ECONOMIC VALUATION OF COASTAL WETLANDS: A STUDY OF COCHIN BACKWATERS IN KERALA

Thesis submitted to the
Cochin University of Science and Technology
for the award of the degree of Doctor of Philosophy
under the Faculty of Social Sciences

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AUGUST , 2004

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CERTIFICATE

This is to Certify that the thesis entitled '***Economic Valuation of Coastal Wetlands: A Study of Cochin Backwaters in Kerala***' is an authentic record of the research work carried out by Ms. Susan Abraham under my supervision and guidance at the School of Industrial Fisheries, Cochin University of Science and Technology, in partial fulfillment of the requirements for the degree of Doctor of Philosophy and no part thereof has been submitted for any other Degree at any other institution.

Kochi-16
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DECLARATION

I hereby declare that the present work entitled "***Economic Valuation of Coastal Wetlands: A Study of Cochin Backwaters in Kerala***" is based on the original work done by me under the guidance of Dr. K. T. Thomson, Reader in Economics, School of Industrial Fisheries, Cochin University of Science and Technology and has not been included in any other Thesis submitted previously for the award of any degree.

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15.02.06

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Acknowledgement

In finishing this thesis, remembering those who helped make this possible gives me very special happiness.

How can I put in words the gratitude and debt I owe my sir, Dr. K.T Thomson? He introduced me to Environmental Economics, instilled in me a love for the subject, spent a lot of his time and energy training me and especially through his critical insights, advice and encouragement, made the completion of my work possible. But for his understanding and help, it would have remained a distant dream.

My time at the School of Industrial Fisheries, Cochin University of Science and Technology was highly rewarding. I am especially grateful to Prof. C. Hridayanathan, and Dr. Ramakrishnan Korakandy, former Directors of the School, Dr. Saleena Mathew, Director of the School, Dr. B. Madhusoodana Kurup and Mr. John Mohan for their advice and encouragement. Thanks also go to the Librarian and Office staff of the School of Marine Sciences, School of Industrial Fisheries and the Department of Applied Economics, Cochin University of Science and Technology, for their timely help.

I specially acknowledge the financial assistance and guidance received from the Indira Gandhi Institute of Development Research, Mumbai and the Kerala Research Programme on Local Level Development, Centre for Development Studies, Trivandrum in connection with the projects I worked in. This database ultimately formed the basis of my thesis work.

Through my research project, I have visited various Institutes such as The Madras School of Economics; Indian Institute of Science, Bangalore; Institute for Economic and Social Change, Bangalore; Centre for Development Studies, Trivandrum and the Centre for Earth Science Studies, Trivandrum. The faculty and Library staffs of these institutes have been of enormous help to me and I would like to sincerely thank them for the same.

Friendship is a gift and my friends have been generous with their warm support. I thank God for all my colleagues during the past years who have directly and indirectly helped with my research work. I wish to specially thank my colleague Baby for all his help during the four years of my research work. His critical comments care and help have been a tremendous relief to me on many occasions. I am also very thankful to Nisha, Research Scholar, Institute for Economic and Social Change, Bangalore for all the trouble she took to help me with my statistical estimation. I thank God for the beautiful companionship of my friends Rajesh and Sunil who have been very supportive and helpful all through my years at the Department. I am forever indebted to them. I also remember Prem, for all the help and encouragement he gave me at crucial stages of my work.I also wish to thank Shyma, Mini, Deepak, Radhika, Mohanan, Pramod, George. I also wish to thank my roommates Minu and Shikha, for their prayers and moral support.

I remember with a grateful heart all the help my juniors of the fourth and second semester have extended to me during the course of my work. I particularly wish to thank Deepanjan. Ashwathy and Praveena have been my constant companions during the last stages of my research work.

They spent countless laborious hours typing and editing my work for me. They were forever ready to help in any possible way. God bless then for their affection, care and help in my hour of need. I also gratefully acknowledge all the help extended to me by Anoop and Pareed in my data collection.

I remember with gratitude all the care, help and encouragement given to me by Dasettan, Anilettan and Praveenchettan during my time at the department. They have always been ready to help with any aspect of my work. Their knowledge of the local ecosystem and people has been of great help, particularly during the initial stages of my work.

I cannot express in mere words my gratitude and debt to Babuchachan, Ponnammama, Joselin, Jelin and Mon for all their prayers, hospitality, support and help through out my academic years in Ernakulam. God bless them for their love and care.

My greatest debt, of course is to both my families. I thank God for Daddy and Mummy who from a very early age gave me the freedom to choose a vocation of my liking. Achachan and Amma have been equally supportive. Their love, prayers and constant support has brought me so far. My brothers and sisters have been very supportive as well. Neeta spend so many laborious hours editing drafts of my chapters. As for my husband, what do I say? He has been very very understanding and patient. I thank God for my family.

Kochi-22 **Susan Abraham**

15.02.06

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CHAPTER 1

Introduction

Wetlands are known for their biological diversity and considered to be one of the most productive but complex ecosystems of the world[1]. They are multifunctional and their linkages to adjacent ecosystems make them highly productive and economically valuable to humanity. Wetland ecosystems habitat a variety of terrestrial and aquatic species, generate many diverse forms of ecological services and functions and even act as an incubator of genetic diversity that sustain economic and social activities. The supply of various natural resources through import or export of different environmental services makes them very valuable capital assets (Gren et al., 1994). Such connectivity between the ecological and economic domains of human activity around wetland uses appeals to maintaining the integrity of ecosystems at large spatial scales. Till recently however, theoretical models and methodological procedures were not sufficient to unearth these multifaceted complexities and constrained the measurement of economic values of wetland ecosystems (Kazmierczak, 2001).

The recent collaborative initiatives of ecologists and economists, largely based on the functioning of the dominant wetland ecosystems of the developed world have produced a variety of tools for studying their ecological and economic interactions and estimating economic values. Such methodologies and

[1] Wetlands are transitional zones between permanently wet and generally dry environments and share characteristics of both. The Ramsar Convention defines wetlands as: "*areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, ... may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands*" (Barbier et al., 1997). They are often referred to as "breadbasket of biodiversity", "kidneys of landscapes", "biological supermarkets" (Mitsch and Gosselink, 1993) etc which are indicative of the immense importance of these ecosystems.

procedures have also been applied to study the structure and functions of wetland ecosystems in developing countries without taking into account the specific economic and socio-cultural issues that govern the uses of wetland resources and environment (Turner et al., 2002). Policy prescriptions and institutional and legal processes that followed, legitimised a bureaucratic program of environmental and resource governance and further added complexities to wetland resource uses in many developing countries.[2]

For instance, although coastal wetlands occupy a special position in India due to their ecological/environmental functions and services to the world communities in general and the remarkable responsibility they shoulder to provide livelihood at low levels of investment and technical skill to the weaker sections of the Indian society on a daily basis, they are intensively exploited by various resource users. The Indian Space Research Organization (ISRO) mapped 3960 sites of coastal wetlands in India, covering a total extent of 40,230 sq. km. (as reported in Garg et al., 1998). There are 26 major wetlands on the west coast and 23 along the east coast of India[3]. Among them six are situated in Kerala, of which, two have been identified by the Ramsar

[2] Unlike the wetland ecosystems of the 'North', a major distinguishing feature of wetlands in developing countries of the South is the over dependence of economically and socially weaker sections of population on wetland resources for livelihood. In fact, millions of poor people in developing countries live very close to coastal wetland ecosystems and make their daily bread. The introduction of coastal zone development projects and increasing impacts of liberalisations have led to the degradation of such systems and enhanced rural poverty in many countries.

