Economic and Social Issues of Biodiversity Loss In Cochin Backwaters

BY

DR.K T THOMSON

READER

SCHOOL OF INDUSTRIAL FISHERIES

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COCHIN 680 016

thomsonkt@rediffmail.com

To

The Kerala research Programme on local level development

Centre for development studies, Trivandrum

This study was carried out at the School of Industrial Fisheries, Cochin University of Science and Technology, Cochin during the period 1999-2001 with financial support from the Kerala Research Programme on Local Level Development, Centre for Development Studies, Trivandrum.

Principal investigator: **Dr. K. T. Thomson**

Research fellows: **Ms Deepa Joy**

Mrs. Susan Abraham

Chapter 1

Introduction

Chapter 2
Species Diversity And Ecosystem Functions Of Cochin Backwaters

Chapter 3

Resource users of Cochin backwaters

Chapter 5

Economic activities and direct economic benefits Of Cochin backwaters

Chapter 6

Rural livelihood in backwater economies: a study of kumbalangi grama panchayat

CHAPTER 5

ECONOMIC ACTIVITIES AND DIRECT ECONOMIC BENEFITS OF COCHIN BACKWATERS

CHAPTER 6

RURAL LIVELIHOOD IN BACKWATER ECONOMIES: A STUDY OF KUMBALANGI GRAMA PANCHAYAT

CHAPTER 1

1.1 Introduction

An outstanding feature of the Kerala's coastal zone is the presence of a large number of perennial or temporary estuaries popularly known as backwaters (Kayals)[1]. Thirty backwaters occur along the 590 km long coast of Kerala covering an estimated area of around 2, 42,000 ha [See annexure 1]. An important characteristic of backwaters is their biological diversity[2], which refers to the diversity of various species of living organisms, plants and animals, the presence of various ecosystem services, and genetic diversity. Such diverse combinations of living organisms and ecological services constitute the natural resource entitlements of the local communities. The wide variety of fish and shellfish resources, aquaculture systems, the brackish water agriculture, mangroves and innumerable forms of micro organisms are directly useful and sustain the economy of local population. The brackish water body benefits coir industry of Kerala as rural communities use Kayals and the nearby wetlands for soaking coconut husks. In fact, Kayal's subsidise the cost of traditional coir processing and enable our coir products to compete in the international markets.

Apart from these direct tangible flows of economic benefits, backwaters also provide a variety of indirect services to local communities and to the rest of the world, whch enhance economic significance of these ecosystems manifold. The capacity of backwaters to regulate various gases, climate, water flows and its

[1] The term estuary is used to denote an enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with freshwater derived from land drainage (**Pritchard, 1967).** In the present study the terms **Backwaters and Kayals** are used inter changeable to denote an estuarine space. Backwaters are partially enclosed coastal body of water, which are either permanently, or periodically open to the sea with a measurable variation of salinity due to the mixing of seawater with freshwater. Kayal systems along the cost of Kerala are exposed to the tides from the Arabian Sea on the west and receive fresh waters of about seventy thousand million cubic meters making the water brackish through out the year. Backwater systems in Kerala have their bed levels at about 1.5 to 1.8 m below the mean sea level and normally remain separated from the sea by a narrow strip of land of about 0.4 to 12 km wide.

[2] The term biological diversity or biodiversity is an umbrella term used to describe the number, variability and variety of living organisms in a given assemblage **(UNEP, 1995).** The term is used to mean species diversity, ecosystem diversity and genetic diversity. **Species diversity** refers to the diversity in species that are important for the functions they perform in the generation of ecological services that are themselves of importance to human society. **Ecosystem diversity** refers to the diversified natural capabilities of Kayals to provide various services to the human population**. Genetic diversity** represents the biological variation or capacity for variation within each species. It is critically important as it allows organisms to adapt to changing environmental conditions and consequently to evolve into new life forms

supply, soil erosion and sedimentation, retention and soil formation, nutrient cycling, waste treatment, pollination and hence control various biological processes is well recognized (Turner et.al., 2000). Moreover, backwaters supply various kinds of recreation services and act as the primary pool of genetic resources. In fact, these diverse ecosystem functions along with the direct flow of benefits through the supply of various goods and services make these systems valuable to humanity[3] These services are enjoyed by the human users almost free of cost or at a price much below the cost of acquiring alternate but similar services.

The economic importance of these ecosystems to the local communities and to the world at large has been recognized in the forums of the Convention of Biological Diversity way back in 1992 and the subsequent Ramsar conventions initiated many programs for the management of estuaries. Despite these initiatives these coastal ecosystems continue to deteriorate the world over, due to the inbuilt socio economic and environmental problems associated with their use and misuse. In India, the Ministry of Environment and Forests has also implemented many programmes and legal measures for the sustainable development and management of these ecosystems partly due to international compulsions.

Backwaters, being the largest common property ecosystems, play a dominant role in the economy of Kerala, although its economic importance has not been properly recognised both in the academic and policy circles. It is unfortunate that these systems were never the primary targets of planning till now. In Kerala, kayals as ecosystems have not raised much concern over their management or lack of management. Till very recently, it was an environment, left to the socially weaker sections of the society. A number of fishing castes and poor agrarian communities were the major organisers of livelihood activities on this environment. Their technology was labour intensive and primitive and the scale of production was small but sufficient to meet the needs of the local rural economy. An important characteristic of their modes of resource use is the active presence and timely

[3] This ecosystem, although valuable to local communities, possessed a number of inherent difficulties in defining and enforcing well-defined property rights. The cost of enforcement of individual property rights on the entire water body was obviously unbearable and therefore, access to this backwater body has always been unlimited, exhibiting characteristics of a free-access property regime.

interventions of local institutions in the allocation, governance and controls over local resources and environment among various stakeholders. The multiple functions performed by these local institutions allowed a sustainable use of biological diversity for the benefit of various human users. Although the traditional uses were sustainable and equitable, very little surplus was left with the traditional stakeholders, which prevented them from undertaking further investments on this environment for development. Therefore, whenever there were demands for economic expansion centred on the use of backwater resources, the local communities could not effectively dominate in the decision-making processes. As we shall explain below this weakness of the system has given birth to the entry of modern stakeholders not necessarily belonging to these traditional user groups.

Recognising the economic importance of these water bodies, a number of new firms started modern industrial activities, using backwater resources and environment indiscriminately. The process of industrialisation started in this state way back in 1939 by locating a factory on the banks of the backwater. The Cochin Port Trust has also entered into this environment during mid Thirties. Today, there are at least 150 small and large industrial establishments located close to the backwaters. Locating industrial units close to backwater bodies has a number of definite advantages. First, market value of wetlands is very low and by locating industries on the banks of backwaters would reduce the capital costs of industrial establishments. There are other advantages too. These systems do not have well defined property rights [4], which make it easy for industries to externalise the costs of pollution abatement easily. Moreover, the population staying near these

[4] **Property rights** are defined in terms of owners and their relationship with others regarding the asset. A property right provides a stream of benefits to the owner (or user) and requires that others respect the property right (Bromley, 1991). Who owns the property right and how this right is specified affects its use. **Property Rights Regimes**: Property rights that have a similar set of characteristics are referred to as property rights regimes. The nature of these regimes is determined by institutional setting, technology and environmental features over which they are held (Devlin & Grafton, 1995). Many types of property regimes exist, each with their own set of characteristics. **Open access**: It describes a situation where no controls are placed on how much firms or individuals can consume or produce and no restrictions exists on the number of firms or individuals. No property rights exist over the resources in question. **State Rights**: It refers to property rights that are vested in a central governing authority. These rights can co exist with other property rights regimes. **Community Rights**: One of the earliest forms of property rights, it sets rules for how the resource should be used by members of the community and prohibits outsiders from using or accessing the resource. **Private Rights**: They are the sole rights of individuals and depend upon the cost of excluding others from a resource relative its benefits.

systems are poor and their political and social mobilization inadequate to resist externalities of large-scale industrialisation. Inspired by these advantages, the Cochin Port Trust, the Navigation and Transport Industries and the international leisure industries have all entered into this ecosystem. [See chapter 3 for details]. Thus the process of commercialisation of backwaters, started during the mid thirties, was an attempt to generate more economic values from these ecosystems

Commercialisation processes of kayal ecosystems accelerated industrialisation of Kerala. In fact, today, the Ernakulam district is known as the industrial city of Kerala. Given the huge amount of public and private investments into new activities that use Kayal resources including its environment, more economic values are created. Sustaining these values required the support of legal processes and social relations that favour new evolving interest groups. Public policies were crafted to provide legal support to the activities of new entrants. Although there were environmental laws preventing activities of modern players, poor enforcement deteriorated the environmental conditions in the backwaters. However, the distributions of these newly created values have been among a smaller number of people and at the expense of traditional stakeholders.

Although the process of industrialisation in Kerala has been accelerated due to the development of a modern industrial agglomeration around Cochin backwaters, it soon started generating external costs to traditional economic activities like fishing, agriculture, aquaculture, coir making, clam fishing, lime shell collection traditional ferry and transport services etc. [see chapter 3 for details] The evolution of a modern sector consisting of various industrial units, and their activities has produced a number of spill over effects on the kayal ecosystem and on the people living in the nearby villages. Pollutants released into the backwaters by various industries on the banks of the water body have caused severe reduction in the productivity of fishing activities and paddy cultivation. Aquaculture activities were also reduced manifold due to the impact of pollution. Dredging of the bottom of backwaters by the Port Trust has produced severe ecological imbalances. Sedimentation externalities has reduced the water holding capacity of the ecosystem causing water logging and reduced fishing. Reclamation has

also affected economic activities and ecological services of estuaries[5]. In short, commercialisation of these coastal zones of late has drawn limits to their capabilities and degraded the biodiversity of these eco-zones.

The threat imposed by the activities of modern stakeholders to the health of backwater ecosystem is severe and dangerous to the level exceeding the carrying capacity of the system. The destruction of mangroves, the silt and sediment accumulation, the impact of dredging on the living organisms and to the island economies, the impact of brackish water pollution to traditional stakeholders like fishermen, farmers and to the general health of the population are the major concerns raised by the degradation of backwater biodiversity. Reclamation of kayals for various development needs is increasing at a rate that would soon lead to the collapse of the major ecosystem services of backwaters. Traditional resource users have been complaining about the manner in which biodiversity has declined due to the commercialization of estuarine space in recent years. Many scholars have produced clear evidences to indicate the nature of the evolving resource crisis and environmental degradation. [Nair, 1992; Gopalan, 1983]

Given the level of modern activities, a good number of these traditional people found themselves being gradually marginalized from the mainstreams of the economy. This has created a lot of livelihood insecurities and led to large-scale mobility of people into cities and towns in search of different kinds of jobs. Traditional institutions that guaranteed the necessary social order among different resource users have collapsed while the modern institutions failed miserably to deliver the necessary support services that would protect biological diversity and livelihood securities of local communities. The pressing issue is that although livelihoods needs are still being met, it is not on a sufficient scale.

At the same time, new values created are not on a sustainable basis. It is noticed that most of the large industrial units are among the top ranking firms incurring losses to the Kerala economy. This means that although the system is still capable of generating new

[5] Subramanian (2000) sites eight specific cases in which a total of more than 680 hectares of kayal land have been reclaimed for development purposes. He also gives details of wetlands and swamps that have been filled up in the recent past for housing projects

economic values from the kayal environment, creation of the new values is at the expense of the biodiversity of backwaters, which in turn would threaten the sustainable existence of the traditional communities in backwater villages. The local population is slowly getting marginalised in the process of development taking place on this environment. Thus the entry of these units into backwater economy of Kerala is not an unmixed blessing.

Environmental economists point out that biodiversity degrades primarily due to the irrational uses of resource by various stakeholders, which result from the failures of market forces to allocate resources and environmental assets efficiently among different stakeholders across generations. It is also caused by various institutional and government failures to regulate such irrational uses through modern environmental governance.[6] Apart from the factors listed above, biodiversity degradation in backwater ecosystems is also related to the nature of weak political and social mobilisations of backwater communities to tackle their problems. In developing countries like India, people's movements play a crucial role in influencing policy.[7] Unless these issues are reasonably examined, it will be difficult to ensure the sustainable use of resources and environment of backwaters. [See chapter 5 for details]

Faced with this crisis of resource degradation and economic exclusion, the traditional communities started responding to the crisis in many ways. First, they have reorganized their economic activities. Fishermen have reduced their mesh size and resorted to indiscriminate fishing of whatever resources they could catch. They have also increased

[6] The conservation of a resource is always depended on the local institutions of resource governance and the management strategies that are followed by resources users and controllers. Traditionally, there have always been local initiatives to control access and harvesting of the common resource. Corresponding institutions that have evolved over a period of time have been sensitive to the resource use as well as users. They have developed a system of resource management that legitimised resource sharing in the kayals. However with the evolution of modern institution for the creation of new values, there has occurred erosion of traditional institutions.

[7] Political and social movements in the Cochin backwaters have existed from time immemorial. However these movements have always arisen in response to events and situations. With the exception of isolated events resource use has never been serious enough an issue to warrant any mass mobilisation or grouping of people. This lack of political and social movements to address resource use can be put down as one of the reasons for the lack of development of well-defined property rights for this resource and its conservation

the number of nets, mostly the Chinese and stake nets, and even reduced the number of workers employed in fishing operations. In fact, there are more illegal nets today than licensed gears. The pokkaly farmers have also reorganised their activities to tune to the evolving crisis. Some of them have stopped cultivation, due to lack of profits. A few of them have sold their lands and shifted to other occupations. A large proportion are even willing to sell their properties and waiting for a better opportunity to do so. The construction of the proposed Goshree bridges once completed will intensify the process in the near future. There are also instances in which people approach the legal machinery for conflict resolution where local mechanisms fail to find an effective solution to the problem

The modern stakeholders also experience serious crisis too. Most of the public sector industries are already making heavy losses to the national exchequer even without undertaking the required abatement costs. Internalising the costs of externalities will certainly increase their costs of production. Small scale industries also face similar problems .The tourism industry, on the other hand, has already moved to the southern side of the backwaters for want of better water quality.

The State by means of legislation and acts have taken over the management of these common resources leaving very little incentive to all stakeholders both traditional as well as modern to conserve the resource or manage its use in a sustainable way. However, many of these modern regulations have at the same time come into direct conflict with the traditional stakeholder use of the backwaters. Consequently parallel systems of management have slowly developed among different types of stakeholders. Alongside this, apathy on the part of the state to approach the ecosystem problem from a holistic perspective, and its failure to recognise property rights of traditional communities caused large scale has violations of rules and regulations.

However a hydraulic state like Kerala cannot afford to ignore the slow degradation of this ecosystem. The proportion of population that directly and indirectly depends on it is very huge. Moreover, a large number of modern stakeholders have already intensified their

economic activities, which use kayal resources and environmental assets mostly by excluding traditional communities and by producing externalities to other players. This choice of development path obviously is a wrong path and if allowed to continue will ultimately ruin the backwaters and the people who depend on these ecosystems for subsistence. In order to introduce appropriate corrections to this development path a scientific study on the nature of biodiversity degradation and the impacts such crisis make on the livelihood security of local communities and on the ecosystems services is essential.

Unfortunately no efforts have been made so far to address these issues by examining the nature of biodiversity degradation in a holistic manner[8]. The objective of this study is to inquire in detail into the nature and causes of biodiversity loss of Cochin backwaters and to highlight the major socio economic consequences of biodiversity degradation. It also suggests appropriate socio economic strategies for the prudent use of estuarine environment and resources.

1.2 The specific objectives of our study are

1. To characterise the nature of biodiversity loss in Cochin backwaters
2. To identify the major causes of biodiversity erosion and to document these processes in detail
3. To explore how different stakeholders have, enforced their claims on the estuarine environment and to estimate the direct economic benefits accruing to these different stakeholders

This report is organized as follows. Chapter 1 introduces the study and provides the necessary conceptual framework and analytical methods of this study. In chapter 2 we characterize the nature of biodiversity and provide evidences of its degradation. We then

[8] This study, therefore, tries to look at the biodiversity degradation problem from a multidisciplinary approach. Lack of a well defined and structured property rights systems on the Kayal environment, the presence of externalities, and the public good characteristics are all instrumental for the loss of Kayal biodiversity. However market failure is not the sole cause of degradation. Human interventions aimed towards the development of these communities, the institutional forms and structures, and the national and state policies also have an important role to play.

.

introduce in chapter 3, the major stakeholders of Cochin backwaters and explore how they enforced their claim on the estuarine resources over the years. Chapter 4 deals with the major causes of biodiversity degradation experienced in these eco zones. In chapter 5 we, give a brief description about the economic activities of various stakeholders and estimate how they derive various direct economic benefits from the kayal ecosystem followed by a case study in Chapter 6 on how local village communities still derive their livelihood in spite of the growing degradation of kayal biodiversity. Chapter 7 summarizes the emerging socioeconomic issues of biodiversity loss in the study area and our conclusions.

It is expected that such an enquiry will throw light on the evolving dynamics of Kerala's coastal zone and will guide better economic policies for the prudent use of kayal resources and environment for the benefit of humanity.

1.3 Conceptual framework and analytical methods

Development initiatives are bound to degrade kayal biodiversity seriously and can therefore be harmful to local inhabitants and to the world community at large. Although many scientists have examined various facets of biodiversity degradation, very few attempts have been made to understand the socio-economic issues of environmental degradation of coastal zones. In India, except for a very few studies, not many have been concerned with the biodiversity degradation of Kayals and the consequences to the sustainable development of the economies. This section details the methodology adopted to understand the biodiversity degradation of backwaters and the related socio-economic issues.

The characteristic feature of tropical backwater ecosystems is their biological diversity. The term biological diversity often shortened to **biodiversity** is an umbrella term used to describe the number, variability and variety of living organisms in a given assemblage. There are several levels at which biodiversity can be discussed. Two have historically dominated the literature: genetic and species diversity. Recently ecologists have begun to focus on a third level, ecosystem diversity. Genetic diversity represents the biological variation or capacity for variation within each species. It is critically important as it

allows organisms to adapt to changing environmental conditions and consequently to evolve into new life forms. Species diversity refers to the diversity in species that are important for the functions they perform in the generation of ecological services that are themselves important to human society.

Biological diversity in backwaters is fast eroding mainly due to state interventions through development projects that promote intensive use of resources and environment. In Cochin backwaters, for instance, the Cochin Port Trust and many other industries like aquaculture, tourism transport and navigation etc. have been using large quantities of resources for their activities. In addition to such uses, these industries have also been creating negative ecological/environmental externalities. No doubt, the choice of a development path that sacrifices environmental sustainability is primarily responsible for biodiversity loss. Degradation is also caused by the failures of markets, institutions and government policies (Swanson, 1995; Pearce and Moran, 1977). A major methodological issue is how these processes can be understood, explained and right inferences derived for drawing up plans and strategies that would ensure sustainable uses of Kayals without harming traditional stakeholders.

In the early literature on environmental economics, biodiversity degradation had been conceptualised as an externality. It was argued that since biodiversity is a public good and cannot be traded in markets, the stakeholders overexploit these assets (Pigou, 1920, Lindhal, 1958, Arrow, 1970;Dasgupta, 1996). Lack of an institutional arrangement to define and enforce property rights on the resources/environment, externalities, market imperfections and information asymmetries are all pointed out as reasons for market failures (Hanley et al, 1997). Thus it becomes very clear that, apart from a variety of hydro-bio-physical processes, biodiversity is degraded due to various social and economic processes internal to the system. External interventions are often found to accelerate the process of degradation. This interdependence calls for the use of a multi disciplinary enquiry towards an understanding of biodiversity and its degradation.

Studies which aim to characterise estuarine biodiversity normally begin with detailed enquires to capture the nature of diversities in species composition of the fish and shellfish, benthos, mangroves, birds, animals trees and vegetation, followed by ecosystem diversities and genetic diversities. This method obviously involves the employment of large manpower and monetary resources for intensive primary enquires. Given the limited time and resources available for this enquiry, a new track without directly adopting this popular methodology. Moreover, this approach popularly adopted by natural scientists, although useful for characterising various facets of biodiversity, does not explain the modes of human interactions with the biodiversity resources for making a living.

As the approach does not permit any meaningful practical suggestions of the issue under examination, this study tries to look at biodiversity degradation problem using a multidisciplinary approach. We begin first, by examining the hydro biological and physical processes of the backwaters over the last four decades to establish how diverse the system was in terms of its species diversity and diversity of ecosystem services. This will also enable us to establish how the kayal diversity had been changing over the years.

The study then proceeds to enquire the major causes for the degradation of biological diversity in the economic and social realms of the system. Economic theory highlights three fundamental causes viz. market failures, institutional failures and policy failures that degrade biological diversity (UNEP, 1995; Pearce and Moran, 1997). Economists argue that biodiversity, being an environmental good, does not get traded in a formal market between buyers and sellers so as to ensure an efficient and optimal allocation of resources and therefore, biodiversity will degrade when markets fail. There are many reasons for this. First, biodiversity is a public good, which once created cannot be denied in use to others. When consumption of one person (stakeholder) rivals that of another but both have legal access to the good, people (stakeholders) have an incentive to consolidate as much benefits the asset provides as soon as possible before others do. In such cases, people may over use the asset relative to what is best for the society. Secondly, markets fail due to the absence of well-defined property rights. Various kinds of externalities, asymmetric information and incomplete markets are also responsible for market failures. Biodiversity is not the mere concern of the present generation alone. Its social relevance for future generations has also been recognised in the literature. Therefore, it is argued that if biodiversity is to be preserved, Governments have to ensure well-behaved markets and take appropriate measures to overcome market failures.

The foregoing discussion reveals that the main reason for environmental damage is the failure of the market to provide the right signals. An important factor to be noted is that traditional institutions could address and mostly solve these problems with the collective efforts of local stakeholders. The failure of institutions to intervene in the conservation of biodiversity is therefore pointed out as responsible for its degradation (Dasgupta, Folke and Maler, 1994). Institutional failures can be local or global. Perrings (1995) views most of the institutional failures as local since ecosystems are localised ones. In his opinion, it is best to ensure that local communities are free to manage their own resources.

Even where traditional institutions were active in the governance of local resources, individual stakeholders could still violate the rules of governance in times of crisis. Poverty is pointed out as responsible for the violation of such rules. It is often postulated that poverty and population pressure result in environmental degradation arising out of natural capital depletion and high rates of population growth (Chopra, 1996). Violations could also arise from ecosystem disorders and other disturbances.

Although, traditional communities had their own institutional arrangements to share resources and environment and to share risks, they were never recognised when kayal ecosystems were drawn into centralised planned development processes executed by national and state governments. In fact, traditional institutions were viewed as obstacles for modern development and therefore, they were not socially or politically acceptable. This led to the creation of a number of modern institutions to replace traditional ones. Traditional institutions also failed in delivering the required services to different stakeholders due to socio-economic conflicts and the plurality of modern and traditional systems. In spite of drawbacks, traditional institutions and the corresponding property rights distributions had their advantages as they could enforce a social control over resources and the environment.

Governments of developing countries sometimes see the environment as an area to extend the role of the state (Pearce and Moran, 1995). After all, this is what one

experiences at least in the case of the kayal environment. These interventions are normally undertaken with the best of intentions of developing these areas and poor stakeholders experience the hardships of these initiatives. Interventions of Governments are aimed not only to correct market and institutional failures but also to provide the necessary legal and political support for better governance of these ecosystems. They may do this with the best of intentions, often to remove the main elements of externality caused by market behaviour. It can also introduce various incentive and penal mechanisms for regulating markets. Creation of appropriate structure of property rights with rights and responsibilities and the trading of such permits are economic tools proposed for the regulation of environmental quality in developed countries.

Despite good intentions, government interventions fail miserably due to many reasons and such failures could cumulatively add to the pace of biodiversity degradation in kayal ecosystems/ coastal zones. For instance, the government interventions could create state property, which in turn may contradict with traditional structure of community rights or common property rights. Secondly, in the process of defending state property claims, state in turn produce various externalities. Dredging externalities, pollution externalities, reclamation externalities are only a few such spillovers generated in the backwater ecosystem by the state [see chapter 5]. It is unfortunate that we do not have a comprehensive policy statement, which indicates how to use the estuaries and their environment. Policy failures are highlighted by examining the policies of the Government on the alternate use of estuarine space for fisheries, aquaculture, agriculture, tourism, navigation and trade through the Cochin Port Trust. We have also attempted to highlight the failures at the local level (say at the level of gram panchayat) and global level and argue that all these aspects have cumulatively contributed to the loss of biodiversity in the backwaters. In short, an attempt will be made in the study to examine the various issues related to market failures and government policy failures

Despite increasing recognition of the importance of wetlands in general and backwaters in particular, one of the major reasons for their slow degradation is that many consider them to be of little or no value. An important follow up therefore, is to value these resources and formulate policies in such a way that every individual stakeholder pays the

relevant price for using the resources and environment. Conducting an environmental economic valuation of biodiversity and then using resource prices to reflect these values normally solve this. However, a simple economic valuation study of biodiversity is highly inadequate to address the livelihood issues of the ecosystem communities who appropriate backwaters of Kerala for a living. Nevertheless it is important and has to be incorporated in all wetland projects interested in generating the real economic worth. But once a general picture is generated, or being accepted for policy formulations, there are chances that the approach may not help us to proceed further. While examining the socio-economic and livelihood issues of backwater ecosystems, one has to look at it from a broader perspective rather than just a matter of environmental valuation and degradation. In the larger context of evolving new scenarios, relying solely on such a valuation framework does not make any sense. Therefore what would be required is a holistic procedure that recognises the economic values and the institutional strengths and weaknesses to govern and ensure fair and equitable distribution of resources and environment. This means that one cannot write off the valuation framework as totally out of context. It does have a role to play as it gives an idea of the extent to which resources and environment are valuable for the national and global communities belonging to the present and future generations. Hence, we have attempted to modify this framework by analysing the role of formal and informal institutions in the allocation and governance of kayal environments. Furthermore, a multiple stakeholder environment such as backwaters requires a much broader institutional framework to work out local level management plans.

However, in the present study, we have undertaken only a valuation of the direct benefits of the ecosystem mainly to indicate how important these activities to the individual stakeholders are and how badly they may suffer in case the biological diversity of estuaries are degraded.

1.4 Scope of the study

This study is based on the Cochin backwaters, which is the largest tropical backwater body in South western side of the Indian peninsula.. Our study area, the Cochin backwaters, is a shallow brackish water which lies between 09° 40' - 10° 12' N 76° 15' - 76° 25' E in the Vembanad lake extending from Alleppey to Azhikode. This estuary has two seasonal openings into the Arabian sea-one at Parur (North) and the second at Andhakaranazhi- and a permanent opening at Cochin. During flood tide the seawater enters the estuary via Cochin bar mouth (12m depth) and the flow reverses during ebb tide. Seven major rivers (Chalakudi, Periyar Muvattupuzha, Meenachil, Manimala, Pamba and Achencoil) discharge fresh water into the estuary. The following figure shows the backwater ecosystem in relation to the rivers joining and the outlets to the Arabian Sea. **(SEE MAP)**

During the monsoon season, the backwater receives average rainfall of 3300 mm and the availability of rainfall has been reasonably stable during the last three decades. Similarly, the highest temperature is in April 32.2° C and the lowest in July 26.7° C. The difference in temperature from surface to bottom is about 1° C in dry season and is about 3° C in monsoon months. The temperature difference between the water at the upper reaches and lower reaches is less than 2° C in all months. The Cochin harbour has a dredged channel, which is 8m long, and this branches further into Ernakulam channel (3km) and Mattancherry channel (4km). The backwater also houses a number of small islands that have significant influence on the circulation of the estuary.

This study concentrates on a geographical space between Aroor in the south and Azhikode in the north, which lie within the boundaries of Ernakulam district. **(See Map 2)** The southern part of the backwater beyond Aroor is purposefully excluded from the study.

1.5 Sources of data and modes of data collection

Characterising biological diversity loss in Cochin backwaters should necessarily rely on a multidisciplinary approach as the process of degradation has been affected both by natural and socio economic forces. Therefore, two sets of database have been used in this enquiry. The first set of data refers to the natural processes while the second set falls

under the economic and social domain. There exists a large body of literature on various natural and physical processes of Cochin estuary through the scientific enquiries conducted by institutions like the School of Marine Sciences of Cochin University, the Centre for Earth Science Studies, the National Institute of Oceanography etc. As suggested by the experts, we surveyed these studies to make meaningful inferences on the nature of biological diversity loss of the estuary. The study makes an attempt to construct the hydrobiological setting of the study area by means of secondary studies. It then attempts a taxonomic classification of different species of flora and fauna found in the ecosystem to have an idea of the biological diversity of the backwaters.

The data on the causes of degradation such as industrial pollution, reclamation, dredging etc. have also been collected from secondary studies. The major cause for the degradation of diversity of estuarine resources, services and processes has been the ever-increasing doses of pollution emitted by the industries located along the banks of estuary. Many authors have examined the nature of backwater pollution and its impact on the ecosystem (Remani, 1979; Remani et al., 1983; Ouseph 1992). The project biologist attempted a critical examination of these studies and the findings establish clearly the loss of biodiversity. An attempt was also made to establish the nature of benthic population at different locations of the estuary at different time points. . We have surveyed studies to examine the spatial and temporal distribution of benthic population in the study area. Moreover, we have also attempted to correlate the magnitude of pollution on the distribution of biomass availability and distribution.

Kayal reclamation is another important cause for the degradation of biomass diversity. In fact, this process has been studied by various natural scientists (Gopalan, 1982; Subramanian, 2000). We made a detailed survey of such studies and collected secondary data to establish the nature and growth of kayal reclamation in the study area. Similarly, data on sedimentation was collected from previous studies while dredging data has been collected from the various administrative reports of the Cochin Port Trust. Although these studies have been made with different objectives, the survey of these findings provided useful and necessary information to highlight the nature of biological diversity loos in Cochin Backwaters.

The second set of data on economic and social factors influencing biodiversity degradation has been collected both from secondary and primary sources. Data on the population engaged in different economic activities in backwater has been collected from various issues of census reports. Demographic data is collected from various panchayat

records also. In order to examine the nature of various economic activities undertaken by different stakeholders, the entire study area (Azhikode in the north to Aroor in the south) has been divided into 2 zones on the basis of selected hydrobiological parameters. Zone I consist of an area between the Bar mouth and Azhikode in the north while Zone II covered the area from the Barmouth to Aroor. Zone I covered 14 panchayats, 1 Municipality and the Cochin Corporation. Zone II covers 7 panchayats and 1 municipality.

Primary data collected through field interviews and observations have been used to identify the major stakeholders living along the banks of this backwater **(see annexure 1.1)**. Their activities and existing property rights structures are captured using personal interviews. Secondary data was also relied upon to construct the evolution of rights. Village elders and leaders of different social and religious communities were interviewed. Information from the archives was also used.

Secondary data was used for evaluating the modern stakeholders. Details of revenue generated by the Port trust were obtained from its administrative report. Similarly economic values generated by the different players in the navigation industry, which included the Kerala Shipping and Inland Navigation Corporation, the State Water Transport Department were also obtained from secondary data. The value generated by private boat operators was computed using a questionnaire by interviewing a random sample of boat owners. In the case of the tourism industry, primary data was collected from all the major tour operators in the region who used the kayal for their activities.

Detailed primary interviews were conducted to highlight the nature of institutional failures. Data were collected from local grama panchayats, government institutions departments, social organisations like the Dheevara sabha, caste / religious institutions etc. A number of political leaders and social activists were also interviewed to substantiate the issues examined in this study.

1.6 Limitations of the study

As mentioned earlier, this study is a humble attempt to project the evolving environmental crisis faced by the people of the most advanced urban city, Cochin, of the state of Kerala. Cochin backwaters provide the natural energy to the city's economic and social life and its degradation therefore is a matter of concern to all interested in the well being of the people of this area. The importance of this study lies in placing biodiversity degradation of Cochin backwaters as the central theme of regional development. However, the study could not explore each aspects of the study in detail mainly due to shortage of resources to conduct detailed year round primary enquiries of various hydro-bio-physical relations and other economic social, political and legal aspects of biodiversity conservation. Still the manner in which the various primary and secondary information on the various facets of biodiversity degradation and its impact, have been compiled provides a clear picture of the evolving crisis on the environment and on the Kerala economy at large.

Annexure 1.1 List of major estuaries in Kerala

	Name of the Estuary / Backwater	District(s)	Area (Ha.)
Thiruvananthapuram			
1	Anchuthengu		521.75
2	Edava-Nadayara		157.65
3	Kadinamkulam		346.88
4	Poonthura		97.59
5	Poovar		30.93
6	Veli		22.48
	Sub total		
Kollam			
7	Ashtamudi		6424.15
8	Paravoor	Kollam	662.46
9	Kayamkulam	Alappuzha, Kollam	1652.33
Kottayam, Alappuzha, Ernakulam			
10	Vembanad	Ernakulam, Kottayam, Alappuzha	15845.89
11	Cochin	Ernakulam	7503.80
Thrissur			
12	Chettuva	Thrissur	713.87
13	Azheekode	Thrissur	82.02
14	Kodungalloor	Thrissur	613.81
15	Ponnani	Malappuram	757.19
16	Kadalundi	Malappuram, Kozhikode	407.41
17	Beypore	Kozhikode	783.74
18	Kallai	Kozhikode	160.13
19	Korapuzha	Kozhikode	1038.08
20	Kottapuzha	Kozhikode	584.12
21	Payyoli	Kozhikode	26.70
22	Rorapuzha	Kozhikode	1038.08
	subtotal		
Kozhikode, Kannur			
23	Mahe	Kozhikode, Kannur	180.17
24	Valapattanam	Kannur	3077.64
25	Dharmadam	Kannur	359.06
26	Palakkode	Kannur	598.25
27	Cheruvattur	Kasargod, Kannur	1153.70
	Sub total		
Kasargod,			
28	Chandragiri		575.81
29	Manjeswar		158.41
30	Nileswar		824.69

Annexure 1.2 Stakeholders in the Cochin backwaters.

Group	Values captured	Scale of Influence	Source of power	Interest/Aims
1. Indigenous people	Direct consumptive and productive values	Local	Very Limited	Livelihood maintenance, use estuaries for subsistence needs, fuel, fishing etc
2. Agriculturist		Local	Limited	Source of water for fields
3. Fishermen	Direct consumptive and productive values	Local	Limited	Source of Livelihood, fishing
4. Aquaculturist	Direct consumptive and productive values	Local	Limited	Source of Prawn seedlings, water for ponds
5. Clam fishermen	Direct consumptive and productive values	Local	Limited	Source of Livelihood, fishing
6. Small scale industries		Local	Limited	Subsidise the cost of coir processing ….
7. Modern Industries		National	Lobbying	Externalising cost
8. Port		International	Official Body	Profits, commercial activity
9. Tourism Industry	Indirect non consumptive values plus direct consumptive values	National / International	Slowly growing	Profits, commercial activity
10. Navigation Industry	Indirect non consumptive values	Local/ National/ some international links	Greater	
11. Government agencies		Local/ National/ some international links	Greater	

Adopted from Brown (1998)

CHAPTER 2

SPECIES DIVERSITY AND ECOSYSTEM FUNCTIONS OF COCHIN BACKWATERS

The manner in which different users appropriate various biological resources in backwaters depends on various natural and social processes. In fact, biological diversity is also composed of the diversity of various ecosystem services that sustain a diverse resource base. Since these services and resources are subject to various biophysical processes of backwater ecosystems, an examination of these features is an essential pre requisite for an understanding of biodiversity in backwaters and its degradation. This chapter undertakes this task with special reference to Cochin backwaters. The chapter is divided into four sections. We begin with an examination of the nature and growth of some crucial physico-chemical parameters that influence the primary productivity of backwaters in section 1 and discuss the nature of resource diversity, which include fish, and shellfish diversity, diversity of mangroves, benthos and planktons in section 2. In section 3 we describe the nature of major ecological services provided by Cochin backwaters. This is followed by a concluding section, which summarises the major findings of this chapter.

2.1 Factors influencing productivity of backwaters

As mentioned earlier, this study concentrates on a geographical space between Aroor in the south and Azhikode in the north, which lie within the boundaries of Ernakulam district. The southern part of the backwaters beyond Aroor is purposefully excluded from this study. It is interesting to note that the environmental quality of the southern zone (area between bar mouth and Aroor) is better than the quality of the northern zone (area between bar mouth and Azhikode). The following descriptions bring out the differences clearly.

2.1.1 Physical conditions of water

Backwaters provide a variety of resources for human livelihood. The ability of these ecosystems to provide such diverse array of resources and services depends crucially on physical parameters like depth, temperature, turbidity and light and chemical specificities like salinity, pH, dissolved oxygen, dissolved solids, inorganic compounds, phosphorus and nitrogen related compounds.

[a] Depth

Depth of a water body has an important bearing on the physical and chemical properties of water. A depth of 2 meters is considered to be congenial. The depth of the water body in the southern zone of the study area (Cochin bar mouth to Aroor) is found to be higher than the northern zone (bar mouth to Azhikode). [Table 2.1] The table also shows that the depth of the study area which ranged between 2.5 metres and eight metres in 1980's (Gopalan, 1983) declined further in stations to the south of Thanneermukkam bund and Bolgatti-Cherai region.

Table 2. 1 Variation of depth range in different locations of Vembanad Estuary during the past 50 years

Stations	Depth range at 1930s (in meters)[2 **]	Depth range at 1980s (in meters)[2]	Depth ranges in 2001++
South of Thanneermukkom bund	8-9	3-3.5	2.5-2.8
Between Thanneermukkom bund and Vaikom	8-9	3-4	3.5-4
Between Vaikom and South Paravoor	7-9	4-5	3.5-4.0
Between South Paravoor and Aroor	5-6	3-4	3-4.5
Between Aroor and South of Willington Island	7-8	7-8	7-8
Cochin harbour region	7-8	7-8*	7-8
Bolgatti to Cherai	3-4.5	2-2.5	1.5-2
Cherai to Munambam	3-6	2.5-4	2.5-4

*Source: 1.Gopalan, U.K, (1983) 2. Primary survey 2001. **Cochin ship channel maintained at 15m depths at constant dredging.*

[b] Temperature

Cochin backwaters receive optimum sunlight as received by any representative tropical estuary. The degree and annual variations in temperature of the water body have a great bearing upon its productivity. All metabolic and physiological activities and life processes such as feeding, reproduction, movement and distribution of aquatic organisms are greatly influenced by water temperature. In the tropics the variation in temperature over the months is minimal. (Nair 1983; Ouseph, 1992) and is stable in the entire study area. (See Table 2. 2).

Table 2. 2 Distribution of temperature in the study area

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1966	29.2	30	30.4	30.4	31.6	25	25.1	27	27.3	29	30.2	29
1992	28.2	29	31	31.5	33.3	27	25	27	28	30	31	28

Source: Nair 1983

[c] Turbidity

The turbidity of a water body is due to the presence of suspended inorganic substances such as clay and silt or due to planktonic organisms. The distribution of turbidity in the study area reveals that in the industrial belt of Eloor where large number of industries is located, the turbidity is very high compared to areas like Kadamakudi and Mulavukadu (Ouseph, 1992:). Table 2.3 shows the extent turbidity in selected locations of Cochin backwaters.

Table 2.3 Distribution of turbidity in the study area.

Turbidity (ppm)					
Eloor	2237	1765	2000	1768	1298
Kadamakudi	447.2	425	417.3	382	411
Mulavukad	9.5	10	13.8	11	12

Source: Ouseph, 1992

It can be seen that the southern zone is relatively less turbid compared to the northern zone.

