender equity indicator of this sector is very low in terms of sex ratio.

All the fisherfolks have clear cut ideas and opinions about the ecosystem changes. A devastating declining trend is noted in production of fish, prawn and clam resources of the Vembanad Lake. The number of species has declined from 150 in 1959 to 65 in 2009. Disappearance of mangroves, reduction in depth of the lake, the high level faecal coliform levels , reduction in water carrying capacity of the lake, retting of coconut husk beyond sustainable level etc are identified as the ecological issues threatening the biological productivity and biodiversity of the Vembanad ecosystem.

It is learned that the endemic fishery resources are over exploited by man made interferences and the suggested strategies for resistance are stocking of manmade and natural water bodies habitat improvement and open water culture and protected sanctuaries. The growth performances of ranched seeds and their rapid recruitment indicate that the stocking programmes are useful for resource conservation. Studies on open water fish culture in cages and pens taking in place in Vembanad Lake ascertain that pressure on natural fisheries can be reduced considerably. The cage concept can protect the biodiversity through eco-friendly approach, and it can be used as a livelihood opportunity by inland fisheries as it involves low capital input and minimal operation cost. The protected fish sanctuary, the first of its kind in the country established in open Vembanad Lake at Kumarakam on experimental basis has been found to provide nesting surfaces for fish and prawns thereby enhance fishery recruitments and production. The protected sanctuaries are also set up by the Lake Protection Forum with financial and technical aid from ATREE. Such fish sanctuaries known as matsyathavalam are set up in Kaipuram, Pallikunnu and Anjuthaikkal.

Suggestions for lake cum fishery management and policy implications

The study has revealed that many of the problems affecting the fisherfolk community depending inland fisheries in general and Vembanad ecosystem in particular are within and outside the realm of fisheries and fisheries governance. Governance of fisheries in a sustainable manner and alleviating poverty of fishing community is basically a political and economic process that demands for participatory structural adjustments in institutional, legal and management frameworks. Participatory approach in fisheries management can be done by evolution of environmentally sound technologies, which are economically viable and socially acceptable in order to ensure livelihood of the fisherfolk and food security of protein starved populace. As the aquatic ecosystem of the state supports a very good fishery potential, harnessing such a bio-energy resources towards solving the problems of food security also seems to be an aspect to be taken care of. For attaining this aim, opportunities and managerial measures to be adopted for the sustainable utilization of inland fisheries resources are to be chalked out.

Some of the management options suggested can be listed as follows for the enhancement of the inland fishery production. Make use all suitable water bodies for aquaculture. Suitable fish farming system and species be adopted in the brackish water as used in aquaculture. Without adequate measures to increase productivity fishing effort should not be allowed to increase further. There needs strict registration system and licensing to all existing crafts, gear and fishermen as in the case of stake net fishery. There is also an urgent need to restrict the mesh size of the stake net. The enforcement machinery is to be strengthened to keep on a strict vigil against those stake nets being deployed during the tide incursion in the backwaters against norms. As considerable area of back waters are already been lost due to reclamation for several purposes, further encroachment and reclamation are to be strictly regulated. Pollution abatement measures are also to be given top priority as several stretches of back waters are subjected to extreme organic/industrial pollution. Fish production need to be enhanced by species and stock enhancement programmes like ranching, cage culture and protected sanctuaries. But ranching programme will be more effective only after implementing regulatory measures very strictly. Adopt location specific management plans such as establishment of sanctuaries, closed seasons, mesh size regulations etc in biodiversity rich areas and regions harbouring a large number of endemic/endangered fish species. The natural breeding and nursery grounds of the endangered fish species shall be protected by declaring them as aquatic sanctuaries. Impose ban on the fishing of buried giant prawns and mother fishes during the breeding season. Provide suitable structures for the spawning and hatching so that berries collected can be deposited that the recruitment of these species will not be hampered. But all these fish conservation programmes are possible on long time basis with the sincere co-operation of fisherfolk community, local people, governmental and non governmental agencies and research communities. Once the fish resources are harvested successfully, setting up of sufficient infrastructure such as landing centers, cold storage facilities for proper preservation of fish and handling and sufficient marketing linkages of the landing centers are to be arranged and co-ordinated systematically.