[3] Major coastal wetlands on the west coast of India are: Ashtamudi, Kadinamkulam Cochin, Korapuzha, Beypore, Olipuram Kadavu backwaters, Edava-Nadayara and Paravur backwaters, Poonthura, Puthuponnani and Chandragiri estuaries, Shiriya, Thotapally and Pozhikara estuaries, Netravathi and Gurupur estuaries, Mulki, Pavenje, Gangolli, Kali, Mandovi-Zuari estuarine complex, Estuaries of Mumbai, Waghotana wetlands, Damaganga - Kolak river estuaries, Vashishti , Purna, Mahi wetlands, Par river wetlands, Ambika-Kaveri-Kareira estuarine complex, Mindola river wetlands, Tapti-Narmada estuaries and Auranga wetlands.

convention[4] as wetlands of great importance due to their rich aquatic ecosystem.

1.1 Statement of the Problem

Despite the economic importance and complex nature of wetland ecosystems, they are valued in different parts of the world for different reasons. In developed countries for instance, wetlands are valued more for their recreational, indirect and non-use values. This is revealed in the fact that most of the wetland valuation studies that have been conducted in developed countries attempt estimation of benefits of the above-mentioned nature. The values attributed to the livelihood provisions from these systems are marginal and negligible[5].

Wetlands of developing countries like India, on the other hand, are often associated with livelihood activities of communities belonging to the lower strata and marginalized sections of the society. From time immemorial, such communities, mainly fishermen and other agrarian communities, settled on the banks of coastal wetlands, have been making their livelihood from this environment through fishing, farming (fish, prawn, clam, paddy etc.) and small-scale industrial activities (coir making, seasoning of timber, collection of

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[4] India is a signatory to the Ramsar Treaty and nineteen wetlands in the country have been designated as Ramsar Sites in view of their rich aquatic ecosystem. In India, 8 sites covering 194,521ha have been declared as Ramsar protected sites: Chilika Lake (116500 ha), Harike Lake (4100 ha), Kanjli (183 ha), Keoladeo (2873 ha), Loktak Lake (26600 ha), Ropar (1365 ha), Sambhar Lake (24000 ha) and Wular Lake (18900 ha). India recently designated 11 new wetlands of international importance, to the Ramsar List in November 2001, bringing the total number of Ramsar sites in India to 19, covering 648,507 hectares. The Vembanad Kol Wetland (151,250 ha) and Astamudi wetlands (61,400 ha) were identified as unique coastal wetlands coming under the list of coastal ecosystem under the Ramasar convention. The other sites are Bhitarkanika Mangroves (65,000 ha), Bhoj Wetland (3,201 ha), Deepar Beel (4,000 ha), East Calcutta Wetlands (12,500 ha), Kolleru Lake (90,100 ha), Point Calimere Wildlife and Bird Sanctuary (38,500 ha), Pong Dam Lake (15,662 ha), Sasthamkotta Lake (373 ha) and Tsomoriri (12,000 ha).

[5] See chapter 2 section 2.2 for details.

molluscan shells for lime and manure, transport and recreational services) etc. The water, land, soil, flora, fauna, hydrological and ecological characteristics of wetlands directly supported such economic activities. Unlike other ecosystems such as forest and rivers, the density of local population depending on these systems is far greater and they provide a diversified portfolio of livelihood options to the rural and marginalised sections of the society.

Though wetlands provide livelihood and income-generating opportunities and are the hub of a number of locally important ecosystem processes, their value and contribution to the economy have never been realised. Although this is the real dynamics of resource use and economic value generating processes, coastal wetlands in India, as in many developing countries, remained a mystery for development planners and practitioners especially in the policy making circles. The State, particularly in developing countries never really understood the complex nature of the ecosystem or how local communities had finely woven together a pattern of resource use and sharing based on their local knowledge.

With the penetration of commercialisation and the development of markets into these systems in a big way, the situation has been further complicated. For instance, since coastal wetlands were considered as waste lands, many big industries located their plants on the banks of the wetlands in an attempt to reduce costs of production. Navigation and tourism industries, fish landing jetties and Ports have also started their activities using wetland resources and services freely to generate quick profits.

To the Kerala local population, these diverse sets of natural resources and other ecological services constitute the initial endowments available to them. Over the years, these rural communities that depend on brackish water bodies

have developed a variety of sustainable production systems for livelihood that are complex and intricately inter-connected (Grimble and Wellard, 1996, Balland and Platteau, 1996; Thomson, 2002[a] and 2002[b]).

As commonly agreed, coastal wetland resources also tend to have unique property right regimes based on the ecological and resource characteristics, seasonal and cyclical variations and local knowledge of these systems etc. The economic values generated from these systems reflect conflicting perceptions of different resource users on their environment (Adger and Luttrell, 2000). In fact, most of these wetlands ecosystems in Kerala were common property resources and access to these resources and their biodiversity shaped user's economic calculations and survival strategies. Disputes among resource users over alternate uses were settled with the active and timely interventions of indigenous informal institutions and non-state laws (Thomson, 2003; Berkes, 2000). According to the nature of activities undertaken, their living conditions differed, although such economic disparities were not highly significant across different producer groups.

In modern societies, technological progress has enabled extraction, processing, storage, and transportation of resources on a larger spatial and temporal scale. Many wetlands in Kerala today are threatened by development activities, particularly those in close proximity to cities and populated areas. In Kerala, three major shifts in the use or abuse of wetland resources marked the dynamics of this development phase. First, most of the modern entrants following traditional resource users used ecological services of wetlands free of costs. Although traditional communities were also free-riding on these ecological services, their production systems did not use them as intensively as the modern entrants use these services today. While pre-market social institutions regulated overuses, it is obvious beyond doubt that the modern environmental regulations are not effective enough to prevent or regulate

externalities of free-riding and overuse of ecological services of wetlands. Second, most of the modern industrial processes generated heavy environmental externalities and the costs of such externalities were not adequately internalised[6]. Such externalising behaviour of firms, although reduced the cost of industrial waste treatment, soon affected the organising practices of interdependent economic activities, especially of the traditional sector. Thirdly, non-use values of wetlands are seldom accounted, valued and incorporated while formulating important policy decisions.

These shifts in resource use/abuse have been attributed to various causes (UNEP, 1995; Pearce and Moran, 1997). In addition to market failures, the State policy towards these wetlands was never one of sharing and mutual coexistence. In fact most wetland policies were formulated in isolation, without giving due consideration to other subsistence activities that were organised over the same space, or their rights structure resulting in either displacing local resource users or dislocating the structure of property rights regimes that had been evolved over centuries of resource use (Conway, 2002). Government interventions, often done with the best of intentions, through crafting appropriate policies, environmental rules and laws to correct market failures, are contrary to the interest of the wetland environment, even when those interventions appear to serve some social purpose (Swanson, 1997).[7]

Due to these basic differences in the nature, functioning, perception and use of wetland ecosystems in developed and developing countries, differential treatments are required when analysing them; one suited to ecosystem

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[6] This has lead to the creation of all forms of externalities such as pollution, human induced silt accumulation and sedimentation, habitat destruction, reclamation etc. See Thomson (2003) for a detailed presentation of the causes of environmental degradation in Cochin estuary, Kerala.