2.1.2 Chemical conditions of water

We shall now turn to the discussion of some of the major chemical features.

[d] Salinity

Salinity varies from place to place, season to season and surface to bottom. During monsoon, salinity ranges between 0.19 ppm and 3.2 ppm. And from October onwards salinity increases to a maximum of 33.5 ppm due to tidal effects. An analysis of data on the distribution of salinity in different locations of the backwater in 1962 and 1992 (see table 2.4) reveals no significant variations (Nair, 1983: and Ouseph, 1992:).

Table 2.4 Distribution of salinity in different locations of the Cochin Backwaters

Salinity	Jan	Feb	Mar	Apl	May	Jun	July	Aug	Sep	Oct	Nov	Dec
South Aroor	26.3	26	29.4	32	3.3	11.1	0.00	0.00	0.00	2.1	6	11.1
North Njarakal	24.2	28.1	28.8	30.5	2.4	15	0.8	0.2	14.9	1.4	3.2	7.2
General	32.14	31.96	32.5	33.33	31.18	12.82	1.4	2.07	6.5	6.4	11.24	20.08

[e] Dissolved oxygen

The optimum level of dissolved oxygen in the backwaters varies between 3 ml/lit to 4 ml/lt. It is observed that, the oxygen values are normally higher in the saline prone regions of the backwater and decreases as salinity decreases. This inference has a major implication for our study areas An analysis of the distribution of oxygen values at different locations in the backwater reveals that the level remains within the tolerance limits mentioned above in most of the months of the year except the monsoon months. (Nair, 1983). Table 2.5 shows the monthly distribution of DO in the study areas.

Table 2.5 Distribution of dissolved oxygen in Cochin backwaters

Dissolved oxygen	Jan	Feb	Mar	Apl	May	Jun	July	Aug	Sep	Oct	Nov	Dec
South Aroor	2.6	2.8	2.7	3.5	3.6	4.5	4.6	4.8	4.0	4.1	2.00	1.90
North Njarakal	3.00	2.7	3.1	2.3	2.9	3.6	4.5	5.0	4.2	3.7	1.3	0.8
General 1966 1992	 5.04 4.17	 4.50 5.04	 4.73 4.7	 3.95 4.8	 4.64 4.6	 2.65 5.6	 3.44 6.4	 3.41 3.04	 3.96 4.2	 4.42 4.4	 4.17 4.5	 4.71 4.64

A comparative analysis of the distribution of dissolved oxygen in 1966 and 1992 shows that, except in June and July, the levels do not show any substantial variation. (Ouseph, 1992:). This shows that the dissolved oxygen content has been more or less stable over the last three decades in the selected locations of the study areas.

[f] pH.

It is normally recognised that the optimum level of pH in the water body varies between 7 and 9. Jhingran (1982) reported that in 1966 the level of pH in Cochin backwaters varied between 7.0 and 8.4. Another enquiry to this aspect at selected locations shows that the pH varies between 6.2 and 7.0 (Gopalan, et.al: 1992). Table 2.6 below shows the values of pH in at different locations of the backwater during 1980-81

Table 2.6 Physico-chemical parameters1980 (pH)

Azhikode	Cherai	Njarakal	Mulaukad	Cochin	Aroor	Kumbalam	Vaikom	Thaneer mukkom	Alleppey
7.00	6.9	6.9	6.5	7.0	6.5	6.5	6.5	6.7	6.5
7.5	6.5	6.5	6.5	7.0	6.5	6.5	6.5	6.5	6.2

Source: Gopalan et al, (April 1980- March 1981)

This means that, the level of ph has been remaining stable for the last three decades. However in Eloor, the level of pH is recorded at 3.1 showing an acidic pH (Unnithan,Vijayan, Radhakrishnan & Remani.,1977 :pp) This is instrumental for high mortality rate of the fish population in this area.

Inorganic compounds.

The primary productivity of backwaters has also been influenced by the distribution of nutrients, nitrogen and its compounds etc. This section reviews the available literature on these aspects, which is aimed to throw some light on the availability and variability of these factors in the study area.

[g] Nutrients:

Table 2.7 gives the distribution of levels of nutrients in Cochin backwaters in 1990.

Table 2.7 Levels of nutrients in a typical estuarine station near Cochin (Unit- mg /l)

Month 1990	Jan	Feb	Mar	Apl	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Phosphate	2.16	2.02	4.32	11.42	3.94	5.43	15.11	1.96	1.52	1.57	0.83	0.83
Nitrite	1.26	0.21	0.35	1.28	3.90	1.55	1.15	0.23	1.08	0.10	0.34	0.23
Nitrate	Nil	-----	98.48	11.52	7.16	16.19	33.25	6.59	2.99	0.91	4.88	nil
ammonia	7.12	5.49	7.82	25.09	30.82	21.80	15.96	5.63	4.02	nil	0.27	nil

Source: KunjuKrishna Pillai, 1991

The inorganic **phosphate** concentration in bottom water varies between 0.11µg /l and 2.8µg /l, the highest value obtained June-July and the lowest in November. The maximum phosphate content is observed during the monsoon period and minimum during post monsoon period.

[h] Nitrite values are subjected to little fluctuation and range between 0.3µg /l in January to 4.8 µg /l in June. The maximum values are during the monsoon period and minimum during the pre monsoon.

[I] Silicate content showed a peak of 155 µg /l and was recorded in July and lowest value was 12 µg /l recorded in December. During monsoon period high concentrations of silicate recorded.

Nutrients coming from the rivers may be utilised by phytoplankton, which in turn serves as a food for other organisms.

[j] Organic matter in the sediment: Organic content in the sediment varies from 0.9 % to 2.2% by weight of dry sediment. It is relatively high in the area during pre-monsoon period than in other seasons. The physical characteristics of the sediment influence the accumulation of organic matter in the sediment. It is seen that silty clay sediments have higher content of organic matter while sediments with higher sand content had lesser organic matter. The high percentage of organic content is related to the land humus associated with the detrimental sediment brought into the estuary by rivers.

The foregoing analysis of physical and chemical parameters reveals that high acidic environment is seen near Eloor industrial area which is harmful to fish and shell fish diversity. The highest values of phosphate, nitrate and silicate during monsoon months shows a blooming in phytoplanktons rendering good supply of food to the organisms during these months, and at the same time results in the overgrowth of aquatic weeds.

2.2 Major phytoplankton species available in Cochin backwaters

The analysis of various physical and chemical parameters of Cochin backwaters has been undertaken mainly to provide an insight into the capacity of primary production in backwaters. This section details the distribution of the primary production/productivity of Cochin backwaters. Fishery resources of the estuaries are directly linked to the primary productivity, which comprises mainly of phytoplankton including blue green algae [10]. As a matter of fact, there exists a large body of literature dealing with various aspects of primary productivity in Cochin backwaters. Main phytoplankton species available in

Cochin backwaters fall under three broad groups, viz. ***Diatoms, dinoflagelleates and blue green algae***.

Diatoms

Amphora sp, Asterionella japonica, Biddulphia mobiliensis, Chaetoceros sp. Coscinodiscus perforatus, Coscinodiscus radiatus, Coscinodiscus sp.,Fragilleria oceanica, Gyrosigma balticum, Navicula spp., Nitzschia closteriium, Nitzschia longissima, Nitzschia serriata, Pleurosigma normanii, Pleurosigma Elongatum, Rhizosolenia robusta, Rhizosolenia spp, Skeletonema costatum Suriella spp. ,Synedra spp. and Thallasionema spp.

Dinoflagellates

Ceratium furca, Ceratium spp., Dinophysis spp., Peridinium pentagonum, Peridiniumclaudicans, Peridinium depressum and Peridiniumspp

Blue Green Algae

Oscillatoria spp., Nostoc spp. Anabaena spp.

It can be seen that 21 species in the first group, 7 species in the second and three species in the third group have been identified in the study area. Gopinathan (1972) found the presence of 120 species of phytoplanktons during pre-monsoon months in the backwaters. The harbour area is the most productive. Later, Kunjukrishna Pillai et al (1975) found highly significant spatial variation in primary production during February 1971 to January 1972. Table 2.8 gives the monthly distribution of primary productivity measures at different locations in the backwaters.

Table 2.8 Primary productivity measurements (Production mg C/m^3/day)

Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Fort Kochi	1825	538	899	1375	719	448	432	561	2548	3900	1850	2880
Mattancherry	1615	432	2012	773	1200	360	1010	911	1134	3400	1130	1740
Willingdon Is.	2035	432	2012	773	1200	360	1010	911	1134	3400	1130	1740

Barmouth	3124	612	716	644	789	503	438	486	715	3600	1034	965

Source: Gopinathan, 1974

The secondary producers (Zooplankton) depend on phytoplankton for their food and are responsible for the production and growth of tertiary producers such as fishes, shellfishes etc). The major zooplankton communities are copepods, crustacea larvae, euphausids, mysids, amphipods, cladocera, pelagic tunicates, polychaete larvae, chaetognaths and the larvae of fishes and other organisms. According to Rao et al (1975), the seasonal and spatial distribution of the zooplankton reflects salinity changes in the backwater. The biomass and the total number of zooplanktons were higher during pre monsoon period. Crustaceans constituted about 93% of the total annual zooplankton counts. Kunjukrishnapillai (1991) has also found similar proportion in 1991.

The basic motive for analysing the physico-chemical parameters at different locations of the estuary in the previous section was to establish the changes in these parameters and to examine how such changes have influenced the estuary's primary productivity that determines the availability of various fish and shellfishes. The discussions show that most of the parameters examined lie within the tolerable critical limits even today. The next section examines the factors influencing the nature and growth of benthic fauna in the study area.

2.2.1 Distribution of benthic fauna in Cochin backwaters

Diversity of benthos

Benthic environment forms a link in the food chain of edible resources and plays a vital role in deciding the health of the ecosystem. These non-edible organisms are polychaetes, echiuroids, sipunculids, molluscs, crabs, echinoderms, certain benthic plants, sponges and corals, protozoa and coelenterates. Kurien et al (1975) reported a decline in benthic fauna during the monsoon months. Many scientists have examined the impact of dredging by Cochin port trust on benthos A recent study by Rashid et, al. (1998) reveals a reduction of bottom fauna immediately after dredging. Similarly, Sarala Devi et.al (1979) have shown

the absence of benthic life at the effluent discharge area of Udyogmandal. High levels of Zn and Cu have caused damages to the benthic life in the vicinity of effluent discharges. A decade later, Saraladevi (1989), **examining the variations in macro faunal biomass and population density at various locations of the backwater, concluded that the benthic diversity in Eloor, Kalamasseri area has been significantly lower.** Similarly, analysing the distribution of population density of benthic fauna in different locations of Cochin backwaters in 1989, Saraladevi and Venugopal observed a remarkable reduction both in the biomass and population density in stations near Eloor .See table 2.9 for details.

Table 2.9 Distribution of population density of benthic fauna in different locations of Cochin backwaters in 1989

Stations	Pre-monsoon		Monsoon		Post monsoon		Annual	
	Pop. Density	Biomass	Pop.	Density	Pop. Density	Biomass	Density	Biomass
Near barmouth	6351	36.10	404917	388.00	23241	47.78	192124	197.76
Mulavukad	3,422	11.01	2,794	8.86	5,754	31.76	3,773	15.69
Varapuzha down	11,398	102.82	1,416	7.90	11,046	10.26	6,765	34.43
Varapuzha	12,997	377.78	3,088	148.90	1,389	21.15	5,327	176.50
Eloor	2,642	23.10	20	0.36	126	0.82	764	8.98
Old panchayats	1,863	8.36	1,415	20.50	1,121	4.69	1,171	12.87
Panchayats jetty	665	2.78	43,547	130.60	2,449	8.42	20,643	62.43
Eloor	**423**	**1.34**	**22**	**0.07**	**9**	**0.07**	**128**	**0.42**
Kalamassery	1,547	8.30	1,281	8.50	631	5.46	1,178	7.64

Source : Saraladevei & Venugopal, 1989

The foregoing discussions revealed the nature of basic natural and physical conditions of Cochin backwaters. The analysis indicates that the ecosystem is retaining its average health expressed through the existence of a diverse floral and faunal composition. However, in certain locations where external interventions are high (due to industrial pollution or dredging activities etc.) a low diversity of organisms is reported. This is a major concern as the fish and shellfish diversity in backwaters depend on the over all health of the ecosystem. In the next section we shall explain the nature of fish and shellfish diversity in the study area.

2.2.2 Diversity of mangroves in Cochin backwaters

Mangroves in and around Cochin backwaters are heavily destroyed. The remaining scattered patches of mangroves are now found in Vypin, Vallarpadam, Malippuram, and Mangalavanam in the north zone and Kumbalam, Panangad, Chellanam and Kumbalangi in the south. The major species recorded in these areas are Avicennia officinalis, Rhizophora mucronata, Excoecaria agallocha, Acanthus ilicifolius, Bruguiera gymnorrhiza (Badaruddin, 1992)

2.2.3 Fish and shellfish diversity

The diverse forms of organisms described above, are responsible for a diverse supply of fish and shellfishes to the fishermen. Studies on the diversity of fish and shellfish populations of Cochin backwaters are very few and they are limited to certain locations. An attempt is made in this section to bring these data together. Kurup (1982) has compiled a detailed listing of the species available in Cochin backwaters. He reported that there were at least 150 species available during early eighties in the backwaters.

43 species (*Labeo dussumieri*, *Megalops cyprinoides*, *Anguilla bicolor bicolor*, Amblypharyngodon mola, Puntius filamentosus, Punctius amphibius, Punctius sarana, Mystus gulio, Wallago attu, Tachysurus subrostratus, Hyporhamphus xanthpterus, Hyporhaphus limbatus, Strongylura strongylura, Xenentedon cancilla, Platicephalus indicus, Ambassis dayi, Ambasis gymnocephalus, Terapon jarbua, Sillago vincenti, Sillago sihama, Caranx sexfasciatus, Lutjanus argentimaculatus, Gerres filamentosus, Gerres setifer, Dendrophysa ruselli, Daysciaena albida, Scatophagus argus, Sarotherodon mossambicus, Etroplus suratensis, Etroplus maculatus, Valamugil cunnesius, Liza macrolepis, Liza parsia, Stenogobius malabaricus, Oxyurichthys tentacularis, Oxyurichthys microlepis, Oxyurichthys nijsseni, Glossogobius biocellatus, Glossogobius giuris, Brachiurus orientalis,Cynoglossus puncticeps, Chelonodon patoca) were classified as resident species and were available round the year.74 species were classified as migrant species while 17 species were vagrant species and the availability of these species is shown in table 2.10 below.

Table 2.10 Species calendar of Cochin backwaters

No	Migrant Species	J	F	M	A	M	J	J	A	S	O	N	D	Total
1	Dasyatis uarnak				x	x	x							**3**
2	Dasyatis sephen	x	x	x	x	x	x	x			x	x	x	**10**
3	Elops machnata	x	x	x	x	x							x	**6**
4	Muraenesox bagio	x	x	x	x	x	x						x	**7**
5	Pisoodonophis boro		x	x	x	x	x							**5**
6	Dussumieri acuta	x	x	x	x	x							x	**6**
7	Sardinella longiceps	x	x	x	x								x	**6**
8	Escualosa thoracata	x	x	x	x	x				x	x	x	x	**9**
9	Nematalosa nasus	x	x	x								x	x	**5**
10	Anadontosoma chacunda	x	x	x	x	x	x			x	x	x	x	**10**
11	Ilisha sirishai	x	x	x	x	X								**5**
12	Ilisha melastoma	x	x	x	X									**4**
13	Stolephorus indicus	x	x	x	x	x						x	X	**7**
14	Stolephorus Commersoni			x	X									**2**
15	Stolephorus waitei	x	x	x	x	x				x	x	x	x	**9**
16	Stolephorus insularis	x	x	x	x	x	x	x		x	x	x	x	**11**
17	Thryssa setirostris	x	x	x	x	x	x	x		x	x	x	x	**11**
18	Thryssa mystax			x	x	X								**3**
19	Thryssa puruva						x	x	x	x	x	x	x	**7**
20	Thryssa camalensis	x	x	x	x	x							x	**6**
21	Chanos chanos						x	x	x	x	x	x		**6**
22	Mystus occulatus							x	x	x	x	x		**5**
23	Horbagrus brachysoma	x	x	x	x	x						x	x	**7**
24	Ompok bimaculatus	x	x	x	x	x						x	x	**7**

25	Heteropneustes fossilis			x	X									**2**
26	Strongylura leiura leiura	x	x	x	x						x	x	x	**7**
27	Tylosorus crocodilus crocodilus	x	x	x	x	x					x	x	x	**8**
28	Gambusia affinis	x	x	x	x	x							x	**6**
29	Atherina duodecimalis	x	x	x	x	x							x	**6**
30	Platicephalus indicus	x	x	x	x	x	x			x	x	x	x	**10**
31	Lates calcarifer	x	x	x	x	x								**5**
32	Ambasis commersonii		x	x	x	x								**4**
33	Megalaspis cordyla	x	x	x	x									**4**
34	Alepes dieddaba	x	x	x	x									**4**
35	Carangoides praeustus	x	x	x	x	x							x	**6**
36	Scomberoides tala	x	x	x	x	x	x	x		x	x	x	x	**11**
37	Trachinotes blochii	x	x	x	x									**4**
38	Lutjhanus jonii	x	x	x	x	x							x	**6**
39	Lutjhanus flaviflamma	x	x	x	x	x	x	x		x	x	x	x	**11**
40	Lutjhanus ruselli		x	x	x									**3**
41	Pomadasys hasta		x	x	x									**3**
42	Plectorhynchus nigrus			x	x									**2**
43	Lethrinus microdon	x	x	x	x	x	x					x	x	**8**
44	Mylio berda		x	x										**2**
45	Johnius belangeri		x	x	x									**3**
46	Upenus vittatus	x	x	x	x								x	**5**
47	Parupeneus indicus	x	x	x	x	x							x	**6**
48	Drepane punctata	x	x	x	x	x								**5**
49	Nandus marmoratus			x	x									**2**
50	Valamugil seheli	x	x	x	x	x							x	**6**
51	Valamugil speigleri	x	x	x	x	x	x					x	x	**8**
52	Liza subverdis	x	x	x	x	x	x				x	x	x	**9**
53	Sphyraena jello	x	x	x							x	x	x	**6**
54	Eleutheronema tetradactylum			x	x	x	x							**4**

55	Eleotris fusca						x	x						**2**
56	Butis butis	x	x	x	x	x				x	x	x	x	**9**
57	Gobiopsis macrostomus	x	x	x	x	x					x	x	x	**8**
58	Acenrogobius viridipunctatus						x	x	x	x	x	x		**6**
59	Acentrogobius caninus						x	x	x	x	x	x		**6**
60	Taenioides buchanani		x	x	x									**3**
61	Taenioides cirratus	x	x	x	x	x	x						x	**7**
62	Trypauchen vagina	x	x	x	x						x	x	x	**7**
63	Acanthurus mataoides	x	x								x	x	x	**5**
64	Siganus javus							x	x	x				**3**
65	Siganus canaliculatus	x	x										x	**3**
66	Channa striata	x	x	x	x	x								**5**
67	Anabas testudineus	x	x	x	x	x						x	x	**7**
68	Mastacembalus guentheri	x	x	x	x	x	x	x					x	**8**
69	Mastacembalus armatus				x	x								**2**
70	Pseudorrhambus arsius	x	x	x	x	x				x	x	x	x	**9**
71	Solea ovata	x	x	x	x								x	**5**
72	Cynoglossus bilineatus	x	x	x	x									**4**
73	Triacanthus brevirostris	x	x	x	x	x							x	**6**
74	Tetradon fluviatilis	x	x	x	x	x							x	**6**
	VAGRANT SPECIES													
75	Thrysoidea macrurus			x										**1**
76	Mystus malabaricus												x	**1**
77	Saurida undosquamis		x											**1**
78	Rhynchorhamphus georgii			x	x									**2**
79	Ambassis thomassi											x	x	**2**
80	Alectis indicus				x									**1**
81	Scomberoides tol				x	x								**2**
82	Lutjanus rivulatus			x	x									**2**
83	Gerres abbreviatus			x	x									**2**

84	Protonibea diacanthus		x											**1**
85	Upeneus sulphurous				x									**1**
86	Bunaka gyrinoides				x									**1**
87	Synbrachus bengalensis				x									**1**
88	Synaptura commersoniana			x	x									**2**
89	Siganus lineatus			x	x	x								**3**
90	Sardinella gibbosa		x	x	x									**3**
91	Tetradon leopardus			x	x									**2**

The analysis reveals that 43 (32.09 %) species were available for 12 months, 42 (31.34%) species were available for a period of six to 10 months, 25 (18.66%) species were available for three to six months and the remaining (17.91%) were available for one or two months only.

2.3 Diversity of ecological services and functions of Cochin backwaters

Ecosystem services of backwaters are valuable supporting services, which influence the organisation of economic activities. An important function that adds value to estuaries is its tidal functions. When salt water enters into the estuary and mixes with fresh water during high tides, a healthy habitat is created for various living organisms. Section 2.2 discussed the nature of fish and shellfish diversity in Cochin backwaters. Similarly, when water recedes during low tide a variety of pollutants and wastes are taken into the oceans. This function in fact subsidises the cost of cleaning of the local population and local bodies including the Cochin Corporation. A large of traditional farmers has been stocking juveniles of prawns in pokkali paddy fields and earning livelihood. The ecological services of mangroves in the Cochin backwater belt are highly valuable to the domestic communities and others. The backwater tourism values and sport fishing potential are also highly valuable to the domestic and foreigners alike. The traditional vallamkali for instance inspires thousands of domestic and foreign tourists. The shore stabilisation functions and sedimentation functions are useful in many ways to the poor people in this

area. A detailed list of such ecosystem services delivered by the backwater is provided below in Table 2.11

Table 2.11 Environmental functions of backwater ecosystems

	Ecosystem Service	Ecosystem Functions
1	Gas Regulation	Regulation of atmospheric chemical composition
2	Climate Regulation	Regulation of global temperature, precipitation and other biological mediated climatic processes at global or local levels
3	Disturbance Regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations
4	Water Regulation	Regulation of hydrological flows
5	Water Supply	Storage and retention of water
6	Erosion Control & Sediment Retention	Retention of soil within an ecosystem
7	Soil Formation	Soil formation processes
8	Nutrient Cycling	Storage, internal cycling, processing and acquisition of nutrients
9	Waste Treatment	Recovery of mobile nutrients and removal or breakdown of excess of xenic nutrients and compounds
10	Pollination	Movement of flgametes
11	Biological Control	Trophic-dynamic regulations of populations
12	Refugia	Habitat for resident and transient populations
13	Food Production	That potion of gross primary production extractable as food
14	Raw Materials	That potion of gross primary production extractable as raw materials
15	Genetic Resources	Sources of unique biological materials and products
16	Recreation	Providing opportunities for recreational activities
17	Cultural	Providing opportunities for non commercial uses

Adapted from Costanza, d'Arge, de Groot, Farber, Grasso, Hannon, Limburg, Naeem, O'Neill, Parulo, Raskin, Sutton & van den Belt, 1997. The value of the world's ecosystem services and natural capital. Nature: 387: 253-260

However, it is doubtful whether the local bodies and the people at large recognise the free delivery of the ecosystem services of backwaters and care for their sustainability through

careful monitoring of economic activities of agents. The governance of these systems also fails due to conflicts and policy and institutional failures. We make no attempt to estimate the ecological and non-use values of backwaters in this study due to financial and time constraints.

2.4 Summary and conclusions

A large proportion of the coastal population of Kerala depends on Cochin backwaters for their daily bread from time immemorial. This was made possible due to the high degree of biological diversity of backwaters. In this chapter we made an attempt to characterise the fish and shellfish diversity, diversity of mangroves and benthos and also highlighted the diversity of ecological services provided by Cochin backwaters to humanity. A detailed survey of previous studies conducted by natural scientists enabled us to reconstitute the nature of biodiversity of Cochin backwaters. The analysis reveals that the Cochin backwater still retains reasonable standards of water quality in many areas except in selected pockets where industries are heavily concentrated. The shocks imposed by the modern stakeholders through industrial activities are unbearable most of the time, but the system does not show serious signs of collapse due to the free delivery of ecosystem services of the backwater. The scenario is likely to worsen if proper environmental governance is not undertaken with people's participation

CHAPTER 3

RESOURCE USERS OF COCHIN BACKWATERS

Cochin backwaters had been the major source of livelihood to various rural communities since time immemorial. The vast wealth of fish and shellfish resources were the target of local fishermen while the saline wetlands were traditionally used by agrarian farming communities to cultivate an organic variety of paddy called *Pokkali.* After harvesting the crop, the paddy fields are converted for prawn culture. This crop rotation sustained their economies for a very long period. Relatively poor people in villages, resorted to *coconut husk retting, coir making, transport* of passengers to other places, called *kadathu*, *collection of lime shell* and other minor produces obtained free from the kayal environment. Poor households also engaged themselves as *wageworkers* in kayal related economic activities of the owner communities.

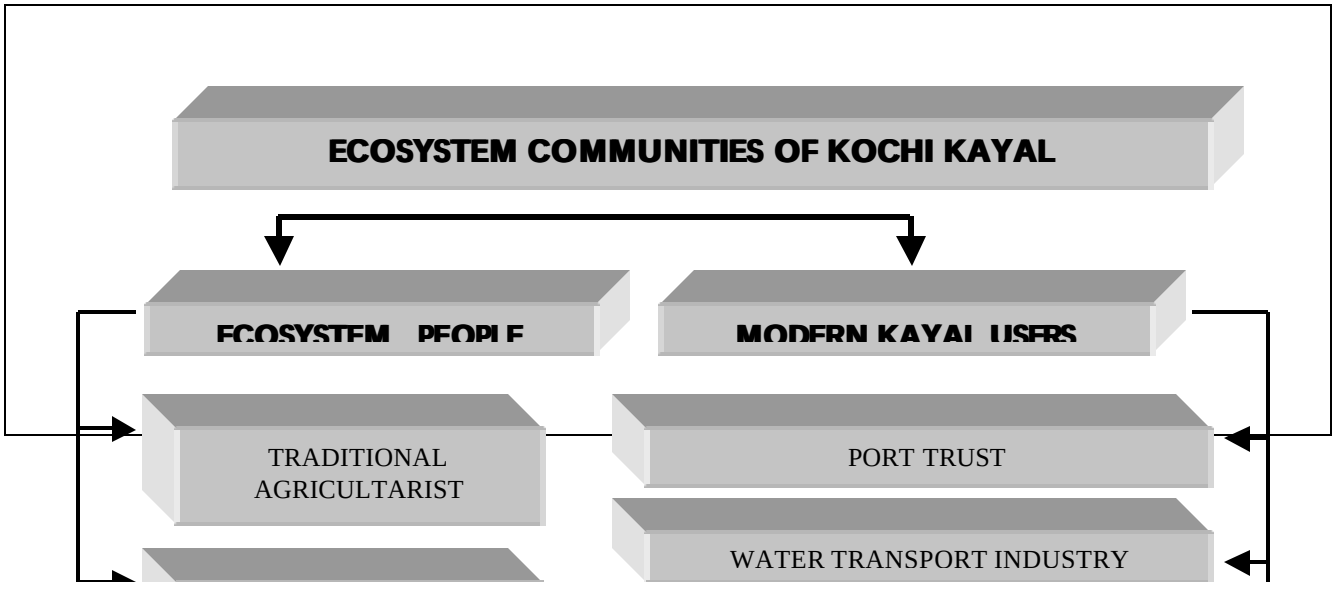
An interesting feature of this subsistence economy is its feeble economic surplus, which prevented traditional village communities from undertaking any substantial investment for coastal zone development. However, the desire of local communities to achieve economic progress demanded their integration with the main land. The state sponsored development programmes and projects were therefore considered the right choice of development path for achieving economic progress and high living standards. This resulted in the entry of a number of large and small-scale industries, the Cochin *Port Trust,* and firms in the navigation, transport and tourism sectors into the kayal environment with the mission of regional development.

The purpose of this chapter is to introduce different resource users of Cochin backwaters and to explain how they appropriated the resources and environment. We begin with the traditional users and then introduce the modern stakeholders one by one in sections that follow. Finally we shall also indicate how, over the years, different groups enforced their claims over backwater resources and the nature of possible conflicts arising fromthe enforcement of such property rights. This is essential to understand how the market for backwater resources and environment fails due to the absence of a well-defined structure of rights over resources. A brief summary of this chapter follows.

3.1 Ecosystem communities of Kochi kayal

The major users of Kayal resources are divided into two broad categories: the ecosystem people and the modern users. The ecosystem people are the traditional agriculturists, the fishers, the rural communities engaged in small-scale activities like coir making, lime shell collection and processing sand and clay mining and the womenfolk. The modern claimants of the biodiversity resources are the Cochin Port Trust, modern manufacturing industries located on the banks of the Kayal and river Periyar, Inland water transport industry, mechanised ferry/ junkar service industry, modern aquaculture industry, the urban construction industry and the inter national leisure industry. In addition to the above mentioned direct resource users, the national and international communities also use kayal biodiversity indirectly and in that sense constitute the set of indirect stakeholder. Finally, state being the custodian and regulatory authority is also considered as an important stakeholder of this environment. It is the major investor and at the same time, the custodian and manager of the estuarine resource. The following diagram pictures the direct beneficiaries of Cochin backwaters.

As the traditional rural communities are poor, the surplus generated from economic activities by these stakeholders was not sufficient to instigate any major forms of investments on modern economic activities. Consequently, the state had to invest for the over all development of the region. It has been an active participant in many activities at various levels. Most of the major industries and activities taking place in this area have government backing. Apart from promoting the modernisation processes in the kayal economy, the state has also been actively involved in crafting policies for the governance of kayals.



There is no doubt that estuarine biodiversity is a matter of concern of every Indian citizen and the world community at large as they are also benefited indirectly in many ways by the existence of these ecosystems. Therefore the beneficiaries of biodiversity are divided mainly into direct users, indirect users and non-users. People who directly appropriate estuarine resources and environment are called the direct users. The commonly seen direct resource users are the fisher folk, the agriculturists, the aquaculture farmers, the wage workers related to these sectors including women. Indirect users are those who do not use the resources but benefits from the indirect environmental services provided by the estuary. The non-users on the other hand, are the national and world community who do not use the services directly but are concerned about its existence and willing to pay for the sustainable use of resources and conservation of environment. Among all these groups, the immediate resource users are to be listed first due to their active involvement in exploiting backwater resources and environment.

3.2 Distribution of population

The total population of the three taluks of Ernakulam district where our study area lies is shown in table 3.1 below.

Table 3.1 Distribution of population in the study area during 1971-1991

Estuarine Taluks	1971	1981	1991
Parur	281047	320987	350364
Kochi	396849	451059	484004
Kanayannur	498884	607084	699867
Sub total	1176780 [49.4%]	1379130 [53.6%]	1534235 [54.5%]
DIST. TOTAL	**2383178**	**2571294**	**2817236**

Source: census data for respective periods

It can be seen that in 1970-71, 49.4 percent of the population in Ernakulam district was settled along the banks of Cochin estuary interacting directly or indirectly with this environment. In 1980-81 this has increased to 53.6% and later in 1990-91 this has further increased to 54.5 percent. This establishes without doubt the fact that the dependence of the human population on the estuarine environment has been consistently increasing over the last few decades. Of this total population, a substantial proportion has been engaged in wetland agriculture known as ***pokkali*** cultivation.[9]

3.1.1 Cultivators and agricultural labourers.

Of this total population substantial proportion of the population had been engaged in wetland agriculture since time immemorial. It is estimated that of the 127930.07 hectares

[9] Pokkali paddy cultivation is an organic farming system that is common to around 20,000 hectares of land in the low-lying areas of Trissur, Ernakulam and Alleppy districts. In the Monsoon season, from May to September, a single crop of the saline tolerant variety locally known as Pokkali is cultivated. The soils of the Pokkali tract are rich in organic carbon, phosphorous and medium to high in Potassium content.

During most of the year, these areas are saline in nature however, just before the rainy season, they are kept fallow and free of water for a short period. During which, Mounds of soil, about half a centimetre high and one meter width are made and allowed to dry up. Soon after, Monsoon follows and with it the saline content of the soil is washed away. Once the topsoil is cleared of salts, germinated paddy seeds are sown on the mounts. The mounds serve as nursery. After 30-40 days, stage transplantation is done by a system known as "Vettieru" whereby, the mounds are cut along with a few seedlings and thrown into the main fields evenly spreading them. Other than the transplanting method, the sowing method can also be employed a lot though this practice is not commonly followed except for a few particular areas. Chemical fertilizers and pesticides are not used.

of wetlands in Kerala, 34199.57 hectares (26.73%)are inland and 93730.50 hectares [73.27%] are coastal. In fact, estuaries and kayals together constitute 33.67 percent of the wetlands .See table 3.2 for details

Table 3.2 Distributions of Wetlands in Kerala

Wetland type	Kerala Area (ha)	Ernakulam Area(ha)
Aquaculture pond	8059	6198
Abandoned quarry	2334	-
Creek	875	-
Estuary	36968	21274
Kayal	6100.5	-
Lake/pond	1973	-
Reservoir	22368.87	132
Rocky coast	2972	-
Sand/beach	34082	2648.969
Tidal/mudflat	4674	-
Water logged	7226	549
Tank	90	-
Water logged sea	207	-
Total	**127929.4**	**30801.97**

Source: Kerala Fisheries: Brackishwater Resources at a glance, 1992

Wetland agriculture is an age-old occupation of the farmers of Ernakulam district. The records of nineteenth century (1863)* indicates that wetlands constituted about two third of the total geographical area and coconut plantations along with residential areas covering the rest. One third of the total geographical area of the present Ernakulam District comes as wetlands (see annexure 3.1 for details).

Wetland farming is normally undertaken in pokkali lands for a period of six months from May to September. After the crop is harvested the lands are used for prawn farming either by the owner himself or by contractors who lease in these lands from private landowners for prawn farming.[10] Table 3.3 below shows the distribution of cultivators in the study area.

[10] Filtration is a suitable aquaculture traditionally practised by the people of estuarine waters and Cochin backwaters is not an exception. Commercially important prawn varieties such as *Penaeus monodon, P. indicus, Metapenaeus monocerus, M. dobsoni* etc enter the backwaters at their early life stage and these predating prawns with the tidal waters are allowed into already prepared fields. The periodical harvesting of seeds with the help of sluice nets are known as filtration.

Table 3.3 Distribution of cultivators in the study area: 1971-91

	1971	1981	1991
Parur	3917 [4.57 %]	3265 [4.42 %]	4234 [5.21 %]
Kochi	1118 [1.30 %]	627 [0.85 %]	855 [1.05 %]
Kanayannur	5986 [6.98 %]	4125 [5.58 %]	5437 [6.70 %]
Sub total	11021 [12.85 %]	8017 [10.85 %]	10526 [12.96 %]
District total	**85787 [100 %]**	**73915 [100 %]**	**81198 [100 %]**

Source: census data for respective periods

The table reveals that there is small decline in the number of cultivators in the district as a whole. Except, in Parur taluk, the number of cultivators has declined marginally in the other two estuarine taluks. Table 3.4 shows the distribution of agricultural workers in the study area.

Table 3.4 Distribution of agricultural workers in the study area

	1971	1981	1991
Parur	10984 [8.68 %]	7581 [5.84 %]	10033 [7.28 %]
Kochi	3387 [2.68 %]	1927 [1.48 %]	2672 [1.94 %]
Kanayannur	19545 [15.44 %]	13569 [10.45 %]	14762 [10.70 %]
Sub total	33916 [26.80 %]	23077 [17.77 %]	27464 [19.92 %]
Total	**126574 [100 %]**	**129848 [100 %]**	**137921 [100 %]**

Source: census data for respective periods

The usual practice is to auction the fields to contractors after the paddy harvest. The contractor who bids the highest and pays a whole lease amount before the commencement of the operation is awarded the lease. Lease is generally only for a period of 4 months, in order to enable preparing the field for rice cultivation. The lease amount varies according to the location and nearness of the fields to the bar mouth, depth, productivity of the fields etc. The lessee has to take a license on a nominal fee of Rs. 15/- per acre, which is levied by the State Department of Fisheries. In areas where there is no paddy cultivation but only filtration, the lease is awarded for a whole year. The lease amount varies from Rs. 4000 to Rs. 6000/- per hector depending on various factors. Kalakkipidutham marks the end of the prawn filtration season.

This table shows that agricultural laborers in the study area have declined steeply during 1971-91. The Kochi and Kanayannur taluks experienced the largest decline.

3.4 Traditional Fisher folk

The distribution of total fishermen population recorded in various censuses is reproduced in **table 3.5**

Table 3.5 Distribution of livestock, fishing, hunting and allied activities in the study area during 1971-91

Estuarine taluks	1971	1991
Parur	5653 [16.00 %]	10526 [16.92 %]
Kochi	11581 [32.78 %]	18530 [29.79 %]
Kanayannur	5524 [15.64 %]	9271 [14.90 %]
Sub total	22758 [64.42 %]	38327 [61.61 %]
Total	**35330 [100 %]**	**62209 [100 %]**

Source: census data

The table shows that around sixty percent of the fishing population in the district is concentrated in these three taluks.

Table 3.6 provides the data on population of inland fishermen in Ernakulam district. (See **annexure 3.2** for details of brackish water fishing villages)

Table 3.6 Distribution of Inland Fishermen Population in Ernakulam district.

Year	Ernakulam District				State
	Male	Female	Children	Total	Total
1980-81	17656	16946	16948	51550 [47.55]	108414 [100]
1998-99	21969	21366	21147	64482 [28.03]	230069 [100]

Source: Directorate of Fisheries

This table shows that although the total inland fishermen population of the state has doubled during the decade, the proportion of inland fisher population in Ernakulam district has declined from 47.55 percent in 1980-81 to about 28.03 percent in 1980-81.

A large proportion of the inland fisher folk are engaged in capture fisheries in the backwaters using a variety of gears. Fishing is an year round activity and is uniformly distributed across the entire brackish water space except in areas of high pollution and protected territories of the Port trust and Ship Yard. **[See annexure 3.3 & 3.4** for the names of various fishing gears and their distribution. Chapter 5 gives details**]**. Clam fishery also supports livelihood of about 5000 families in the study area **[See annexure 3.5]**. Traditionally this raw material was used as manure in the coconut plantations and for other domestic uses. However, with the development of modern cement manufacturing units in Kerala and nearby states the demand for lime shell has considerably increased in recent years.

In addition to these two major ecosystem communities mentioned above a large number of people were also engaged in coir making, traditional ferry services, clay and sand mining, kayal related manual works etc. The exact number of such people is not available at present.

The description above reveals that the agriculturists and fishers (the ecosystem people) have been using Cochin backwaters from time immemorial. It was the main source of livelihood for them and they had their own historical systems of sharing resources.

Modern stakeholders of the backwater economy

We now introduce the modern claimants of the estuarine space. There are many players. The Cochin Port Trust; major and small scale industries established along the banks of the estuary, modern navigation industry, national and international leisure industry are only a few such ventures discussed in this section.

3.5 Cochin Port Trust

Cochin Port Trust, which started its operations during the early 1930s, is a Central Government public sector company offering various services to firms engaged in the export import business, **[See annexure 3.6]**. The first chart of developing Cochin into a deep-sea port was made way back in 1835 itself. The idea was constantly developed and in 1920, development works of the harbour started. In 1929, the first approach channel of 450 ft. wide was cut and the sediments were used to reclaim Kayal for the activities of the port trust. This was probably the first organised reclamation of the estuarine ecosystems in the country. In 1930-31, the port trust was thrown open for vessels and in 1936 the government of India took over the administration of this port.