As the study has concentrated on the sustainability and livelihood issues of Vembanad ecosystem and depended fisherfolk community, the identity of this ecosystem has to be focused. Based on the rich biodiversity and socio-economic importance, Vembanad Lake along with adjacent Kol lands declared as Ramsar site is a wetland of international importance. As this wetland ecosystem provides multitude of valuable benefits such as agriculture, fisheries, tourism and as it plays an important role in reducing the negative impacts of climate change, this ecosystem can best be cited as vibrant wetland ecosystem all over the world. But at the same time it is also known for the highly degraded ecosystem due to environmental pollution resulting from large scale reclamation of wetlands, unscrupulous methods of waste disposals and many other unrestricted human interventions without having any proper remedial measures. Vembanad wetland ecosystem exemplifies a situation, how a rich biodiversity can turn to a waste land. The degrading factors behind this drastic change have to be considered for all other ecosystems that are undergoing high stress due to environmental pollution as a result of human interferences. If proper management measures could save Vembanad to save earth, it is implied that similar approach be followed for other endangered ecosystems in different parts of the world. Hence it is high time to develop a wetland database in relation to Vembanad ecosystem for monitoring and assessing changes to biodiversity values and ecological services specially for conserving fishery resources. For this purpose developing a policy is the need of the hour.

Economic evaluation of Vembanad wetland with clear focus on studies of resource development and management of this wetland and sustainable resource utilization by the local communities is an effective tool for the wise use of this wetland. To attain this goal, strategic integrated management action plans should be evolved. The first step is to survey and inventorize this particular water body to enable impact analyses of ecosystem and evolve suitable restoration work. The next step should be to initiate action on integrated water resources management. But permanent solution depends on institutional restructuring for effective governance. The components which need to be addressed here enable environment and institutional framework. Along with this the involvement of local communities should be ensured through participatory social and economic appraisals and extensive consultations. Conservation of the flora, fauna and the existing resources, preventing further degeneration of the system is an essential requirement. The recent development of the concept of 'Eco development' for *in situ* conservation of biological diversity need to be brought into practice. Thus new concept will take care of the economic needs of the local communities with the maintenance of earmarked regions surrounding protected areas. A management action plan is to be implemented by the government to emphasize the balance between conservation measures and economic benefits to local communities. Additional income generation programmes be envisaged with a focus on poverty reduction and biodiversity conservation along with social equity and gender sensitivity.

As the constitution empowers panchayats and urban local bodies with functions and responsibilities for lake protection, local bodies need to use their power and resources for the conservation of the system. The Coastal Zone Regulation Notification, 1991 under the provision of Environment Protection Act, 1986 declared the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action in landward side upto 500 meters from the high tide line and the land between the low tide line and high tide line as coastal zone where restrictions are imposed on setting up and expansions of industries and such other operations and processes. This notification is important for conservation of Vembanad. Efforts should be made to make the public aware of the existing legal provision to protect the ecosystem. Local organizations and self help groups could be given guidance, guidelines with support from legal authorities. To implement this, a legal cell could be constituted for Vembanad ecosystem.

Tourism related activities which hinder the fishing activities of the local fishing communities should be prohibited. The destructive activities like felling of mangroves reclamation of the waterfront areas nearby to the resorts, building up of walls on the foundation stones laid down by the irrigation department, dumping of wastes from resorts to Lake etc. should be banned by the concerned authorities. At the same time these authorities should also take care of the fishing population who have lost their rights in different ways such as loss of direct view of the lake due to huge resort walls, loss of anchorage facilities, loss of facility for processing clams etc. the number of houseboats also be limited to that extent, it should not exceed the carrying capacity of the lake. Some alternatives should be provided for these poor fishing households who have lost their right to live. This is possible only through a socio-political process in consultation with resource users, tourist operators and fishing communities. The solution should evolve an ecologically sustainable tourism activity which does not affect the livelihood of the concerned fisherfolk community.

Some regulations should be observed by local communities also. This is possible only through proper monitoring by the authorities concerned. They are regarding the fishing efforts, restrictions beyond sustainable levels, mesh size restrictions for different types of gears and unsustainable fishing and issues related to overfishing. This would also ensure more growing period to juvenile fishes. Ban of fishing activities during the critical stage of fish breeding (pre-monsoon and summer) is another measure for the development of juvenile fishes. Mangrove reforestation will serve as a restoration method to bring back the lost biodiversity. For this process, awareness programmes for conservation of mangroves among the local people is needed.