[7] The State, at one point of time, even regarded wetlands as 'nuisances - barriers to travel and the expansion of settlement. These attitudes promoted the reclamation of wetlands via their conversion to agricultural and other lands, through diking, filling and draining (Kazmierczak, 2001). State also super imposed neo-liberal value systems on to the wetland environment and promotes a speedy degradation of these systems.

specificities. Natural scientists in India have studied the scientific aspects of wetlands in depth. Social scientist and economist have also studied wetland ecosystems and local population depending on them. They are interlinked activities, but few studies in Kerala combine their analysis so as to attain a more holistic perspective of wetland resource use dynamics. Combining then and extracting meaningful conclusion is a difficult but much more meaningful task. Economic valuation is a useful tool in such a context.

As de Groot et al. (2002) pointed out "the economic value or importance of a given ecosystem is determined both by the integrity of the wetland functions and by ecosystem parameters such as complexity, diversity, and rarity". Since most functions and related ecosystem processes are inter-linked, the estimation of economic values generated by different resource users from wetland ecosystems should also throw more light on the dynamics of value relations and value generation processes that occur (Limburg et al., 2002).

Natural scientists would argue that ecosystem services and life support are essential for society irrespective of their recognition by humans. But when there is no recognition by human beings, they tend to waste little effort on their preservation or prudent use. Each choice or option for resource use has implications in terms of values gained and lost. The decision as to what use to pursue and ultimately whether current rates of resource use are prudent, can only be made if these gains and losses are properly analysed and evaluated. It is in fact a necessary pre-condition for recognizing the economic significance of wetlands, especially when such ecosystems are the subject of economic forces of modernization and liberalisation. When wetlands are lost, important values are lost, some perhaps irreversibly.

In such a situation, valuation is definitely a first step in the right direction and only one element in the effort to improve management of environmental

resources such as wetlands. According to Pritchard et al (2000), economic valuation of natural systems and their services are undertaken for at least three reasons. A study may be attempted to show that natural systems are indisputably linked to human welfare (even when they are priced at zero), to describe the relative importance of various ecosystem types or to justify/critique particular decisions regarding wetland use. The goal of ecosystem valuation need not necessarily be to summarise ecosystems with a single bottom line number. In fact, the fundamental aim is not to put a "price tag" on the environment (Randall, 2002) or its component parts, but to generate a better and more comprehensive understanding and information base of the dynamics of wetlands as ecosystems and the interactions of resource users who depend on it for their livelihood which may ultimately be reflected in the decision taking and policy formulation process. Availability of such information on the local resource base and its essential ecological linkages is a crucial factor in sustainable utilisation of natural resources. It may not always be appropriate to put a value on wetland benefits, however, environmental valuation should not be treated as an impediment or adversary to sound wetland management but should be considered its best ally.

During the last thirty years, valuation of environmental goods and services has become one of the most significant and fastest evolving areas of research in environmental and ecological economics. In fact, the attitudes and perceptions people have about wetlands have shifted enormously over the past several decades. Such studies can inform decision makers about efficient and alternate allocation of scarce resources and support preference-based approaches (consumer and/or citizen preferences) and are compatible with a common monetary metric deployed across competing uses.

Any serious attempt to estimate economic values of coastal wetlands in developing countries must look into the resource base, the present dynamics of the wetland ecosystem, and the value perceptions of various resource users together and accordingly choose the appropriate bundle of tools to elicit economic values of the system.[8] However, in Kerala, there have been relatively very few studies along similar lines and yet, wetlands have and still do play a very important role in the Kerala economy. To paint a true picture of wetland resource use and dynamics would require a combination of such studies. This thesis attempts to undertake the task of estimating the economic value of one of the famous coastal wetland ecosystems in the southern most state of Kerala, India along the lines suggested above. Accordingly, the following objectives were framed.

1.2 Objectives

1. To identify the major resource users of the Cochin coastal wetland ecosystem and to analyse how they have enforced their claim on wetland resources and environment to develop economic activities over the years.

2. To quantify the direct benefits of this ecosystem and to estimate their economic value.

3. To estimate the recreational value of Cochin backwaters.

4. To estimate the indirect and non-use value of Cochin wetland ecosystem.

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[8] Few studies incorporate the influence of system dynamics and resource user complexities in influencing wetland value generation. In other cases, they assume system complexities to be given from where they proceed with the valuation study. As mentioned at the onset of the chapter, a simple valuation study that begins and ends with estimations of benefits provided by wetlands for policy inferences does not throw much light on the foundations of the system or the roots of the problem.

1.3 Scope and Limitations of the Study

The main objective of valuation is in assisting wetland management decisions by throwing light on the overall economic scenarios in terms of the economic benefits and costs of various uses. Although pure valuation itself is part of economics, and therefore a subject for economists, the process of wetland valuation is complex and requires an interdisciplinary approach. The study has tried to incorporate this diversity as far as possible. It attempts to include the system dynamics that define the resource base of the Cochin wetlands as well as the perceptions of resource users that shape institutional mechanisms and their access to the resource base.

Hence the analysis begins with a detailed examination of the resource base provided by the wetlands and the conflicting notions and institutions of property regimes that evolved around alternate uses of wetland resources. It adopts a systematic approach to analyse the complex multi-stakeholder ecosystem, which is subject to neo-liberal forces.

In this respect, the present study is probably one of the few initial attempts to conceptualise and quantify the economic value of coastal wetlands in Kerala. Although, it may not always be appropriate to put a money-value on wetland benefits, the reality is that human societies put price tags on nature every day. Every resource use decision involves implicit assumptions about value, even when no money equivalent is assigned. The same is true for the Cochin wetlands as well. However, there are very few studies[9] that attempt to throw any light on the value of this ecosystem or the need for more prudent resource management. In this context, the economic valuation of a coastal wetland

[9] See Thomson (2002; 2003) for similar attempts.

system undertaken in this study has definite advantages to better understand the significant connections of wetland uses and the society that uses these ecosystems for a living[10]. This is not however, a study of a valuation method or tool although a variety of modern environmental economic tools have been used. Instead the focus of the study is on developing a conceptual framework that approximates the dynamics of this coastal ecosystem and estimate different sets of values generated by various users and non-users.

This task however, is difficult and most often, the value of services provided by the earth's ecological infrastructure does not fit into current economic equations, partly because most of the benefits fall outside the marketplace. Such services are public goods that contribute immensely to human welfare without ever being drawn into the money economy. Although one cannot attribute exact monetary magnitudes to all such services that coastal wetlands render to human beings, until there are some reasonable estimates of value, wetlands policies will not be optimal for society (except by chance).