In 1964, the Cochin port trust was formally constituted under the Major port trust act of 1963 with defined boundaries and title deeds. Hence, the Port Trust emerged as a major stakeholder in the Cochin backwaters with exclusive rights over a large estuarine space and legal titles and power to enforce its property rights. The **Port Trust Act** has assigned a given area to the Port Trust, the jurisdiction of which lies with the Port Trust Authority. Any activity, which takes place within this area, requires the prior permission of the Port Authorities. **[See Annexure 3. 7 for details]**

3.4 Modern navigation industry

Inland canals of Kerala have considerable potential for both passenger and goods transport. The state has about 1900 km of navigable waterways. The main canals viz. the West Coast canal has a length of about 555 kms, made up of a string of backwaters connected together by navigable rivers and artificial canals, in addition to feeder canals. Inland water transport operations in the State are carried out by agencies, which involve Government departments or organizations like the Inland Waterways Authority of India (**IWA),** Kerala Shipping and inland Navigation Corporation (**KSINC),** State Water Transport Department (**SWTD)** and private enterprises

3.4.2 Inland Waterways Authority of India [IWA]

The IWA of the government of India had identified 10 important waterways, all passing through the Cochin backwater system in Kerala and declared them as national waterways as of February 1st 1993.[11] The movement of cargo along this waterway has been entrusted to the Central Inland Water Transport Corporation (CIWTC). With this declaration, the Central Inland Water Transport Corporation has also emerged as a stakeholder in the Cochin backwaters. It may be noted that IWA through CIWTC has carried a cargo of 34,01,872 tones through Cochin backwaters to different destinations of Kerala.

3.4.4 Kerala Shipping and Inland Navigation Corporation

The Kerala Shipping and Inland Navigation Corporation works under the Coastal Shipping and Navigation Department .The state owned Kerala Shipping and Inland Navigation Corporation Limited (KSINCO) set up in December 1975 with a capital of Rs one Crore, acquired vessels and entered into the cargo transport and passenger service business. The company has been in the field of commercial transportation in Cochin backwaters since August 1977. The Corporation undertakes ferry services to 2 major destinations in Ernakulam. The present fleet strength of the corporation consist of 4 bulk cargo carriers, 3 petroleum tankers, 2 phosphoric acid barges, 2 portable water barges, 12 passenger boats, 2 Jhankars and 1 speed launch. With two barges the corporation is transporting drinking water to the islands of Vypeen and Murukkumpadom.

3.4.5 State water Transport Department

The State Water Transport Corporation was formed in 1968 under the State Water Transport Department with its headquarters at Alleppy[12]. This department offers navigation services to the tourists and to local

[11] Considering the need to develop Inland Waterways and Inland Water Transport, the Government had identified 10 important waterways for consideration to declare them as National Waterways. This includes the Kollam-Kottapuram stretch of West Coast Canal (168 km) along with Champakara Canal (14 km) and Udyogmandal Canal (22 km) in Kerala with effect from 1 February 1993 have so far been declared as National Waterways and the same are being developed for navigation by Inland Waterways Authority of India.

[12] The State Water Transport Corporation is concerned with providing transport services to the public, its activities mainly confined to the 4 Districts of Alleppy, Ernakulam, Kottayam and Quilon as mentioned earlier. The State Water Transport Corporation did not initially operate in the Ernakulam district. It was the Water wing of the Kerala State Road Transport Corporation that operated Ferry services in the Cochin Backwaters. As on 01-07-1994, Ernakulam District, SWTD took over.

inhabitants and industries around the Cochin backwaters **[see annexure 3.8 for details]**. The total revenue of SWTD has increased from 135.65 lakhs in 1990-91 to Rs. 408.8 lakhs in 1998-99. However, it may be mentioned that, the firm is continuously incurring losses to provide these services to the estuarine communities

3.5 National and international leisure industry of Cochin backwaters

It was mentioned in the introduction that apart from the direct goods and services to different stakeholders, the backwater environment also provides rich potential for the development of leisure industry. In fact, modern backwater ecotourism is built on capitalizing this environmental service. This section briefly introduces the major firms/players of this industry

It is true that the local communities had traditional rituals that recognized environmental values of backwaters. This is what one experiences in the communal sport "vallamkali" **[see annexure 3.9 for details]**. However, commercial backwater eco-tourism undertaken by modern enterprises is a relatively new experience. Tourism in the Cochin backwaters is fast developing as an industry with potential for high levels of profit at low investment. Consequently the number of stakeholders involved in this business is numerous. The major stakeholder is of course the Government, which plays an active role in tourism promotion. Along side are the private tour operators, Travel agencies and private tourist boat operators.

Route	No. of Trips	Distance	Total Distance
1. Kumbalm – Arookutty	8	6	48
2. Arookutty – Edacochi	5	4	20
3. Panavally – Panagad - Eda kochi	1	14	14
4. Ernakulam – Mulavukad	22	9.6	211.2
5. Ernakulam – Panavally	6	25	150
6. Ernakulam – Perumalam	4	22	88
7. Ernakulam –Vypeen	26	4	104
8. Panavally – Kumbalam	2	3	6
9. Mulavukad – High Court	14	7	98
10. Ernakulam Alappuzha	2	70	140
Total	90	164.6	879.2
State Total	553	1749.2	7131

Source: SWTD Administrative Report

Government of Kerala has adopted many policies that promote backwater tourism. The State Tourism Department is very active in the sphere of tourism promotion. Each district has District Tourism Promotion Council, which is actively engaged in delivering various tourism services. Since this is a new industry, tourism promotion activities are eligible for tax exemptions. Licenses are not required for operation in this field. However the boat crew is required to have a driver's license from the Port authorities. Local governments, till now do not have any direct dealings with these operators.

Micro enterprises in the private sector of this industry are divided further into private tourist boat operators, travel agencies and speedboat operators. Private tourist boat operators provide boats on hire. They have no fixed destination but a fixed rate per hour. They can be hired to travel to any location in the backwaters. The tour operators on the other hand provide package tours, which not only have fixed charges but fixed timings as well as routes. They offer four main types of packages. There is the city tour, the sunset tour, Village backwater canal tour and the houseboat ride. Many travel agencies also arrange tours in the backwaters. This however comprises a small part of their total business. Speedboat operators also have a stake in this region. Their boats are hired both for tourism and transportation purposes. They have fixed rates per hour but no fixed routes.[13] The tourism industry claims to provide employment opportunities to the local people. Unfortunately, this industry so far has not generated rural employment on any substantial scale.

Thus we note that modern stakeholders who use backwater environment and resources vary widely. The Port Trust uses the brackish water body for its smooth shipping operations. In order to ensure the minimum depth for ship transport, it dredges the water body causing dredging externalities. Modern industries on the other hand emit wastes into the water body causing pollution externalities.

3.7 Structure of Property Rights on Cochin Backwaters

Backwaters are indivisible common property resources. In addition to a beautiful serene environment, Cochin backwaters supply a variety of biological and non-living resources and many useful ecological services. An important pre requisite for the sustainable

[13] It is very difficult to obtain an exact number of the total number of tour operators in this region due to the wide scatter and ill organized nature of these activities. However, a rough primary survey of the Cochin backwaters gives the number of boats owned by the KTDC as 2, by private package tour operators as 4, speedboat owner as 15 and by the private tourist boat owners as 35. A single houseboat also operates in the backwaters as opposed to a hundred, which operate in the Alappuzha region.

exploitation of these resources and environment is a well-defined regime of property rights. This section details the nature of backwater property rights regimes on Cochin backwaters.

3.6.1 Evolution of Customary Rights

Property defines access to the resources and environment. For traditional stakeholders backwaters are common property resources whose appropriation had been guided by well-defined social norms and customs.[14]. Various forms of customary rights centered on fisheries and pokkali agriculture existed in backwater economies. This section details the nature of such rights in the study area.

3.6.1.1 Evolution of fishing rights in backwaters

The fishermen were mainly targeting on the potential of the fisheries wealth from backwaters. We have already indicated in chapter 3 that this wealth is highly diverse and seasonal and its availability depended mainly on ecosystem functions. The tidal functions (locally known as **veliyirakkam and veliyettam**), the inflow of fresh water from river systems and the existence of supporting ecosystems like mangroves, benthos, planktons etc. were therefore important and valuable for the fishermen. Their modes of defining and enforcing an appropriate bundle of rights and the production conditions therefore depended on the above mentioned ecosystem services.

[14] These relations were the outcome of interactions of these communities with the ecosystem for making a living. The process of resource sharing and the organisation of various production processes of fisherfolk and other rural communities had been influenced by their perceptions of ecosystem services too and in that sense these ecosystem functions and services were valuable for traditional communities

Most of the fishers perceived (and still believe) the half of the brackish water territory between their shore and the neighbour's as their village property. Although customary rights have evolved from the above notion, fishers did not always defend local boundaries. In fact, when fishing is over, mostly in the morning, other stakeholders were allowed to use these territories for activities like lime shell collection, sand and clay mining, traditional ferry services etc. These activities were normally undertaken without disturbing fishing activities.

Having defined boundaries and excluded other potential uses from these fishing territories, they shared these areas themselves. This sharing depended on the type of gears used by individual gear groups. For instance, the Stake net or **Oonnivala** was traditionally the monopoly of the **Dheevara** caste. Historical evidences indicate that the king had issued royal writs **(Theethorams)** to the **Valans** for the services (supply of fish, organise voyages of the king and soldiers etc.) rendered to him. Certain fishing areas of the backwaters were assigned to the **aravans** [15] (headman of valan community) even free of tax. These rights were later on distributed among other **valans** in return for the payment or a fee. These fishermen were entitled to fix stake nets in such assigned territories and thus **aravans** got the monopoly of fishing in certain pockets. Although the king issued fishing rights to aravans, these were redistributed among individual households through Ponambans [16] who were the caste leaders of the valan community.

[15] The Valans have their tribal organization and their headman, ARAVAN or ARAVAR is appointed by the 'Theettoram' or royal writ used by the Raja and the head man appoints other social heads called 'ponambans' who are stationed at each desom (village) or kadavu (landing place) to collect tax. The valans are expert rowers and posses the special privilege of rowing from Tripoonithura the boat of his highness the raja for his installation in the Cochin Palace. When the aravan with sword in hand had to stand in front of him in the boat. Further on the occasion of the journey of his Highness the Raja through the backwater or on the occasion of state functions such as visit of the British Resident, the Governor or other dignitaries, the Head man has to lead the way as an escort in the Snake boat as they are called to supply the requisite number of men for rowing the boats of these high officials and other members of the establishment. He also has to see that during their stay at the Residency, they are furnished with all the necessary fish food for all of which the men are endowed with the privilege of fishing in certain assigned areas of the backwaters free of tax. They were later deprived of the privileges and given a wage for the services rendered to the state, which levies a tax on fishing. Arvans thus got the monopoly of fishing in certain pockets. These rights were later on distributed among other valans in return for the payment of a fee.

[16] The headman (Aravan Or Aravar) appointed other social heads (ponambans) who were stationed at each desom (village) or kadavu (landing place) to collect tax. Each ponambans ruled his area of jurisdiction (Muri) with a firm hand. The right to issue Ooru velakku, fire and water vilakku gave him immense power over his people. All matters of dispute were brought to him for settlement. Although the king issued fishing

Ponambans normally distributed fixing rights to individual households by collecting a fee. He also intervenes in fishing disputes and suggests solutions, which were normally obeyed by gear owners. (Iyer 1909)

Fishing rights hence granted stayed in the family passing from one generation to the next. A license fee, however, had to be paid in this regard. Water being indivisible, the right to fix an **Ooni-nira** (a row of stake nets) was always allotted in relation to landmarks and varies from place to place depending on the width of the water channel and flow of currents and tides. It is reported that Oonni niras were normally fixed at a minimum distance of 16-18 links from the bank. The fisherman was sole owner of the area allotted to him and no one else could fish there unless royally decreed otherwise.

The evolution of fishing rights around Chinese nets, on the other hand, was not very clear in historical records. Households who owned landed property adjacent to the brackish water body fixed Chinese nets in front of their lands normally. No one could install nets on the water adjoining in front of the property of a land owner without consent or payment of a rent, which generally varied between eight and 18 rupees depending on the ignorance of the net owner. A number of Chinese nets were thus erected on the banks of backwaters without affecting the activities of other gear owners and stakeholders.

Efforts were made during the British regime to legalise the operations of stakenets and Chinese nets. The British government levied Rs. three per net as tax for using fixed nets on the backwaters. Although the Chinese nets were not allocated to any particular cast, the newly converted Christian fishermen owned the major portion of these nets today.

Rights to fish over backwater territories were enforced by the respective gear groups mainly by excluding other gear groups and other stakeholders. In fact, this was a routine activity performed every day by the respective gear groups lasting a couple of hours depending on the tides and availability of resources. These territories remained open to

---

rights, it was the Ponamban who saw to it that all disputes related to it were resolved. Consequently, there rarely arose any disputes that developed to large-scale conflicts within a clan. But this fishing community showed all the characteristics of a tribal organisation

all other stakeholders to organise other economic activities during the rest of the day. However, the cost of enforcement of individual property rights on the entire water body was obviously unbearable and therefore, accesses to this backwater body had appeared to be free, exhibiting characteristics of a free-access property regime. In fact, this feeling has done more harm to the ecosystem and is primarily responsible for the degradation of biodiversity in backwaters.

3.6.1.2 Evolution of Rights on Wetlands

The agricultural communities on the other hand, had enforced their rights mainly on the wetland territories adjoining backwater body. These wetlands are subject to saline intrusion through channels and inlets carrying brackish water into the fields. Although this imposes a "natural externality" to the human population, the process of tidal functions delivered a large quantity of prawn and fish seedlings, nutrients and waste dissemination through change of water.

The history of rights on the wetlands adjoining Cochin backwaters dates back to the evolution of organised brackish water wetland agriculture, locally called "pokkali krishi. Pokkali agriculture in the low-lying belts of Cochin was an occupation that was generally undertaken by the upper classes of the society. Two types of land tenure systems were reported in the low-lying fields around Cochin backwaters (Kumar, 1999). The first category was *Pandaravaka* (State property). It was either rented to individuals or managed by state officials (Naduvazhis/ Desavazhies). The second category was the Puravaka (private property) of Jenmies and mostly controlled by the *Nayars*. Territorial boundaries were well maintained and kept by state officials and no one disputed it. Individual owners strictly maintained the outer boundaries of their paddy fields. During the period of prawn filtration, however, it was difficult to delineate and protect boundaries. But once filtration was over, these boundaries were once again well maintained. As majority of lands was the property of the King, which was leased out on rent, outsiders were careful not to encroach on these rights.

A change in this patter occurred with the fleeing of the Brahmins from Karnataka to Kerala due to religious persecution in 13 AD. The ideology of land to the temple as atonement for sin, led to large-scale transfer of property to Temples. Jenmi rights were extended to Brahmins and Nampoothiries. Temple Trusts and Devaswoms were constituted for the management of such lands and they were leased out to tenants on rent. Temples became the single largest owners of landed property next to the King.

This pattern of rights changed with the coming of the Land reforms. The first tenure legislation of Cochin was the settlement Proclamation of 1905. Various other Acts, ordinances and laws were passed before the Kerala Land Reform Act, 1963, Kerala Land Reform (Amendment) Act, 1969 and the Kerala Land Reform (Amendment Act,) 1971. " Land to the Tiller" changed the nature of property ownership and rights that were associated with its use. Although many of the Temples lost a good share of their lands, they still managed to retain control over crucial water channels and inlets. This helped them to maintain their control over the resource and its production possibilities to a great extent. In certain regions, panchayats gained control over such resources. In the new scenario, owners of such water channels gained greater power, access and control.

Today, most of the Pokkali fields are organised as padashekarams as they are called. Padashekaram were originally a collective *of individual neighbourhood farmers* with fields that vary in size. Individual farmers make the cost for cultivating paddy while the padasekharam undertakes collective investments like construction of bunds, cleaning of inlets and maintenance of sluice gates etc. During the period of prawn filtration, the whole area is leased out to an outside party. In most cases, the Devasom Trust controls the crucial water channels to these fields and therefore engulf a major portion of the lease amount. Private individuals also control some channels and hence are eligible for their share of the lease amount. In return, they are responsible for the timely pumping in and out of water from the fields and the maintenance of the outer bunds. They are permanent owners of the land, which in most cases have been passed on from generation to generation. There are very few instances of people leasing out land for very long periods (that often extend to years) or leases without fixed periods.

3.6.1.3 Customary Rights of Agricultural Labourers

The description on traditional property rights on brackish water resources will not be complete until we mention the customary rights of the local agricultural labour classes. Pokkali cultivation in fact is a highly labour oriented activity and large numbers of local people were employed at various stages of cultivation. The landlords and the tenants alike expressed this mode of demand for local labour. To reciprocate the services drawn, the owners of land granted fishing rights to the labourers. These customary rights, known locally as ***Kalakkipidutham is*** prevalent even today.[see chapter 7 for a detailed description of this customary right system in the village Kumbalangi]. Kalakkippidutam provides free access to the labour class, especially the local women, to earn an income from fishing in pokkali fields and ensure livelihood securities during the rainy season. Today, kalakkippidutham meets the requirements of the local ***Pulaya and Kanakkan*** women in the study area.

To summarise, the major claims of this section, we make the following remarks. First, the analysis has shown that backwater ecosystems were never a free access resource. Various kinds of customary rights existed on the backwaters. Fishermen exercised fishing rights on the brackish water territories while agrarian communities exercised their rights on wetlands along the low-lying fields. The local labour also enjoyed customary right for extracting fishery resources from prawn filtration farms, which is locally known as kalakkippidutham. As the fishing communities and agrarian communities enforced their claims on different resource endowments and territories, inter community interaction was extremely poor among traditional stakeholders. In other words the rights defined and enforced by fishing communities and agricultural communities were mutually exclusive. Fishermen were treated as polluted subaltern classes by the landed gentry and this social distance exists even today.

3.6.2 State Interventions And Property Regimes

Although communities engaged in fishing and agriculture were the traditional owners of backwaters, many activities based on ecological services such as navigation services,

were mainly organised by the state itself by creating suitable bundle of rights for the smooth conduct of such activities. In the past, these services were organised by the King himself. This has led to a general feeling among the public that backwaters belonged to the King. Since kayal was the major medium of transport to distant places and to other parts of Kerala (erstwhile Travancore state), both the Travancore and Cochin Monarchies levied taxes from traders and others for using the water channels of this backwater. This has further strengthened the belief that the kayal belongs to the King.

Exercising this power, the king allowed fishing rights to various groups who were helping him in his fiscal administration law and order, war and transport services. Wetlands were also given to trustworthy subordinates close to the administration. Hence, excepting places where fishermen and agricultural communities established rights, the Kayal was treated as a freely accessible property. Consequently, incentives for conservation or optimal use have never existed. Many of the important function that these estuaries performed like shore stabilization, mangrove functions, delivery of global services etc have also been ignored.

Once the State government came to power, the confusion in defining and enforcing property rights on the kayal environment continued. First, the state was not quite sure whether to accept and legalise the customary rights of traditional communities. Secondly, the state being the custodian of environment had to decide the nature of management of this resource. The government did not acknowledge the already existing rights and traditional management regimes. It merely continued the policy that was followed by the British government.

An important factor contributed to the state take over of backwater environment was related to the nature of primitive rural surpluses made by the traditional communities and the lack of incentives for bringing up investments in modern activities. Given the low economic surpluses and the local demands for development, the state itself was forced to invest in development projects. The development of the modern stakeholders is to be seen in this context. Having promoted such activities, the government distributed the

responsibility of management to various State departments and Government agencies. Thus, the Irrigation department of the State Government is responsible for managing inland waters that includes backwaters. The bar mouth and port area has been segregated and given to the Port Trust for management. Land areas bordering the kayal came under the jurisdiction of the Cochin Corporation, Greater Cochin Development Authority, Port Trust or panchayats depending upon their geographic location. The government also came out with a new set of rules and regulations in continuation of old policies that were to be adhered to by different stakeholders regarding use. (See annexure 4.11 for details)

3.6.3 Property Claims Of Modern Stakeholders

We have pointed out in section I of this chapter that a number of modern stakeholders were actively involved in using Cochin backwaters in recent years. The most popular ones being the port trust, the navigation industry, the leisure industry and the manufacturing industries. This section explains how these stakeholders define and enforce their rights on the resources and the environments of the backwaters.

Property rights of Cochin port trust were created by an act of Indian parliament. The act claims that the boundaries of Port shall comprise of all areas contained on land lying within 45.76 meters (50 yards) of high water mark, Kerala backwaters and the Sea bounded by straight lines joining the following positions.

The northern boundary begins from a point on the Ernakulam foreshore (10°00’ 44.5”) roughly up to the Thevara peninsular region to a point on the eastern shore of Vypeen

Island in position latitude…….. and then along the high water mark on the Vypeen shore via Cochin harbour entrance to a point on the western shores of Vypeen island and thereon to a position in the sea 9 nautical miles due west due west in latitude … …

The southern boundary begins from a point on the southern end of Thevara to a point on the Eda Kochi shore along the high water mark on the Mattancherry shore via Cochin harbour entrance to a point on the western shore near Mundamveli and there to a position in the sea 9 nautical miles due west. The western boundary is a straight line at sea joining the other two lines. The eastern boundary shall lie along the high water mark on the Ernakulam Foreshore between the northern and southern boundaries defined above. In addition to all these areas, the Port Trust shall also have jurisdiction on all land reclaimed or to be reclaimed in future, from the backwaters or the sea.

This is the first time, in the history of Cochin backwaters that such exclusive property rights were defined to promote industrial activity. It may be recalled that no such declarations were acceptable even in principle for the state in the case of backwater fishing. This declaration affected economic activities of traditional stakeholders. The construction of jetties, the use of a Chinese fishing nets the operation of fishing and passenger boats within the boundaries of the Port required license.

State has also nationalized major waterways in Cochin backwaters through appropriate notifications to give a big boost to the state sponsored **national inland water transport industry**. This enabled the industry to accelerate its activities many fold compared to the already existing traditional water transport industry, mostly operated by domestic communities. **Modern industries,** on the other hand, treated backwaters as a freely accessible territory where their pollutants can be dumped. Creation of any form of rights on the backwaters would hence be faced with severe resistance from this powerful industrial lobby, as the creation of such rights will enhance their abatement costs considerably. Hence, they regarded backwaters as an **open access** resource.

Recently, the government of Kerala has decentralized its modes of public governance and issued clear instructions about the nature of ownership on water bodies. According to the provisions made in the Kerala Panchayat Raj Act 1994, article 218, the estuaries belong to the village panchayat. The article states the following:

218 Vesting of water course, springs, reservoirs, etc in village panchayats

1. Notwithstanding anything contained in the Kerala Land Conservancy Act 1957 (8 of 1958) or in any other law for the time being in force, **all public water courses** (other than rivers passing through more areas, than the panchayat area which the government may, by notification in the gazette, specify), **the beds and banks of rivers, streams, irrigation and drainage channels, canals, lakes, backwaters** and water courses all standing and flowing water, springs, reservoirs, tanks, cisterns, fountains wells, kappus, chals, stand pipes and other water works including those used by the public to such an extent as to give a prescriptive right to their use whether existing at the commencement of this act or afterwards made, laid or erected and whether made, laid or erected at a cost of panchayat or other wise and also any adjacent land, not being private property appearing thereto, **shall stand transferred to and vest absolutely in the village panchayat. ……**
2. Subject to the provisions of this act, all rights and liabilities of the government in relation to the water courses, springs, reservoirs, tanks, cisterns, fountains wells, kappus, chals, stand pipes and other water works vested in the village panchayat under sun section (1) shall from the date of such vesting be the rights and liabilities of the village panchayat

3. Notwithstanding anything contained in sub section (1) or sub section (2), the government may, by notification in the gazette, assume the administration of any public source of water supply and public land adjacent and appertaining thereto after consulting the village panchayat and giving due regards to its objections, if any.

4. It shall not be lawful for any person to remove or appropriate for himself, any tree, earth, sand, metal, laterate, lime shell or such other articles of value as may be notified by the village panchayat from any land which is transferred to or vested in the village panchayat, …. under this act whether a puramboke or not except under and in accordance with the terms and conditions of a permit issued by the village panchayat in this behalf and on payment of such fees and compensation at the rate determined by the village panchayat. (Kumar, 1997:127-28)

From the above sections it becomes increasingly clear that the backwaters and some of its resources are vested with the local village panchayat and individual stakeholders will have to acquire prior permission for using the resources. Nowhere the law recognises those local communities especially the fishermen and the pokkali farmers possess traditional rights over backwaters.

The analysis on the nature of property rights on backwaters reveals the existence of multiplicity and plurality of rights. Traditional common property relations co-exist with state property. Free access property relations are also quite strong especially among those who want to pollute backwaters. This confusion over rights and responsibilities of different stakeholders has done more harm to the stock of various biological resources, ecological services and is primarily responsible for the evolving economic crisis in backwaters.

Conclusions

The Cochin backwaters had been a major source of livelihood for various rural communities that lived on the banks of this backwater. The pokklai farmers, the fisherfolk, the aquaculturist, clam pickers, the small scale kayal based industry workers etc have eked out a living from these systems for centuries. However these users had a subsistence economy with feeble economic surplus, which prevented traditional village communities from undertaking any substantial investment for developing this zone. The state was therefore assumed to have a responsibility in undertaking such kind of development programmes and projects. This brought in new stakeholders like the port, the navigation and tourism industry, modern industries etc and each group had its own means of appropriating the resources and the environment of Cochin backwaters. In

addition to the traditional and modern stakeholders, the national and international communities as indirect users and the state as a regulator of the environment also form part of this stakeholder group. Agriculturists and fishers (the ecosystem people) have always been the most prominent users of this ecosystem from times immemorial. It was the main source of livelihood for them and they had their own historical systems of sharing of resources.

The process of resource sharing and the organisation of various production processes specific to such resources among rural communities had been influenced by their perceptions of ecosystem services too and in that sense these ecosystem functions and services were valuable for traditional communities. Rights over fishing territories were enforced by respective gear groups during the process of fishing mainly by excluding other gear groups and other stakeholders even while their territories remained open to all other stakeholders to organize other economic activities. Therefore this has lead to a general perception that the backwater ecosystem did not belong to anyone in particular and was therefore open to all for use. Subsequent State rules and regulations have reiterated this feeling. This however, is a misguided notion. The kayal environment has always belonged to these ecosystem people and no management strategy excluding this claim of theirs would be effective.

Annexure 3.1 Distribution of total area of Ernakulam District of Kerala (ha).

Ernakulam District	60-61	70-71	80-81
Total Geographical area	7,84,381	3,17,428	2,35,319
Forest	136551	55212	8123
Land put to non agricultural use	407999	27430	29587
Permanent barren uncultivated land	28519	4219	2124
Permanent pasture & grazing land	11082	2000	189
Land under miscellaneous trees	24188	321	1349
Cultivable waste	24012	3064	5255
Fallow land	27590	5935	6462
Net area sown	491695	219251	182230
Total cropped area	5,45,588	2,84,651	57,277

Source : Compiled from Economic Review.

Annexure 3.2 Inland Fishing Villages declared by the State Fisheries Department

	Fishing villages	No. of fishermen
1	Vadakkekara	7558
2	Puthenvelikkara	5698
3	Kadamakudi	952
4	Ezhikkara	10155
5	Mulavukad	3900
6	Cheranellur	1480
	Sub total	**29743**
7	Maradu	1457
8	Kumbalam	4839
9	Udayamperur	9340
10	Ernakulam west	1079
11	Thripunithura	3578
12	Nadamagramam	2537
13	Ernakulam east	2398
14	Kumbalanghi	2261

15	Palluruthy	5492
	Sub total	**32981**

	Male	**21370**
	Female	**20783**
	Children	**20571**

Source: Kerala Fisheries, Facts and Figures, 1992

Annexure 3.3 Classification of Gears and other fishing methods that were prevalent in the Cochin Backwaters

I. Gill net	II. Seine net	III. Stake net	IV. Dip net	V. Cast net	VI. Lines	VII. Indigenous methods
Catla vala	Chemeen koru vala	Oonni vala	Kamba vala	Chemeen veesu vala	Crab lining (Ayiram choonda)	Bow & arrow
Chemmeen vala	Kambaketti koru vala			Karimeen veesu vala	Hand line	Changala payikkal
Idi vala	Koru vala			Konchu veesu vala		Crab trap
Kandali Vala	Paithu vala			Koonachemeen veesu vala		Hand picking
Kanampu vala	Pattukanni vala			Padal veesu vala		Odangil
Kara vala	Peru vala			Veesu vala		Ottal
Karimeen vala	Pongu vala					Ottal with bait
Kidukku vala	Thappu vala					Padal
Kola vala/ morasu vala	Thelivan vala					Spear
Koncku vala	Vadivala					Vattavala
Koori vala	Vallivala					Vellavalli
Kozhuva vala						Vettipiditham
Malan vala						
Meen vala						
Nanku vala						
Neettu vala						
Odakku vala						
Oodu vala						
Ottam vala						
Ozhukku vala						
Pattu vala						
Thirandi vala						
Thirutha vala						

Source: Primary data collected from Fields

Annexure 3.4 Distribution of major inland fishing gears in the study area

Ernakulam district	Chinese Net No.	Stake Net No.	Gill Net No.	Free Nets No.
Northern Zone of Kochi Kayal				
Pallipuram	35	78		
Vadakkekara	41	160		
Chittathukara		30		
Kuzhippalli				
Paravoor Muncipality	4			
Kottuvally	75	100		
Edavanakkadu	80	100		
Elankunnapuzha	25	32		
Njarakkal	15	22		
Nayarambalam	12	25		
Varapuzha	3	5		
Ezhikakara	80	100		
Mulavukad	18	22		
Kadamakkudy				
Cheranelloor				
Sub Total	**388**	**674**	**0**	**0**
Southern Zone of Kochi Kayal				
Kumbalangi	21 256[a]	34		
Chellanam	5	42		
Maradu				
Kumbalam	40	400		
Cochin Corporation	234	302		
Thripunithura Muncipality	2			
Udayamperoor	25	13		
Sub Total	**327**	**791**	**0**	**0**
TOTAL	**715**	**1465**	**0**	**0**

Source: Pan book, Directorate of Fisheries, 2001 [a] *Field data collected.*

Annexure 3.5 Live lime-shell fishing for 1965- 1968

Year	Landings (tones)	Value (Rs)	People involved	Per capita Income	Factory demand	Supply by co-operative societies
1965	20542.175	37848620.	**5788**	66.56	65437.5	33458.928
1966	14754.015	305841.40	**5595**	55.06	61474.1	35202.220
1967	16890.575	401045.50	**6381**	67.12	75639.0	40173.364
1968	26858.557	651320.00	**9816**	65.56	70639.0	35907.680

Source: Sebastian & Rasalam, 1976

Annexure 3.6 Chronology of the Evolution of Cochin Port

Year	Event
1835	The first chart of developing Cochin into a Deep sea Port was made
1920	Execution of Harbour Development work began
1929	Cutting the approach channel 450 feet wide
1930 – 31	Port was thrown open for vessels upto 30 draft
1st Aug, 1936	Cochin was declared a Major port and the harbour administration was taken over by the Government of India
29th Feb, 1964	Cochin port trust was constituted under the major Port Trust Act, 1963. The Port became a trust with effect from 29/02/1964 when the Government of India constituted the first Board of Trustees for the Port under subsection (i) of section 4 of the Major Port Trust Act, 1963.
7th Sep, 1970	The first stage of the Cochin Fisheries harbour was commissioned
22nd Aug, 1980	Cochin Fisheries harbour was commissioned

Source: Compiled from administrative reports, Port Trust

Annexure 3.7

Property rights of Cochin port trust

Definition of Port Limits

It shall comprise of all areas contained on land lying within 45.76 meters (50 yards) of high water mark, Kerala backwaters and the Sea bounded by straight lines joining the following positions.

The northern boundary begins from a point on the Ernakulam foreshore (10°00' 44.5") roughly up to the Thevara peninsular region to a point on the eastern shore of Vypeen Island in position latitude…….. and then along the high water mark on the Vypeen shore via Cochin harbour entrance to a point on the western shores of Vypeen island and thereon to a position in the sea 9 nautical miles due west due west in latitude … …

The southern boundary begins from a point on the southern end of Thevara to a point on the Eda Kochi shore along the high water mark on the Mattencherry shore via. Cochin harbour entrance to a point on the western shore near Mundamveli and there to a position in the sea, 9 nautical miles due west.

The western boundary is a straight line at sea joining the other two lines. The eastern boundary shall lie along the high water mark on the Ernakulam Foreshore between the northern and southern boundaries defined above. In addition to all these areas, the Port Trust shall also have jurisdiction on all land reclaimed or to be reclaimed in future, from the backwaters or the sea.

Annexure 3.8 Operational details of SWTD of Kerala

Particulars	1990-91	1991-92	1995-96	1996-97	1997-98	1998-99
No. of boats /jhankars	88	91	77	77	78	81
Boat/ Jhankar in operation	36	36	51	54	55	59
Scheduled trips	44	46	408	400	401	399
Passenger (lakhs)	56	56	243.24	266.22	2201.95	240.79
Gross route	1861.60	1861.60	1527.6	1493.6	1475.6	1549.86
Volume	119.57	116.72	229.47	223.35	-	-
No of employees	189.33	220	-	-	1272	1285

Source: Compiled from Economic Review

Annexure 3.9

The communal sport - Vallamkali. Apart from the direct and indirect values derived from the estuaries, the local population values the environment is manifest in many ways. One such example is the community sport called "vallamkali" which is a collective initiative. Usually a snake boat is manned by four helmsmen, 25 singers and 100 - 125 oarsmen who row in unison to the fast rhythm of the *vanchipattu* (song of the boatman). Thousands of people crowd the water's edge to cheer the huge black crafts as they slice through the waters to a spectacular finish. The oldest of these events have curious legends and myths attached to their origin. Myths closely linked to the rustic people and their beliefs. Details of different vallamkali are given below.

A calendar of the snake boat races of Kerala from with four of the oldest and most important events -

1. Champakulam Moolam Boat Race
2. Aranmula Uthrattadi Vallamkali,
3. Payippad Jalotsavam
4. Nehru Trophy Boat Race

Other boat races held during Onam

1. ATDC Boat Race, Alappuzha
2. Rajiv Gandhi Boat Race, Pulinkunnu
3. Neerettupuram Boat Race

4. Kumarakom Boat Race
5. Karuvatta Boat Race
6. Kavanattinkara Boat Race,
7. Kumarakom Arpookara Vanitha Jalamela,
8. Kottayam Mahatma Boat Race, Mannar
9. Thazhathangadi Boat Race, Kottayam
10. Kottapuram Boat Race,
11. Kodungallur and Kumaranasan Smaraka Jalotsavam, Pallana.
12. The Indira Gandhi Boat Race, Ernakulam Lake

From the perspective of our study, this activity shows that the, local inhabitants value their environment although these are not traded in the market. With the introduction of tourism ministry into this activity, this sport is commercially organized for the promotion of eco-tourism on the backwaters.

Annexure 3.10

Chronological Order Of Inland Fisheries Regulation That Have Evolved Over The Years

- Regulation To Make Better Provision For The Protection And Preservation Of Game Fish, 1914
- Indian Fisheries (Madras Amendment Act, 1927
- Travancore – Cochin Fisheries Act, 1950
- Travancore – Cochin Fisheries Rule, 1952
- Regulation of Fishing With Fixed Engines (Stakenets, Chinese Nets etc), 1973
- Issue Of Fishing Licence Rules, 1974
- Regulation Of Prawn Fishing In Private Waters Rules, 1974
- Rules For Management And Control Of Fisheries Of Fisheries In Government Water Rules, 1974

According to the Travancore - Cochin Fisheries Act, 1950 and the Travancore – Cochin Fisheries Rules, 1952,the government stipulates certain regulations to be followed by fishermen using gears that are fixed. The Government prohibits nets with meshes having a cod end less than 20mm mainly to protect the very young ones but these regulations are neither observed nor enforced. The number of illegal or unauthorized fishing gears in this region itself is an indicator of how ineffective these rules are from the view of the people. Enforcement of the rules is also reflected here since the fisheries department entrusted with the job of patrollin g such a vast area does not have the necessary machinery. In most cases they have to depend on the help from the police department which is already over burdened. The Government clearly states that fishing in

Government waters using either a fixed net or a free net requires a license from the government. Licenses are to be issued only to people who are genuine and active fishermen. Fixed nets are not to be planted at the mouth of the river. Transfer of licence is not allowed. In cases it is allowed, it transfer requires the sanction from concerned authorities. Unauthorised nets are physically removed. It is returned only after the payment of the penalty fees. It ranges from Rs 50 onwards depending upon the intensity of the crime. All penal cases are registered in the Crime Register.

STAKENETS

- No Person shall posses more than 4 stake nets at a time.
- No stake shall be planted with in a distance of 20 metres from either side of the shore of backwater. In the case of narrow canals the licensing authority shall determine the distance in consultation with the Irrigation department &the water transport authorities.
- No stake net shall be planted with in 40 metres on either side of a landing place or ferry or in the river mouth.
- The distance between two stake lines should not be less than 50 metres and that between two stakes in a stake line should not exceed 4 metres.
- Fishing by any means (free sets etc) in the area between stake lines of with in a distance of 40 metres around a stake net is prohibited.
- Nets should not be tied to stakes during flow- tide (high tide).
- The end post shall be so fixed as to ascertain the exact location of the stake line from any two conventional fixed survey points.
- Upper end of each stake net shall be visible at least 1.5 metres above the surface of the water during high tide.
- Light shall be provided at night at the end post of the lines of stakes and the cost of maintaining such light shall be borne equally by all the owners of stakes in the respective line.
- The use of powerful lights such as Petrol-max or gaslight or electric bulb (60 volts) for fishing with stake is prohibited.

CHINESE NET

- Fishing by any means with in a distance of 40 metres around the net is prohibited.
- The minimum distance between two adjoining Chinese nets shall be 30 metres and the measurement being taken from centre to centre of the nets.
- The end post shall be so fixed as to ascertain the exact location of the Chinese net from any two conventional fixed survey points.
- The use of powerful lights such as petrol-max or gas light or electric bulb (60 Volts) for fishing with Chinese net or other fishing Implements is prohibited.
- No fixed engine is allowed to operate during high tide.
- Chinese nets are not allowed across the channel i.e. against water flow.

FREE NETS

- Gill nets are not to be used in water transport channels and navigation channels. However this does not come under the purview of the State Fisheries Department but the irrigation department and the Water Transport Authority and so, fishermen do not heed this.
- Koruvala Mesh size Due to it destruction of juveniles and spawners, it has been completely banned. Use of ligts electric bulbs and Petromax Lighters are not allowed according to government rules.

Licence fee for single net per annum (Rs.)