The ecological interventions including restricted closure of Thaneermukkom barrage, reduction in pollutants, and removal of water hyacinth are recommended for revitalizing fish habitats of Vembanad Lake. Fishery resources may be further enhanced through ranching of high value and high utility fishes and prawns and undertaking targeted conservations of important species. Specific programmes for promoting specific fishery habitats, particularly for economically important native species is to be taken up under the technical guidance of RARC Kumarakam. The dredging process should be regulated to extent that the large scale mechanized dredging by Travancore Cements Ltd be restricted and the clam shell required by the company be provided by manual dredging effectively. This will promote ecological strengthening of the area. Specific provisions for establishing fish sanctuary in the lake area are also needed. The fishing community should follow of code of conduct for responsible fishery exploitation on the basis of guidelines already available. Management of this wetland cannot be addressed at government level alone, rather it requires the participation of all stakeholders concerned. As far as fishery management of the ecosystem is concerned, the fishery managers should respect fisher's knowledge and concerns and make them effectively involved in management process. Then the regulations are likely to be more problem solving. In the planning process also, it should envisage adoption of a community based approach to resource management facilitated by the government agencies and scientific institutions. There should be a system to provide technical and managerial support to implement the management action plan. It is also prosaic that a wetland like Vembanad which is a hot spot in terms of species diversity be declared as 'bio-diverse' for conservation. The natural functions of this wetland which have real economic values should be included in planning, policies and decision making processes.

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APPENDIX

HOUSEHOLD INFORMATION

ON THE SUSTAIABILITY OF THE LIVELIHOODS OF THE FISHING COMMUNITY IN KERALA

HOUSE No./address

Name of the head of household:

Religion

Hindu 1 ( ) Muslim 2 ( ) Christian 3 ( ) Other 9 ( )

Caste S T ( ) SC ( ) OBC ( ) OEC ( )

Date of interview :

Name of investigator :

Sample serial No :

DEMOGRAPHIC PARTICULARS

Sl. No	Name of the householder	Relation with HoH	Age	Sex	Marital status	Educational Status (>5 years)	Occupation: Main	Occupation: Supplementary	Fishing Activity(1)	Non Fishing Activity(2)
1	2	3	4	5	6	7	8	9	10	11
2										
3										
4										
5										
6										
7										
8										
9										
10										

CODES

Relation with HoH	Sex	Marital status	Education	Fishing related occupation(1)	Non-fishing related(2)
Head(1) spouse of head(2)	Male(1)	Married(1)	Illiterate 1		
Son/daughter (3)	Female(2)	Unmarried(2)	Literate but below primary (2)	Owner worker 1 a	Agriculture(2a)
Spouse of son/daughter(4)		Divorced(3)	Primary(3)	Owner only 1b	Wage employment(2b)
Grand child(5)		Separated(4)	Secondary(4)	Worker only 1c	Salaried(2c)
Father/mother(6)		Widowed(5)	Higher Secondary(5)	Middlemen trader 1d	Self employed in trade, Business(2e)
Brother/sister(7)			Degree(6)		
Father in law/mother in law(8)			PG(7)		Professional/Technical(2e)
Brother in law/sister in law(9)			Technical(8)		Other(2f)
			Others(9)		

EXPENDITURE ON FOOD ITEMS

ID Code	Items consumed	Unit	Consumption during the month(last 30 days)					
			Home grown		Purchases		Total	
			Qty	Value(Rs)	Qty	Value(Rs)	Qty	Value(Rs)
100	**Food Items**	****	****	****	****	****	****	****
101	Rice	Kg						
102	Wheat and Wheat Products	Kg						
103	Tapioca/Other cereal Products	Kg						
104	Pulses and pulse products	Kg						
105	Edible oils	Kg						
106	Salt/spices/Codiments	Kg						
107	Sugar	Kg						
108	Milk and milk products	Ltr						
109	Meat	Kg						
110	Fish	Kg						
111	Eggs	No						
112	Potatoes/other tubers	Kg						
113	Vegetables	Kg						
114	Coconut	No						
115	Fruits and nuts	Kg						
116	Tea and coffee	Kg						
117	Cigarattes/Tobacco/Beedi/Pan	****	****	****	****		****	
118	alcohol and other intoxicants	****	****	****	****		****	
119	Prepared food from outside home	****	****	****	****		****	
120	Eating outside	****	****	****	****		****	
121	Other food items	****	****	****	****		****	
122	**Subtotal**	****	****	****	****		****	