In this regard, the major limitations of this study are pointed out. The attempt to generate a total economic value for Cochin coastal wetland is faced with the question of whether the figure generated represents the total economic value of the system accurately. The use of price as a proxy to estimate value of direct benefits is open to questions. Under complete markets and perfect competition, such an approach would not be unreasonable. In the real world, price is no safeguard against scarcity (Torras, 2000). Hence, basing values of natural resources such as fishery, paddy etc. on corresponding market prices does not reflect their true value and may even result in artificially low resource

[10] As Pritchard et al. (2000), observed, "the goal of ecosystem valuation need not necessarily be to summarise ecosystems with a single bottom line number but to understand the structure and functions of these systems to formulate good policies of governance".

values. Lack of information regarding the complex environmental system of Cochin wetlands and the ecological and hydrological processes that result in the values is another issue. Due to this, the valuation attempted may turn out to be grossly understated at times.

It may also be mentioned that although the study has attempted to incorporate as many economic activities as possible, many have still been left out due to time and resource constraints. The first case omitted from this analysis is the manufacturing industrial units located along the banks of Cochin backwaters. Although they are the most powerful secondary users who use wetlands for dumping industrial wastes, they are excluded from the analysis to avoid unnecessary complications in value calculations. Similarly, extensive aquaculture farms have not been surveyed due to problems in definitions and distinguishing various technical aquaculture systems. Therefore, aquaculture values are under estimates of the true value generated by this economic activity. Wetland sand mining is fast developing in the study area as an economic activity. However, it is still in its infancy and therefore not included in the study. Similarly coir retting and related value addition processes were important wetland based activity that was undertaken in almost all villages around Cochin wetlands. However, today, this activity is no longer wetland based and hence not considered in the present study. Given these limitations, it is felt that the values estimated in the chapters that follow, remain as a gross underestimate.

In the estimation of indirect and non-use values of Cochin wetlands, many functions have been left out due to methodological reasons. Given the unfamiliarity of the Kerala population with contingent valuation surveys, it was deemed more prudent to value a few functions rather than attempt an estimation of all functions and risk biasing the analysis. Also, it should be

noted that the current study attempts to provide the total economic value of Cochin wetlands and not its Total Value.

Although the study uses three different valuation techniques, the concept of Total Economic Value encompasses wetland values that overlap. In this regard the sum of the values calculated may be overestimates. However, according to Torras (2000), assuming that only sustainable portions of direct benefits are counted, the overestimation resulting from aggregation of all values types in most cases will not be too severe.

As Turner et al. (2000) pointed out, a wetland research framework using a combination of economic valuation, integrated modelling, stakeholder analysis and multi-criteria evaluation would provide complementary insights into sustainable and welfare-optimising wetland management policy. The scope of the present study did not allow for such a vast and in-depth analysis. Hence, it attempts only an economic valuation. Nevertheless, it was felt that at least a brief analysis of the structure of property rights in the Cochin wetlands should be undertaken before any attempts at valuation. Hence, the study also attempted to briefly look into the norms and property rights institutions that influence and contribute to the value of the system and the value generated using the system. This was considered most relevant since, welfare estimates of wetland benefits are significantly affected by whether the resource is managed or open access (Barbier, 2000). A dynamic analysis would have been more appropriate. The attempt here is peripheral and touches only the tip of the iceberg.

1.4 Plan of the Thesis

This thesis is divided into eight chapters. After introducing the study in the first chapter, a detailed review of both the theoretical and empirical studies on economic valuation of wetlands is presented in the second chapter. The third chapter outlines the conceptual framework and methodology used in the study. The study aims to fabricate a conceptual framework for comprehensive analysis of wetlands and their valuation. Following the first principles of the framework for analysis, the fourth chapter presents a description of the resource base of Cochin coastal wetlands, which covers a detailed account of its fisheries, agriculture, aquaculture and very many traditional industrial activities like ferry services, clam fisheries etc., and the most prominent ecological services and functions that sustain various economic activities. The property rights institutions that guide perceptions of various resource users are also discussed. This is necessitated to compare the conflicting notions of economic values of various resource users. The three subsequent chapters attempt a documentation of the estimation of the corresponding direct (including recreational) and indirect monetary values of Cochin wetland ecosystem. Chapter five calculates the production, productivity and value generated by different direct resource users of the wetland while Chapter six gives details of the travel cost method used to estimate the recreational values and the corresponding recreation values of Cochin backwaters. Chapter seven gives details of the Cochin wetland's indirect benefits and non-use values using the contingent valuation method. Chapter eight provides a summary and conclusions of the study.

CHAPTER 2

Economic Value of Wetlands: A Review of Literature

Despite Wetland's ecological and economic significance, they were traditionally viewed as "wastelands" that could be sacrificed for the sake of increasing social welfare. The recent attempts of natural and social scientists to highlight the significance of these ecosystems have drawn various procedures and methodologies to account for the sustainable uses of these ecosystems in development projects. While the ecologists targeted on identifying various ecological functions and services of wetlands to establish their economic and social relevance to humanity, economists were mainly engaged in evolving procedures to attribute monitory values to such uses. The objective of this chapter is to survey briefly relevant literature on the economics of wetland valuation. The chapter is divided into four sections Section 1 presents a brief survey of studies dealing with economic valuation of wetlands. In doing these surveys, special care is taken to explore the major issues of wetland valuation and the various theoretical approaches developed to address them. Section 2 brings together the major findings of various case studies on wetland valuation to highlight how these studies are useful in planning and managing wetlands. A brief note on the limitations of the approach and reasoning for using the valuation framework is presented in section 3. This is followed by a brief summary of the chapter in section 4.

2.1 Economic Valuation of Wetlands: A Methodological Review

Economic valuation "is an attempt to assign quantitative values to goods and services provided by environmental resources, whether or not market prices are available to assist us. It is conceived of as putting a number, either on an ordinal

or cardinal scale, on the utility accruing from current production, which may be either consumed or saved" (J. S. Mill). According to environmental economists, wetlands deliver a variety of direct and indirect benefits to various sections of the society and therefore the process of assigning monetary values invoke moral and ethical arguments. Economic value of an ecosystem function or service is the contribution it makes to human welfare and is measured in terms of each individual's own assessment of his or her well being and what one is willing to pay for the commodity, less what it costs to supply it (Smith, 1995). Freeman, (1993) pointed out that wetland's value is the sum of the present values of the flow of all private goods and non-marketed goods and service from this natural system. These arguments led to the development of the general taxonomy of Total Economic Value (TEV) that represents the economic value of wetlands[1].

2.1.1 Total Economic Value (TEV)

Several economists (Krutilla, 1967; Boyle and Bishop, 1987[a]; Bateman and Turner, 1993; Freeman, 1993) have offered well-composed definitions of total economic value and the relationships among its components. Total economic value of a wetland area is the sum of the amount of money that all people who benefit from the wetland area would be willing to pay to see it protected (Whitehead 1992). Accordingly, it is the sum of its direct, indirect, option and existence values (Pearce, 1991). In this sense, estimating economic values would guide resolving the fundamental issues of wetland uses and abuses

Economists disagree on the components that constitute economic value. Broadly, environmental values can be broadly split into *use and non-use values*

[1] The total economic valuation framework is a means to identify different uses and services, which could be potentially provided by an environmental good or service and to facilitate an understanding of the origins of different wetland values. It helps to ensure that all-important values are accounted for in the valuation exercise.