	Average annual net earning	**1974***	**1980**	**1990**
Stakenet				
Class I	More than Rs.1000	0.75	3.00	25.00
Class II	Between Rs. 750 & 1000	0.40	1.00	20.00
Class III	Less than Rs. 750	0.20	0.75	20.00
Chinese net				
Class I	More than Rs.1000	0.75	5.00	20.00
Class II	Between Rs. 750 & 1000	0.50	3.00	15.00
Class III	Less than Rs. 750	0.25	1.00	15.00

** During 1974 government of Kerala passed the rule for the issue of licence*

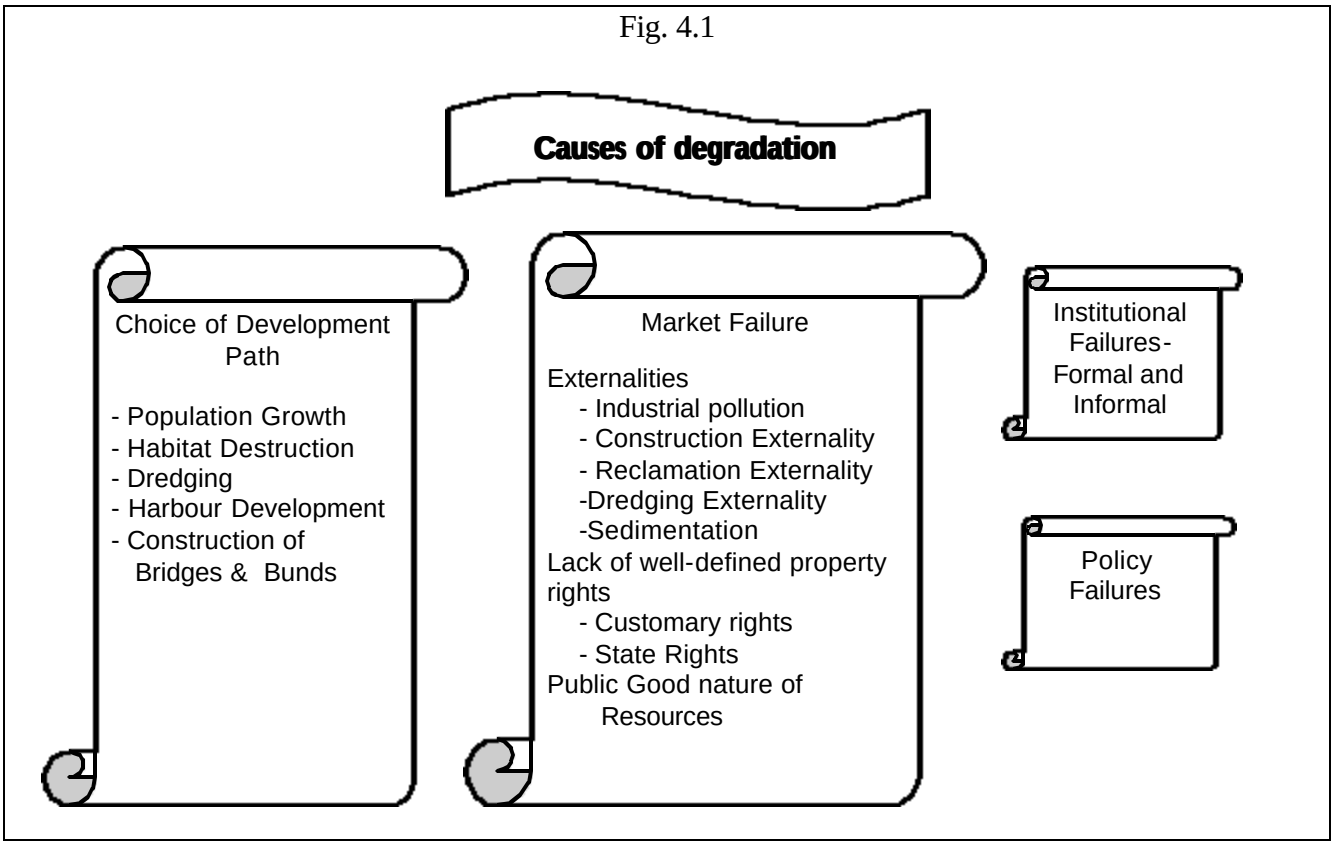
CHAPTER 4

CAUSES FOR BIODIVERSITY LOSS IN COCHIN BACKWATERS

In chapter 3 we mentioned that the local Kayal communities could not mobilize sufficient economic surplus from their traditional activities and failed to benefit from modern developments. Recognizing this state of local investors, the state sponsored a number of programs and projects for the development of the region. Such initiatives started as part of the centralized planning of the state and central Governments, in the fifties, were strengthened many folds during later decades. An interesting dimension of the state involvement in the whole process of industrial development is the intensive use of the resources and environment of Cochin backwaters. For instance, the activities of Cochin Port trust necessitated dredging of backwaters for providing smooth transportation channels to the incoming ships. The Navigation industry has also nationalized a number of water channels to organize economically profitable navigation activities. The small and large modern industries located on the banks of the backwaters were dumping their wastes into the waterbed in an attempt to save the costs of pollution abatement. The national and international leisure industry has also introduced many measures to promote tourism related activities on backwaters. The net result of all these external interventions is the intensive use of the resources of kayal and its environment. Traditional communities on the hand have been complaining about the externalities of modern stakeholders on their traditional activities. The objective of this chapter is to explain in detail the nature of causes of biodiversity degradation in Cochin backwaters.

It was mentioned in chapter 1 that biodiversity degradation is an inevitable outcome of the manner in which development path is selected by the nation. Degradation also occurs due to the failures of markets, institutional failures and government faiures. Figure 4.1 below summarizes the major causes for the degradation biological diversity.

Fig. 4.1



The chapter is divided into four sections. Section 1 deal with the nature of market failures. This is followed by a discussion on government's policy failures and institutional failures in sections two and three respectively. A conclusion of this chapter is then followed.

4.1 Market Failures

Market for environmental goods and services fails due to many reasons. First and foremost reason for failure is externalities. In our study area, modern stakeholders produce four kinds of externalities while using kayal environment. They are industrial pollution externalities, construction externalities, reclamation externalities and dredging externalities. In addition to these, degradation could arise due to the lack of well-defined property rights on natural resources including environment. Finally, degradation can also

arise due to the public good nature of biodiversity. This section introduces these issues one by one so as to describe the manner in which kayal resources and its environmental qualities are degraded due to the interplay of these factors.

4.1.1 Industrial pollution in Cochin backwaters

Cochin is the industrial capital of Kerala and a large number of factories are located on the banks of the river Periyar and Cochin backwaters. In an attempt to save the costs of pollution abatement, these factories dump their wastes into the brackish water body. Backwater receives effluents from industries such as chemical engineering, food and drug manufacturing, paper, rayon, rubber, textiles and plywood manufacturing industries. Backwaters also receive domestic sewages and urban wastes, organic fertilizers and residues from agricultural lands, Oil spillage and other hydro-carbons from Cochin Refineries, Cochin Port and Caprolactum plant of FACT, chemical wastes from fertilizer plants, effluents from other small industries, fish spoilage and residues from fish landing centers, boat yards, dock yards, and fishing harbor, oil, paints, metal and paint scrapings from Cochin shipyard and port and other sediments from dredging.

Although the evidences that quantify pollutants by source, are scarce, the general picture on the nature and growth of industrial pollution from the industrial agglomerations is indicative of the evolving nature of pollution externalities in the study area. For instance tables 4.1 and 4.2 show the quantity and nature of heavy metallic pollutant discharged into river Periyar.

TABLE 4.1 Discharges of industrial pollutants in the study area

Industry	Year Started	Raw materials	Products	Wastes produced	Waste discharge / day × 106 ltr
Indian Aluminium	1943	Alumina Aluminium fluoride Cryolite	Aluminium rod, Aluminium ingot Aluminium- extrusion	Fluorine, Aluminium, Sodium	4110
TCM	1943	Copper , Boxite Sulphuric acid, Hydrochloric acid Caustic soda, Garnalite sodium chloride	Copperoxichloride Copper sulphate Sodium aluminate Sodiuim chlorite Aluminium- sulphate Potassium chlorite	Copper chloride Sulphate Aluminate	239
FACT	1947	Sulphur Rock phosphate Naphtha, Benzene	Ammonia, Ammonium- sulphate, Ammonium- phosphate, Sulphuric acid, Phosphoric acid, Caprolactum olium	Fluorine, Phosphate, Ammonia, Chemicals that affect COD, BOD, Carbon-Dioxide, Sulphur- dioxide	21000
TCC	1951	Salt	Caustic soda, Hydrochloric acid	Mercury ,Caustic soda, Acid	3504
Travancore Rayons	1949	Cotton, Sulphur, Caustic soda, Sodium- sulphide Zinc chloride, Wood pulp	Cotton pulp, Sulphuric acid, Viscos yarn, Carbondisulphide Cellulose film	Sulphur- dioxide, Acid, Carbon- disulphide, Chemicals that affect COD, BOD	5360
IRE	1951	Monosite, Sand, Caustic soda, Hydrochloric acid, Nitric acid	Trisodium earths phosphate, rare earths oxides, Sirium oxide Rare earths chloride	Phosphate acid, Rare earhs radio ----	705
HIL	1958	Benzene, Alcohol, Chlorine	DDT, BHC, Endosurphan, Dicaphol	DDT, BHC, Endosurphan, Dicaphol	65
Binani Zinc	1967	Zinc blend	Zinc, cadmium, Sulphuric acid	Acid, Cadmium, Zinc	845
Periyar Chemicals	1969	Sodium formate, Sulphuric acid	Formic acid, Sodium sulphate	Acid, Chemicals that affect COD	43
United catalyst	1970	Alumina, Copper,Fe, sulphuric acid, graphite, Sodium chloride,Ammonia,Carbondioxide	Catalyst	Acid, Metals, Chemicals that affect COD	126
Copper & chemicals	-	-	Copper sulphate	Copper, acid, Mercapto benzothiosole, Sodium	-
Mercum	-	Benzene, Caustic soda, Chlorine, Sulphur	Mercapto- Benzothiosole Materials used in rubber industry	Chemicals that affect the COD, Hydrogen sulphide, Acid, Caustic soda, Sodium- sulphide	-
Cochin Chemicals & Rutiles	-	Rutile, Hydrochloric acid	Titanium dioxide, Ferric chloride	Acid, Metals	-

Source :Kerala Shastra Sahitya Parishad, 1999

It is seen that the pollutants Cu, Zn, Cd, Pb, Ni, Fe (dissolved metals) were the most commonly found heavy metals in the backwaters. Examining the distribution of heavy metal pollutants discharged into Periyar and Chitrapuzha, Ouseph (1992) observed that the levels are beyond tolerable limits. The findings are reproduced in the table 4.2 below.

TABLE 4.2- Quantity and nature of heavy metal pollutants discharged into Periyar and Chitrapuzha.

Name of company	Average concentration of metallic pollutants in effluents mg/l		Quantity of effluent discharge Kl/day	Discharge of heavy metallic pollutants gm/day	
Travancore Rayons	Zn 2.8	Pb 0.06	460	Zn 1288.0	Pb 27.6
Travancore chemicals	Zn 0.8	Cr 0.08	900	Zn 720.0	Pb 9.0
	Pb 0.01	Cu 2.8		Cr 72.0	Cu 520.0
Binani Zinc Alwaye	Zn 4.5	Pb 0.07	800	Zn 3600.0	Pb 640.0
	Cd 0.8	Hg 0.002		Cr 256.0	Cu 1.6
Travancore Cochin Chemicals	Hg 0.006		980	Hg 5.8	
Indian Rare Earths	Pb 0.05		3000	Pb 150.0	
Periyar chemicals Eloor	Zn 1.3		33	Zn 42.9	
FACT Udyogamandal	Zn 1.2	Cr 0.03	88000	Zn 105600.0	Cr 640.0
United Catalyst Alwaye	Zn 1.3	Cr 0.09	537	Zn 698.0	Cr 48.0
Kerala Newsprint Mills (HPC)	Hg 0.002		35000	Hg 70.0	
FACT Cochin division	Cr 0.03	As 0.001	92000	Cr 2760.0	As 92.0
	Zn 1.2			Zn 110400.0	

Source: P. P. Ouseph, CESS, 1992

The table shows that the concentration of Mercury, Lead, Zinc, Chromium and Cadmium was highest at the effluent discharge point and lowest in the upstream (See Annexure 4.1 for details).

4.1.2 Some evidences

There exist clear evidences to establish that the intensity of different pollutants in the backwater has been increasing over the last three decades. For instance, Qasim & Madhupratap (1981) has pointed out that the ever-increasing loads of industrial waste and

sewage in the Cochin estuary have created conditions, which are extremely destructive to plants and animals. Kurian (1972) and Ansari (1977) have studied benthos of the backwaters. The studies indicated that the density of bivalves, gastropods and isopods in the backwaters have been considerably reduced with time. These have been attributed to the increase in pollution (Qasim & Madhupratap, 1981). Studies by Remani (1979) indicates that in some of the polluted waters the BOD (Biological Oxygen Demand) values reach 513.76 mg/ l, Sulphide 4.97 mg/ l and oxygen content less than 0.05 ml/ l. The effects of industrial pollution are seen in the form of depletion of biota, especially benthic organisms, fish mortality and presence of high concentration of ammonia in the water.

Hydrobiological conditions of the estuary are greatly influenced by seawater intrusion and influx of freshwater according to studies on the distribution of salinity and temperature (Lekshman et al, 1982). It has been shown that the organic carbon in the sediments was higher during monsoon due to the contribution from land run off (Remani, et al, 1980). The study with reference to the indicator bacteria reveals that the principal source of faecal pollution is of the non-human type originating from land drainage, sewage and organic discharge (Gore et al 1979). The higher COD (Chemical Oxygen Demand) values observed are probably due to the domestic sewage and water discharged into the harbour area (Sarala Devi et al 1979). Studies have further shown that there is appreciable degree of organic pollution in the harbour area (Unnithan et al, 1975).

4.1.3 Nature and growth of pollutants in Cochin backwaters

It was observed that pollutants like Copper, Zinc, Cadmium, Lead, Nickel and Iron (dissolved metals) were highest at the effluent discharge point and gradually decrease towards the bar mouth, it was lowest in the upstream of the river Periyar. Data shows that the pollutants were greater during the pre-monsoon season and lowest during the monsoon season due to freshwater influx (See annexure 4.1).

Incidence of mortality of fish (*Ambassis gymnocephalus)* due to industrial pollution is reported from the upper reaches of Cochin backwaters (Unnithan et al, 1977). The effluents carrying a heavy load of ammonia at the rate of 432-560 ppm which is far above the accepted lethal limit of 2-5 ppm pouring into the incidence area together with many other pollutants such as acids and suspended solids in varying quantities, have changed the hydrographic conditions to extreme toxic proportions so as to cause heavy mortality of the animals in the area. Fish shoal entering the polluted zone is unable to tolerate the cumulative effect of pollution, resulting in their sudden death due to asphyxiation. It is suggested that treatment of waste be adopted to recycle and recover the ammonia and other pollutants from the effluent before it is let out into the estuary.

Studies conducted by N. Rajendran, C V Kurian and V George showed that concentration of mercury in the oyster Crassostrea madrasensis collected from the Cochin backwaters showed levels of mercury, which ranged from 15 to 48ppb for small size oyster and 7.0 to 37.0 ppb for larger size group. The concentration of mercury in the sediment samples ranged from 31 to 144 ppb. Mercury is discharged into the estuary by a paper mill and other factories engaged in chemical manufacturing. The levels of mercury in backwaters of Cochin are also high.

Organic pollution exists to a considerable extent in the Cochin backwaters especially in areas like Padiyathukulam canal, Mullasherry canal and Market canal. High amounts of hydrogen sulphide were observed in the areas of discharge of organic waste into the estuary. Highest values obtained were 3041 and 2.25 mg/litre. Lower oxygen values showed higher values of BOD and hydrogen sulphide. The extent of pollution in these areas is well above the tolerance level of estuarine fauna. Continued discharge of effluents at the present rate will influence the ecosystem and estuarine life of the harbour and harmful effects may extend to the inshore waters also.

Retting of coconut husk is another major source of organic pollution in the backwaters of Cochin. Retting is brought about by the pectinolytic activity of microorganisms, which liberates large amounts of organic matter into the medium. Higher temperatures and salinity accelerates the process with consequent increase in organic load of the medium. Sediments are the indicators of quality of water overlying the sediments. A study was conducted by Remani (1981) at Vaduthala located about 5 km upstream from the bar mouth, in the northern region of the Cochin backwaters showed that Organic carbon and organic matter showed

enrichment in the retting ground sediments (av. 46.8 and 92.3 mg/g respectively) compared to the reference station (20.6 and 48.9 mg/g). Annual average of bacterial biomass was higher in the reference station (25.7 mg/g as against 22.8 mg/g in the retting yard. Bacterial contribution to total organics was higher at the reference station (av. 72.55%) compared to the retting yard (av. 32.59%). Average energy content calculated for the retting ground was 1819 J/g dry weight, twice that for the reference station and higher than the average for sediment detritus in the Cochin backwaters (1497.9 J/g).

To summarize, the analysis made above shows that the level of many pollutants in Cochin backwaters is very high even to the extent of causing serious threat to its biodiversity. Industrial pollution has already caused fish mortality in the regions of Chitrapuzha and Periyar, which is an indication towards taking necessary steps to prevent such practices. Many scientists have hence suggested the need for implementing compulsory regimes to treat the effluents before discharging into the backwaters.

4.1.5 Construction externalities

Traditional settlements of human population in the erstwhile state of Cochin were around the backwaters and the reasons for this are obvious. The water body acted as the medium of transport and exchange among the island village communities. As these economies progressed over time, the demand for speedy transport and communication increased and the government has approved construction of bridges, yielding to local political pressures The bridges connecting Aroor–Edakochi, Kumbalangy-Perumbadappu, Thevara and Arookutty and the Gosree project connecting Ernakulam and the isolated islands of Mulavukad, Vallarpadam, Vypeen and adjoining areas are examples of strong government interventions in the area of rural infrastructure.

Construction of these bridges and related structures require reclamation of kayal and wetlands to reduce costs. This however narrows the channel width, reduces flow of water and affects the current and tidal functions. It affects the distribution of fishery resources that come in with the tide. Catch reduction has affected a number of fishermen and naturally conflicts have occurred. In most cases, these conflicts are observed between the fishermen on opposite banks of the estuary. From the number of such bridges sanctioned,

it is obvious that no one is seriously concerned about the kind of development activity that is taking place provided the bridge comes up in time. The Goshree plan is depicted as a great leap forward as far as the people of the isolated islands of Mulavukad, Vallarpadam, Vypeen and adjoining areas are concerned. Yet, one wonders at the cloak of secrecy that is associated with such a big budgeted investment plan and the absence of an accompanying environmental impact assessment.

4.1.5 Land reclamation externalities

Human interventions, during the past have resulted in drastic alterations in Cochin backwaters. Reclamations of kayal and the adjoining wetlands have been undertaken by various stakeholders for various purposes such as agricultural expansion, aquaculture practices, harbor development, urban development and other public and private uses. Of these, reclamations for agricultural purposes mainly paddy cultivation and paddy-cum-shrimp culture has contributed immensely to the horizontal shrinkage of the backwater (Gopalan, 1983).

Due to the non-availability of sufficient data, an accurate documentation on the total area reclaimed from the Cochin backwaters is difficult. Different stakeholders have undertaken it at different periods of time for various purposes. Local communities reclaim kayal and small channels for domestic needs, roads, and for raising commercial crops like coconuts and aquaculture. It has been estimated that the backwaters had an area of nearly 365 km^2 till 1834. About 2,226.27 hectares have been reclaimed till the beginning of the century. Thereafter reclamation activities have been banned in 1903, according to a Government notification on the presumption that these activities would adversely affect the Cochin harbor development (Kurien, 1978). However, reclamations continued. In 1912, an area of 5,223.15 ha was reclaimed. The large-scale reclamation was of 700 ha in the relatively deeper areas of southern Vembanad region between 1941 and 1950 (Kurien, 1978) was confined to the Kuttanad region of the Vembanad Lake under the support of the then state Government. Apart from this, private owners have also reclaimed an area of 1,500.0 ha along the banks of the main channels, connecting canals

and islands for agriculture, cottage industries and housing during the present century. Of this, the coconut husk retting ground enclosures alone occupy an estimated area of about 500 ha. Table 4.3 provides a summary of information on the nature of reclamations undertaken in Vembanad estuary.

Table 4.3 Reclamation in the Vembanad estuary for developing agriculture and aquaculture

Period	Area Reclaimed (ha)	% Area Reclaimed	Purpose
1834- 1903	2226.72	6.100	Agricultural
1912- 1931	5253.15	14.392	-do-
1941- 1950	1325.00	3.630	-do -
Till 1970s	5100.00	13.972	Paddy cum shrimp culture
1970- 1984	800	2.191	-do -
1900- 1984	1500.00	4.109	Housing, agriculture & traditional industries
1975	6900.00	18.904	Ecologically served from backwaters as a result of bunding at Thaneermukkom
Total	23104.97	63.298	

Source: Gopalan, U.K, 1983, NIO

Reclamation has also been undertaken for housing and promoting institutions like the Cochin shipyard, Central Institute of fisheries Technology (CIFT), Central Maine Fisheries Research institute (CMFRI) and also for the Cochin port for additional berth facilities. Plans were made by GCDA to reclaim 640 acres (269.7 ha) of land on the northern foreshore of Ernakulam for urban development in future (Gopalan, 1983). This was subsequently carried out in later years and is still continuing even today. Large areas of the Kayal are under reclamation along the foreshore of Ernakulam particularly near Tatapuram and Goshree project boundaries.

An area of 69 km^2 of brackish water has been reclaimed for constructing a spillway for flood control at Thottapally in 1955 and at Thaneermukkom for checking the intrusion of saline water in 1974. (Gopalan, 1983). A total of 5,100 ha has been converted into

paddy cum shrimp culture systems till 1970. The expansion in this field has been faster during the past 15 years and a further area of about 800 ha has been converted to paddy cum shrimp culture fields and for other aquacultural purposes.

The area of 203 acres north of the Rail and Road Bridge and 113.48 acres south of the bridge were leveled and handed over to the Navy. In early 1959-60, reclamation was undertaken south of the Dry Docks up to the Mattancherry Bridge at an estimated cost of Rs 1,30,000/-. 1965-66 saw the Ernakulam channel being widened and the 9.54 lakh cubic yards of material pumped into areas earmarked for reclamation, opposite the Ernakulam Warf. In order to solve the problem of shortage of land on the Willingdon Island, for Port development, large-scale reclamation of the backwaters is still being undertaken. In addition to this a 25-meter strip of land was reclaimed from the backwaters between the south and north Coal berth for laying pipelines for Bharath Petroleum.

4.1.6 Harbor and Urban Development Activities

The project on development of Cochin into a major port on the west coast of India commenced in 1920 under the direction of an eminent harbour engineer Sir Robert Bristow and was completed in 1936. During this period of constant dredging, Wellington Island, the present seat of Cochin port having an area of nearly 365 ha has been reclaimed. Thereafter there was no major reclamation till the 1970's, when the fishery harbor having an area of 10.78 ha had been reclaimed. This was followed by an integrated project for the development of the Cochin port, under which, Vallarpadom-Ramanthuruth-Candle island complex having an area of 141.7 ha had been reclaimed. Further under the same project a similar area is being reclaimed as a southerly extension to the Willington Island. Table 4.4 shows the details on reclamation for harbor and other infrastructure development projects.

Table 4.4 Reclamation in the Vembanad estuary for Harbour and Urban

Period	Area reclaimed (ha)	% reclaimed	Purpose and location
1920 - 1936	364.37	0.9982	Creation of Willingdon Island for harbour development
1978 1981-1985	10.78 141.70	0.0295 0.3882	Fishing harbour project Vallarpadam- Ramanthuruthu- Candle Island complex under Integrated Development project
-do-	141.70	0.3882	Southern extension to Willington Island
-do-	23.91	0.0655	Foreshore urban development by GCDA and Cochin Town Planning Trust
-do-	11.73	0.0321	Reclaimed for the use of Cochin Shipyard, CIFT, North Tanker Berth and other berths
Total	694.19	1.9017	

Source: Gopalan, U.K, 1983, NIO

Backwaters were never part of planning, in Kerala. Local panchayats, municipalities or corporations do not seem to been worried about the economic activities organised on the estuaries and its economic significance. Even specialised agencies with mandate for urban development follow a similar laziness in these matters. Under various urban development schemes, the Greater Cochin Development Authority (GCDA) and Cochin Town planning trust have reclaimed 23.61 ha mainly for the construction of a marine drive on the foreshore of Ernakulam

Many scholars have reported destruction of mangroves and the reclamation of these areas to other commercial uses. A conservative estimate indicated that the total extent of mangrove areas in the Cochin backwaters and Vembanad Lake was around 70,000 ha (Subramanian, 2000). This area has progressively reduced as they were converted for coconut plantations, paddy cultivation, traditional pond culture, reclamation and other development activities.

4.1.7 Sedimentation externalities

Sediment accumulation, which badly influences almost all the economic activities in the backwater, is an important form of externality caused both by natural processes and human actions. Available information shows high growth of sediment accumulation in Cochin backwaters. Seven major westward flowing rivers (Chalakudi, Periyar, Muvattupuzha, Meenachil, Manimala, Pamba and Achencoil.) discharge their fresh water and dump huge quantities of silt and sediments every year into Cochin backwaters at various point. Sedimentation is also cased by soil erosion, reclamation and construction activities and is found to obstruct the tidal functions of the backwaters at various locations.

. It is estimated that the average sediment yield from the catchments of Western Ghats region is of the order of 23 t/ha/year (CWRDM, 1986). Based on the reservoir sedimentation surveys carried out in the wetland, the average yield of sediments is 26-t/ha/year. Therefore the total annual sediment yield from all the rivers basins draining into the Venmbanad lagoon is estimated to be 32 million tones. The composition of sediments is given in annexure 4.2. We do not have enough evidences on the extent of wastes produced by the construction industry and its subsequent sedimentation in backwaters. However, the growth of urban constructions in Cochin City and its suburbs indicate towards high discharges of such sediments into backwaters. Sediment accumulation has reduced he mean depth of estuaries in many places affecting fishing transport and trade.

The accumulation of sediments in Cochin backwaters has produced serious imbalances on the eco system functions of backwaters seriously in recent years especially in selected stations. The comparative data shows that the average depth in different locations of the study area has been declining over the last 50 years. Table 4.5 shows the variation of depth ranges in Vembanad estuary during the last 50 years (see annexure 4.3 for details).

Table 4.5 Variation of depth range in different sectors of the Vembanad Estuary during the past 50 years

Stations	Depth range 1930s(m)[2 **]	Depth range 1980s(m)[2]	Depth in 2001*
South of Thanneermukkom bund	8-9	3-3.5	2.5-2.8
Between Thanneermukkom bund & Vaikom	8-9	3-4	3.5-4
Between Vaikom & South Paravoor	7-9	4-5	3.5-4.0
Between South Paravoor & Aroor	5-6	3-4	3-4.5
Between Aroor & South of Willington Island	7-8	7-8	7-8
Cochin harbour region	7-8	7-8*	7-8
Bolgatti to Cherai	3-4.5	2-2.5	1.5-2
Cherai to Munambam	3-6	2.5-4	2.5-4

*Source: Gopalan, U.K, 1983 * Primary data 2001*

From the available data it can be deduced that in course of the last fifty years, the average depth of Cochin backwater has reduced from 6.7 meters to 4.4 meters. As a result of the reduction in area and depth the total volume of the brackish water system between Alleppey and Azhikode has been reduced from 2.449 km^3 in the beginning of this century to 0.559 km^3 in 1985.

4.1.7 Dredging externalities

The externalities caused by sedimentation are harming the activities of both the traditional and modern stakeholders alike. The local fishermen are the most affected other than the Cochin Port trust and the navigation industry. The Cochin Port Trust has been (and still is) dredging backwaters without considering the ecological and socio economic implications of such activities. The magnitude of silt in the backwaters of Cochin is reflected in the removal of 2.5 million cubic yards of silt by dredging every year in order to maintain the shipping channel at Cochin harbor, where the rate of silting is 180 cm/year (Kurup, 1971). The Port Trust has been undertaking dredging activities in connection with the maintenance of the shipping channels, annually on a large scale so as to keep it at a depth of 10-13 metres in certain areas and in other areas to a depth of 18m (Subramanian, 2000). These kinds of operations generally cause wide fluctuations in turbidity and productivity of different forms of life. Table 4.6 summarizes some evidences on the quantity of silt dredged and the expenditure incurred under this head by

the port trust. No doubt, huge quantities have dredged by incurring heavy expenditure. (See annexure 4.4 for details)

Table 4.6 Dredging data of Port Trust for the last 50 years

Year	Sediments dredged lakh m^3
1951-60	23.66
1961-70	39.27
1971-80	28.87
1981-90	14.22
1991-98	24.17

Source: Compiled from Administrative Report

4.2 Government failures and degradation of biodiversity in Cochin backwaters.

In the last section, we examined the nature of various externalities and demonstrated how market failures degraded biodiversity in backwaters. We shall now turn to the discussion of government failures and how these cause degradation of kayal resources. When market as an institution fails to conserve biodiversity due to externalities, public good characteristics or lack of well-defined property rights, governments have a habit of intervening in markets to remove the main elements of externality caused by market behaviour. This is normally undertaken by adopting a series of penal and incentive structures, crafting policies and institutions and also by enforcing these structures efficiently so as to conserve biodiversity (EPW, 1998)

Unfortunately a great many of these interventions are contrary to the interest of the environment, even when those interventions appear to serve some social purpose (Pearce & Moran, 1994). Besides, since the values of ecosystem services are not fully captured in commercial markets, or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions (Coztanza et al 1997).

Often Government policy for each sector is made with a shortsighted view usually ignoring the long-term perspectives. In addition, a lot of policy regulations exist on paper that is never really implemented either due to political reasons or shortage of manpower

in the associated enforcing agencies. In many developing countries, governments may indeed intervene; just as much environmental damage is done by government interventions. This inability to act efficiently often accelerates natural resource exploitation and degradation. Subsidies, taxes are all examples of government intervention that alter the market. Misdirected subsidies are most common and usually seen wherever markets are heavily administered. However in practice government fails to provide a socially desirable level of biodiversity protection[1]

Government policies related to the use of backwaters

It may be mentioned at the outset that government has not enacted laws exclusively for regulating degradation of biodiversity in Cochin backwater ecosystem. Instead, the government has adopted a sectarian approach towards the management of different resources and environment. Hence, policies influencing allocation of backwater territories, resources and environment are scattered in various documents and laws relating to fisheries, minerals, agriculture, Industries, navigation and the Port development, coastal environment and tourism. We shall now turn to the discussions of

[1] Two broad approaches are available for analyzing Policy failures. The former approach looks at the issue from the point of view of the State and examines how effective the rules of governance have been in attaining the goals. The second view on the other approaches the problem from that of the stakeholders and examine how people abide by the rules and regulations imposed on them. Whether these rules take into account the customary rights of the people. Whether or not they were followed or broken according to convenience.

The study team made an attempt to collect information on the various stakeholders using the resources and environment of selected estuaries. National and state policies towards the use and control of estuarine resources and environment have also been looked at. A list was made of all the different Acts, rules and regulations that have been passed by the State regarding the governance of the backwaters and what rules and regulations people have to keep while using these resources for their livelihood activities.

The following were identified for critical evaluation: The Panchayat Raj Act, Kerala Land Reforms Acts, the Fisheries Act, The Coastal Regulation Zone and Aquaculture Authority bill, the navigation bill, Port Trust Act, The Minor resources use act, and the biodiversity act.

A documentation is made of the various Acts, rules and regulations that have been passed by the Government and its various departments so as to regulate the use and misuse of the estuaries over a period of time. Instances of significant conflicts in the backwaters have been identified and case studies are documented.

some of these policies and examine how different stakeholders organize their activities on backwater environment subject to these regulations.

4.2.1 Inland fisheries policies

Formal inland fisheries laws and legislations date back to the Indian Fisheries Act of 1897 passed by the British Parliament. Since then a series of laws were introduced both by the Indian and Kerala governments for the development of inland fisheries. A careful reading of these regulations reveals that these rulings are mostly advices discouraging fishermen from fishing. One wonders how fisher folks can honestly follow all the rules and directions listed in these. As a result, inland fishermen do not take these instructions and legal decrees seriously. Table 4.7 below lists the major inland fisheries policies of the government

Table 4.7 Major Inland Fisheries Regulations in India

Year	Description of the law
1914	Regulation To Make Better Provision For The Protection And Preservation of Game Fish,
1927	Indian Fisheries (Madras Amendment Act)
1950	Travancore – Cochin Fisheries Act,
1952	Travancore – Cochin Fisheries Rule,
1973	Regulation of Fishing With Fixed Engines (Stakenets, Chinese Nets etc)
1974	Issue Of Fishing License Rules, Regulation Of Prawn Fishing In Private Waters Rules and Rules For Management And Control Of Fisheries Of Fisheries In Government Water Rules,
1994	The new fisheries policy accorded fish production the status of agriculture to make it eligible for all assistance /subsidies recommended for agriculture. The policy had also envisaged the formulation of an "Aquarian" reform with the objective of ensuring ownership rights of fishing implements exclusively to real fishermen

Although a number of guidelines were issued for the good governance of inland fisheries, fishermen do not follow them leading to the failure of policies and resource degradation. Some commonly found violations are given below.

- According to the Travancore-Cochin Fisheries Act of 1950, the Government prohibits nets with meshes having a cod end less than 20mm mainly to protect the very young ones but these regulations are neither observed nor enforced. The mesh size reported today is as low as 4mm to 6 mm
- According to the Fisheries Department rules, operations of fixed nets like Chinese nets and stake nets would require license from Government which is a renewable contract between he Government and the fishermen But as per the data published by the Department itself, in 1989, of a total of 4823 Chinese nets, 1692 were licensed and 3131 were unlicensed (Pauly, 1991). In 1995 – 96, there were a total of 211930 nets, a substantial number being illegal (Department of Fisheries, 1989).

- Fishing by means of fixed nets (especially Chinese nets an d Stake nets) is prohibited during high tide to enable the seedlings and fishery to enter the smaller channels in the backwaters. But most of the nets in the bar mouth and Thevara, Aroor area operate during high tide as well affecting movement of fishery resources into the estuary.

- The minimum distance between two adjoining Chinese nets should be 30 meters and that between two poles of a Stake net 4 meters. However, today, the Chinese nets are fixed so closely leading to clashes between gear owners. Stake net owners, on the other hand, fix their nets leaving a little waterway in between for boats to move. Often boats have to deviate from their path to avoid these nets when they are put across the backwater in a row. These nets strain the water and the resources that pass through it.

These violations reveal that fishermen do not follow government regulations. The mediations of the government are also not efficient either. Disputed parties sometime approach the formal courts for redressal. As this mode of redressal is time consuming and expensive very few people have faith in the legal machinery. Instead, they look forward for speedy and cost effective grievance redressal mechanisms. A look at the conflict

redressal mechanism shows that in most cases attempts are made to redress it at the grass root level itself with the help of local leaders. It is curious to observe that very rarely do political leaders have any say in this matter. People approach courts only in cases where other kinds of settlements impossible.

4.2.2 Brackish Water Aquaculture Policies

Aquaculture development policies are also loaded with axioms that discourage sustainable entrepreneurship. The following rules and violations are noteworthy.

- According to the 1974 prawn regulation act, no kind of prawn fishing should be undertaken in any private waters or fields without a special license from the concerned authority. The Inspector of Fisheries is supposed to grant the license after he is satisfied that the farming if undertaken will not be harmful to the prawn filtration in adjoining farms. Very few aquaculture farms obtain such clearances. A comparison between the number of licensed aquaculture farms and a field survey of the actual number of farms in the study area is greatly mismatched.

- According to the Punja Act[2], low lying brackish water wetlands are to be used for prawn culture only for a period of six months. However, many farms do not comply with the stipulations of the Punja Act. They are engaged in the culture activities round the year without considering the ecological consequences of monoculture and socio economic significance of integrated farming. Although the Pokkali Land Development Agency is responsible for the monitoring of crop rotation, it is neither authorized nor does it have the machinery to take appropriate penal actions against offenders. It can only negotiate with these farms and use the incentive of subsidies to lure these farms to undertake rotation of paddy and prawn culture.

[2] According to the Punja Act passed by the State of Kerala, low lying brackish water wetlands are to be compulsorily used for prawn culture only for a period of six months. The remaining six months are to be used for Paddy cultivation. To monitor this a Punja Special Officer was to be appointed in each district to monitor this.

4.2.3 Policies For Wetland Paddy Cultivation

- Recognizing the importance of wetland paddy cultivation, the government has enacted many laws to boost production. Introduction of radical land reforms brought in a number of structural changes in the nature of ownership and control of agricultural land in the study area. Most of the *Paattakkars* and *varikkars* became owners of soil. At the same time, the synergies produced through collective action in traditional agriculture were lost and pokkali paddy cultivation became highly unattractive for the farmers.

- As per the Punja Act, paddy cultivation has to be undertaken compulsorily for 6 months every year. The Rural Development Officer (RDO) who is also the Punja special officer of Ernakulam, Allapuzha and Trichur, is vested with special powers to take action against farmers who violate this rule. Despite these rules and incentives offered, the wetland agriculture has not revived from stagnation.

4.2.4 Policies For Regulating Industrial Activities

Localization of industries along the water bodies that discharge water into the Cochin backwaters is not an accident. It is the product of the national industrialization policies, which encouraged clustering of industries to provide economies of scale and efficiency. No doubt, this search ended in coastal zones, areas that were undervalued. Soon, these industrial clusters emerged as the major sources of kayal pollution affecting thousands of people who directly depend on this water body for livelihood.

The responsibility of maintaining environmental quality is vested with the Central and State Pollution control Boards. The Ministry of Environment and Forests also lay down broad policy perspectives and guidelines for the better management of coastal zone environment. The mining and geology department is responsible for granting permission for sand and clam mining from backwaters. The perspectives of these departments and

agencies are contradictory and therefore fail miserably in bringing up the required quality of environment and resources use. For instance, most of the policies of the state and central government departments of industries are production oriented with built in incentives such as subsidies and other concessions, which accelerated use of kayal resources and environment.

The Ministry of Environment and Forests and the state and central polltion control boards have brought out a number of guidelines and laws for the better management of backwater resources. The Coastal zone regulation act introduced in 1992 was aimed to provide a formal control over the entire coastal zones within 500 metres high tide line on the landward side including backwaters[3]. Despite these controls and formal laws the biodiversity of backwaters of the country eroded. Thus most of the government policies failed to generate optimum and efficient allocation of kayal resources and environment.

4.2.5 Policies For Developing Navigation And Shipping Industries

[3] **Some of the pertinent norms regulating activities are the following.**

Category I (CRZ – I)
Areas that are ecologically sensitive and important such as national parks, …… mangroves, ….. Areas close to the heeding and spawning grounds of fish and other marine life, may be declared b the Central authority or the concerned authority at the State level from time to time.
Category I (CRZ – I)
Areas between the low Tide line and the high Tide Line. No new constructions shall be permitted within 500 metres of the High Tide Line.
Category II (CRZ – II)
The areas that have already been developed up to or close to the shore line. …….. within municipal limits or in other legally designated urban areas……. Buildings permitted on the landward side ….. shall be subject to the existing local Town and Country Planning Regulation including the existing norms or FSI/FAR.

Category III (CRZ – III)
Areas that are relatively undisturbed and those which do not belong to either Category I or II. This area has been earmarked as 'No Development Zone'. No constructions shall be permitted here except repairs of existing authorised structures……. Development of vacant plots between 200 and 500 metres of High Tide Line in designate areas of CRZ – III with prior approval of the Ministry of Environment and Forest …….. subject to the conditions as stipulated in the guidelines at Annexure – II.
Annexure – II
The project shall not undertake any construction within 200 metres in the landward side from the High Tide Line and within the area between the Low Tide Line and High Tide Line.