EXPENDITURE ON NON-FOOD ITEMS(During the year)

ID Code	Items consumed	Quantity	Value (Rs)
400	**Miscellaneus goods & services**	********	********
401	Educational expense other than in 309		
402	Medical expenses other than in 308		
403	**Subtotal**		
500	**Clothing and footwear**	********	********
501	Clothing		
502	Bed sheets, towel, etc		
503	Foot wear		
504	**Subtotal**		
600	**consumer durables**	********	********
601	Furniture & fixtures		
602	Vessels		
603	Kitchen Equipments		
604	Other home appliances		
605	Clock & Watches		
606	Cassettes, CD's, Records, etc		
607	TV, Radio, Tape recorder, VCR / VCP, etc		
608	Vehicles		
609	Repaid & Maintanance		
610	**Subtotal**		

EXPENDITURE ON NON-FOOD ITEMS

ID Code	Items consumed	Unit	During the month: Home grown Qty	Home grown Value(Rs)	Purchases Qty	Purchases Value(Rs)	Total Qty	Total Value(Rs)
200	**Fuel & lighting**	****	****	****	****	****	****	****
201	Firewood	Kg						
202	Kerosene	Ltr	****	****				
203	LPG(in cylinders)	No	****	****				
204	Electricity	Kg	****	****				
205	**Subtotal**							
300	**Miscellaneous goods & services**	****	****	****	****	****	****	****
301	Toilet soap, tooth paste, detergent, cosmetics, etc							
302	Telephone charges							
303	Cable TV	****	****	****	****	****	****	****
304	Water charges							
305	Transport charges							
306	Wages to servant	****	****	****	****	****	****	****
307	Household cleaning articles							
308	Medical expenses							
309	Educational expenses							
310	Rent							
311	Taxes & other charges	****	****		****		****	
312	Religious expenses	****	****		****		****	
313	Social expenses(marriage, death, donations)	****	****		****		****	
314	News paper and magazines	****	****		****		****	
315	Entertainments	****	****		****		****	
316	Other miscellaneous expenses	****	****		****		****	
317	**Subtotal**	****	****		****		****	

OTHER ASSETS

Assets	Year of Purchase	Year of sale	Reason for sale
Radio			
TV			
VCR			
Mixi-grinder			
Bicycle			
Motor cycle			
Car			
Fridge			
Washing Machine			
Tractor			
Telephone			
Mobile phone			
Gold			

INCOME OF THE HOUSEHOLD

Month	Main employment generation (Mandays)	Items a b c d	Income	Supplementary income generations (Mandays)	Items A B C D	Income
Jan						
Feb						
Mar						
Apr						
May						
June						
July						
Aug						
Sep						
Oct						
Nov						
Dec						

Fishing related	Supplementary Activity
a. Fishing asset	A. Salaried govt. employed
b. Fishing labour	B. Non govt. employee
c. Processing	C. Self employed in trade
d. Vending	D. Rent

DETAILS ON PHYSICAL ASSETS

1. Home tenture( )			
owned-1		Rented-2	
Rent free-3		Others-4	
2. Type of structure ( )			
Temporary Shed-1		Kutcha-2	
Semi Pucca-3		Pucca-4	
Old & dipapidated-5			
3. Roof type ( )			
Thatched-1		Tiled/Tinned/Asbetos-2	
Concrete-3			
4. Floor type ( )			
Mud-1		Stone/Tile/Cement-2	
Mosaic/Granite/Ceramic -3		Others-4	
5. No of separate rooms(excluding kitchen)			
6.Kitchen type ( )			
Separate kitchen-1		Common kitchen-2	
no kitchen-3			

7. Electrification (yes-1. No-2)			
8. Latrine facility ( )			
Water sealed-1		Bore hole-2	
open pit -3		Not latrine-4	
Others-5			

FISHING ASSETS

Fishing	Asset type	Purchase year and price	Period of duration of using the fishing asset	Resale value of these assets
	Craft Engine(HP) Gear hook & line Other equipments (I, II)			

Natural Assets

Land Owner ship (IP)	No.of cents per house hold	Present Value percent	Acess to safe drinking water	Source
1 2			1 2	1 2 3 4 5 6 9

I	Ice Box	1	Yes	I	Inherited	Pipe Water	1	Public Tap	5
II	Vessels	2	No	P	Purchased	Open Wall	2	Neighbour's well	6
						Pond	3	Others	9
						Tubewell	4		