(Pearce 1993; Barbier, 1994). The former is further divided into *direct use value*[2] and *indirect use value*[3] depending on whether the resource is used as an input in production or directly as consumption good or for protecting or sustaining economic activity indirectly (Barbier et al., 1997). Option value is defined as the value of actually retaining the good for future consumption and expected value of future consumption of the good (Weisbrod, 1964). It is the value an individual places on the environment for future consumption. It represents an individual's willingness to pay to maintain the option of utilizing a resource at some time in the future. Quasi option value[4] refers to uncertain future benefits (Torras, 2000). Existence value,[5] the most debated component of non-use value, is commonly used to denote the value individuals place on the environment unrelated to its present or future use (Turner et al., 2000). It represents an individual's willingness to pay to ensure that some resource exists. Part of this motivation may be the desire to bequeath the resource to future generations (Bishop 1987).

Non-use value on the other hand refers to the monitory gain to people who derive satisfaction from the mere existence of a resource, even though they may never see it or consume any product obtained from it (Boyle and Bishop, 1987[b]; Pearce 1993). Two broad types of non-use values - 'existence value' and 'bequest value' - are recognized (Weisbrod 1964; Krutilla 1967).

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[2] Direct use value includes goods input in production or good consumed directly such as fishery resources, paddy, mangroves etc and services such as recreation, tourism and ferry etc.

[3] Economists often disagree on what constitutes each type of value. According to Aylward and Barbier (1992), the distinction between components of indirect use values lies predominantly in the support function of ecological systems on the one and their protection function on the other hand. Farnsworth et al. (1981) used the tern 'inherent' value instead of indirect value. Costanza et al. (1997) refers to them as "Infrastructure values" of an ecosystem while Norton (1986) used the term 'contributory value'.

[4] Quasi-option values also exist according to some economist. It is the value of obtaining better information by delaying a decision that may result in irreversible environmental loss (Walsh et al., 1984).

[5] Only in 1967 was existence values identified as a potential benefit of natural assets. They were altogether unknown before that date (Krutilla, 1967). Existence value have been variously defined in the literature as bequest value, cognitive value, non-paternalistic altruism, paternalistic altruism, option value, intrinsic value, ethical, moral and social values (McConnell, 1983; Randall and Stoll, 1983; Smith, 1987; Boyle and Bishop, 1987; Loomis, 1988; Stevens et al., 1991; Bishop and Welsh, 1992; Kopp 1992; Freeman, 1993; McConnell, 1997; Kramer and Mercer, 1997; Turner et al., 2000).

Although the "total economic value taxonomy" is the forerunner in wetland valuation, economists have pointed out two serious objections to this approach. First, some economists object to using a framework with classification of values into use and non-use values. This is not fully satisfactory since it does not explicitly differentiate between alternative life-support functions of an environmental resource (Gren et al., 1995) and therefore fails to reflect Total Primary Value[6] (TPV) of the ecosystem (Turner et al., 1993). But going beyond total economic value to measure the extra 'glue value' that comprises total primary value is extremely difficult (Barbier, 1995). Secondly, wetlands being complex systems, simple aggregation of the value of ecosystem benefits are not acceptable since some functions are pre-conditional to others (Gren et al., 1995).

Departing from the conventionally followed definition of the components of total economic value, Mäler (1992) distinguished between values revealed by markets and those not revealed by markets.[7] His argument was that estimations could be made of benefits based on observed behaviour, but lack of complete knowledge about ecosystem services made it impossible to value the whole system.

As noted, most objections raised were regarding the components of Total Economic Value rather that the framework as a whole. It has been accepted and used by many economists as a first step. Hence, it provides a useful framework and starting point for a wetland valuation study. Figure 2.1 below presents the famous taxonomy for estimating the total economic value of wetlands.

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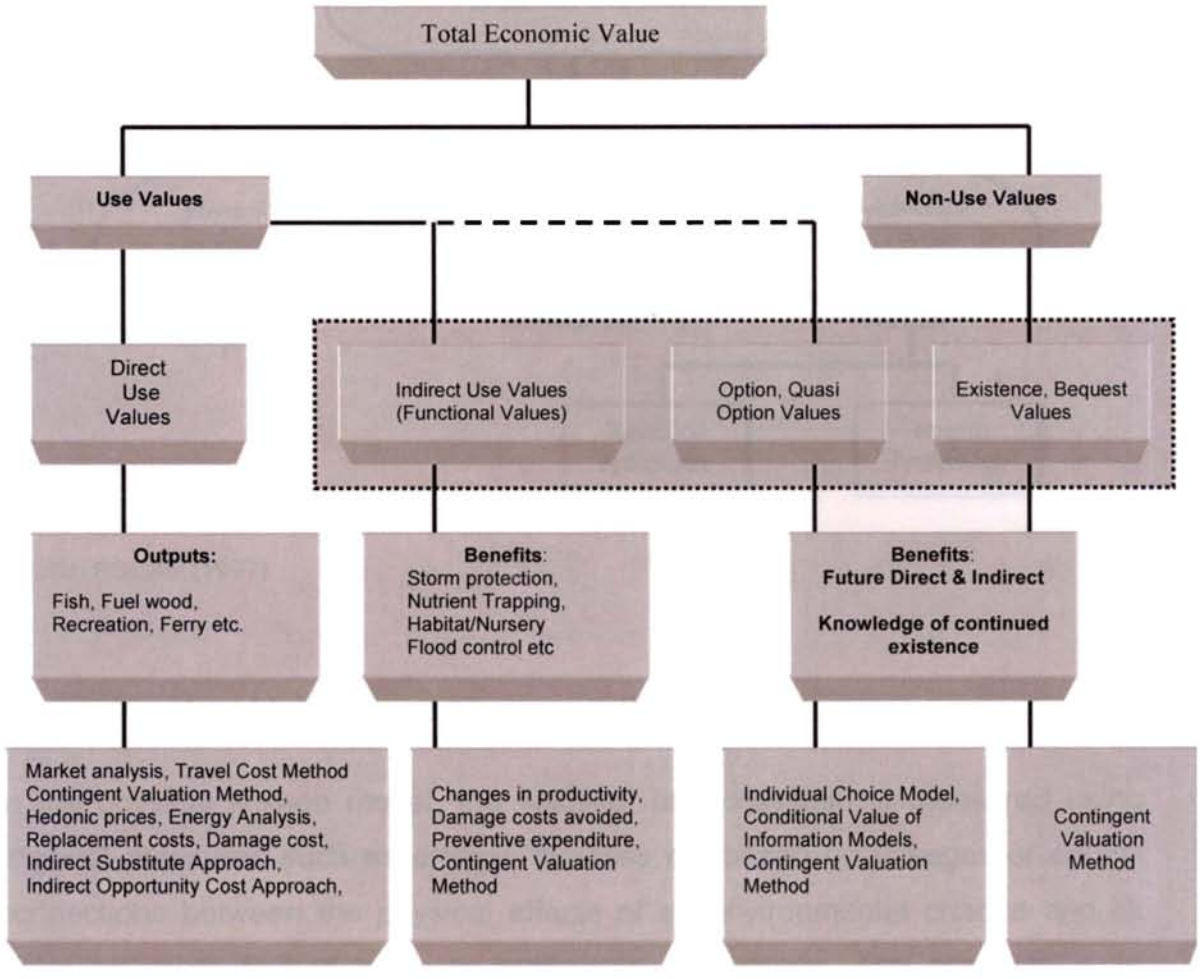
[6] Although a lack of consensus exists with regard to the components of Total Economic Value, academicians generally agree that a clear distinction exist between the concept of Total Economic Value and Total Value of an ecosystem (Turner et al., 1993). Total Value of a system is much more than just an aggregation of its individual parts and includes a 'glue value'. Most studies conclude with the observation that only a part of total wetland values can be captured in monetary terms and this part is referred to as total economic value.