These policies also do not raise any hopes for the conservation of biodiversity and livelihood securities for the rural communities either. During the periods of the princes in Travancore and Cochin, backwaters were the major means of transport. Consequently there had been a well-developed and monitored system of water navigation. All boats had licenses and they were required to register at the office of the 'Chokki' or tax collectors who were stationed in certain allotted regions. Even after the merger of these princely states, this system of navigation continued.

Today, navigation in Cochin backwaters does not come strictly under the mandate of a single government department. The operation of boats in any backwater of Kerala require license from the irrigation department. The over all maintenance of navigation system on backwaters is the responsibility of the irrigation department. However it has been years since any serious investment has been made. Consequently the government is hesitant to raise the taxes levied on boats, services etc. For years now it has being leaving Rs. 4 per a tonne capacity boat. Maintenance or introduction of new technology has not been forthcoming to this economical and convenient means of transport for the marginalized and isolated islands of this region. Consequently, a number of departments have overlapping authority over this water giving way to policy failures.

For instance, the Port Trust crafts rules and regulations related to shipping and major navigation. According to the powers vested with the Port Trust, access to the backwaters was redefined at least in the areas that came under port's jurisdiction. The central authority of the Port overrules the authority of irrigation department. All economic activities that occur in its territory require the prior permission or license from the Port. Only licensed fishermen are allowed to operate in the port area. Penal and prompt action is taken on those violating this rule. The license fee levied by the Port trust is higher than that collected by the irrigation department. Similarly, harbor crafts or vessels cannot be operated without a license from the Trust. Licenses vary between Rs. 75 to Rs. 350 varying according to the tonnage of the vessel.

The fisheries department too collects Rs.15 and Rs.10 for II grade and I grade nets respectively in the case of Chinese and Stake nets. Free net license fee varies between Rs.5 and Rs. 10 depending on type and mesh size. In the case of the Port Trust, only Chinese fishing nets are allowed and they require a license fee of Rs.168 including inspection charges. The Port Trust also imposes regulations on the construction of Jetties irrespective of whether it is for private or public requirements. They levy Rs.515/ annum for Jetties and Piers, Rs.453 for slipways and Rs. 215 for boat pens excluding Rs250 as inspection fees. Even the State Water Transport Department has to pay a fee for use of the Port Jetty.

Despite these broad spectrum of polices for governing economic activities on backwaters, the resources continued to decline over the years causing severe threats to the local traditional stakeholders. Agencies responsible for ensuring the optimum use of resources were not enforcing these rules either due to the lack of clarity or due to the costs of enforcement. Traditional stakeholders objected rules that threatened their livelihood directly leading to the total failure of government policies[4]

4.3 Institutional Failures and Degradation of Estuarine Biodiversity

[4] Many examples of government failures can be cited A major failure that was highlighted was when the question of allotting part of the estuary for the new National Waterways III came up. Licensed stake net fishermen refused to move unless paid a huge compensation. Their argument was that those fishermen along the main channels of the Cochin estuary are required to pay a tax of Rs.25 per net, at a time when the tax levied for landed property was only 50 paise per acre. The total compensation for shifting these fishermen would then have run into lakhs in that case.

Yet another government failure that is obvious is the one observant during bridge construction. Often these bridges are constructed after reclaiming land from both sides of the water so that the cost of the bridge is reduced. This however narrows down the channel gap, reduces the flow of water, the current and tide affecting resources. In Kumbalangy, parts of the estuary are rising up as a result of sedimentation and changes in the flow of the water. The movement of fishes is also affected. With a large number of fishing gears and too little area to operate, one finds a lot of Chinese fishing gear in the middle of the estuary there.

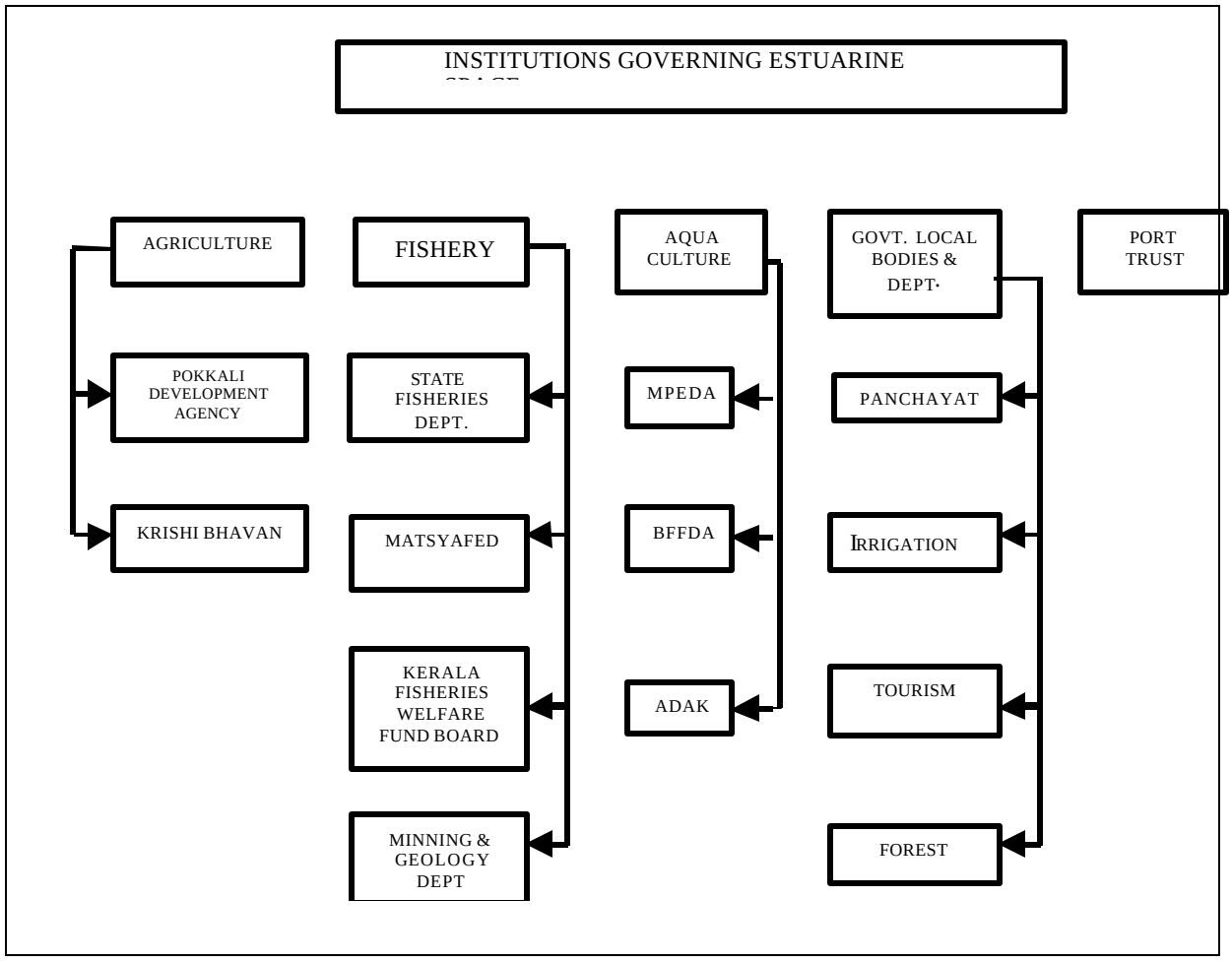
As mentioned in the previous section, government does not have a holistic vision in crafting policies for ecosystem governance and the situation in Cochin backwaters is no exception. In fact, it adopts an opportunistic behaviour to collect revenue by issuing permits and licenses to various stakeholders including its own share from the profits of public sector enterprises, which use backwaters. In this process, the state has established a number of institutions. One is surprised at the number of institutions that are engaged in the management of backwater ecosystems.

A close look at the structure and function of these institutions reveals that their activities overlap. When a number of parallel and sometimes overlapping policies and policy objectives exist, a lot of confusion arises. Sometimes disagreements on policies are carried on for a long period. This section describes in detail the nature of institutions in Cochin backwater.

Institutional economics distinguishes two kinds of institutions that stabilise and legitimise economic activities. These are broadly classified, as formal and informal institutions. State has created many formal institutions for the smooth introduction of development projects in the isolated villages around backwaters. Figure 4.2 below lists the formal organisations in different sectors.

Krishibhavans and the Pokkali Land Development Agency (PLDA) are state sponsored organisations for implementing various programmes in the agricultural sector. The jurisdiction of PLDA extends to 33 panchayats, 2 municipalities, in addition to the limits of Cochin Corporation. Krishibhavan is located in each panchayat. Even with the coming of PLDA, some schemes like production bonus, subsidies etc are still implemented through the Krishibhavan since it has a wider network. This arrangement obviously creates duplication and inefficiencies in governance.

Fig. 4.2 Formal Organisations

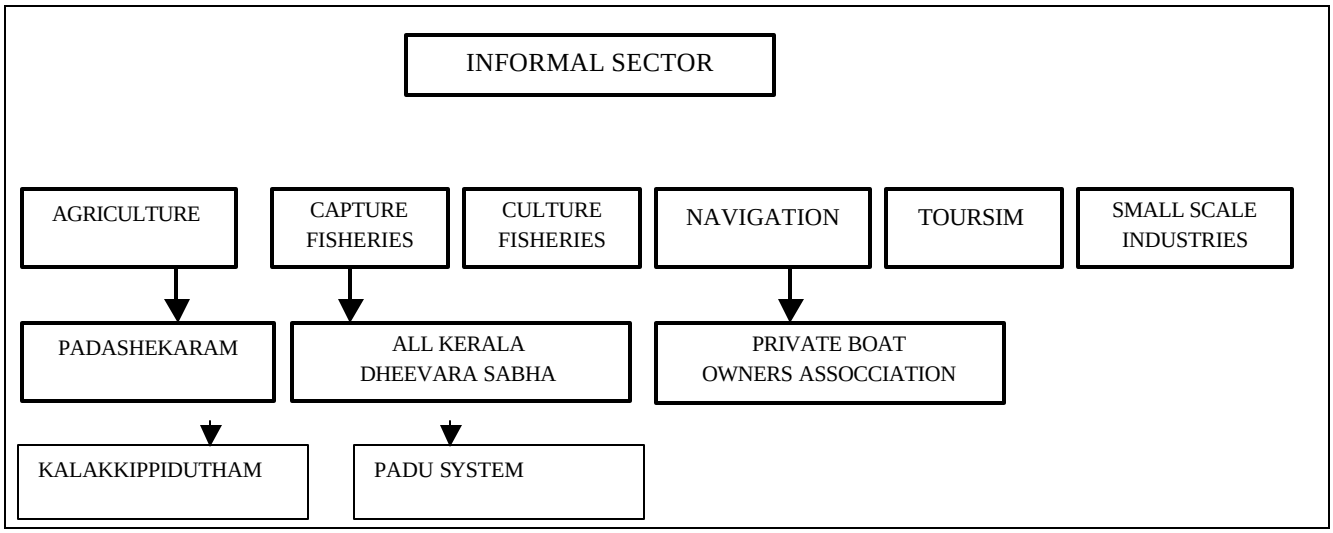


Brackish water fishery activities are under the control of the Fisheries department. As the diagram shows clearly, specialised agencies like the Brackish water Fish Farmer's Development Agency (BFFDA), the Agency for Development of Aquaculture, Kerala (ADAK), the Marine Products Export Development Authority (MPEDA), are also actively engaged in the development of brackish water capture fisheries and aquaculture in the Cochin backwater zone[5]

[5] The Brackish water Fish Farmer's Development Agency (BFFDA) is a district level organisation set up in the six kayal districts of the state. The Agency for Development of Aquaculture, Kerala (ADAK) was set up with external fund, is a single unit. Nevertheless, they disperse similar functions and aim at the development of aquaculture in the state. The Marine Products Export Development Authority (MPEDA) aims primarily at export development. With this view, it promotes among others culture activities in the state. A look at the amount dispensed as subsidies by these institutions combined is enormous. However, the total numbers of recipients are small in number. Besides these institutions do not have any foolproof mechanism to ensure that farmers do not avail subsidies from more than one agency at a time.

Informal Institutions, on the other hand, are indigenously evolved sets of customs and societal practices. The following figure 4.3 shows the major informal organisations in our study area.

Fig. 4.3 Informal institutions of Cochin backwaters



These institutions had performed many functions that sustained traditional activities in the brackish water body[6]. For instance, the institution of common property seen in backwater ecosystems had performed the allocation and distribution functions efficiently for centuries. Similarly, the padashekhara committees, in the agricultural sector, the dheevara sabha in fisheries and the institution of Kalakkippidutham had also been performing similar functions in the traditional economy. It may be mentioned here that, these organisations are still active in many places even today.

Resource sharing under old forms of institutions was never a smooth process either. Property rights of traditional users, the state and new users overlapped causing uncertainties in production processes. Decline in traditional institutions has also led to the erosion of resources and biodiversity. This suggests the need for strengthening traditional institutions and evolving appropriate bundle of rights that support the new economic uses. New institutions developed for this purpose could not address the real issues. As a result,

[6] The estuaries have a unique physical trait of being water dominated, which directly affects their uses and the institutional setups that dominate them. This means that many of the uses of the wetlands are cyclical with the time scale of the cycles depending on the water regime. This adds complexity to the property rights structure of the wetlands as they include aspects of the management of the aquatic resources in addition to the systems for land resources **(Thomas and Adams, 1997).**

people have developed their own sets of rules for management that rationalised their resource use, causing further degradation and economic crisis.

Institutional failures

An important characteristic of the present backwater eco system economies is the co existence of traditional and modern institutions towards better resource governance. The government does not recognize the capabilities and limitations of indigenous institutions. At the same time biodiversity degradation arises due to the failure of various human institutions to attribute proper values to estuarine biodiversity. Although, institutional failures could arise due to national/regional or global failures, most of the institutional failure are characterised as local since ecosystems are localised ones (Pearce & Moran 1997). There is no single window for disbursement of funds or subsidies. Sometimes it may be the panchayat, sometimes any of the fisheries institutions and sometimes the Krishi Bhavan.

4.5 Impact Of Biodiversity Degradation

So far, in this chapter, we have examined various causes for the degradation of biodiversity in Cochin backwaters. This section provides some evidences on the impact of biodiversity degradation on the human population.

Biodiversity loss in Cochin backwaters has reduced quantity of fish landed. Prior to the commissioning of the Thaneermukkom bund, an average daily catch of 5 tonnes of shrimp was available during the summer months (Kannan, 1979). Production has been decreasing during the past 3 decades. Table 4.8 shows estimated landings from Cochin backwaters.

Table 4.9 Distribution of fish production from Cochin backwaters

Year	Production kg/ha
1950's	1131
1960's	600-700
1970's	600-700
1980's	300-400

Source : Kannan, 1979

The table shows that the productivity of backwater has reduced from 1131 kg/ha in 1950's to the range of 300-400 kg/ha during the eighties.

The bund has reduced the extent of backwater nursery grounds by 25% and led to the total collapse of the juvenile shrimp fishery of this region. The decrease in the kayal area and increase in the demand for shrimps has resulted in a more intensive exploitation of the backwater nursery grounds causing shortage of shrimp seeds in the estuarine farms[7].

Summary

This chapter discussed in details the major causes for the loss of biological diversity of Cochin backwaters. We argued that the degradation of biodiversity is due to market, institutional and government failures. Major externalities produced by modern stakeholders were explained in detail. The descriptions revealed that unless externalities are internalized, the problem of degradation would worsen in future. Lack of a well

[7] The survey of studies on the biological processes of Cochin estuary reveals clearly that biodiversity of Cochin backwater has been declining. **Unnithan (1975)** reported that high levels of organic pollution exist in the backwater, which is well above the tolerance levels of the estuarine fauna. The **bottom fauna** of polychaetes, crustaceans, and molluscs shows considerable decrease in their number in the polluted areas. (**Unnithan et al.1975).** In the polluted and marginal zones bivalves are lesser in number. Molluscs being mostly filter feeding in habit, concentrate more pollutants than other animals. Hence they are not able to tolerate the increase of pollutants beyond a level.

Maximum **BOD value** high hydrogen sulphide and minimum oxygen values of certain zones in the Cochin backwater are the indication of pollution. High values of BOD indicates an increase in the organic content and bacterial activity and consequent decrease of oxygen content and hence decrease in the number of animals including zooplankton and benthic macro invertebrates and there by fishes. The **polychaetes** being the tolerant group of macro invertebrates exist in good number in all the zones including the polluted zones. Crustaceans and molluscs are few or absent in the polluted zones than the healthy zones. The density of **benthic fauna** becomes reduced and fish mortality due to ammonia content was reported by unnithan et al (1975). Saraladevi (1986) found that the benthic organisms were totally absent in the polluted areas of Cochin backwater. Jayapalan (1976) reported deleterious effect of effluents on plankton productivity of Cochin backwater due to pollution. Kurup (1995) raises doubts about the decline in fish catches and loss of certain species due to biodiversity degradation in Cochin backwaters. Incidence of mortality of fish Ambasis gymnocephalus due to industrial pollution is reported from the upper reaches of Cochin backwaters. Unnithan et. al. (1977). The effluents carrying a heavy load of ammonia at the rate of 432-160 ppm, pouring into the incidence area together with many other pollutants such as acids and suspended solids in varying quantities have changed the hydrographic conditions to extreme toxic proportions so as to cause heavy mortality of the animals in the area. Due to the influence of high temperature of the effluent, temperature of surface and bottom waters of the mortality zone which extends to an area of 500 m2 is considerably increased, enhancing the chemical and biochemical processes of the environment which indirectly accelerates the pollution effect of the mortality zone.

defined and enforceable bundle of backwater property rights and the public good nature of kayal diversity are all responsible for this sad state of affairs. The analysis of institutional failure revealed that modern institutions often lack the flexibility, adaptability and accountability that would regulate access to resources and environment. Multiplicity of institutions with overlapping delivery systems also caused problems. Each institution is designed to look after the commercial organization of an activity for which it is designed and do not care for other stakeholders of the ecosystem. This failure adds to the pace of biodiversity degradation. Finally, the government does not treat the backwaters as an integrated system and craft policies for the conservation of biodiversity. Instead, its policies of governance are issued under the banner of different departments and specialized agencies and do not therefore produce the synergies and collective efforts needed to conserve resources and biodiversity. Thus the aquatic ecosystem has failed miserably to provide decent means of survival to many indigenous agrarian and fishing communities. At the same time, a few group of people use this estuary for making quick profits by dumping industrial and agricultural wastes into its environment mainly by producing externalities. Large scale economic activities on the estuarine environment, different forms of externalities and the increasing amounts of wastes and pollution, if unregulated, will deplete biodiversity and ultimately ruin the environment and the people who depend on it for their livelihood. It may be noted that environmental depletion such as loss of estuarine biodiversity accelerates rural poverty, especially among the marginalized and weaker sections of the population.

Annexure 4.1 Concentration of Some Heavy Metals & Organic Carbon In The Sediments

Location	**No. Of samples**		**Hg (ppm)**	**Pb (ppm)**	**Zn (ppm)**	**Cr (ppm)**	**Cd (ppm)**	*T/org. Carbon (%)*
Fresh water zone (unpolluted)	4	A	.04-.06	10-65	40-60	7-20	ND	.2-.6
		B	-	2-15	10-24	2-8	-	-
		C	-	(20-25%)	(25-40%)	(28-40%)	ND	-
Effluent Discharge Point	5	A	5.5-11.5	160-190	420-780	85-120	6-8.4	0.8-3.5
		B	-	15-40	350-700	15-42	5-8	-
		C	-	(9-21%)	(83-89%)	(17-35%)	(83-95%)	-

Cochin Harbour Area	34	A	0.12-1.1	30-165	35-380	20-130	0.5-4.5	.2-3.4
		B	-	1.5-17	2-230	6.5-20	0.05-3.6	-
		C	-	(5-10%)	(5-60%)	(2-15%)	(10-80%)	-

A = Total Attack B = Acetic Acid Attack

C = % of bioavailably elements ND = Not Detected)

Annexure 4.2 The trends of sediment distribution in the Vembanad wetlands

Station no.	**Gravel 2mm**	**Very coarse sand 2-1 mm**	**Coarse sand 1-0.5 mm**	**Medium sand 0.5-0.25 mm**	**Fine sand 0.25-0.0625 mm**	**Silt**	**Clay**	**Remarks**
Barmouth	16.31	2.52	8.50	46.88	25.76	--	--	Medium and fine sand with shell gravel and coarse sand
Off port Trust building	--	--	0.22	1.41	67.51	11.92	18.88	Fine sand with clay and silt
Bolghatty	--	--	--	--	2.38	62.15	35.46	Silty clay
Thevara	--	--	4.54	34.57	22.62	12.53	25.73	Medium and fine sand with clay
Aroor	--	--	10.59	36.16	34.40	9.89	8.96	Fine medium and coarse sand. Small amount of silt and clay.

Source : Dept. of Agriculture, 1978

Annexure 4.3

Examinations of bore-hole data from various stations at Cochin and Azhikode shows the presence of lumps of degraded wood at depths of about 30-50 metres which might have deposited at a time when the river bed was at this level. Dating of wood sample from 30m depth at Azhikode indicated that it is about 1500 years old (P.S.N.Murthy). This shows a high sedimentation rate of 20 mm/year. Azhikode was an important port on the west coast of India from the pre-Christian era and has later become practically distinct due to sand bar formation and siltation, presumably after the deluge in 1341 A.D., when the river Periyar took a diversion and opened up the Cochin gut.

Bore hole data from Cochin harbour area also reveals that shell deposits of estuarine oyster Crassostrea madrasensis, extend upto a depth of over 5m below the present bed level. The bottom level of these reef shells indicate the bed level of the backwaters at the time of their early settlement. In the southern Vembanad region, the shell deposits are known to occupy a depth of 2-5m below the present bed level. Such shell deposits are available from almost all over the backwater system. These indicate that the backwater was deeper in the past than it was today. It is presumed that the settlement of estuarine oyster commenced only after the deluge of 1341 A.D from which time a typically estuarine condition began to prevail in the environment. From the available data it has been deduced that in the course of fity years, the average depth of Vembanad estuary has been reduced from 6.7 meters to 4.4 meters. As a result of the reduction in area and depth the total volume of the brackish water system between Alleppey and Azhikode has been reduced from 2.449 km^3 in the beginning of this century to 0.559 km^3 in 1985.

Annexure 4 Distribution of quantity silt dredged and expenditure incurred by the Port Trust: (952-1998)

Year	Quantity dredged (lakh m3)	Expenditure (Rs.)	Year	Quantity dredged (lakh m3)	Expenditure (Rs.)
51-52	15.81	-	75-76	34.64	14229010
52-53	25.84	-	76-77	37.29	15680776
53-54	23.93	-	77-78	21.85	15429466
54-55	20.65	-	78-79	13.62	17430504
55-56	19.9	-	79-80	20.13	28810142
56-57	31.59	-	80-81	17.76	23237089
57-58	22.38	-	81-82	22.8	43799497

58-59	29.49	-	82-83	18.48	72647054
59-60	25.71	-	83-84	21.25	33901194
60-61	22.12	-	84-85	16.23	79639129
61-62	65.06	-	85-86	12.71	1.07E+08
62-63	68.01	-	86-87	15.43	94229134
63-64	28.26	-	87-88	12.85	62969853
64-65	28.79	-	88-89	3.13	91651360
65-66	32.96	-	89-90	1.57	98252437
66-67	26.61	30.94	90-91	-	-
67-68	42.56	46.19	91-92	-	-
68-69	34.08	-	92-93	-	-
69-70	44.22	57.24649	93-94	-	-
70-71	26.77	58.95585	94-95	-	-
71-72	33.12	62.43282	95-96	-	-
72-73	32.13	71.90188	96-97	126.52	-
73-74	38.12	99.22499	97-98	115.19	-
74-75	31.07	13038557			

Source: Administrative reports of Port Trust.

CHAPTER 5

ECONOMIC ACTIVITIES AND DIRECT ECONOMIC BENEFITS OF COCHIN BACKWATERS

We have argued that the Cochin backwaters provided immense opportunities to the traditional stakeholders for livelihood in the form of wetland agriculture, fisheries, aquaculture and many other activities. In addition to these possibilities, the interventions of the state during the last couple of decades on this ecosystem have also created more economic opportunities in the region. The most important activities under these initiatives are the development of modern industries, port trust, passenger and cargo transport services and the leisure industry. As this ecosystem is now valuable to both the traditional and modern stakeholders alike, it is therefore necessary to analyse how these different groups generate economic values through their activities. We undertake this task in this chapter in detail. We begin by examining the nature of economic activities of traditional stakeholders and provide a detailed description of the activities of modern stakeholders. A brief summary of this chapter follows.

5.3 Economic activities of traditional stakeholders

As detailed in chapter 3, pokkali agriculture is the major economic activity of the rural communities in this area. Farming had been organised on the low-lying wetlands adjoining the backwater system by local communities since time immemorial. Even today, pokkali farming is an activity driven by nature. Fishing is the next most important activity organised by the fisherfolk in the interior areas. Although organised at a subsistence level, backwater capture fishing is an year round activity in this region. In addition to these activities, aquaculture, and small-scale industrial activities like clay and sand mining, coir making and limeshell collection have also been undertaken by small groups of traditional rural communities in the study area. This section highlights how

these different groups organise their production activities. An attempt is also made to estimate the gross revenue generated from each of the activities to highlight the economic importance of these systems to local population.

5.1.1 Pokkali Agriculture

Records of the nineteenth century (1863) indicate that wetlands constitute about two third of the total geographical area of Alappuzha and Ernakulam districts which is the largest administrative region on the banks of the backwater. Although, the wetland area has been reducing, it still provides direct livelihood to 7,000 families and employment to 25,000 male and female labourers.

The preparation of land for pokkali cultivation begins in the month of April after Vishu. Cultivation begins immediately after the onset of south-west monsoon in the month of May. Local male workers are used for land preparation and sowing while female labourers are used for transplanting, weeding and harvesting. The crop is harvested in September.

Traditionally, the local landlords with the help of lower castes undertook paddy cultivation in the wetlands around Cochin backwaters. Most of the Devaswom lands were leased out to wealthy landlords while some portion of the lands was cultivated directly by them. Since paddy cultivation in wetlands required lump sum investment for the construction of external bunds, cleaning of channels for distribution of water etc, collective action evolved in the economy as a natural mode of economic organisation.

Soon after the paddy is harvested in September, these fields are converted for prawn filtration. This activity ends in April and the lands are back to cultivation again. Although cultivation of paddy and prawn filtration were undertaken by individual landowners, leasing out the lands to prawn contractors and to take it back from them for cultivating paddy again after six months was a very difficult proposition for most of them, especially the marginal farmers. This led to the evolution of a co-operative movement among indigenous paddy farmers and resulted in the formation of farmer's collectives called ***padashekarams***.

Table 5.1 Distributions Of Pokkali Pa dasheramas In The Study Area

	Panchayath	Number of Padasekharam	Area in hectors	No: of farmers	Average Holding (ha)
Northern Zone of Kochi Kayal					
1	Pallipuram	1	12	33	0.36
2	Kuzhippalli	6	347	1151	0.30
3	Paravoor Muncipality	1	43	32	1.34
4	Kottuvally	14	598	715	0.98
5	Edavanakkadu	2	72	104	0.58
6	Elankunnapuzha	7	107	116	0.92
7	Njarakkal	4	312	378	0.83
8	Nayarambalam	3	242	283	0.86
9	Varapuzha	29	272	422	0.64
10	Ezhikakara	4	586	964	0.61
11	Mulavukad	2	25	32	0.78
12	Kadamakkudy	11	137	179	0.77
13	Cheranelloor	2	63	47	1.34
	Sub Total	**86 (72.88 %)**	**2816 (63.27 %)**	**4456 (69.74%)**	**0.63**
South Zone					
14	Kumbalangi	8	434	592	0.73
15	Chellanam	9	688	808	0.85
16	Maradu	2	94	110	0.85
17	Kumbalam	7	201	198	1.02
18	Cochin Corporation	3	18	20	0.90
19	Thripunithura Muncipality	2	100	120	0.83
20	Udayamperoor	1	100	85	1.18
	Sub Total	**32 (27.12 %)**	**1635 (36.73 %)**	**1933 (30.26 %)**	**0.85**
	TOTAL	**118 (100 %)**	**4451 (100 %)**	**6389 (100 %)**	**0.70**

Source: PLDA, 2000

Padasekharam is a neighbourhood association of farmers -a voluntary coalition-which provides securities to individual members in their bargains with prawn contractors. Most of the Padashekarams are registered organisations with an elected committee consisting of a President, secretary and executive members. Today, organising production in pokkali fields revolves around Padashekarams.

In 1996, the government instituted the Pokkali Land Development Agency [PLDA] for the promotion of paddy cultivation in the wetlands. The information provided by the Pokkali Land Development Agency [PLDA] allows us to undertake a highly disaggregated analysis of activities of pokkali padashekaram in the study area. For instance the table below (Table 5.1) provides the distribution of pokkali padashekaram towards the north and south zones of Kochi kayal.

It is interesting to note that 72.88% of padashekaram are located in north zone while only 27.12% is located in south zone. Similarly 63.27 % of the total pokkali fields lie in north zone and 36.73 % lies in southern zone. Moreover 69.74% of the farmers are found in north zone while 30.26 % is found in south zone. It may be mentioned that although the incidence of industrial pollution is high in the north zone, (see chapter 4 for details) the bulk of the pokkali fields are still located in the same zone.

Table 5.2 shows the distribution of Padashekarams by average operational holdings in the north zone and table 5.3 shows the distribution in the south zone. It is noted that in the north zone, 73 % of Padashekarams operate holdings less than 1 ha. 20 % Padashekarams operate holdings between 1 and 2 ha and only 7 % operate holdings above 2 ha. Similarly table 6.3 reveals that 63 % of Padashekarams in South zone operate holdings less than 1 ha. 27% operate holdings between 1 and 2 ha and 10% operate holdings above 2 ha. This means that the proportion of small holdings (less than 1 ha) in north zone exceeds that of south zone while the proportion of medium holdings is higher in the south zone.

Table 5.2 Distribution of average operational holdings of different Padashekarams in the north zone

Class [ha]	Pallipuram	Kuzhippalli	Paravoor Muncipality	Edavanakkadu	Elankunnapuzha	Njarakkal	Nayarambalam	Varapuzha	Kottuvally	Ezhikakara	Mulavukad	Kadamakkudy	Cheranelloor	Sub Total
0 - 0.25	0	2		0	0	0	0	1	0	0	0	0	0	3
0.25 - 0.05	1	2		0	0	1	0	7	4	1	0	0	0	16
0.5 - 0.75		0		2	2	1	1	10	4	3	1	1	0	25
0.75 - 1		1			2	2	1	9	2		0	1	1	19
1-1.5		1	1		3		1	2	2		1	4	1	16
1.5-2									1			0		1
2 to 3									1			3		4
3 to 4												0		0
>4												2		2
Total	1	6	1	2	7	4	3	29	14	4	2	11	2	86

Source: PLDA, 2000

Table 5.3 Distribution of average operational holdings of different Padashekarams in the south zone

Class [ha]	Kumbalangi	Chellanam	Maradu	Kumbalam	Cochin Corporation	Thripunithura Muncipality	Udayam peroor	Sub Total
0 - 0.25	0	0	0	0	0	0	0	0
0.25 - 0.05	2	1	0	0	0	0	0	3
0.5 - 0.75	1	3	0	0	0	1	0	5
0.75 - 1	2	3	2	2	3	1	0	11
1-1.5	1	1	0	2	0	0	1	5
1.5-2	0	1	0	2	0	0	0	3
2 to 3	2	0	0	0	0	0	0	2
3 to 4	0	0	0	1	0	0	0	1
>4	0	0	0	0	0	0	0	0
Total	**8**	**9**	**2**	**7**	**3**	**2**	**1**	**32**

Source: PLDA, 2000

Distribution of operational holdings of households

Tables5.4 and 5.5 exhibit the distribution of households by the size of land holdings in the study area.

Table5.4 Distribution of households in the north zone by size of land holdings

Class [ha]	Pallipuram	Kuzhippalli	Paravoor Muncipality	Edavanakkadu	Elankunnapuzha	Njarakkal	Nayarambalam	Varapuzha	Kottuvally	Ezhikakara	Mulavukad	Kadamakkudy	Cheranelloor	**Sub Total**
0 to .5	33	1103	0	0	70	12	0	137	167	200	0	167	0	**1889**
0.5 to 1	0	28	0	104	46	366	201	269	268	764	26	4	4	**2080**
1 to 2	0	20	32	0	0	0	82	16	280	0	6	3	43	**482**
2 to 3	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
3 to 4	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
> 4	0	0		0	0	0	0	0	0	0	0	5	0	**5**
Total	**33**	**1151**	**32**	**104**	**116**	**378**	**283**	**422**	**715**	**964**	**32**	**179**	**47**	**4456**

Source: PLDA, 2000

Table 5.5 Distribution of households in the south zone by size of land holdings

Class	Kumbalangi	Chellanam	Maradu	Kumbalam	Cochin Corporation	Thripunithura Muncipality	Udayamperoor	***Sub Total***
0 to .5	194	60	0	0	0	0	0	**254**
0.5 to 1	366	634	110	162	20	120	0	**1412**
1 to 2	25	114	0	33	0	0	85	**257**
2 to 3	7	0	0	0	0	0	0	**7**
3 to 4	0	0	0	3	0	0	0	**3**
> 4	0	0	0	0	0	0	0	**0**
Total	**592**	**808**	**110**	**198**	**20**	**120**	**85**	**1933**

Source: PLDA, 2000

It may be inferred that 89% of households in north zone operate holdings less than 1 ha. 11% operates holdings between 1 and 2 ha while households operating holdings above 2 ha are insignificant. In south zone on the other hand, 86% households operate holdings less than 1 ha and 13% between 1 and 2ha and only 1% operate holdings above 2 ha. The conclusion is that in terms of operational holdings there is not much difference between the two zones.

Revenue from Pokkali Paddy Production.

As mentioned earlier, the farmers of this region have been undertaking pokkali cultivation mainly for livelihood. In order to assess the economic importance of this activity, we made an attempt to value the revenue generated from this activity in the study area. The results are produced in tables 5.6 and 5.7 below.

Table 5.6 Distribution of revenue generated by different class holdings of Pokkali paddy in the North Zone

North zone						
Size of holdings [ha]	**Area under cultivation [ha]**	**Ave. yield [kg]**	**Price (Rs.)**	**Gross revenue Generated (Rs.)**	**No. of households**	**Value per hector (Rs.)**
0 to .5	617	865	7	3735935	1889	
0.5 to 1	1498	865	7	9070390	2080	
1 to 2	668	865	7.5	4333650	481	
2 to 3	7	1400	6	58800	1	
3 to 4	0	1400	8	0	0	
> 4	26	1400	7	254800	5	
Total	**2816**			**17453575 [58.07 %]**	**4456**	**6198.00**

Source: primary data

The table shows that the gross revenue generated from pokkali paddy cultivation in the year 2000 is Rs.1, 74,53,575 (one crore seventy-four lakhs fifty three thousand five

hundred and seventy five). It can also be seen that the revenue generated per hectare from pokkali cultivation in the north zone is Rs. 6198/-

Table 5.7 shows the distribution of revenue generated by different class holdings of Pokkali paddy in the south zone

Table 5.7 Distribution of revenue generated by different class holdings of Pokkali paddy in the South Zone

South zone						
Size of holdings [ha]	Area under cultivation [ha]	Ave. yield [kg]	Price (Rs.)	Gross revenue Generated (Rs.)	No. of households	Value per hector (Rs.)
0 to .5	86	1100	7	662200	254	
0.5 to 1	1185	1100	7	9124500	1412	
1 to 2	337	1100	7	2594900	257	
2 to 3	17	1100	6.5	121550	7	
3 to 4	10	1400	7	98000	3	
> 4	0	1400	7	0	0	
Total	**1635**			**12601150 [41.93 %]**	**1933**	**7707.13**

Source: primary data

The data reveals that pokkali paddy cultivation in the south zone generated gross revenue of Rs. 1,26,01,150 [one crore twenty six lakhs one thousand one hundred and fifty] and the average value per hectare is Rs. 7707/-

In order to compare the performances of pokkali cultivation in the south and north zones we bring together the productivity figures of the selected zones in table 5.8.

Table 5.8 Distribution of value of Pokkali paddy generated by different class holdings in the North and South Zones

North and South Zones							
Size of holdings [ha]	**Total Acreage [ha]**	**Average yield (Kg)**		**Total Value Generated (Rs.)**			**Value per hector (Rs.)**
		North Zone	South Zone	North Zone	South Zone	Total (Million)	
0 to .5	703			3735935	662200	4398135	
0.5 to 1	2683			9070390	9124500	18194890	
1 to 2	1005			4333650	2594900	6928550	
2 to 3	24			58800	121550	180350	
3 to 4	10			0	98000	98000	
> 4	26			254800	0	254800	
Total	**4451**	**871.27**	**1101.84**	**17453575 [58.07 %]**	**12601150 [41.93 %]**	**30.054725 [100 %]**	**6752.35**

Source: primary data

The table shows that 4551 ha of wetland generated gross revenue of Rs. 3,00,54,725 in 2000. 58 percent (Rs. 17453575) of this value is generated from the northern side while 42 percent (Rs. 1,26,01,150) is from the southern zone. The average yield in the north zone (871.27kg) is found to be lower than the yield in the southern zone (1101.84kg). It may be mentioned that the Northern Zone of the Cochin Backwaters locates large number of modern industries and modern aquaculture farms compared to the southern zone. In short, the wetland paddy systems of Cochin backwaters is capable of generating direct gross economic benefit of Rs. 30054725 (Rupees Three crores fifty four thousand seven hundred and twenty five) during a period of six months. This reveals without doubt the economic importance of the ecosystem to the local agrarian communities.

As soon as the paddy is harvested by the end of September, the lands are prepared for prawn filtration, which continues till the first week of April. Local padashekaram committee plays a crucial role as a mediator on behalf of the members to negotiate and fix leasing rights with prawn contractors, to collect the lease amount and distribute to individual members and to supervise the smooth transfer of the land back to individual members for paddy cultivation in April. This is achieved mainly by legitimising the social practice of Kalakkipidutham in the pokkali fields. Soon after the lease period for

prawn filtration ends in April (On the day of Vishu, the Malayalam new year day), owners of lands allow their labour classes and the poor people in the village to catch the remaining fishes Women of the lower caste are generally involved in this gear-less fishing practice. These people belong to the agrarian labour class and are engaged in agriculture related activities during the paddy season. They also help out in the fields during the period of prawn filtration. This reciprocal arrangement between the owners and labour classes provided secure livelihood to a large number of rural labour households in the study area. This is an example of a kind of traditional redistribution mechanism of the benefits of biodiversity to the deprived section of the society especially the womenfolk who in turn supply the necessary labour force in the chapter. **(A detailed case study is given in Chapter 6).** Prawn filtration ends with ***'kalakkipidutham'*** and the lands are back to cultivation once again.