LOANS / BORROWINGS / SAVINGS

Do you have any outstanding loans or savings Yes - 1 ( ) No - 2 ( )

Loans

Agency	Year of loan taken	Amount taken	Purpose	Interest rate	Amount of loan repaid	Year of repayment	Balance	Pay back Method (1 2 3 4 5)	Purpose codes
Bank									Fall in price 1
Co-operative bank									To increase production 2
Govt.financial institutions									To increase non productive expenditure 3
Chitties/Kuries									To repair house 4 To acquire production assets 5
Gold loan									To acquire land 6
Money lenders									To meet medical expeses
Friends/relatives									Marriage expenditure 8
Others									To repay existing loans 9

SAVINGS					
Agency	Amt	Type of deposit	Term of deposit	Interest rate	Utilisation of matured amt
Bank					
Co-operative bank					
Chitties/Kuries					
KSFE					
Post office					
Lending to individuals					

Whether you have faced any recovery actions by the credit agencies yes (1) No (2)

If yes from which agency and mode of recovery

Pay back method codes

Daily	1
Weekly	2
Monthly	3
Areas with penal interest	4

SOCIAL CAPITAL

1. Has any numbers of household joined during last five years in any social organization

   Yes - 1 ( ), No – 2 ( )

2. If yes, give details on each participating members
3. Member code 1 2 3 4 5
4. Do women have equal decision power at home: Yes/No

Social organizations	Year of joining	Present status	It code 1 or 2 in column 3, type of membership	Main activity of the social organization
		Active 1 Passive 2 Non member 2 Others 9	Ordinary 1 Executive 2 Special 3 Others 9	Organization involved
1	2	3	4	5
Self Help groups				
Credit co-operatives				
Marketing co-operatives				
Other co-operatives				
Fishermen organization				
Religious organization				
Sports and Arts club				
Political organization				
Trade unions others specify				

Social Security benefit	Type of benefit	Agency
Yes(1) No(2) Housing 1 Toilet 2 Well 3 Fishing equipment 4 Old age pension 5 Free ration 6 Savings cum relief programme 7 Widow pension 8 Other 9		Panchayat 1 Matsyafed 2 NGO 3 Others 4
	1 2 3 4 5 6 7 8 9	

DETAILS REGARDING FISHING AND ATTITUDES TOWARDS OCCUPATIONAL

Reasons for mobility	Qualities which describes the skills of a fishermen	Reasons for not fishing on some days	Type of occupatiuon to which mobility has taken place
1 2 3 4 5 6 9	1 2 3 4 5 6 9	1 2 3 4 5 6 9	
Low income 1 Lack of employment regularly 2 Quest for a change 3 Acquision of education 4 Opening of new doors due to changed situations 5 Lack of interest in finishing 6 Others 9	Good at locating fishing grounds 1 Very brave 2 Can fish in any sea or backwater 3 can use all type of gears 4 Other qualities 9	Poor catches recently 1 Bad weather condition 2 Obligatory village meetings 3 Social eventing Involving crew 4 Repair/maintenances 5 No craft available 6 Other 9	Beach & backwater tourism 1 Construction 2 Carpentary 3 Agency service 4 Migration 5 Direct marketing 6 Skilled work such as electrification and plumbing 7 Other 9

MOBILITY RESOURCE DEPLETION AND CONSERVATION

Have you noticed resource depletion	Species	Reasons coastal wetlands species	Remedies for conservation
Yes -1 ( ) No - 2 ( )		1 2 3 4 5 6 7 8 9 10 11 12 13 14	1 2 3 4
		Climate 1 Overfishing 2 Unsustainable fishing 3 Barrage at Thaneermukkom 4 Fertilizers + pesticides 5 Oil spillage 6 Backwater tourism 7 Drudging 8 Coconut husk retting 9 Distillery waste 10 Coir factory 11 Depletion of mangroves 12 Excessive weed growth 13 Shrinkage due to reclamation 14 Resorts 15 Sand mining from lake 16 Bird attack 17	Control over Overfishing 1 Restrictive 2 Access Area restriction Others 4 (specify any special reason if responded)

Do you need a say in policy making of development and management of fishing resources

Yes 1 ( ) No 2 ( )

Do you think that fishing right to be restricted to actual fishermen yes 1 ( ) No 2 ( )

Do you think that first sale right of fish be restricted to fishermen Yes 1 ( ) No 2 ( )