[7] The former referring to those values obtained from observed market behaviour while the latter refers to all other values that can never be revealed from observing individual behaviour in markets.

Fig. 2.1

Taxonomy of wetland valuation



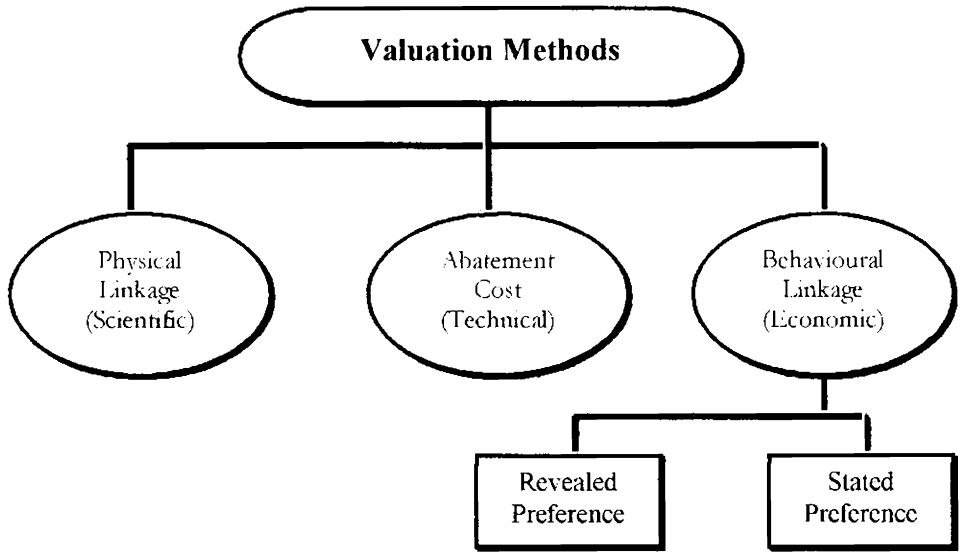
Source: Adapted from Barbier (1994) and modified

2.1.2 Valuation methods

An important advantage of using this framework is its ability to identify all the relevant benefits and value them using appropriate methods[8]. Valuation techniques are essentially divided into three broad classes, namely the physical linkage, abatement cost and the behavioural linkage methods. Figure 2.2 depicts various methods of valuation.

[8] Valuation methods may originate from economics, ecology, social psychology, philosophy or other disciplines (Bingham et al., 1995).

Fig. 2.2 Valuation Methods



Source: ESCAP (1997)

2.1.2.1 Physical Linkage and Abatement Cost Method

In the physical linkage model, the value of an ecosystem is measured using physical measures such as energy, biomass etc based on linkages or causal connections between the physical effects of an environmental change and its effect on other factors such as processes or persons. The objective is to measure changes in net benefits as revealed in physical terms or market prices caused by *environmental damages/improvements*[9].

A second set of methods found in the literature, is the damage cost or *replacement cost methods*[10]. *It is based on the view that the cost of abating an* environmental damage would estimate the value of the damage. Value is

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[9] Such studies employ energy analysis methods (EAM) and ecological modeling to value ecosystem assets by directly relating to their energy processing abilities.

[10] This method is also referred to as Damage cost or Dose Response approach.

reflected in the proxy costs of providing, maintaining or restoring environmental goods and services (Bishop, 1998).

Since both these methods use the biophysical and functional relationships as the basis of value rather than an attempt to measure the environmental value of resources, economists do not generally favour these methods for wetland valuation.

2.1.2.2 Behavioural Linkage Method

The behavioural linkage methods, on the other hand, assume that the value of an environmental good should be based on people's willingness to pay (WTP) to secure better environmental quality or to escape deterioration. These techniques estimate behavioural parameters[11] that reveal preferences directly (market prices, net factor income, cost of avoidance), or indirectly in the market (travel cost method and the hedonic price method) or are stated in a survey (contingent valuation, choice experiments and conjoint analysis).

2.1.2.2 (1) Market Based Techniques

Price is the value in exchange of a good or service. Market based methods therefore use market prices for valuation. These methods have the advantage of easy applicability as well as simplicity in methodology. Most of the calculations can be done using simple accounting techniques like change in productivity[12]

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[11] The usefulness of any particular classification depends upon how well it illuminates important similarities and differences among types of service flows. Mitchell and Carson (1989) have offered classification of methods for estimating values that are based on two characteristics of the method. The first characteristic is whether the data come from observations of actual human behavior. The second yields monitory values directly or must be inferred indirectly through technique based on models of human behaviour and choice.

[12] The basic assumption of this method is that environmental changes cause changes in productivity of resources and/or environmental goods or services. In such a case, the cost of environmental change is estimated using market prices, provided these resources/ environmental goods and services have a direct market value.

(Barbier et al., 1993), production function approach[13] (Barbier, 1994; Bell, 1997), present value generated per unit area[14] or the residual rent approach[15]. Annexure 2.1 provides details.

2.1.2.2 (2) Non-Market Based Techniques

[a.] Revealed Preference Methods

Non-market based techniques are broadly classified into revealed preference and stated preference approaches. The revealed preference approach infers value of the missing markets for environmental resources from data on behavioural changes in actual markets related to the resource/service in some way. The value of an environmental amenity is estimated directly or indirectly from the purchase price of a commodity whose market value at least partly depends on the quality of the environmental amenity in question. Three approaches - travel cost, random utility and hedonic price models - are worth mentioning.

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[13] In this approach, the environmental attribute (soil stability, water quality, etc) is considered as an input in the production function, which relates the output of a particular marketed good or service (for example wetland agricultural production, fishing catches) to the inputs necessary to produce it. The effects of the other factors affecting production can be incorporated into the production function as well. Although this method is very popular and widely applied, it is not commonly used in multiple use systems such as wetland studies especially those measuring total economic value since its application is slightly more problematic (Mäler, 1992; Aylward and Barbier, 1992; Barbier et al., 1993; Barbier, 2000).

[14] Under this method, the gross value of change in production over the time period the environmental change occurred is calculated for each time period and discounted to get the present value. Then the total gross value per unit area is calculated by dividing the change in production by the total area affected. This method is applicable when the affected resource enters the consumption process with a minimum additional cost. This approach however, ignores the cost of inputs, which are expended in extracting the resource.

[15] In this approach, the cost of extracting or harvesting the resource is subtracted from the market value of the resource. When the extraction/harvest costs includes labour costs (as usually would be the case), it is the opportunity cost of labour and not the market wages that is considered.