5.4 Fisheries And The Fisher Folk

Fishing is an age-old occupation of estuarine fishing communities. The local communities in this area are mainly engaged in capture and culture fisheries on the ecosystem. As mentioned in chapter 3, the *ichthyophona* of Cochin Backwaters in comparison with those of other brackish water lakes and estuaries of India is richer and more diversified. **Kurup (1982)** has listed one hundred and fifty species of fishes belonging to 100 genera under 56 families from this estuary. The species, which inhabit the different zones of the estuary, are oligohaline fishes (23 species), and truly estuarine fishes (38 species). Cochin backwaters have a highly diversified fishery consisting of about 150 species of fish and shellfishes during early eighties (Kurup, 1982; Kurup and Samuel, 1985 and 1987).

5.2.2 Social Organisation Of Fishing

Backwater fishing even today is the occupation of the socially backward communities of Kerala. It is reported that during the sixties, fishermen were using as many as 42 different types of gears for fishing in this backwater [see annexure 4.4]. Today this number has reduced and about 15 types of these gears (Chinese net, the stake net, the gill nets, caste net, seine net, ring net, trap net, scoop net, the hook and line etc.) are commonly found in the study area. The most commonly used fixed nets are the Chinese dip net and the Stake net. Both are stationary nets hence their operation depends on tides.

Fishing is subject to the physical characteristics and natural processes of the backwaters. We have already indicated that the water quality in the backwater is fast eroding due to the externalities of industrialisation and urbanisation. This is extremely grave in the north zone of the backwaters than the south zone. The northern region of the Cochin estuary compared to the south is narrow and not very deep. Natural sedimentation, effects of dredging by Cochin Port and for the Vallarpadom Container Terminal has resulted in sedimentation of silt in this region and has considerably reduced the water flow.

The southern zone of the Cochin estuary consists of two parts. The area demarcated by the Port as its jurisdiction space is very deep and has strong currents. Consequently a large number of fishing gears and of different types can be found in this region. The Stake nets are dominant, followed by Chinese nets and other free nets. Beyond the Port limits towards further south, the water flow is practically stagnant. Stake nets are very few in this region compared to the bar mouth region.

5.2.2 The Structure Of Customary Rights

Various formal and informal rules evolved internally or dictated by the modern stakeholders also influence fishing activities. Stakenets are believed to be the first type of fixed nets that have historically dominated in the backwaters of Cochin. It is believed that the rights to erect stake nets had been granted by the King of Cochin as a reward for the services rendered to him by the caste Valas or Dheevaras. Since then these communities have been gradually increasing stake net operations. The operations of this net is very

much dependant on the strength of water currents and consequently can be found in the middle of the estuary where currents are strong during tides.

For Dheevara communities, stake net fishery is the primary source of livelihood. Neighbouring village communities on the basis of hydro biological and societal needs and requirements divide productive fishing areas in the backwaters. Fishermen claim that territories that lie adjacent to their villages belong to them and therefore others should not erect similar nets in that territory. These rights are violently defended by excluding other gear groups from the areas where stake nets are fixed. Violations do occur but are often resolved through mutual negotiations and sometimes through formal legal mechanisms.

A row of nets (Oonni padu) may consist of any number of nets from five to a hundred. Depending upon the area where the oonnipadu is located and the nature of water currents, tides and availability of resources, different types of sharing mechanisms prevail among Oonnipadu fishermen. For instance, a system of gear rotation exists among the members of oonnipadu in the barmouth region. Here, the fishermen rotate the position of their net everyday so that everyone in the team has an equal chance of getting good catches. Similarly earnings of an extra net they put are donated to the common funds of the community. In certain locations like Thevara and Eda kochi, if a fisherman is not using his stakenet on a particular day, the Oonnipadu sangam puts up a net and the proceeds go to the common fund. There are also some onnipdau that follow the system of half oonni or "Ara Oonni". Here the fisherman is allowed to sell or lease out his net to another fisherman for a fee. This normally happens in households, which cannot organise the fishing operations in time due to various internal problems. If rights are leased out, the owner collects lease money either in cash or in kind spread to mutually agreed period. Sometimes, arrangement is also been made to divide the day's catch equally between contracting members. The discussions made above indicate clearly that various forms of community co-operation and sharing systems exist among the stake net fishermen community. The process of sharing fishing grounds was never a smooth process. Conflicts are observed between two Oonnipadus or between Oonni sangams especially if operations affect catch rates of users.

The second popular fixed gears, the Chinese nets (Cheena vala) are commonly found along the banks of the backwater. The size of the net varies according to the depth of water channel, the strength of water currents, and the availability of resources. Towards the bar mouth one finds dip nets that are huge in size and require a minimum of six or seven fishermen to haul it in. On the other hand one can find nets of smaller size towards the interior regions of the backwaters, which engage a maximum of two or three labourers. Chinese nets are normally operated after sunset. Lowering and hauling of nets go on usually till the wee hours of the morning. These nets are best for catching ***Chemmeen*** and ***Karimeen*** and hence considered a lucrative gear.

Koruvala is another type of fishing net that is used in the Cochin backwaters which is a modified version of the gill net. This type of gear has been banned by the Fisheries Department due to the small mesh size (less than 8mm) of the nets. However they are mainly used by migrant fishermen especially those coming from the Kollam region. It is reported that the operations of koruvala are highly destructive to the fishery resources and conflicts occur between local fishing communities and the migrant fishermen who use koruvalas. The migrant fishermen from the Kanyakumari district of Tamilnadu also fish in the backwaters of Kerala. In the Cochin estuary, they use round or oval shaped floating baskets made from bamboo or cane sealed with tar on the bottom. They use either gill nets or hook and line to fish. Despite local resistance, they continue to fish in this backwater by making informal arrangements with local community leaders and traders.

We have argued above that whether the net is fixed or moving, customary rights exist among the fishermen. In normal situations, an individual fisherman does not encroach upon the territory of others. In the case of free nets, definitions of territoriality come from what they have been able to demarcate as their own. But violations occur frequently leading to clashes or police cases. Majority of the conflicts and fishing disputes occur between those owing fixed and free nets. Obviously this means that among fishermen of the same gear type, notions of territoriality are well kept and one does not normally intrude into the activities of the other one.

5.5.3 Economic Value From Fishery Resources

As indicated earlier, fishing is an year round activity in Cochin backwaters. Fishermen reported that the best season is between December and May. During these months they use a variety of fixed as well as free nets for fishing. Major fixed nets are the stake nets and Chinese nets. The free nets include a variety of gill nets, hook and lines, caste nets etc. Although fishermen use a diverse variety of nets for fishing, 10 popular gears are sampled in this study for estimating average fish landings and gross revenue form fishing. Table 5.9 shows the distribution of major gears and the number of active fishermen by zones in the study area.

Table 5.9 Distribution of different Gear Groups and active fishermen in the North and South Zone

	North Zone		South Zone		Total No. of gears	Total No. of fishermen
	No of gears	No of fishermen	No of gears	No of fishermen		
Chinese Net	866	2598	2163	6489	3029.00	9087
Stake net	1759	3518	5650	11300	7409.00	14818
Free net [1]	2203	4406	6211	12422	8414.00	16828
Total	4828 (25.61)	10522 (25.83)	14024 (74.39)	30211 (74.17)	18852 (100)	40733 (100)

Source: Primary Survey , see end note [1]

The table reveals clearly that the fishing activities are more centred in the southern zone of the study area than the northern zone. Around 25 percent of the active men and gears are concentrated in the north zone while 75 percent of the same is concentrated in the southern zone. This uneven distribution of fishing tackles and men in the study area is

due to reduction in the depth of the water body, resource scarcity and incidence of high levels of water pollution.

Fishing days

Table 5.10 shows the distribution of active fishing days per month in the study areas. Fishermen reported that the best season for Chinese nets and stake nets begin in December and extends upto May. Most of the free nets on the other hand have only 10 days of active fishing although they try their luck for about 25 days per month.

Table 5.10 Distribution of active fishing days per month in the study areas.

Distribution of active Fishing days in each month											
	March	April	May	June	July	Aug	Oct	Nov	Dec	Jan	Feb
Chinese Net	7	7	7	3	3	3	3	3	7	7	7
Stake net	7	7	7	3	3	3	3	3	7	7	7
Free net	10	10	10	10	10	10	10	10	10	10	10

Source: Primary Survey

Table 5.11 summarises the average landings per gear per day in the north and south zones**.**

Table 5.11 Landings by different class of gears in the North and South Zone

	North Zone			**South Zone**		
	Chinese Net (Kg)	Stake Net (Kg)	Free Net (Kg)	Chinese Net (Kg)	Stake Net (Kg)	Free Net (Kg)
Average catch / net / day	8.03	11.47	10.19	5.86	13.37	11.05

Source : Primary Survey

It may be inferred that the average Chinese net landings per day in the north zone are higher than (8.03 kg.) that in the southern zones (5.86 kg.) In the case of stake nets and other free nets the average landings in the north zone is lower than the south zone.

Table 5.12 shows details of the gross revenue generated from fishing in the study area.

Table 5.12 Revenue Generated by different class of gear in the North and South Zone for the year 2000-01 (Million)

	North Zone				South Zone				Total (million)
	Chinese Net (Rs.)	Stake Net (Rs.)	Free Net (Rs.)	Total (million)	Chinese Net (Rs.)	Stake Net (Rs.)	Free Net (Rs.)	Total (million)	
Revenue / net / day	896	405	216		521.41	440.15	561		
No. of gear operated	866	1759	2203		2163	5650	6211.00		
No. of days operated	60	60	120		60	60	120.00		
Total Revenue	46.56 (31.8%)	42.74 (29.19%)	57.10 (39.00)	146.40 (100) (18.74)	67. 67 (10.66%)	149.21 (23.50)	418.12 (65.85%)	635.00 (100) (81.26)	781.40 (100)

Source : Primary Survey (See annexure 5.4 for details)

As shown in the table, the gross revenue generated during the year 2000-01 is estimated to be Rs. 781.41 million of which the largest proportion, Rs. 635 million (81.26%) is contributed by south zone and Rs.146.40 million (18.74 %) is contributed by north zone. Free nets dominate in both zones. Two third of the total landings in the south zone is contributed by free nets; stake nets contributes 23 percent and Chinese nets contribute around 10 percent. In the North zone on the other hand, stake nets contribute 29 percent and Chinese nets 31 percent. The above discussion reveals the economic importance of fishing to the local fisherfolk.

5.6 Fish farming and aquaculture

Aquaculture is the second largest livelihood supplier to the traditional agrarian communities around Cochin backwaters. Table 5.13 shows the distribution of brackish waters of Ernakulam district into its various uses.

Table 5.13Distribution of brackish water in Ernakulam District.

Uses of brackish water	Area (ha)	Percentage
Suitable for aquaculture	13666.96	84.30 %
1. Cage & pen culture in future	6796.70	(49.73 %)
2. Suitable for extensive farming of P. indicus	5565.62	(40.72 %)
3. Suitable for extensive farming of P. monodon	1181.37	(8.65 %)
4. Marshy land suitable for culture	123.03	(0.90 %)
Total brackish water area	16212.71	100 %

Source : Surendran, 1990, Brackish water areas of Kerala. A profile; ADAK, Cochin.

In the Ernakulam district, total brackish water area is about 16212.71 ha and prawn filtration is carried out in 10597.01 ha of which 9655.14 ha is seasonal and 941.87 ha is perennial as on March 1984.

Three types of culture practices are noticed in the area. Prawn filtration, extensive prawn culture and the modified semi intensive culture. Prawn filtration, the most popular culture of prawn, is organised by collecting seedlings entering the estuary during high tides in the Pokkali fields Such traditional prawn filtration ensures high rates of utilisation coastal wetlands in the area. The crop is harvested within 150 days. What makes the prawn culture attractive is its organic character. Prawns in pokkali fields subsist on organic matter from decayed stubble, drying waterweeds etc and are not fed with chemical feed. In turn pokkali fields are enriched in manure and the excreta of organic wastes from fish and prawns.

Prawn filtration or Chemmeen Kettu in Pokkali paddy fields is an age old culture practice that has existed in Kerala. Saline swamps and mudflats adjoining coastal areas are used with little or no care, dependant upon the natural fertility of the soil and tidewater. **Chemmen vattu, the Varshakettu** or the extensive mode of aquaculture is

another culture practice followed traditionally. It is usually carried out in paddy fields where pokkali is cultivated. The difference with the traditional prawn filtration is that here the culture activities are done round the year and is not confined to six months alone. The Fishing rights during the period of the pokkali paddy are given to the "Moopan" who supervises agricultural operations. He sees to the cultivation and provides agricultural labour for the fields. In return, he is given the right to fish in the fields for those six months. Culture during the next six months is on a commercial basis and the laborers have the right to catch fish only at the end of the season with "kallakipidutham". **Semi intensive culture** form is the modern culture system, which applies modern science and technology to produce living organisms. It is not practiced in its true form rather it is a modified semi intensive culture system that is seen practiced in the backwaters of Cochin. Table 5.14 gives the distribution of various aquaculture farms and revenue generated in these farms in the year 2000 in the study area

Table 5.14 Distribution of aquaculture farms and revenue generated in 2000

	Dist. Total	**Average Yield (Kg)**	**Price (Rs.)**	**Gross Revenue Rs. million**
Modified Extensive	1087.42	1255	335	457.18
Modified Semi Intensive	419.119	2552	475	508.06
Total Revenue (Million)				**965.24**

Source: calculations based on secondary and primary data

Thus the above analysis revealed that three major traditional economic activities together contributed a gross value of Rs. 965.24 + 781.40+30.054725 = 1776.7 million rupees during the year 2000. This indicates the economic importance of such activities to the large number of traditional fishermen and agrarian communities alike in the Cochin backwater's watershed.

5.7 Modern Stakeholders In The Backwater Economy

In this section we will introduce the nature of economic activities carried out by the modern stakeholders and present estimates of gross revenue generated by them from backwater environment. The major stakeholders who have started economic activities on the kayal environment are the Cochin Port Trust; Kerala Shipping and Inland Navigation Corporation, State Water Transport Department and the Tourism Industry. (see chapter 3 for details).

The Cochin Port Trust is a central government public sector company engaged in the export import business. Table 5.15 gives the gross revenue generated by port trust .It is noted that during the year1998-99, port trust generated 1234.29 million rupees from the export import business through the backwater environment.

Table 5.15 Gross revenue generated by Cochin Port Trust

Cochin Port Trust	1996-97	1997-98	1998-99
Cargo handling & Storage Charges (Rs)	945614026	1048958655	1073547399
Port & Dock charges (Rs)	345649906	403447803	43861883
Railway earnings (Rs)	0	0	0
Estate rentals (Rs)	86366289	102090451	116882906
Total revenue income (Rs)	**1377.630221**	**1554.496909**	**1234.292188**

Source: calculated from annual reports

As indicated in chapter 3 the modern navigation industry in Cochin backwaters is a mixture of public and private participation. The State has nationalized certain routes and provides services to these regions. The State Water Transport Department provides the passenger services and the Kerala State Inland Navigation Corporation provides ferry, Jhankar and barge services. Private boats also provide ferry and Jhankar services in the interior regions like Varapuzha, Kadamakuddy, Chitoor and Cheranalloor.

The gross revenue generated by the modern navigation industry is the sum of the revenues of KSINC and the State Water Transport Department. Table 5.16 shows the distribution of gross revenue generated by Kerala shipping and inland navigation corporation and table 5.17 shows the distribution of values by the state water transport

department. It can be seen that the KSINC generates Rs.56.62 lakhs while the state water transport department generates Rs. 408.8 lakhs. This means that the total value generated by the navigation industry from Cochin backwaters is Rs. 46.54 millions in 1998-99.

Table 5.16 Gross revenue generated by Kerala Shipping and Inland Navigation Corporation

Operational Statistics of KSINC								
Particulars	87-88	88-89	90- 91	91-92	95-96	96-97	97-98	98-99
Total No of boats/ Jankars	2+2	2+2	1	1	1+2	1+2	2+2	2+2
No of trips	9.85	5.78	-	-	9403	2622	4967	3617
Gross route distance (Lakh Km)	25717	79800	70	-	81228	60824	25717	79800
Total revenue received (Rs Lakhs)	**51.64**	**56.62**	**7.21**	**9.44**	**01.94**	**18.68**	**51.64**	**56.62**
Total Revenue Expenditure (Rs Lakhs)	41.28	69.23	5.6	8.25	42.64	93.93	41.28	69.23
Net loss	10.36	87.39	.39	.81	8.62	4.03	10.36	87.39

Source: Economic Review

The Tourism Industry based on Cochin backwaters is fast developing mainly due to the environmental value of the backwaters. It is a new and economically promising activity with scope for profits at low levels of investment. Consequently the number of stakeholders involved in it is numerous. The stakeholders in the Cochin backwaters in the field of tourism are the micro level enterprises such as the Tour Operators, the Government, Local Bodies, Local hotels, foreign tie-ups with hotels or travel agents etc

Table 5.17 Gross revenue generated by the State water transport department

Particulars	**State Water Transport Department**					
	1990-91	1991-92	1995-96	1996-97	1997-98	1998-99

No. of boats /jhankars	88	91	77	77	78	81
Passenger (lakhs)	56	56	243.24	266.22	2201.95	240.79
Total Revenue (lakhs)	**135.65**	**118**	**360.28**	**382.19**	**339.68**	**408.8**
Total Expenditure (lakhs)	135.65	341	595.89	702.71	864.3	927.1
No of employees	189.33	220			1272	1285
Profit/ Loss(lakhs)	1167	1167	-235.6	-320.52	- 524.62	- 518.30

Source : SWTD

Government, being the leading player, plays an active role in promoting backwater tourism. Each district has District Tourism Promotion Council, which is very active, and doing commendable job in the sphere of tourism service. This industry also manages to invoke the participation of local people in the form of selling their wares to the tourist or providing them with food and beverages etc.

Apart from the tourists, who go in for organised tour packages, the backwater also receives an influx of tourists who visit it for its scenic and aesthetic beauty alone. Such population can be seen along the Marine Drive and Willingdon Island as well as the premises of the Bolgatty palace and such other small islands. Table 5.18shows the gross revenue generated from the private and public sector activities in backwater tourism. The table shows that tourism along Cochin backwaters generates Rs. 28.20 million of which the major portion is contributed by the public sector.

So far we have introduced the activities of different stakeholders of the backwater economy and calculated the potential of the system to provide economic opportunities to them. In order to highlight the economic importance of this eco system we calculated the gross values of different activities and divided them into the traditional and modern activities. In the section to follow we bring these results together to compare the existing scenario in Cochin backwaters.

5.8 Conclusion

Table 5.19 below summarises the direct gross revenues accruing to different stakeholders from the backwater. The total direct value generated amounts to Rs. 3051.42 million of

which Rs. 811.47 million (26.59 %) is contributed through paddy cultivation and capture fisheries. Aquaculture activities generated Rs. 965.24 million (31.63%) while Rs. 1274.71 million (41.77%) is the contribution of service values from export import, navigation and tourism.

These calculations reveal that the traditional sector is slowly loosing its economic importance as new modern enterprises encroach into the backwater environment. This mad rush to commercialise the ecosystem hence works against the economic interests of the millions of poor people who depend on this ecosystem for livelihood and hence require immediate and careful coastal zone management with peoples, participation.

Table 5.18 Gross revenue generated by the Tourism industry from the Cochin Backwaters

Tourism	Season				Off season			
	No. of trips / year	Rate/ person/	No. of passenger	Value generated	No. of trips / year	rate/ person/ trip	No. of passenger/ trip	Value generated

	year	trip			year	trip	trip	
KTDC								
City tour (2)	624	70	80	**3494400**	624	70	30	**1310400**
Sunset Tour	312	40	30	**374400**	312	40	10	**124800**
Tourist desk								
Village backwater tour (2)	624	275	6	**1029600**	312	275	6	**514800**
House boat cruise	156	1500	4	**936000**	104	1500	4	**624000**
Overnight cruise (24 hrs)	260	1750	4	**1820000**	104	1750	4	**728000**
18 hrs	208	1375	4	**1144000**	52	1375	4	**286000**
day cruise	208	600	NA	**124800**	52	600	NA	**31200**
Bird flower island trip	104	750	2	**156000**	52	750	2	**78000**
Sunset trip	156	400	4	**249600**	52	400	4	**83200**
Sea land tours and travels								
City tour (2)	728	70	60	**3057600**	510	70	30	**1071000**
Sunset tour	364	50	25	**455000**	260	50	8	**104000**
Backwater tour	728	300	6	**1310400**	416	300	6	**748800**

	No. of trips / year	**Contract rate / hour (Rs)**	**No of hours**		**No. of trips / week**	**Contract rate/hour (Rs)**	**No of hours**	
Private operators								
37 Boats	10920	300	2	**6552000**	1820	300	NA	**546000**
Speed Boat Operators (15)	3120	300	1	**936000**	1040	300	NA	**312000**
Sub Total				**21.639800**				**6,562200**
Grand total (Rs.)	28.202000							

Source: calculations based on administrative reports and field work data

Table 5.19 Direct Economic Values generated from kayal based activities by traditional and modern stakeholders (Rs. Million)

Traditional Stakeholders	Modern Stakeholders

Agriculture	Fishery	Sub total	Culture	Port Trust	Tourism	Navigation	Sub total
30.06	**781.41**	**811.47**	**965.24**	**1234.29**	**28.20**	**12.22**	**1274.71**
Total							**3051.42**

ANNEXURE 5.1

The history of land ownership the erstwhile Cochin State is very interesting. Land tenure was of two types (Kumar, 1999). The first category was Pandaravaka or state property that had been either given away to individuals by the King for cultivation in return for a rent or those managed by state officials or *Naduvazhis* or in cases, *Desavazhies*). The second category was the *Puravaka* or private property of Janmies. Consequently records show that most of the agricultural lands in Kerala were under the control of Non Brahmins until the 13th centaury A. D.

A change occurred in this pattern with the fleeing of the Brahmins from Karnataka and Goa to Kerala. When the Brahmins who came were successful in getting land from the King, Devaswoms were constituted and Jenmi rights were extended to Brahmins and Namboothiris. Trusts were formed for the management of this property, which was leased out to tenants with obligations to pay rent. And Temples became the single largest owners of landed property after the King.

However, as the condition of the various tenants progressively deteriorated, the state was compelled to act for its upliftment. The first tenure legislation of Cochin was the settlement Proclamation of 1905. Various other Acts, ordinances and laws were passed before the Kerala Land Reform Act, 1963, Kerala Land Reform (Amendment) Act, 1969 and the Kerala Land Reform (Amendment Act,) 1971.

With the land reforms, most of the Pokkali fields under the control of the Dewaswom Trust, temples or high class Brahmins disintegrated and passed into the hands of the new and up coming middle class. Today, prawn filtration is now taken up on a large scale and a lot of revenue is generated from it . In fact, agriculture generates a lot of revenue but this is more than made up for from the revenue generated from the lease of the field for prawn filtration. Government rules stipulate compulsory paddy cultivation for six months if prawn filtration is to be undertaken. There are also farmers do filtration for six months and then letting the land lie fallow. Their economic rationale finds it more profitable rather than go in for paddy cultivation as well.

ANNEXURE 5.2

Each landlord had a certain number of tenant families attached to his household. Both the women folk and the men folk together provided the necessary labour required for all the activities in the field as well as in the homestead. The tenants either cultivated the land or had to give a good portion of it to the Landlord as rent or the landlord cultivated the field with the help of these labourers and a portion of the produce was given to them as payment. During the months of prawn filtration also, the selfsame labourers were employed in all the activities of the field. Here however, the payment system was of a different nature. During the last two weeks of the season, the labour class was given full rights to fish in the fields belonging to his landlord. Whatever he caught was his for keep. This amounted to a great deal and often it was this amount that saw him through the next two months of heavy rainfall no work and poverty. Outsiders were not allowed to fish and it was the womenfolk who had the skill to catch the prawns with their bare hands, gearless.

ANNEXURE 5.3

Fishing has a history of over a thousand years in Cochin. Iyer (1909) gives a detailed account of the tribes and castes of the state of Cochin in his book. Among the prominent fishing caste of Kerala were the Arrayasu of Thiru Kochi, the Mukkuvar of Malabar and Kochi, the Mukayanmars of Malabarand the Valas and Padananmar of Kochi (Udayabhanu,1993). The fishing caste of Cochin included the four sub caste namely the Valan, Arayan (Kadalarayans), Mukkuva and Marakkan. The Mukkuva and Marakkans came to settle in Cochin from Malabar and Travancore. Consequently it has been the first two castes that have traditionally dominated the fisheries field (Iyer, 1909).

Low sandy tracts of land on each side of the backwater formed the abode of the low caste and no high caste man chose to reside in the neighbourhood. In a majority of cases, these lands belonged to the Janmis who lent them out either rent-free or on nominal rent. Consequently one found a clustering of this cast along the banks of the estuary. Fishing implements were primitive. Yet caste nets, stake nets, Chinese nets, bow and arrow, hand picking, etc were common even then.

The word *Valan* is derived from Valayan or a person who throws a net for fishing. History has is that the *Valan*s were also Arayas but they became a separate caste only after one of the Perumals of Cochin selected some of their families for boat service and conferred on them special privileges. The descendants of these families were believed to be called '*Valan*'. The superior group of fishermen, the *Valan*s, migrated to the banks of the Estuary concentrating on Estuary fishing. The lower cast of Arayans, the *Kadalarayans* otherwise called 'Katakkoties' were the tribe of people lower in status to the valas, living along the coast from Cranganoor to Cochin. They were in former times considered an inferior race and as such excluded from travelling along the public roads. Consequently they kept to the seashore. They were of great help to the Portuguese and Dutch as boatmen during war campaigns. Their degraded form was taken advantage of by the Romish missionaries who converted these poor sea fishermen in large number to Christianity thus elevating their social scale. Some were also converted into Muslims. These people mainly concentrated on marine fishing leaving the backwater fishing to the higher caste of Valans.

At one time, there was no tax upon fishermen or on the nets but from the entries in the old revenue accounts prior to 993 M.E., it is seen that there were 4 sources of income to the State under fisheries namely tax on fishing net, rent on fishing status, rent on fishery farming in inland waters and tax in kind. The tax system continued even after the coming of the Europeans. Those who lived in Cochin during the Dutch reign had to pay tax in kind - 8 pounds of fish while in the Portuguese territory there existed tax both in cash and kind.

ANNEXURE 5.4

Calculations of the number of active fishermen are made on the following are bases

Chinese net	3 (8)		Hooks & line	1
Stake net	2		Trap net	2
Cast net	2		Scoop net	2
Gill net	2		Drag net	2
Seine net	2		Ring net	2

CHAPTER 6

RURAL LIVELIHOOD IN BACKWATER ECONOMIES: A STUDY OF KUMBALANGI GRAMA PANCHAYAT

In this report so far, we have analyzed several issues related to the degradation of biological diversity in Cochin backwaters and highlighted the major impacts at the macro level. We have also indicated that the traditional stakeholders like farmers and agricultural laborers', fishing communities, the coir producers and workers, traditional ferry operators and the modernization process affects the local women. In order to support these arguments, it is necessary that we explain how village economies still derive their livelihood from this ecosystem and the major issues of resource sharing at the local level. This chapter provides a detailed case study to highlight these issues at the micro level. This chapter is divided into five sections. **Section 1** introduces the ecological and socioeconomic settings of the study area. **Section 2** deals with the major economic activities and their social organization. The livelihood potentials derived by different stakeholders from the kayal is estimated and presented in **section 3**. **Section 4** deals with the involvement of women in kayal and related activities. The major conflicts in resource sharing are explained in **section 5**. This is followed by a brief presentation of our conclusions of this chapter.

6.2 Ecological And Socio-Economic Setting Of Kumbalangi

Kumabalangy is an island surrounded by the Cochin brackish water body. It is located at the south west of Ernakulam district between 9° 51' 2 " and 9° 53' 56" and have an area of 15.77 sq. km, having a length of 5.21 kms and a width of 1.5 km. Elders remember that the island Kumbalangi was formed during the Great flood of 1341 AD. The island shares its northern boundary with the Cochin Corporation; Aroor panchayat lies on the east, Ezhupunna panchayat on the south and Chellanam panchayat on the west. There are 13 wards in the panchayat. **[See location map]** Kumbalangi has a population of 24,779 (Census 1991). The male population is around 11927 while women number 12674**.** The members of the schedule casts constitute 6.6% of the total population. Today, Kumbalangi is no more a closed society. With the commissioning of the Kumbalangi Bridge in 1996, the village has attained direct access to the rest of the world.

6.2.1 Brackish Water And Characteristics

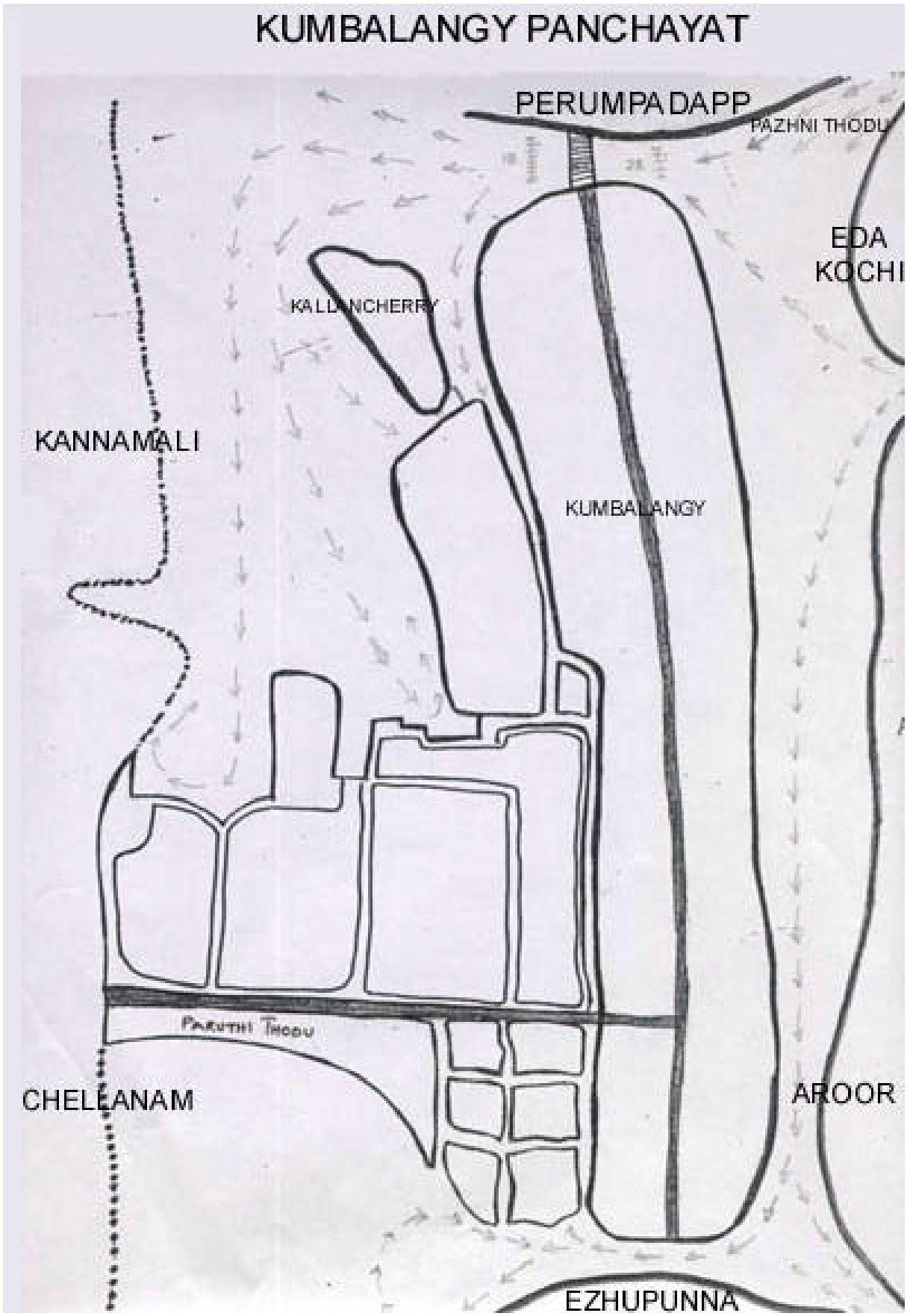
Kumbalangi being an island surrounded by the Kayal on all side means that the water resource has a distinct role to play in the livelihood and sustenance of the local people. The island, located about 15 kilometres afar from the Cochin bar mouth, experience routine tidal currents (high tide and low tide (***Veliattam*** and ***Veliyirakkam*** respectively). Kumbalangi experiences two sets of Veliattam and Veliyirakkam within a period of 24 hours. During high tide, water levels rise up to 2 feet (60 cm). Water currents usually move at a speed of three and a half kilometres (2 miles) per hour. However during rainy season, it varies depending upon the inflow of freshwater. During these months, the salinity of the water is very low almost fresh water in nature.

During high tide, water enters the kayal from two distinct openings (see the map attached) and carries with it a diverse flow of fisheries wealth. The major opening that lies between Eda Kochi and Aroor supplies bulk of the fishery resources to the fishermen of Kumbalangi. The other opening is the ***Paszhini Thodu***. The water current is split in two directions. The Aroor channel currents turns left and flow along the ***Veluthulli Kayal*** until it reaches the southern tip of Kumbalangi. The Perumpadappu-Kannamali current, which happens to be the major one, takes a right turn and flows between Kumbalangi and Perumpadappu through the ***Perumpadappu Kayal*** into the ***Kannamali Kayal*** along the western bank of Kumbalangi. Village elders speak of earlier times when the two water currents joined once again in the Kandakadavu region and flowed on in a southward direction until it reached the Andhakaranazhi where it finally emptied into the Arabian Sea. The construction of the Kumbalangi-Kandakadavu Bund road cut off this water channel. Similarly natural and human reclamation in the Ezhupunna region also led to the slow reclamation of this water channel. Consequently today this channel does not open into the Arabian Sea. They take separate paths and enter and recede along the same path during low tide.

The Perumpadappu channel is about 250 m wide and ends near the Padashekaram region located to the south west of Kumbalangi Island near Kannamali. The topography of the

Kannamali kayal is slopped and uneven. Compared to the other Kayals in the region, this kayal is wider in area and its depth keeps on reducing as we move southward until finally it ends in the low lying paddy fields of the Kandakadavu region. The Veluthulli kayal is deep and narrow. This channel is only 60 meters wide. Villagers recall times when a wooden bridge was enough to cross over to Ezhupunna.

Kumbalangi receives unusual water currents and tidal flows during the Malayalam month of Vrisschikkam (October-November). Locals refer to it as the " Vrischikka Vellapokkam". These local water currents deliver many useful services not only to the fishermen but also to agricultural and aquaculture communities. For the agriculturist during the period of prawn filtration, it is the major source of juvenile prawns and seedlings as well as water for the farms.


KUMBALANGY PANCHAYAT
PERUMPADAPP
PAZHNI THODU
EDA
KOCHI
KALLANCHERRY
KANNAMALI
KUMBALANGY
PARUTHI THODU
CHELLANAM
AROOR
EZHUPUNNA

The material life in Kumbalangi is centered on the economic potentials of the brackish water body. More than a source of livelihood for the people this kayal is the sole inspiration for their social and spiritual life. The water quality parameters around Kumbalangi waters are presented in Table 6.1 below

Table 6.1 Selected water quality parameters around Kumbalangi 2001 February

pH	DO Mg/lt	Salinity	Chlorinity (Ppt)	Dissolved Solids (ppm)	Suspended Solids (Ppm)	Hardness $Mg/CaCo^3$	AlkeNity $Mg/CaCo^3$	Phosphate (ppm)	Nitrate (ppm)	Nitiite ppm)
7.8	2.50	18.90	10.50	3950	29	4700	80	0.00	0.00	0.021

Source: Primary survey

The values showed in the table highlight a reasonably good ecological health around the Kumbalangi watershed in early February 2001.

6.2.2 Land As A Resource And Its Characteristics

Two types of soil are found in Kumbalangi- the Vypeen series and the Vytilla series **(Soil survey organisation Report, 1995).** The soil found in the Pokkali fields of Kumbalangi is very deep, poorly drained black clay soil usually found in areas with proximity to the sea. It usually occurs in flat lands under submerged conditions with a thickness of 120-150 cm. These soils have high organic matter content, medium phosphorous and potassium and high water holding capacity. The permeability, however, is low.

Garden lands of Kumbalangi, on the other hand, range between the mean sea level to 1m above mean sea level. This soil is mainly sandy and therefore subject to loss of topsoil during rainy season. Its low fertility and highly acidic nature results in root wilting and rooting of the palms. Therefore there is no scope for growing inter crops. Hence land productivity is very low. Besides paddy and coconut, aracanut, banana, cocoa, pepper, Nutmeg, tubers are grown in homesteads. During rainy season, vegetables are also grown. Therefore, crop diversity along the brackish water coastal zone is lower compared to the crop diversity of plains and forest ecosystems.

6.2.3 Land Use, Cropping Pattern And Crop Diversity

Kumbalangi is a densely populated village. A large part of the island is used up for residential purposes. In 1991, this island inhibited 4553 households, Agriculture and prawn filtration are the two major land based activities in the island. The island panchayat has a total land area of **1450 ha** of agricultural land of which **300 ha** are suitable for cultivation. The major crop, pokkali paddy, is cultivated in an area of **200 ha**. Other crops like Coconut, aracknut, pepper, mango, cashew etc are cultivated in **277 ha.** A hundred acres lies uncultivated today. Garden lands are used for raising banana, cassava, beans etc.**176 ha** of land are barren and not suitable for cultivation. Uncultivated land constitutes **100 ha.** [See table 6.2 for details].

Table 6.2 Distribution of land use in Kumbalangi

Cultivable land	**300 ha**
Cultivated land	226 ha
Pokkali land (Viripu)	**200 ha**
Other Crops	**277 ha**
Coconut	250 ha
Aracknut	10 ha
Pepper	10 ha
Mango tree	5 ha
Cashew	2 ha
Garden land	**26 ha**
Beans	10 ha
Vegetable	10 ha
Plantain	5 ha
Cassava	1 ha
Unsuitable for cultivation / Barren land	**176 ha**
Uncultivated land	100 ha
Non agricultural purposes	100 ha
Total land area	**1450 ha**

Source: Panchayat vikasana rekha, 1996

6.1.4 Social Setting Of Kumbalangi

The island of Kumbalangi has a population of 24,779 of which the male population constitute 11,927 and the female population 12,674 according to the census of 1991. Males constitute 48.3% of the total population. Table 6.3 provides the ward wise distribution of population of Kumbalangi in 1991.

Table 6.3 Ward wise population details of Kumbalangi Panchayat

Wards	Population			No. of Households	Total main workers	Marginal workers	Non workers
	Total	**Male**	**Female**				
I	2461	978	1105	378	718	38	1327
II	2083	1160	1172	423	794	43	1495
III	2332	1127	1156	410	859	124	1300
IV	2112	1007	1105	410	808	17	1287
V	2400	1193	1207	465	976	88	1336
VI	2452	1160	1292	456	896	94	1462
VII	2784	1302	1482	492	982	206	1596
VIII	2791	1389	1402	532	912	79	1800
IX	2706	1338	1368	508	790	68	1848
X	2658	1273	1385	479	762	124	1772
Total	**24,779 [100%]**	**11927 [48%]**	**12674 [52%]**	**4553**	**8497 [34%]**	**881 [4%]**	**15223 [62%]**

Source: Census Report, 1991

According to the census report of 1991, 34 percent of the total working population of Kumbalangi constitute main workers while the remaining 4 percent comprise marginal workers and 62 percent non-workers. Of the total marginal workers Cultivators constitute only 1 percent while Agricultural labours comprise 2 percent and people engaged in fishing and other allied activities comprise 11 percent. The remaining 86 percent of the main workers is employed in other activities like mining and quarrying, manufacturing units, business and trade etc.

Table 6.4 shows the distribution of main workers by wards in the Panchayat

Table 6.4 Distributions of main workers by wards in the Panchayat

Wards	Total Main Workers			I. Cultivators			II. Agricultural Laborers			III. Livestock … Fishermen. …		
	T	**M**	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**	**M**	**F**
I	718	497	221	2	2	0	1	1	0	64	64	0
II	794	555	239	5	5	0	9	7	2	83	79	4
III	859	521	338	13	13	0	13	6	7	42	38	4
IV	808	496	312	7	6	1	7	7	0	72	62	10
V	976	581	395	14	12	2	52	34	18	111	79	32
VI	896	535	361	11	10	1	15	10	5	70	47	23
VII	982	618	364	19	11	8	34	13	21	175	157	18
VIII	912	622	290	7	5	2	4	4	0	76	66	10
IX	790	590	200	12	12	0	10	9	1	184	182	2
X	762	575	187	5	5	0	0	0	0	64	63	1
Total	8497 [**100%]**	5590	2907	95 **[1%]**	81	14	145 **[2 %]**	91	54	941 **[11%]**	837	104

It is obvious from the above table that the dependency of this population on the Kayals has increased. The census figures of the previous decade further strengthen this argument as can be seen from the tables below.

Table 6.5 Details of Population of Kumbalangi Village 1971- 1991

Kumbalangi Village	**1981**	**1991**
Total Population	22376	37201
Total Main Workers	9704	12117
Cultivators	131	160
Agricultural Labourers	450	323
Livestock, …..., Fishermen.	265	2374

Source: complied from the Village Primary Census report, 1971-1991

In order to highlight the socio-economic characteristics, a survey was undertaken during August -November 2001 in the village. Around 87 percent of the households in the village are reported to be permanent settlers (settled 20 years ago) and only 7 percent is recent settlers (5 to 10 years) See table 6.6

Table 6.6 Nature of settlement pattern in Kumbalangi

Settled	No. of Families	Percentage
Less than 5 years	8	4.25
5 to 10 years	6	3.19
10 to 15 years	5	2.66
15 to 20 years	6	3.19
More than 20 years	**163**	**86.7**
Others	0	0
Total	**188**	**100**

Source: Primary data, 2001

Table 6.7 shows the distribution of sample respondents by different age groups

Table 6.7 Distribution of respondents by different age groups

Age	No. of Persons	Percentage
1-10	63	7.04
10-20	134	14.97
20-30	229	25.59
30-40	142	15.87
40-50	122	13.63
50-60	100	11.17
60and above	105	11.73
Total	**895**	**100**

Source: primary survey data, 2001

The table shows that one third of the population in Kumbalangi is either below age 20 or above 60years. Two thirds of the population lying between 20 and 60 belong to the potential working group.

Table 6.8 shows the educational status of sample respondents

Table 6.8 Distribution of sample respondents by level of education

Education	No. of Persons	Percentage
Post Graduation	6	0.67
Graduation	29	3.24
B. Ed, TTC	7	0.78
B. Tech, Diploma, ITI	8	0.89
Higher Secondary	54	6.03
High School	325	36.31
Upper Primary	258	28.83
Primary	156	17.43
Kindergarten	4	0.45
No formal education	33	3.69
Pre schooling	15	1.68
Total	**895**	**100**

Source: primary data, 2001

The table shows that 89.04 percent of the respondents have received formal education from primary to higher secondary levels. 3.91 percent are either graduate or postgraduate, 1.67 percent received technical education or 5.37 percent are either infants or elders who have not received any formal education so far. An outstanding feature of Kumbalangi is the high level of literacy, which was made possible due to the age-old missionary activities in the field of education. Almost every body in the village live in own houses see table 6.9

Table 6.9 Distribution of households by ownership on house

House Ownership	No. of Persons	Percentage
Own	187	99.47
Rented	1	0.53
Total	**188**	**100**

Source: primary data, 2001

Table 6.10 shows the results on the distribution of occupation in the village.

Table 6.10 Distribution of sample population by occupation

Sectoral Distribution of Jobs

Sector	Number	Percentage
Agriculture	30	3.35
Fishery	67	7.49
Aquaculture	5	0.56
Coir	48	5.36
Navigation	1	0.11
Port (Service)	2	0.22
Sub Total	**153**	**17.09**
Service	101	11.28
Trade	15	1.68
Other Works	21	2.35
Construction	**122**	**13.63**
Sub Total	**259**	**28.94**
Housewife	**170**	**18.99**
Children	15	1.68
Student	127	14.19
Educated Unemployed	26	2.91
Aged And Idle	15	1.68
Unemployed	130	14.53
Sub Total	**313**	**34.97**
Total	**895**	**100.00**

Source: primary data, 2001

The table shows that 17.09 percent of the population is engaged in kayal related activities like pokkali agriculture, fishing, aquaculture, coir making, navigation and port trust services. In fact this proportion is equivalent to around 59 percent of the working population. Another 28.94 percent of the population depend on service sector activities like government and private sector jobs, construction and trade. It may be mentioned that around 14 percent of the sample population is employed in the construction industry. One third of the population is not working which includes children, aged and idle and unemployed.

Table 6.11 sows the distribution of women's occupation in the study village.

Table 6.11 Distribution of sample women population by occupation

Women's Occupational Distribution

Sector	Number	Percentage
Agriculture	4	0.91
Fishery	23	5.22
Aquaculture	1	0.23
Coir	32	7.26
Sub total	**60**	**13.62**
Service	**32**	**7.26**
Construction	8	1.81
Others	8	1.81
Sub total	**16**	**3.62**
Housewife	170	38.55
Educated Unemployed	11	2.49
Unemployed	71	16.10
Student	67	15.19
Child	8	1.81
Idle	6	1.36
Sub total	**333**	**75.5**
Total	**441**	**100.00**

Source: primary data, 2001

It may be noted that 13.62 percent of women is still involved in kayal related activities 75.5 percent of women sampled are either involved in household related activities or unemployed.

We also made an attempt to classify the respondents shift in occupation from that of their parents mainly to see the major age groups shifting from traditional kayal related occupations to other activities. The results are shown in table 6.12

Table 6.12 Distribution of respondents who shifted occupation by age

Age	No. of Individuals Shifted	Percentage
0 to 10	0	0.00

10 to 20	5	1.21
20 to 30	83	20.15
30 to 40	65	15.78
40 to 50	52	12.62
50 to 60	29	7.04
60 to 70	23	5.58
70 above	2	0.49
Sub total	**259**	**62.86**
Not shifted	**153**	**37.14**
Total	**412**	**100.00**

Source: primary data, 2001

As revealed in the table, 37 percent of the population has not shifted their occupation while 63 percent have shifted. The shift in occupation is experienced the most in the age group of 20- 30 years (20.15%) followed by 30-40 [15.78%] and 40-50 age groups.[12.62%]. This finding is further reinforced when we classify the working respondents by age. Table 6.13 shows the distribution of working respondents by age in the study area.

Table 6.13 Distribution of working respondents by age

Age	Fishing	Aqua culture	Agri culture	Coir	Port	Navigation	Construction	Trade	Service	Other	Manufacturing	Total	%
0 to 10	0	0	0	0	0	0	0	0	0	0	0	0	0
10 to 20	2	0	0	0	0	0	1	0	3	1	0	7	1.699
20 to 30	**8**	**0**	**0**	**1**	**1**	**0**	**52**	**1**	**25**	**5**	**1**	**94**	**22.82**
30 to 40	26	1	5	4	0	0	22	4	28	5	1	96	23.3
40 to 50	14	2	14	16	0	0	25	4	24	3	0	102	24.76
50 to 60	10	2	5	15	1	0	15	4	14	2	1	69	16.75
60 to 70	7	0	6	12	0	1	7	2	7	2	0	44	10.68
> 70	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**67**	**5**	**30**	**48**	**2**	**1**	**122**	**15**	**101**	**18**	**3**	**412**	**100**

Source: primary data

This table reveals that the younger generations in the age group 20-30 are shifting from kayal related activities to the emerging construction industry in the urban city. It can be seen that 122 (29.60%) are now engaged in the construction industry due to the shortage of jobs related to backwater. Similarly, of the 122 respondents engaged in construction activities, 42.6 percent (52) belong to the age group 20-30.

6.2 Social Organization Of Major Kayal Related Activities In Kumbalangi

As mentioned in the introduction to this chapter, people in Kumbalangi undertake a variety of activities by using resources from kayal either directly or indirectly. Major groups earning livelihood from kayal resources are the pokkali farmers, the fisherfolks, the aquaculture farmers, the small-scale producers of coir products and lime shell, the sand and clay miners and people operating traditional ferry services. Each group of stakeholders has their own distinctive ways of organizing production activities. We shall now introduce these groups with special emphasis on how they socially organize economic activities within the boundaries of the village.

6.3.2 The Pokkali Farmers

Kumbalangi is said to have formed during the great flood of 1341 AD from the sediment and silt deposits from rivers. Of the total area of, Kumbalangi physiography comprises 140 ha of low-lying paddy fields, which are mostly below sea level, concentrated towards the southwestern region of the panchayat. Production activities in these fields have been organized into 9 major padashekarams (The Thekku-Vadakkur, Chudukkad, Manakkur, Kappithankari-Padanankari, North Kumbalangi, East and West Puthenkari-Cheriya Puthenkai and Kattikonam). The Thekku-Vadakkur, Chudukkad, Manakkur and Kappithankari-Padanankari Padashekarams are located in the Kandakadavu region. The East and West Puthenkari and Kattikonam padashekarams are located toward the south of Kumbalangi. The North Kumbalangi padashekaram is isolated in the north of the panchayat.

The number of members of each padashekaram varies. Manalkur has the largest number of farmers [195] while East Putenkari has the least number of members. Production activities in padashekarams depend upon the availability of water. Wetland paddy cultivation depends heavily on the various functions of the ecosystem. Water channels are the main source of prawn seedlings during the months of Prawn filtration and water during the period of paddy cultivation. Consequently ownership and control of such channels play an important part in the dynamics of these systems. The primary sources of water are the ***Nattu thodu, Pazhni thodu*** or sluice gates that directly open into the backwaters.

The ***Nattu Thodu*** is the main water channel of Kumbalangi. It begins in the Kannamali kayal from the ***Azhikakthu region*** of Kumbalangi and flows through the Kappithankari-Padanankari padashekaram in a northward direction up to ***Kallancherri***. It is more or less 7 km long and about 4 km wide. It has a large number of distributaries that water small ponds, channels and fields on the western side of Kumbalangi. It was once the major source of water to the pokkali fields of Kumbalangi as well as the commonly used means of transport in earlier times. The channel opening into the Kannamali Kayal is closed with a sluice gate. An extension of the ***Nattu Thodu*** also opens into the Kannamli Kayal at another vantage point. This has however been cut off by the Kumbalangi-Kanammali bund road. This part of the thodu ***(Dewaswom Chira)*** is under the control of the ***Cherai Sree Varaham Dewasom***. The other channel continues south and eventually opens into the ***Veluthulli kayal***. The Manakkur and Kappithankari-Padanankari Padashekarams depend upon the Nattu Thodu. Since the Dewaswom controls this water channel and maintains the sluice gates, the dynamics of activities in these fields particularly during the period of prawn filtration also depend very much upon the decisions of the Dewaswom. Today however, the Nattu Thodu has been reclaimed in many areas.

The ***Paruthi Thodu*** is another major water channel located in the southern part of Kumbalangi. It runs parallel to the Kumbalangi-Kanammali bund road and waters the Kattokonnathu, East and West Puthenkari and Kandakadavu region. The Puthenkari, Kattikonam and North Kumabalangy padashekaram have sluice gates that directly open into the Kayal. The Thekku-Vadakkur and Chudukkad padashekarams shared a common water channel and sluice gate into the Kannamali Kayal. However the Chudukkad padashekaram has rights over this water body and difference of opinion regarding sharing of water rights has split up this common arrangement. Thekku-Vadakkur is trying for a sluice gate of their own but they are very heavy investments and often the combined efforts of a single padashekaram do not make it economically viable.

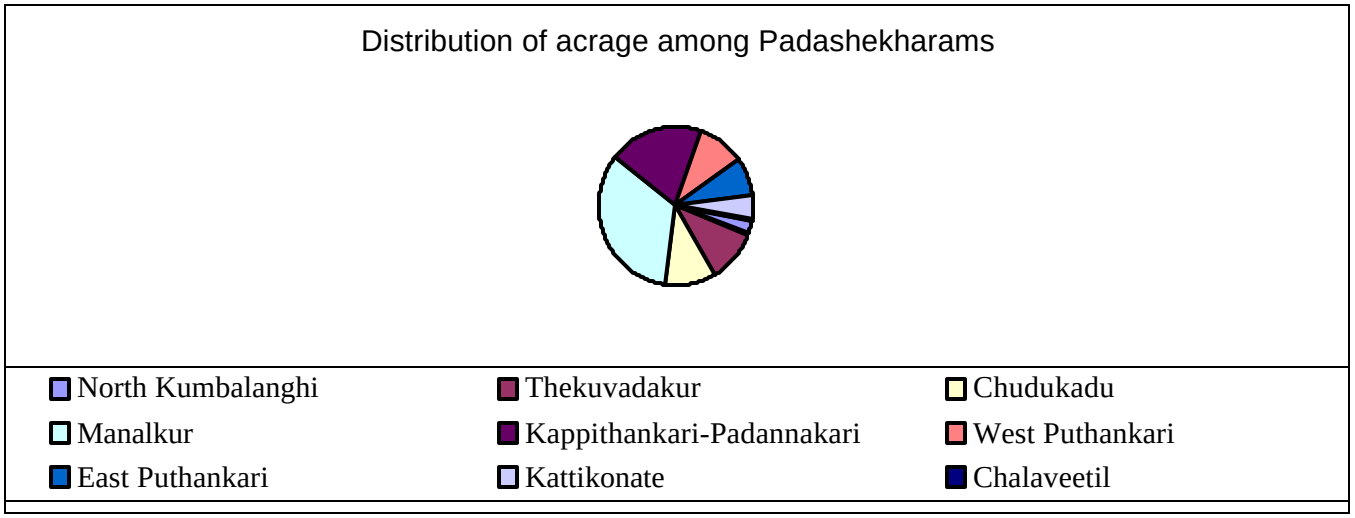
Table 6.14 shows the distribution of padashekarams of Kumbalangi (**See diagram 6.1 for details)**

Table 6.14 Distribution of paddy fields among padashekaram in Kumbalangi

	Name of Padasekharam	**Area (Ha)**	**%**	**No of members**	**%**
1	North Kumbalanghi	10.00	2.74	22	3.8
2	Theku vadakur	40.00	10.97	89	15.89
3	Chudukadu	40.00	10.97	165	29.88
4	**Manalkur**	**121.20**	**33.22**	**195**	**33.85**
5	Kappithankari-Padannakari	68.80	18.86	67	11.57
6	West Puthankari	36.00	9.87	20	3.8
7	East Puthankari	28.00	7.68	7	1.21
8	Kattikonate	18.80	5.15	*	-
9	Chalaveetil	2.00	0.05	*	-
	TOTAL	**364.80**	**100**	**565**	**100**

Source : Primary survey,2000 * Waterlogged and uncultivated at present

Diagram 6.1



364.80 hectares of wetlands are presently under cultivation in the panchayat. The table shows that 33 percent of land is cultivated by the *Manalkkur padashekaram* followed by *Kappithankari-Padannakari*, *Chudukadu* and *Theku vadakur*. These Padashekarams together constitute around 92 percent of the agricultural farmers. Other five *Padashekarams* play insignificant role in the village economy. (See diagram 6.2 for details)

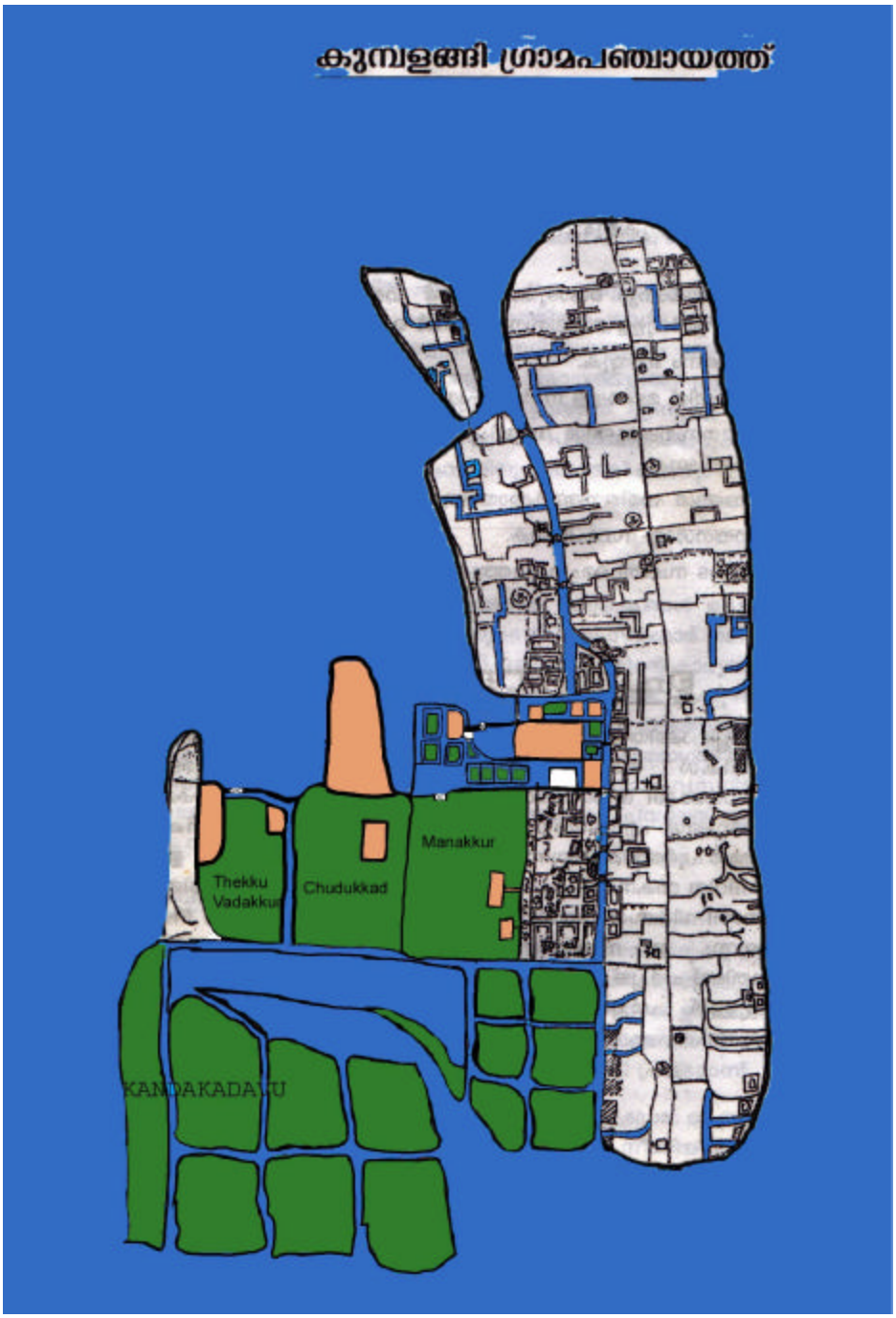


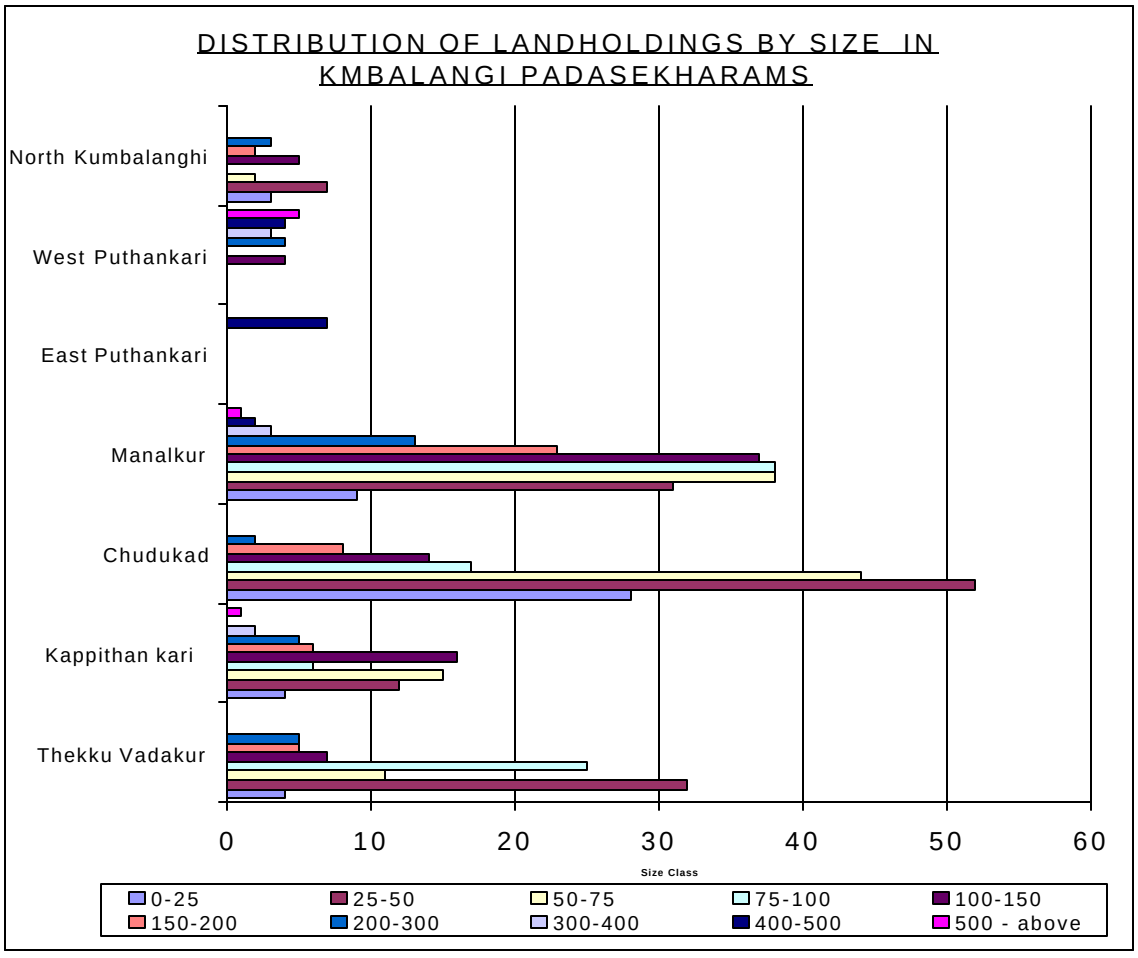
Table 6.15 Distribution of wetlands by size of holdings in Kumbalangi

Size class	**Number Of farmers**								
Cents	Thekku Vadakur	Kappithankari-Padananakari	Chudukad	Manalkur	East Puthankari	West Puthankari	North Kumbalanghi	Total	%
0-50	**36**	16	**80**	40	0	0	10	**182**	**32.2**

50-100	**36**	21	61	**76**	0	0	2	**196**	**34.7**
100-200	12	22	22	60	0	4	7	**127**	**22.5**
200-400	5	7	2	16	0	7	3	**40**	**7.1**
400-500	0	0	0	2	7	4	0	**13**	**2.3**
> 500	0	1	0	1	0	5	0	**7**	**1.2**
Total	**89 [100 %]**	**67 [100 %]**	**165 [100 %]**	**195 [100 %]**	**7 [100 %]**	**20 [100 %]**	**22 [100 %]**	**565**	**100**

Source: Field Survey, 2000

Diagram 6.2



The table shows that, 89.4 % of the holdings are less than two acres .32% of holdings are belonging to less than 50 cents while 34.7% lie between 50 cents to one acre.

As mentioned earlier, padashekaram is an institutional arrangement of local farmers whose primary objective was the smooth conduct of paddy cultivation and prawn culture within the wetland boundaries of the panchayat. Although padashekarams have definite

boundaries, indivudal owners enforce private rights on their properties during the period of paddy cultivation. The padashekara committees undertake common investments like construction of bunds and sluice gates, cleaning, supervising the activities etc. During the time of prawn filtration, the padashekara committee has to find out a suitable contractor, collect the lease money from him and distribute it to individual members Most of the padashekarams are managed by an elected body consisting of a President, a secretary and committee members depending on total membership. All padashekarams have a committee that is responsible for the auction of the padashekaram to prawn filtration contractors. Once auctioned off, these padashekarams are under the sole control of the contractors for the next six months. Policing of its boundaries to prevent poachers is very common.

This age-old institution of the traditional farmers, however, has undergone several changes recently mainly due to the introduction of various agrarian policies relating to land and aquaculture development. With the implementation of land reforms, many padashekarams disintegrated and a few of them became dormant.
However, the Padashekarams of Kumbalangi panchayat are still acknowledged as agencies through which government distribute subsidies and other benefits.

6.3.3 Fishery Resources, Diversity And Fisher folk In Kumbalangi

As mentioned earlier, fishery is the second most important livelihood potential to the people of Kumbalangi. For the fishermen in Kumbalangi, backwater fisheries are common property resources, whose sharing is guided by a variety of informal rules and customs.[17] Kumbalangi shares boundaries with Perumpadappu on the north, Eda-kochi on

[17] In his article "The Tragedy of the Commons" written three decades ago, Hardin argued that the eventual fate of all resources held "in common" is over-exploitation because access is unrestricted and there is no incentive among individuals towards resource protection (Hardin, 1968). However, critics now assert that Hardin's thesis does not properly distinguish the type of property regime susceptible to such a process, arguing that it applies not to "common property", but to "open-access" regimes. Common property is now generally defined as a system where "the resource is held by an identifiable community of users who can exclude others and regulate use" (Berkes et al, 1989). This is very much true in the case of Kayal fishery in the Cochin backwaters.

the Northeast, Aroor on the east, Ezhupunna on the south, Chellanam on the southwest, and Kannamali on the west. **Fishing communities of Kumbalangi normally treat half the brackish water territory between the village boundaries as their fishing territories. Nets of one village are normally set within these boundaries and individual fishing units do not encroach upon the boundaries of "outsider communities" during normal days.** This customary practice decides the external boundaries of their property relations with outsiders. Internal boundaries are also kept well. Territoriality as a property relation between Kumbalangi and "outsider communities" defined the terms of access and control over the area. The Chinese nets are most common along the banks of Kumbalangi followed by free nets and stake nets. Except for the region near the bridge, notions of space and distance are well kept.

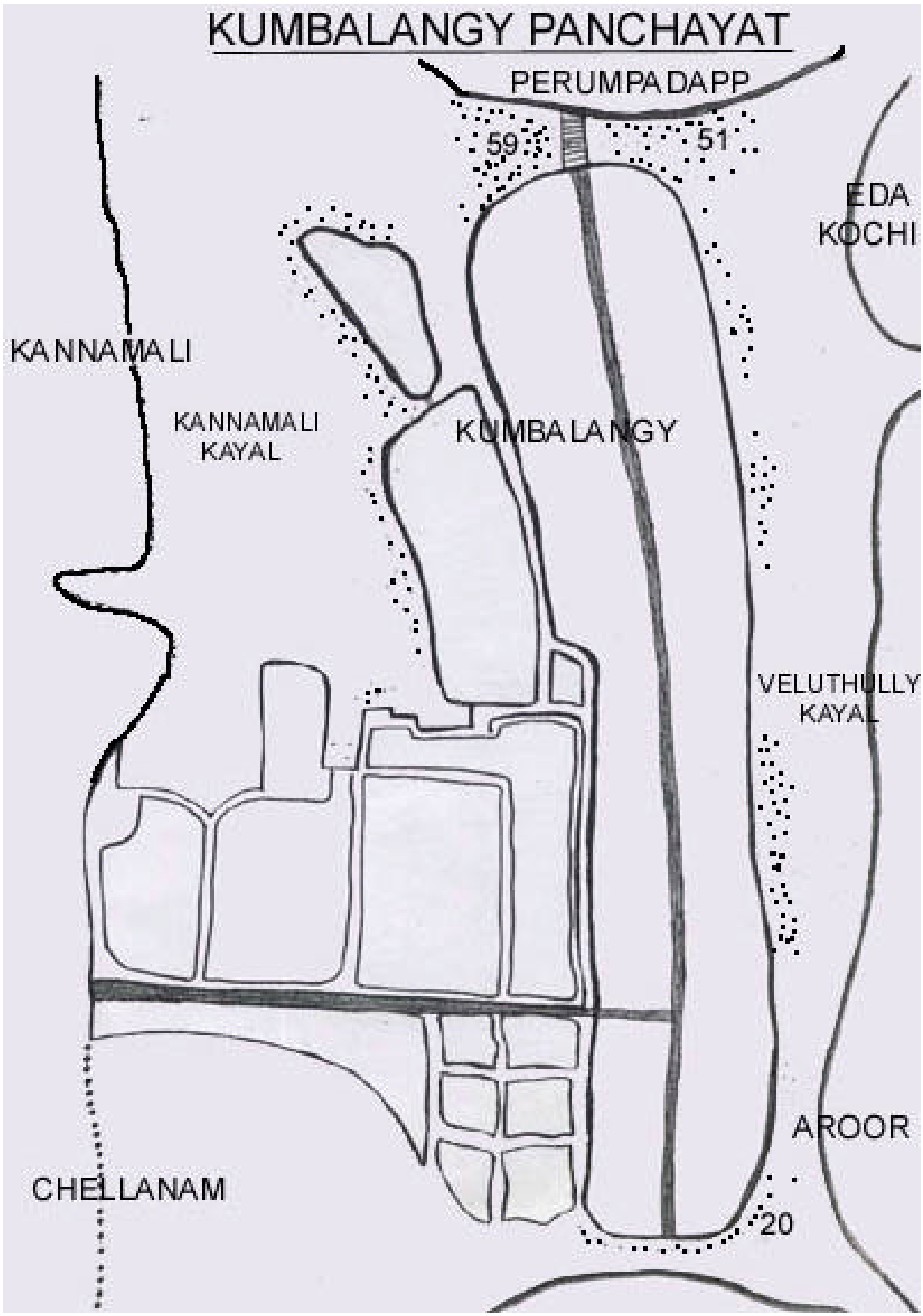
The following figure shows the major fishing areas accessed by the local fishing communities. Although the brackish water body brings similar fishing potentials to the fishermen in this area, the local village communities name the water body in different names indicating clear inclusive notions of customary rights. For instance, the area between Kumbalangi and Perumpadappu is locally known as Perumpadappu kayal, the area between Kannamali and Kumbalangi is known as Kannamali kayal. Kayal spread between Kumbalangi and Aroor is known as Veluthulli kayal. As mentioned earlier, half of the territories are exploited by the village communities while the other half is left to the fishing teams of the other village.

The **Perumpadapp Kayal** is an exception in many ways. There is an over crowding of chines nets in the first place. The region near the bridge between Kumbalangi and Perumpadap is where this concentration is found the most. In fact the nets can be found practically across the backwater. There are 59 Chinese nets on the west side of the bridge and 51 located on the east. Secondly, notion of distance is defined with respect to the nature of tides and other natural conditions. However, most of the nets, except 3, in that region are unlicensed. This has created a feeling of common survival among the fishers. Those who do have licensed nets also have unauthorised nets as well. Consequently, they too do not complain. Another factor is on going court case with the Stakenet fishermen of Perumpadappu. This has helped foster a feeling of brotherhood among the Chines net owners of Kumabalangy. There are a total of 110 Chinese nets in the Perumpadappu

kayal. There are 18 stake nets and 58 Chinese nets located to the west of the bridge. On the east. Side of the bridge there are 28 stake nets and 52 Chinese nets.

As mentioned at the beginning of this section, the **Kanammali Kayal** although very wide in area does not have much depth for the operations of stake nets. Therefore, the viable gears in this region are the Chinese nets and free nets. **Majority of the Chinese nets in this Kayal are owned by the fisherfolk of Kumabalangy**. There are 53 nets located in the Kallancherry region and 26 on the west bank of Kumabalangy. The Kannamali fishermen are users of free nets like the gill net and cast net. They also use species-specific nets. Although these Chinese net owners are very particular about their fishing territories, Kanammali fishers are found to violate this territoriality once in a while.

Such instances often end in clashes between the two groups. In fact there are a number of such cases pending settlement with the police and the court.


KUMBALANGY PANCHAYAT
PERUMPADAPP
59
51
EDA
KOCHI
KANNAMALI
KANNAMALI
KAYAL
KUMBALANGY
VELUTHULLY
KAYAL
AROOR
CHELLANAM
20

Kumbalangi and Aroor Fishermen together share the **Veluthulli Kayal**. The major gear seen here is the Chinese net. Free nets also equal in number. There are 40 Chinese nets located in this space belonging to either of the two villages. The eastern side of Aroor has stronger water currents and more lucrative catches. Hence, only a few fishermen from Aroor fish in the Veluthulli Kayal. Similar situations prevail in the area between Kumbalangi and Eda Kochi and only a few fishermen from Edakochi fish in this water. There are 40 nets located between Kumbalangi and Eda Kochi and majority of these belong to the fisherfolk of Kumbalangi. There are 12 Chinese nets located in the Keltron Ferry region and 20 in the Ezhupunna region. This region also has a number of women who go for "Kallakipidutham" or "Thappiyedukkal" in the kayal and adjoining fields**. Of the total 306 Chinese nets and stake nets located in the Kayals around Kumbalangi 166 (54.3%) Chinese nets and 11 stakenets belong to fisherfolks of Kumbalangi.** Thus it is clear that due to the peculiar nature of the ecosystem, the fisher folk use the Kayals for their livelihood and allow others to use it at the same time. However it would be wrong to assume the resource to be of open access nature. These rights are carefully guarded by them and defend territories in times of conflict with other village groups/ gear groups from the same village. (See section 6.5 for details). Table 6.16 given below shows the ward-wise distribution of gear in Kumbalangi

Table 6.16 Distribution of fishing nets by ward in Kumbalangi

Ward	Dip net	Cast net	Seine net	Neetu vala	Vatta vala	Jnanu vala	Jnanu ring	Oonni vala	choon da	Total
I	21	1	0	0	0	0	0	1	0	**23**
II	33	4	0	0	0	1	0	7	0	**45**
III	34	1	0	2	0	0	1	0	1	**39**
IV	1	17	0	1	0	0	0	0	0	**19**
V	1	6	0	0	0	0	0	0	0	**7**
VI	3	1	0	20	24	0	24	3	1	**76**
VII	5	41	0	0	21	0	0	0	0	**67**
VIII	4	15	1	1	-	0	0	0	0	**21**
IX	1	30	1	6	2	0	0	0	0	**40**
X	3	31	11	1	3	0	0	0	0	**49**
XI	0	2	0	0	0	0	0	0	0	**2**
XII	0	2	0	2	0	0	0	0	0	**4**
XIII	60	26	0	1	2	2	0	0	0	**91**
Total	**166 [34.4]**	**177 [36.7]**	**13 [2.7]**	**34 [7.0]**	**52 [10.8]**	**3 [0.6]**	**25 [5.2]**	**11 [2.3]**	**2 [0.4]**	**483 [100]**

Source: Primary survey 2001

From the above table, it is evident that nine major gears types are used in Kumbalangi at present. **Of these, 34.4% is Chinese dip nets, 36.7% is Cast net and 26.3 percent is other free nets. Stake nets constitute only about 2.3 percent.** Majority of the stakenets found in the water bodies adjoining the Kumbalangi village belong to the fishermen of Perumpadappu and only 11 of them belong to fishermen of Kumbalangi.There are 500 members belonging to 92 families of Dheevras residing in Kumbalangi today. Most of the stake nets fixed in the Perumbadappu kayal, however, belong to the Dheevara community of Perumpadappu. **The field surveys revealed that different region of Kumbalangi specialise in different gear combinations.** For instance, 89.2 percent of Chinese nets are concentrated in wards I, II, III and XIII, while 66.1 percent of cast nets is concentrated in wards VII, VIII, IX and X.

The map alongside gives a clear idea about the distribution of various gears used by different gear groups of Kumbalangi. Table 6.17 gives detailed account of the duration of different fishing gears operated off Kumbalangi.

Table 6.17 Fishing calendar of Kumbalangi village

	Period of Operation (No. of Days)													
Name of Gear	**No of Gears**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JLY**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**
Dip Net (Chinese Net)	166	22	22	22	24	24	10	6	16	16	22	22	24	230
Cast Net (Veesu Vala)	177	15	22	28	22	-	-	-	-	-	-	-	-	87
Gill Net (Ozhukku Vala)	34	-	-	-	11	22	22	22	22	22	22	-	-	143
Gill Net (Karimeen Vala)	52	-	-	-	-	-	-	10	10	10	-	-	-	30
Stake Net (Ooni Vala)	11	22	22	22	15	6	-	-	-	6	12	20	22	147
Drag Net (Koru Vala)	13	-	-	-	-	-	-	-	-	-	-	-	-	-
Traps (Njandu Vala)	28	-	-	-	-	-	-	15	22	22	22	10	-	91
Clam Fishing (Kakka Vaaral)	25	20	20	20	20	20	-	-	-	-	20	20	20	160
Line Fishing (Choonda)	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Hand Picking (Thappal)	100	-	12	26	26	26	-	-	-	-	-	-	-	90
Prawn Filtration (Chemeen Kettu)	**14**	**22**	**28**	**30**	**-**	**-**	**-**	**-**	**-**	**-**	**10**	**22**	**22**	**134**
F A D (Papp/ Nurambu)	25	-	-	-	-	1	1	2	2	2	1	-	-	9
Average values		20.2	21	24.7	19.7	16.5	11	11	14.4	12.7	15.6	18.8	22	

Source: Primary data, 2000

As revealed through the table, the best fishing season of Kumbalangi during the year 2000 was December to March and the number of average fishing days during these months varied between 20 to25. The lean fishing season was during June and July while all other months fishing days varied between 13 to 20 days.

6.2.3 The Aquaculture

As mentioned above, the majority of Paddy fields in Kumbalangi follow the 2 crop system of Pokkali and Prawn filtration. However the practice of prawn culture activities round the year, is fast stabilizing only in one padashekaram in Kumbalangi. The ***Kandakadavu Nilam*** carries out modified semi intensive aquaculture round the year.

The social organisation of culture activities does not involve any traditional institutions since this is a recent phenomenon. Under this method of production, the backwater is used only as a supplier of water and recipient of waste. Prawn seedlings and feed are supplied from outside. Labour is required in very small numbers. Consequently locals oppose this method of culture. This necessitates watchmen to guard the farm from poachers.

6.2.4 Small scale industrial activities in Kumbalangi

In addition to agriculture and fishing, people of Kumbalangi undertake a variety of household level industrial activities, which directly or indirectly use brackish water system. The most popular activities are the clam and lime shell collection; sand mining, traditional ferry services, traditional cargo transport and coir making. We shall now turn to the description of these activities

[I] Clam Fishery and Lime shell collection

Fishing for clams is an important activity of a specialized group of fishermen of Kumbalangi. Locally known as ***kakka vaaral,*** this activity provides livelihood to a number of fishing families, including many local women. The primary data collected indicate that during the year 2000, fishing for live clams was organized for about 160 days. There were about 25 nets used for this activity.