The travel cost method[16] (TCM) is often used to measure direct uses of wetlands such as the recreational benefits. This method attempts to place a value on a non-market environmental good (such as a recreation site) by drawing inferences from expenditure made to "consume" the good, including the cost of traveling to the site, entry fees, on-site expenditures and outlays on capital equipment (such as fishing equipment or a boat). It translates the physical, psychological and social benefits generated by the individual use of this non-marketable environmental resource for recreational purposes, into monetary terms. A number of studies were conducted in different parts of the world to estimate the recreational values of wetlands (Farber, 1988; Amacher et al., 1989). See section 2.2 and chapter 6 for details.

The Random Utility Model (RUM) is conceptually similar to the travel cost model. They seek the same kind of values and use similar logic. However, instead of focusing on the number of trips a tourist takes to a given site in a season, these models focus their choice amongst the discrete alternative recreational sites. This type of model is particularly appropriate when there are many substitutes available to the individual and when the attempt is to value a change in the quality characteristics of one or more site alternatives.

[16] The travel cost method originated in a letter from Harold Hotelling to the director of the US Park Service in 1947, but was formally introduced in the writings of Trice and Wood (1958) and Clawson and Knetsch (1966). Since then, all research on travel cost methods in the last 50 years have attempted to elaborate on the original suggestion either theoretically or empirically. Hotelling suggested measuring differential travel rates according to travel distances that visitors overcome in reaching a site. Exploiting the empirical relationship between increased travel distances and associated declining visitation rates should permit the estimation of a true demand relationship. It was generally believed then and is still believed that development of a method to measure economic values of outdoor recreation and outdoor recreation policies should be based on underlying preferences of visitors and the economic constraints that govern their choices. Clawson (1959), Knetsch (1963) and later Clawson and Knetsch (1966) were instrumental in further development of travel cost method.

The Hedonic Price Method[17] (HPM) attempts to evaluate environmental goods or services by estimating their effects on certain market prices such as property and land. It is based on the assumption that the prices of marketed goods such as houses are affected by the numerous characteristics including size, location, neighbourhood, etc.

[b.] Stated Preference Methods

The stated preference approach avoids conventional markets and searches stimulated markets (UNEP, 1995). A survey instrument is designed in which a market like situation is constructed. Respondents record their choices in the light of the hypothetically changed circumstances and the data are used to calculate the value of environmental amenities and other goods or services. The Contingent Valuation Method[18] (CVM) is the most common form of stated preference method for valuing non-market goods. It is a standardized and widely used survey method to estimate willingness to pay for use, option, existence, and bequest values (Mitchell and Carson, 1989; Brent, 1995; Fisher, 1996).

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[17] Hedonic models are used to capture the relationship between the bundle of environmental characteristics and its price. Hedonic models estimate the implicit price of the characteristics of a good. Environmental attributes such as trees, aesthetic views, etc also influence market price of the commodity. By explaining the price of the commodity with these features using a multiple regression model, it is possible to isolate and value the effects of environmental characteristics on property prices and infer how much money individuals are willing to pay for certain environmental attributes. The value of the change in the environment is therefore given by the commodity price change. However, even when implicit prices for environmental amenities can be estimated, the connection between the implicit prices and value measures is technically very complex and sometimes empirically unobtainable.

[18] The contingent valuation method began to be used in the early 1960s. Robert Davis (1963, 1964) used questionnaires in an attempt to measure the benefits associated with outdoor recreation in Maine. Acton (1973) conducted the first contingent valuation study examining health risks. He estimated willingness-to-pay for improved ambulance service to heart attack sufferers. Historically, the growth of the contingent valuation method as a viable alternative for estimating the benefits of public goods was in part fed by funding from the United States Environmental Protection Agency, beginning in the mid 1970s. The method developed through gradual acceptance and use by United States Government Agencies. An important milestone was the acceptance by the United States courts of the use of contingent valuation method in natural resource damage assessments under the 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In July 1984, a review panel of experts, including economists and psychologists, actively involved with contingent valuation research (NOOA Panel) concluded that although the contingent valuation method held promise, further exploration of the technique was necessary (Mitchell and Carson, 1989). Through the 1970s and 1980s, contingent valuation (CV) research progressed steadily.

Contingent valuation method tries to obtain information on consumers' preferences by posing direct questions about willingness to pay. "It basically asks people what they are willing to pay for a benefit, and/or what they are willing to accept by way of compensation to tolerate a cost. This process of "asking" may be either through a direct questionnaire/survey, or by experimental techniques in which subjects respond to various stimuli in "laboratory" conditions. What is sought are personal valuations of the respondent for increases or decreases in the quantity of some good, contingent upon a hypothetical market" (Munasinghe, 1990). The Contingent valuation method involves constructing a hypothetical market or referendum scenario in a survey. It represents the amount people would be willing to pay to avoid a specified environmental damage, to achieve a stated improvement in environmental quality, or to receive a specified supply of a public good.

Early work attempted to examine the "design bias" effects (Mitchell and Carson 1989). Later, much attention was, in contrast, given to explain large differences between willingness to pay (WTP) and willingness to accept (WTA)[19] measures of value (Schulze et al., 1983; Knetsch and Sinden, 1984; Cummings et al., 1986; Shogren et al., 1994; Goldar and Misra, 2001; Bateman et al., 2002).

[19] Standard economic theory's prediction is that WTP and WTA should be approximately equal. In practice, the discrepancy between an individual's willingness-to-pay (WTP) and willingness-to-accept (WTA) for the same amenity, was sometimes four to fifteen times (Hammack and Brown (1974) Hausman, 1993). This disparity was heavily researched throughout the late 1970s and 1980s and four possible explanations began to emerge: rejection of the WTA property right, consumer cautiousness, prospect theory and modifications of established economic theory (Mitchell and Carson, 1989). Mansfield (1999), Hanemann (1991), Tversky and Kahneman (1991), Hoehn and Randall (1987), Boyce et al., (1992) examined various issues behind this variability. Mitchell and Carson (1989), after extensive review of the literature surrounding the WTP-WTA discrepancy, concluded that this discrepancy may be due to a combination of the factors discussed above. Randall (1987) reported that the discrepancy between WTP and WTA values tended to narrow as respondents repeated the valuation process. Hanemann (1984) argued that this discrepancy was due, in part, to the discrete choice format prevalent in CVM surveys. Theoretical work by Hanemann (1986) further explored the work of Randall and Stoll (1980) and reported that the size of the WTP-WTA gap depended upon availability of substitutes for the hypothetical public good in question, narrowing as the number of available substitutes increased.

Although the Blue Ribbon Panel (NOAA panel) put forth a set of guidelines[20] on the use of contingent valuation method especially in the case of non-use values (Carson et al, 1996), the controversy surrounding the method continued (Hausman, 1993; Diamond and Hausman, 1993; Hanemann, 1994; Bateman and Langford, 1997).

2.2 Wetland Valuation: A Review of Selected Case Studies

During the last two decades, a large number of empirical studies have been undertaken by individual researchers to value wetlands. These studies can be broadly divided into *impact analysis, partial valuation* and *total valuation studies*[21]. Impact analyses studies are relatively few and are undertaken when quick decisions are to be made. In cases where an ecosystem study is not warranted but only certain aspects need be valued, a partial valuation study is done[22]. Total valuation studies aim to comprehend the economic values of various direct and indirect benefits including ecosystem functions and services in its entity.