[ii] Sand mining

Sand mining was never a dominant occupation in Kumbalangi. The people used to take clay and sand from the kayal mainly for reclaiming kayal and for construction purposes. Due to high doses of salinity in the sand, large-scale sand mining is not possible from Kumbalangi kayal. However with the shortage in sand due to banning of mining from rivers, vendors took to mixing sand from rivers and Kayal. This raised the demand for kayal sand and local people have now taken it up on a commercial scale.

[iii] Traditional Ferry Services

This is a kayal related activity that thrived before the coming of roads and bridges to the island. It had been the most convenient means of transport. There were 6 major ferry jetties on the island. The major water transport ferries namely the Eda kochi-Kumbalangi ferry service, Kumbalangi-Veluthulli (Chandiroor) canoe service, the Ezhupunna-Kumbalangi (OBM) and the Aroor-Kumbalangi boat (Changadam) service Kumbalangi Janatha ferry (OBM canoe), Kumbalangi-Chakkiyamuri (Canoe).

[iv] Coconut husk retting and coir making

Coir related activities were, once upon a time, one of the dominant occupations of the people of Kumbalangi, which provided large-scale employment to both men and women alike. When some patches of land on the banks of the kayal experience water logging, locals used such patches of land to rett coconut husk to manufacture coir. The men folk were engaged in digging pits, arranging coconut husk and filling the pits with mud for retting. Later on they would unearth it and take to the coir sheds where the womenfolks would beat and spin it into coir ropes. Boats took this coir to Allapuzha and from there to other parts of the state.

Faced with difficulties in marketing coir products, the people set up co-operatives for looking into marketing of these coir products. There were 3 Coir co-operatives working in Kumbalangi until the early 1980s. The North Kumbalangi Coir Co-operative, which

had 361 sangham, the South Kumbalangi Coir Co-operative with 7 sanghams, and the co-operative located at Illikal with 568 sanghams.

In recent years, however, technological developments have influenced this industry. It was no longer required to dig pits and rett coconut husk the old fashion way. Machines were available which facilitated easy retting and in certain case the processing of raw husk. This caused a change in the structure of this industry. Contractors came forward and purchased raw materials on large scale and gave them to households to spin into coir on a commission basis. The menfolk shifted to new forms of occupation while women now dominated since it was their type of work that was available.

6.4 The Livelihood Potentials Derived By Different Stakeholders From The Kayal

As indicated in the last two sections, kayal provides a variety of options for the rural communities in Kumbalangi. In order to assess their relative significance to different stakeholders we shall now undertake a detailed analysis of the revenue generation capabilities of different activities. We first estimate the potential of pokkali paddy and then introduce the estimation of fisheries and other activities subsequently.

6.4.1 Pokkali paddy

Table 6.18 provides the distribution of area cultivated, yield and the revenue generated by different padashekarams of Kumbalangi during the year 2000.

Table 6.18 Distribution of revenue generated by paddy producing padashekarams of Kumbalangi

Name of Padasekharam	Area (Ha)	Yield/ha	Total Yield (kg)	Revenue generated
North kumbalanghi	10.00	900	90000	63000
Theku vadakur	40.00	1250	50000	350000
Chudukadu	40.00	2009	80360	562520
Manalkur	121.20	850	102850	719950
Kappithankari-padannakari	68.80	1562	107465.6	752259.2
West puthankari	36.00	1420	51120	357840
East puthankari	28.00	1420	39760	278320
Kattikonate	18.80	**		
Chalaveetil	2.00	**		
Total	**364.80**		**521555.6**	**3083889.2**

Source: Primary survey, 2000 *** Not cultivated due to financial mismanagement.*

The table shows that the pokkali paddy cultivation in Kumbalangi produced around 522 tons of paddy from an are of 364.8 hectares for the year 2000-01. The average yield therefore is calculated to be 1430 kg/ha. The gross value generated from pokkali cultivation is thus calculated as Rs 3083889.2. This means that the gross value generated per hectare works out to be Rs.8454.

6.3.2 Fishing

Table 6.19 provides data on various species landed in Kumbalangi and the value generated from fishing by gears. Ten nets are being monitored for this purpose.

Table 6.19 Distribution of estimated gross revenues generated from fishing by gears in Kumbalanbgi during March 2000

Kumbalangy - ESTIMATED TOTAL VALUE FOR THE MONTH of March (Rs)											
Species	**Ch. N**	**St. N**	**Cst. N**	**G. N**	**S. N**	**H&L**	**T. N**	**Sc. N**	**D. N**	**R. N**	**TOTAL**
Etroplus suratensis (Karemeen)	0	23296	105840	291600	117180	11200	95850	3830	12800	8960	670556
Oreochromis mossambica (Thilapia)	0	7000	17640	30000	47250	5750	3516	72	1071	750	113049
Gerrus filamentosus (Prangil)	0	30240	16538	105750	42525	10875	18141	0	0	0	224068
Arius platistomus (koori)	0	16856	0	64575	17640	0	0	0	0	0	99071
Puntius filamentosus (Paral)	0	13619	11007	12000	26712	3360	0	0	0	0	66699
Leognathus equulus Mullan)	0	13440	12348	14625	22050	0	0	0	0	0	62463
SUB TOTAL	0	104451	163373	518550	273357	31185	117506	3902	13871	9710	1235906
Penaeus monodon	0	3920	0	3920	250	0	0	0	0	0	8090
Macrobrachium rosenbergii	20160	2800	10240	22400	857	0	0	400	0	0	56857
Macrobrachium idella	504	378	480	34	64	0	0	0	0	0	1460
Penaeus indicus	84000	21000	400	29400	2500	0	0	1875	0	0	139175
Metapenaeus monocerus	33600	63000	7360	34720	3000	0	0	1300	0	0	142980
Metapenaeus dobsoni	36960	59640	0	26880	2229	0	0	1500	3000	0	130209
Crab	15680	3920	2560	8400	250	0	0	0	2143	585000	617953
SUB TOTAL	190904	154658	21040	125754	9150	0	0	5075	5143	585000	1096723
Chaca chaca	0	6272	0	16275	4410	0	0	0	0	0	26957
Congresox talabonides	0	0	8644	18900	0	0	0	0	0	0	27544
Chelonodon tauvina	0	9016	0	24150	0	0	0	0	900	630	34696
Chanda commersoni	2548	0	8026	12075	0	0	0	0	0	0	22649
Daysiana albida	0	11648	17640	78000	18900	12800	10800	259	0	0	150047
Ambasis comersoni	0	0	4939	18375	0	0	3150	0	0	0	26464
Esculosa thoracata	980	12152	7409	27300	17089	0	0	0	0	0	64930
Euryglossa orientalis	0	3136	5557	6300	6615	0	1181	0	0	0	22789
Etroplus maculates	0	0	7100	12075	11576	2800	0	567	0	0	34118
Gerrus oyena	0	0	7938	26250	14175	3000	0	0	0	0	51363
Hemiramphuscaritori	0	9957	0	13125	0	0	0	0	0	0	23082
Hemiramphus far	0	12096	9526	16200	3780	0	0	0	0	0	41602

Liza macrolepis	0	0	8644	18375	0	0	0	0	0	0	27019
Labeo dussmieri (Pullan)	0	0	7718	18375	15435	0	0	0	0	0	41528
Latus calcarifer	0	17640	25799	20250	0	0	0	0	5571	3900	73160
Leognathus brevirostris	0	14784	6112	12375	0	0	4269	0	0	0	37541
Mystus malabaricus (Chillan Koori)	0	0	7100	12075	24806	0	4528	214	0	0	48724
Silago sihama	0	14560	7938	34500	10238	0	4219	0	0	0	71454
Megalops cyprinoids	0	21840	20286	19500	22050	0	0	0	0	0	83676
Otolithus argentius	0	0	3528	10500	9056	0	0	0	0	0	23084
Ompok malabaricus	0	7056	9570	16275	5513	3325	0	0	0	0	41738
Therpon jarbua	1176	1960	4631	12075	3308	0	0	151	0	0	23300
Thryssa malabarica	0	9800	6395	12000	7088	0	0	810	357	250	36699
SUB TOTAL	4704	151917	184497	455325	174038	21925	28148	2002	6829	4780	1034163
Others Total	12740	108584	41983	61425	50715	19775	11813	5040	4700	0	316775
GRAND TOTAL	208348	519610	410893	1161054	507260	72885	157466	16019	30543	599490	3683567
No. of days operated	14	16	21	25	21	10	10	15	18	20	
No. of gear op.	38	56	21	60	75	15	20	30	25	30	
Average income per net per day	391.63	579.92	931.73	774.04	322.07	485.90	787.33	35.60	67.87	999.15	

Source : Field Survey

The table shows that the fishing activities in Kumbalangi generated gross revenue of Rs. 36,83,567 (thirty-six lakhs eighty three thousand five hundred and sixty seven).

Table 6.20 provides the distribution of sample households undertaking different kayal related activities into different income classes.

Table 6.20 Distribution of households undertaking various economic activities by various income classes

Income	Households engaged in						
	Agriculture	Coir	Fishing	Trade	Other	Total	Percentage
0 – 10000	0	4	0	0	0	4	2.13
10000 - 20000	5	6	1	0	0	12	6.38
20000 - 30000	20	0	7	0	1	28	14.89
30000 - 40000	34	1	3	3	1	42	22.34
40000 - 50000	20	0	1	1	0	22	11.70
50000 - 60000	22	3	4	2	0	31	16.49
60000 - 70000	13	1	1	2		17	9.04
70000 - 80000	10	1	0	1	1	13	6.91
80000 - 90000	4	0	0	1	0	5	2.66
90000 - 100000	4	1	0	1	0	6	3.19
100000 and above	7	0	1	0		8	4.26
Total	**139**	**17**	**18**	**11**	**3**	**188**	**100.00**

Source: Primary data, 2000

The table reveals that 8.5 percent of the households are earning a monthly per capita income of Rs.1041.67, a substantial proportion of them come from coir making activities, 37.2 percent of households earn Rs.2583.33 (majority being agricultural households followed by fishing) 28.19 percent of the households earn a monthly per capita of Rs.4237.42. 18.61 percent of households earn a per capita of Rs.5964.29 while the remaining 7.45 percent of households earn Rs.8392.86. It is noted that these households are also engaged in agriculture or fishing.

Table 6.21 on the other hand provides data on the distribution of the income of individuals from all activities related to the kayal based on our primary survey.

Table 6.21 Distribution of income from various activities of sample respondents of Kumbalangi

Individual Income Distribution													
Amount	Fishery	Aquaculture	Agriculture	Coir	Navigation	Port	Manufacturing	Service	Trade	Constructions	Others	Total	%
0 – 10000	**2**		**1**	1	0	0	0	1	0	1	0	**6**	1.46
10000 – 20000	**26**		**13**	30	0	0	2	22	1	16	1	**111**	26.94
20000 – 30000	**30**	1	**11**	8	1	0	0	39	4	75	1	**170**	41.26
30000 – 40000	6	1	3	6	0	0	0	20	5	28	2	**71**	17.23
40000 – 50000	2	2	1	1	0	0	0	7	2	2	4	**21**	5.10
50000 – 60000	1	0	1	1	0	0	1	6	2	0	4	**16**	3.88
60000 – 70000	0	0	0	0	0	1	0	1	0	0	2	**4**	0.97
70000 – 80000	0	0	0	0	0	0	0	1	1	0	0	**2**	0.49
80000 – 90000	0	0	0	1	0	0	0	0	0	0	0	**1**	0.24
90000 - 100000	0	0	0	0	0	0	0	0	0	0	0	**0**	0.00
> 100000	0	1	0	0	0	1	0	4	0	0	4	**10**	2.43
Total	**67 [16.3]**	**5 [1.2]**	**30 [7.3]**	**48 [11.7]**	**1 [0.2]**	**2 [0.5]**	**3 [0.7]**	**101 [24.5]**	**15 [3.6]**	**122 [29.6]**	**18 [4.4]**	**412**	**100.00**

Source: survey data 2000

The results of the survey clearly indicated that :

- Even today, kayal provide livelihood to 36.5 percent of the population in agriculture, fisheries and coir making sectors at various levels.
- Surprisingly, the survey also indicated a remarkable shift of the younger generations (age group of 20 –30 years) to construction related activities as masons, carpenters and manual workers partly due to the crisis in kayal related activities in recent years.
- 29.6 percent of our sample respondents reported that they have already shifted to these activities while their elders are still involved in kayal related jobs.
- Another noteworthy result emerged from the survey is the involvement of 24.5 percent of individuals in the service sector jobs in nearby areas. This was made

possible due to the communities' careful investments on educational institutions, which imparted reasonably good education to the local population.

In table 6.22, we made an attempt to classify the respondents undertaking various activities into different income classes

Table 6.22 Distribution of sample respondents engaged in economic activities by income classes

	Income From Activities						
Amount(RS)	**Salary**	**Coir**	**Fishery**	**Aquaculture**	**Others**	**Total**	**Percentage**
0 to100000	7	0	0	0	0	7	1.70
10000 to 20000	90	2	2	0	1	95	23.06
20000 to 30000	147	3	19	0	1	170	41.26
30000 to 40000	88	2	2	1	2	95	23.06
40000 to 50000	6	1	1	0	4	12	2.91
50000 to 60000	6	1	2	0	4	13	3.16
60000 to 70000	4	0	0	0	2	6	1.46
70000 to 80000	1	0	0	0	0	1	0.24
80000 to 90000	1	0	0	0	0	1	0.24
90000 to 100000	0	1	0	0	0	1	0.24
100000 and above	4	0	0	3	4	11	2.67
Total	**354**	**10**	**26**	**4**	**18**	**412**	100.00

Source: primary data, 2000

We found that majority (87.38 %) of the respondents earn income between Rs. 833 and Rs. 3333

6.3.3 Traditional institutions and survival securities: The case of *Kalakkipidutham*

We have mentioned in the introductory sections of this chapter that there existed many traditional institutions in Kumbalangi, which provided access to traditional communities to kayal resources. The institution of common property is one such institution. Another important social institution, which granted access to the workers, especially women, to earn a substantial amount of cash income from the fishery resources in wetlands, needs special description here. This section explains this social arrangement as practiced in

Kumbalangi.

Kalakkippidutham is a social arrangement, an institution, by which the land owning classes granted free access to the working classes of pokkali fields for a limited period of the year. It is seen as a reciprocal arrangement of the land owning classes to acknowledge the services offered to them by the agricultural laborers. For laymen, and even to many technocrats and policy makers, ***Kalakkipiditham*** and ***Thappiyedukkal*** are merely traditional fishing methods commonly found in Pokkali fields. It is described in official documents as a tribal activity undertaken by the ***pulaya*** women belonging to the agrarian labour class. They are engaged in agriculture activities during the paddy season and help out in the fields during the period of prawn filtration.

As soon as the Pokkali paddy is harvested by the end of September, prawn filtration starts from November onwards and continues till the first week of April. The lease period between the leasee and the panchayat normally terminates by the end of March 31st. In the case of private property or ***Padashekarams*** the lease period ends in April 22nd. As soon as this contract terminates, the owners allow free access to the fisher folk and the female workers from the Pulaya caste. Each Pokkali field has a group of agrarian labours belonging to the Pulaya caste who were responsible for all the work associated with dyke preparation, planting, replanting and harvesting. It was the self-same people who were also given the customary rights over these fishing grounds once the prawn harvesting by the lessee was over.

This arrangement is an institutional arrangement, which reduced uncertainties of crop rotation. First, the arrangement is helpful to the owners for the forceful encroachments of the general public to the prawn farms ensures the timely eviction of the lessee so that the land thus regained can be immediately transformed for paddy cultivation. Second, this process reduces a substantial proportion of the transaction costs of the owners in the cultivation of paddy. Thirdly, it ensures timely availability of agricultural workers for the next agricultural season by attaching at least those workers to whom free access was offered.

In earlier times the labor class was sufficient to meet the labour requirements of paddy and prawn cultivation. With the passage of time a gradual reduction in the strength of this

labour class saw the coming of migrant Pulaya labours.

The method of caching fish in this arrangement is very simple. The deliberate movements of fisher women, as they enter the field, create disturbances in the water causing the fish to hide in the detritus on the bottom of the fields. These fishes are them hand picked by the fisherwomen. Gears are also used sometimes by men folk. Aluminum pot, and in certain cases a scoop net forms the total of their gear requirements.

In order to assess the potential of this institution we organized a detailed survey aimed to estimate the gross revenue generated from ***kalakkippidutham***. Table 6.23 lists the composition of major species caught by the women.

Table 6.23 Catch composition in Kalakkippidutham

Local Name	Scientific name
Naran chemeen (White prawn)	Penaeus indicus
Thelly chemeen	Metapenaeus dobsoni
Kara chemeen (tiger prawn)	Penaeus monodon
Karimeen (Pearl Spot)	Etroplus suratensis
Pallathi	Ertoplus maculatus
Tilapia	Tilapia mossambica
Nandan (Glass pearch)	Ambasis gymnocephalus

Source : Field Survey, 2000

The table shows that only a limited number of species are caught in this process.

Table 6.24 summarizes our calculations of value produced through ***kalakkippidutham*** in Kumbalangi padashekarams during April May 2001

Table 6.24 Distribution of value generated through kalakkippidutham during April-May 2001

No of days fished	Quatity caught (Kg)		Price (Rs)		Value produced (Rs)		Total value (Rs)	No of workers
	shrimp	fish	shrimp	fish	shrimp	fish		
April 1-22	3500	1800	125	**30**	437500	54000	442900	500
April 22-30	4800	2400	110	25	528000	60000	534000	1000
May 1-10	2450	2000	75	25	183750	50000	188750	700
May 11-31	1800	1500	50	30	90000	45000	94500	450
Total							**1260150**	**2650**

Source: primary data 2000

Total Effort in man days = 35,000
Revenue realised (Rs) = 12,60,150
Average revenue/ manday = 360.04

6.4 Fishing Conflicts In Kumbalangi Village

In this chapter, so far, our attention was mainly on explaining how access was defined and enforced on the kayal environment by various traditional communities in Kumbalangi grama panchayat. We have also indicated the economic potential of these traditional activities in determining their economic status. A note worthy characteristic of their social organisation is the institution of kalakkippidutham which ensured subsistence securities to different working classes of the panchayat, mainly the women. As argued, the system provided enough securities to the poor in the village especially to tide over the hardships of the rainy season.

The process of sharing of resources and the environment, however, was not a smooth process either. Conflicts do occur in the process of sharing resources and these were settled by the timely interventions of local institutions. This section details some of the most popular kinds of conflicts in Kumbalangi.

Two kinds of fishing conflicts are generally seen in Kumbalangi. First, conflicts do occur within the traditional sector itself among various gear groups or among padashekarams. These conflicts are known as **Intersectoral conflicts.** Conflicts can arise between two sectors; between fishermen and agricultural communities or between kayal fishermen and marine fishermen or even between fishermen and ferry/transport/tourism/navigation service operators. These conflicts are known as **intersectoral conflicts (Charles, 1988**). We shall now discuss four case studies to highlight the nature of the problem in the study area.

Case Study 1

Conflicts between the stake net and Chinese net operators

This dispute is based on spatial allocation of fixed nets in Perupadappu kayal. We mentioned in section 2 that the water channel between Kumbalangi north and Perumpadapu has always had a large number of stationary fishing nets, both Chinese and stake nets. Among these, 34 stake nets and 12 Chinese nets are licensed. All the remaining nets, which come to around 98, are not licensed. As the number of fishing nets increased day by day, **some fishermen** started fixing the nets even in the middle of the water channel, violating the legal distance allotted to stakenets. When the number of illegal Chinese nets increased, the catch quantity from each net declined and a dispute arose between the two sets of fishermen.

A petition was filed before the **Ernakulam district collector** who referred this to the **Deputy Director of fisheries.** He was however unable to solve this issue. Consequently the stakenet holders filed a case in the **court** requesting the removal of illegal Chinese

nets from the water channel. The court referred this to the District Collector. He called a meeting in his chamber of both parties involved to find a solution to this case. But a compromise could not be reached. This case thus, came back to the court and a subsequent judgement was made ordering the removal of all illegal and unlicensed nets from the said water channel. The state **Fisheries Department** was given this task. The fishermen physically prevented twice the state Fisheries officials from removing theses illegal nets.

It is significant to note that none of the **political leaders** took any stand in the dispute especially during the initial stages. Later, however, the Kumabalangy **Grama panchayat** gave a written document to the Court stating that these said illegal nets were the means of livelihood for about 120 families and hence should not be removed. The **case is still ongoing in court.**

Case Study 2

Conflict between Chinese net operators and gillnet operators

Fishermen react violently when other net users invade their territories. This case study presents one such dispute between fishermen of Kannamali and kayal fishermen of Kumbalang. Kannamali is a coastal fishing village lying to the western side of Kumbalangi. These two villages share a common kayal spread also. Kannamali fishermen use mainly gill nets while the Kallancheri settlement of Kumbalangi panchayat operate mainly Chinese nets.

Due to severe shortage of fish in the Kannamali kayal fishermen from that locality started gillnet fishing in the territories of ***Kallencheri*** Chinese net operators. Since this reduced fish catches in Chinese nets, Kallancheri fishermen attacked the other gill net operators leading to severe law and order problem in that area.

In this case, however, the **local political leaders could settle this conflict** by drawing up mutually agreed solutions. According to the newly evolved criterion, it was agreed that gill net operators would not fish in the 50metre territory of the Chinese net. Hence this dispute was settled to the favour of Chinese net operators of Kumbalangi.

Case Study 3

Conflict between Thangu vallam (OBM) and Chinese net operators.

This conflict has occurred between the Chinese net owners of Kumbalangi and the coastal fishermen from Kannamali. Cochin backwaters often act as a natural harbour for marine boats like trawlers, gill-netters and motorised boats (Thomson, 1989). The Kannamali coastal fishermen anchor their motorised boats (called dingis or thangu vallam) in the Kumbalangi kayal during rainy seasons to protect them from natural calamities. These vallams are taken to the sea mainly through the Kannamali kayal. The conventions being that, the movements of boats should not damage any fixed nets belonging to Kumbalangi fishermen. In case of any damage, the boat owner has to pay adequate compensation for the loss of catch and property. This custom shows clearly that Kumbalangi fishermen had a notion of territorial claim on the water body and protect these rights by excluding outsiders.

When the number of Chinese nets increased during the recent years, it became difficult for thangu vallams from Kannamali to pass through that way. The problem aggravated during the rainy season as more boats from Challanam panchayat also anchored in the same kayal channel. To reach the other side of Chellanam, these boats have to pass the water channels in Kumbalangi. The crowded collection of fixed nets owned by the kayal fishermen of Kumbalangi caused a lot of difficulties towards the movement of boats and crew.

As mediations of local leaders failed, the **President of Swathanthra Matsya thozhilali Sangadana)** filed a complaint to the local **Circle Inspector of police.** During this round of negotiation, a compromise was reached by which Chinese fishermen were to reallocate their nets so as to leave a gap of 50 meter for the passage of boats.

Case Study 4

Stakenet holders Vs Kerala Construction co-operation

Another important conflict worth mentioning is related to a dispute occurred during the construction of Kumbalangi-Perupadappu bridge which connects the island to the main land through Perumpadappu. When the construction of the Kumbalangi bridge was initiated, it was decided to reclaim 250 meters of kayal area on both banks. The Dheevara community (stakenet holders) opposed this move and a mass petition was filed before the collector. There were even situations where the construction was stopped many time due to the objections of the stake net owners. As the local initiatives failed miserably, the local MLA was invited to solve the dispute. At last, a solution has arrived by both parties agreeing to go ahead with the proposal of the bride construction, as linking Kumbalangi Island with the main land would bring in economic progress to the stagnant village economy.

6.5 SUMMARY

In this chapter we made an attempt to describe in detail how village communities derive livelihood using the diverse potential of biological resources and ecosystem services of Coch9in backwaters. A detailed socioeconomic survey was conducted in a typical kayal-based village to examine various aspects of resource use. Being an island surrounded by backwaters on all sides, the livelihood patterns of the people have been solely dependent on kayal resources and environment. Almost all economic

activities are related either directly or indirectly to the kayal. The analysis has shown that although limited in resources, a multitude of activities are possible at a time without infringing on the activities and resource endowments of other stakeholders. This was made possible for the stakeholders due to the existence of well defined property rights regimes and supporting institutions. Village communities do not defend these rights normally but enforce them strictly when threatened or encroached by outsiders.

CHAPTER 7

Summary and conclusions

Biodiversity degradation is a global concern and the world communities have been responding in many ways to arrest its growth. Although policy makers and administrators suggested many measures, most of those prescriptions were largely drawn on the experiences of forest and agrarian systems. Coastal zone biodiversity and its degradation received only partial attention so far. This project undertakes the task of analysing the process of biodiversity loss in a typical coastal zone ecosystem, the backwaters, and highlights the possible socio economic consequences of environmental degradation. The case study centres on Cochin backwaters, which is one of the largest brackish water ecosystems on the southwest coastal zone of the Indian peninsula. The study looks at the degradation of biological diversity of coastal zones both as a natural and social process and attempts to reconstitute the nature of such processes using the secondary sources of information.

We mentioned in chapter 1 that the brackish water coastal zones of Kerala State have been undergoing structural changes mainly due to the rapid incorporation of these systems to world markets. As most of the local communities living around Cochin backwaters are poor fishermen and marginal farmers, the state had introduced many programs for developing this region. These interventions have not only altered the ecosystem drastically, but also produced various economic and social inequalities within rural communities. The report aims to explain these dynamics with special reference to a backwater ecosystem in Kerala. It is expected that such an inquiry will throw light on the evolving dynamics of Kerala's coastal zone and will guide better economic policies for the prudent use of Kayal resources and environment.

The study looks at the degradation of biological diversity of coastal zone both as a natural and social process and attempts to reconstitute the nature of such processes using the

secondary sources of information. Due to the limited financial resources, except one case study, detailed primary inquiries were not undertaken in this present enquiry.

The analysis of biodiversity degradation in Cochin backwaters begins with a detailed examination of the diversity of various fish and shellfishes, mangroves, benthos species and ecosystem services and then proceeds to an analysis of various human interventions on the ecosystem. The former analysis provides the necessary insights towards the distribution of various natural endowments on which the human populations depend while the latter component provides how various economic and social processes decide and direct the uses and overexploitation of these natural endowments.

Following the major claims of mainstream economic theories, we hypothesized that biological diversity in our backwaters degrades mainly due to the cumulative influences of the failures aggravated when government sponsored (or market induced) development projects and backwater communities choose strategies for their rapid economic development. Such interventions bring more harm to the stock of resources and ecosystem services and to the traditional rural communities.

The rest of the report is designed to explain various aspects of these processes in the study area. In chapter 2 we introduced the study area, characterised the nature of biodiversity and provided some evidences of degradation. We then introduced in chapter 3, the major stakeholders of Cochin backwaters are explored how they enforced their claim on the estuarine resources over the years. Chapter 4 examined various causes of biodiversity degradation. A brief description on the major economic activities and an estimation of direct benefits to different stakeholders is attempted in chapter 5. In chapter 6, we presented the case study o how local village communities interact with backwater ecosystems and make their livelihoods.

We argued in chapter 2 that the large proportions of the rural population of Kerala depend on Cochin backwaters for their daily bread sine time immemorial. This was made possible due to the high degree of biological diversity of backwaters. The analysis

revealed that the Cochin backwaters still retains reasonable levels of water quality of in many areas except in selected pockets where industries are heavily concentrated. An examination of studies on the biology of various fish and shellfishes indicated the presence of around 150 species, which made an active fishing possible round the year. The shocks imposed by the modern stakeholders through industrial activities are unbearable most of the time; the system does not show serious signs of collapse of the free delivery of ecosystem services of the backwater. The scenario is likely to worsen if proper environmental governance is not undertaken with people's participation.

Apat from fishery resources, the nearby wetlands are used for cultivating paddy, which is the staple food of the isolated island communities. The traditional arrangement of crop rotation enabled communities to ensure the production of their staple food and to earn cash income from prawn filtration. The existence of various customary rights and institutions ensured a wide participation of different sections of rural labourers for the collective action required to organise production activities and ensured the necessary pre conditions of social inclusion and access to food. In addition to these activities, small groups of rural communities are engaged in small-scale cottage industrial activities at lower scales for earning a livelihood. Small-scale prawn filtration, clam fishing, coir making, clay and sand mining, traditional ferry service operations etc. being the most popular ones.

As these activities were undertaken at an extremely lower scale, traditional village communities could not undertaken any substantial investments for developing their coastal zones. The state was therefore assumed to have a great responsibility in undertaking such initiatives through large-scale development programs and projects. These interventions brought in new stakeholders like the port, the navigation and tourism industry, modern manufacturing industries etc. and each group had its own modes of appropriating resources and environment of Cochin backwaters. In addition to the traditional and modern stakeholders, the national and international communities seeking leisure on this environment as indirect users and the state as a regulator of the environment also form the part of this stakeholder groups.

Agricultural communities and fishers (the ecosystem people) have always been the most prominent users of this ecosystem since time immemorial. It was the main source of livelihood for them and they had their own historical systems of sharing of resources. The process of resource sharing and the organisation of various production processes specific to such resources among rural communities had been influenced by their perceptions of ecosystem services too and in that sense these ecosystem functions and services were valuable for traditional communities. Rights over fishing territories were enforced by respective gear groups during the process of fishing mainly by excluding other gear groups and other stakeholders, even while their territories remained open to all other stakeholders to organise other economic activities. Therefore this has led to a general perception that the backwater ecosystem did not belong to anyone in particular and was therefore open to all for use. Subsequent state rules and regulations have reiterated this feeling. The kayal environment had always belonged to these ecosystem people and no management strategy excluding their claims would be effective.

The quantitative estimation of gross economic values produced by different stakeholders is an eye opener to the policy formulations in many ways. The total direct value generated amounts to Rs.3051.42 million of which Rs.811. 47 million (26.59%) is contributed through paddy cultivation and capture fisheries. Aquaculture activities generated Rs. 965.24 million (31.63%) while 1274.71 million (41.77%) is the contribution service values from export import navigation and tourism. These calculations reveal that traditional stakeholders are slowly loosing control over backwater resources and environment. Modern enterprises started dominating the economic sphere of the kayal. This mad rush to commercialise the ecosystem hence works against the economic interests of the millions of poor people who depend on this ecosystem for livelihood and hence require immediate and careful coastal zone management with people's participation.

Cochin backwaters started experiencing resource crisis and environmental degradation during the seventies. We argued that the degradation of diversity is due to market,

institutional and government failures. Industrial pollution, dredging, sedimentation and reclamation of water bodies and wetlands, lack of a well defined and enforceable bundle of property rights over backwaters and the public good nature of kayal diversity are all responsible for this sad state of affairs. The descriptions revealed that unless externalities are internalised, the problem of degradation could worsen in future.

The analysis of institutional failures revealed that the modern institutions often lack flexibility, adaptability and accountability, qualities essential for the prudent use of resources. Multiplicity of institutions with overlapping delivery systems also caused problems. Each institution is designed to look after for the smooth functioning of an economic activity and do not care for other stakeholders of the ecosystem. This failure adds to the pace of biodiversity degradation. Finally, the government does not treat backwaters as an integrated system and craft policies for its conservation. Instead, its policies of governance are issued under the banner of various departments and specialised agencies and do not therefore produce the synergies and collective efforts needed to conserve resources and biodiversity. Thus the aquatic ecosystem has failed miserably to provide decent means of survival to many traditional agrarian communities an social groups. At the same time, a few group of people use this backwater body for making quick profits by adopting unsustainable technologies and externalities. Large-scale economic activities and their externalities, if unregulated will deplete biodiversity and ultimately ruin the environment and the people who depend on it for livelihood. We have shown that the major causes for the poor economic and social conditions of the marginalized and weaker sections of kayal communities are related to environmental degradation through the loss of biodiversity.

The case study presented in chapter 6 has shown how the local communities derived their livelihood from an ecosystem that is degrading. It also revealed how various social groups adapt to changing conditions of the ecosystem. Being an island surrounded by brackish water on all sides, the livelihood patterns of the people have been primarily determined by kayal resources and environment. Almost all economic activities are related either directly or indirectly to the kayal. The analysis revealed that, although

limited in resources, a multitude of activities are chosen by different groups without affecting the economic activities of other groups and communities. This was made possible for the stakeholders due to the existence of well defined property rights regimes and supporting institutions. Village communities do not defend these rights normally but enforce them strictly when threatened or encroached by outsiders.

Altough village communities had their own institutional arrangements for secured living, the forces of modernisation are fast eroding such rules.At the same time. Modern institutions crafted by the state for providing incentives and support services fail miserably to deliver the necessary services. The socio-economic survey conducted in the village indicated the possible direction towards the economy is moving. On the one hand, most of the traditional stakeholders are loosing interest in their traditional activities die to various reasons. The shortage of labour, labour militancy, low wage rates, lack of government support etc. are reasons for farmer's not undertaking agriculture. Fishermen on the other hand have responded to the biodiversity degradation by intensifying their fishing effort many fold even by operating illegal nets. The enforcement authorities refrain from enforcing rules due to lack of facilities, political interference and public resistance. The old generations are still undertaking their traditional activities on a marginal scale while the new generations are found to shift away from kayal related activities. A large proportion of our sample respondents have already shifted their occupations due to the evolving crisis in the economy. The dynamics of biodiversity degradation and its impact on the local communities are therefore going to be the crucial sets of issues on which the entire development of coastal zone is set at present.

REFERENCE

Achary, G.P.K., 1987. *Characteristics of clam resources of Vembanad lake- a case study*. In.. Proc. Natl. seminar on shell fish resources and farming. Session-1. Bull. No 42, 10-13.

Adger, W. N., and Cecilia Luttrell (2000) Property rights and the utilisation of wetlands. Ecological Economics Special Issue 35: pp 75-89.

Brown (1998). The political ecology of biodiversity, conservation and development in Nepal's Terai: Confused meanings, means and ends. Ecological Economics 24 (1998). pp73-87

Devassy, V.P.&P.M.A. Bhattathiri, 1974. Phytoplankton Ecology of the Cochin Backwater. Ind.J.Mar.Sci. 3:46-50

Desai,B.N.&M. Krishnankutty,1967.Studies on the Benthic fauna of Cochin backwater. Proc. Indian.Acad.Sci. 66: 123-142

Brown (1998). The political ecology of biodiversity, conservation and development in Nepal's Terai: Confused meanings, means and ends. Ecological Economics 24 (1998). pp73-87.

Chopra K. and Gulati S. C. (1996). Environmental Degradation, property rights and population movements: Hypotheses and evidence from Rajastan. Institute off Economic Growth E/182/96., New Delhi

Constanza R., Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, et al (1998). The value of the world's ecosystem servces and natural capital. Ecological Economics, 25 pp 3-15.

Devlin R. A. & R. Q. Grafton. Economic rights and Environmental Wrongs: Property rights for the common good. Edward Elgar, UK.

Gopalan U. K., et al., (1987) Macrobenthos of Vembanad estuary in relation to the deposition of degraded water fern Salvinia and other macrophytes . *Proc. National. Seminar. Estuarine management, : 410-414*

Gopalan U. K., D. T. Vengayil, P. Udayavarma andM. Krishnan Kutty (1983). The Shrinking backwaters of Kerala. *J. Mar. Biol. Ass. India 25: 131-141*

Iyer L. K. Anantha Krishna (1909). The tribes and caste of Cochin
Kolstad, C. D., (2000). Environmental Economics. Oxford University Press, New York.

Kumar N. K., (1999) Land Laws in Kerala. Em Tee En Publications, Kochi.
Murthy, M. N., A. J. James & Smitha Misra (1999). Economics of water pollution: The Indian Experience. Oxford University Press, Mumbai.

Kurup, B.M, M. J. Sebastian, T. M. Sankan and P. Ravindranath, 1990C. Exploited fishery resources of the Vembanad lake - clam fisheries. Mahasagar 23: 127-137.

Madhupratap, M, 1977 Studies on the Ecology of Zooplankton of Cochin backwaters (A tropical estuary), Ph.D. Thesis, Cochin, India.

Nair, P.V.R., k.J. Joseph, V.K. Balachandran & V.K. Pillai, 1925. A Study On The Primary Production In The Vembanad Lake. Bull. Dept. Mar.Sci.Uni.Cochin. 7:161-170

North, Douglass C., (1998) Where have we been and where are we going? Economics, Values and Organisation. Ed Ben-ner A., & Putterman L., Cambridge University press, UK.

Ouseph, P P, 1992, dissolved and particular trace metals in Cochin estuary.
Mar.Pollu.Bull. 24, p 181.

Pauly, K. V. (1991). Studies on the commercially important fishing gears of Vembanad Lake. Ph. D thesis, Cochin University of Science and Technology, Kerala.

Pearce D. (1994) Blueprint 2: Greening the world economy Earthscan publications, London.

Pearce D. and Dominic Moran, (1994). The Economic Value of Biodiversity. Earthscan publishers, London.

Perrings, Charles., (1997). Economics of Environmental Resources. Selected essays. Edward Elgar Pub. House, UK.

Pritchard, D. W., 1967.Estuaries. American Association for the advancement of Science.
Remani K.N., Studies on the Effect of Pollution with special reference to Benthos. Ph.D. Thesis. University of Cochin, `1979.

Quasim S.Z.and Gopinathan C.K. 1969 Tidal Cycle and the Environmental Features of Cochin Backwater (a tropical estuary), Proc.Indian.Acad.Sci. B-69

Quasim S.Z. & Sankaranarayanan V.N. Mar.Biol. 15,1972

Remani,K .N. 1979. Studies on the effect of pollution with special reference to benthos in Cochin Backwater. *Ph.D Thesis*, University of Cochin.

Remani, K.N., K. Saraladevi,P. Venugopal & R.V. Unnithan, 1983. Indicator Organisms of Pollution in Cochin Backwaters. Mahasagar 16:199-207

Rasalam, E.J. and M.J. Sebastian, 1976. The limeshell fisheries of Vembanad lake, Kerala.J. Mar. Biol. Ass. India. 18: 323-335.

Saraladevi, K and P. Venugopal, 1989, benthos of Cochin back waters receiving industrial effluents. Ind. Jn.Mar. Sci 18: 165-169.

Subramanian. V., (2000). Environmental problem of coastal areas in India. Vinod K. Sharma ed Bookwell, New Delhi.

Sunilkumar, (1981). Studies on the Benthic Fauna of mangrove swamps of Cochin area. Ph. D. Thesis, Cochin University, Kerala.

Swanson, T. M. ed. (1995). The economics and ecology of biodiversity decline
The Economic Value of Biodiversity. Earthscan Publications, London.

Turner, R. K., Jeroem C. J. M van der Bergh, Tore Soderques, Aat Barendregt, Jan van der Straaten, Edward Malthy, Ekko C. van der Lerland (2000). Ecological economic analyssi of wetlands: Scientific integration for mamgement and policy. Ecological Economics, Specia; issue, 35 : pp 7-35

Unnithan, R. V., M. Vijayan, E. V. Radhakrishnan and K.N. Ramani, 1977, Incidence of fish mortality from Industrial pollution in Cochin Back waters. Ind. Jn. Mar. sci. 6: 81-83.

Vannuci, M., V. Santhakumari and E. P. dos Santos (1970) The ecology of hydromedusae from the cochin area. *Mar. Bio., 7, 49-58.*

Publications

Kerala Fisheries: Brackish Water Resources Survey-1991 at a glance

Kerala Fisheries - An over view, Department of Fisheries, Govt. of Kerala. (1992)