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[20] The principle recommendations were as follows: (1.) A dichotomous choice format should be used; (2.) A minimum response rate from the target sample [70 %] should be achieved; (3.) In-person interviews should be employed with some role for telephone interviews in the piloting stages; (4.) WTP, not WTA, measures should be sought; (5.) After excluding protest bids, a test should be made of whether WTP is sensitive to the level of environmental damage; (6.) CVM results should be calibrated against experimental findings; otherwise a 50 percent calibration factor should be applied to CVM results; (7.) Respondents should be reminded of their budget constraints; and (8.) Respondents should be given "adequate" information about the environmental change in question.

[21] According to Barbier et al (1997), three broad categories of issues are most relevant to the economic analysis of wetlands. *Impact analysis* is an assessment of the damage inflicted on the wetland from a specific external environmental impact (Bann, 1997; Dixon et al., 1988). *Partial valuation* is used in the assessment of two or more alternative wetland use options. Here, choices involving diversion, allocation or conversions of wetland resources compare the net benefits generated by each of the wetland uses (Barbier, 1994; Hanley and Craig, 1991). The third type of wetland valuation is a *Total valuation* of the total economic contribution, or net benefits, to society of the wetland system. It is most appropriate where a full accounting of the costs and benefits associated with a particular wetland is required (Costanza et al., 1989; Gren, 1995).

[22] See annexure 2.2 for a summary of studies.

2.2.1 Partial Valuation Studies

According to Barbier et al., (1997), partial valuation studies involve assessment of alternate options of two or more wetland uses. Those studies date back at least to 1926, when Percy Viosca, Jr., a fisheries biologist, estimated the value of fishing, trapping and collecting activities from wetlands in Louisiana (Vileisis, 1997). Economists entered the arena of estimating value of wetlands much later (Boyer and Polasky, 2002). A landmark early valuation study on wetlands was by Hammack and Brown (1974). They focused on wetlands as waterfowl habitat and estimated the value in terms of hunting using market valuation. It was only later on that attempts to value wetlands moved beyond estimates of direct benefits. Studies estimating only direct benefits have used the market price methods since they are the easiest to compute, particularly when the commodity already has a market (de Beer and McDermott, 1989). Majority of these studies opted for *net values* - the gross value of a benefit less the costs that must be incurred to receive that benefit measuring direct use values of wetlands.

Since these partial valuation studies estimated only direct benefits of wetlands without considering the ecosystem functions that contributed to these values, they did not generate much meaning. This failure was soon resolved with the development of theoretical approaches and methods that meaningfully incorporated the economic significance of various ecological functions into the process of valuation. Such studies adopted methods like the marginal value product, residual rent approach, production function approach or present value generated per unit area approach to value various benefits of wetlands (Farber and Constanza, 1987; Farber 1988; Barbier, et al., 1993; Gren 1995; Acharya (1998)[b]; Emerton et al., 1998; Seyam et al., 2001; King 2002).

Following these lines, attempts were made to quantify economic values of various ecological functions of wetlands around the world. Thibodeau and Ostro,

(1981) attempted to value five different ecological benefits of the Massachusetts wetland using replacement cost methods. The value of open space per capita was calculated using a telephone survey of local appraisal. The value of the marshes as nutrient sinks was calculated as the associated cost savings at sewage treatment plants. The difference between the cost for wetlands wells and the cost of providing water from the next best source was used to value the supply of water. The value of recreation was estimated by the use of results from other studies where travel expenditures and consumer surplus had been calculated.

Bell (1997) used a non-linear bio-economic production function method to place an economic value on the contribution of wetlands in supporting recreational fishing in the Florida wetlands. The production function linked the recreational catch to angler fishing effort and wetlands. Leschine et al., (1997) used the replacement cost method to produce a proxy for values of the flood protection services of Western Washington wetlands. Cost estimates for engineered hydrologic enhancements to wetlands that currently provided flood protection was used to establish proxies for the dollar-per-acre value of the flood protection these wetlands currently provide. Acharya (2000) also used the production function approach to capture the value of hydrological services of the Hadejia-Nguru wetland ecosystem in northern Nigeria (i.e. agricultural production and domestic water demand analysis). However the study itself points out that these values were not an estimate of the total value of the environmental functions performed by the wetlands nor did they fully capture the value of the recharging function itself. It also emphasized the importance of integrating such values in development and conservation policies.

Barbier (2000) used production functions to value wetland's contributions to local fishery in South Thailand and Mexico. Static and dynamic approaches were

adapted to value ecological functions. This study was different in that after attempting an economic valuation, it concluded by pointing out the importance of management regimes and institutional norms in determining long run benefits generated from the system. Farber (2002) estimated the storm protection and fishing values from wetland of south Louisiana using a 'yield function' that established a statistical relation between fishery catch, effort, wetlands area and fishers that reflect the annual marginal value product of wetlands. Recreational values (hunting and fishing) of wetland preservation from the Barrier Island were also estimated using survey information collected by Bergstrom et al., (1989). Although valuation studies in developed countries began with direct benefits valuation, they subsequently moved to indirect and non-use benefits considering them to be of more relevance.

Similar studies were also undertaken in developing countries. Eaton and Sarch, (1997) conducted a study on the economic value and importance of wild resource production systems in agriculture and fishery of the floodplain of Hadejia-Nguru in northern Nigeria. Emerton et al., (1998) attempted to quantify the benefits associated with different economic activities, of Nakivubo wetland in Kampala, Uganda, with the aim of providing information on profits and returns from reclamations and conversions of wetlands for industrial developments using market valuation techniques. In order to value wetlands services, the study used indirect methods like replacement costs and mitigative expenditure. The study called for greater internalization of externalities by modern users. Seyam et al. (2001) attempted valuation of freshwater wetlands in the Zambezi Basin, Kenya based on market prices. Direct use values of floodplain agriculture, fish production, wildlife services and goods, livestock grazing, eco-tourism, biodiversity, natural products and medicine were estimated using different methodologies. Certain studies also employed various proxy methods to estimate recreational values (Hanemann et al., 1987; Hodgson and Dixon, 1988; Edwards, 1992; Pendleton, 1995; Desvousges and Waters, 1995; Cesar, 1996; Dixon et

al., 1993; Driml, 1999). Studies in developing countries gave more importance to valuation of direct benefits and the ecosystem functions that contributed to those benefits. These studies either looked very briefly into or mentioned the role of institutional norms and sharing mechanisms in determining value generated.

While some ecological economists were engaged in the valuation of various direct and indirect benefits using 'market valuation' and 'proxy methods', several others were involved in estimating direct benefits of wetland services using travel cost methods[23] (Leeworthy, 1986; Bergstrom et al., 1990; Markandya, 1992; Green, 1992;) or contingent valuation method (Titre et al., 1988; Bell, 1989; de Groot, 1994). van Vuuren and Roy (1993) used the travel cost method to estimate the recreational benefits of bird hunting, angling and trapping in the wetlands of the Canadian lake St. Claire. Similarly, Navrud and Mungatana (1994) applied the travel cost and the contingent valuation methods to value the recreational value of wildlife viewing, which was used as a valid, but very conservative, estimate of the total economic value of the wildlife species. Estimating expenditure and consumer surplus associated with on-site recreational uses of this coastal wetland, they pointed out the need for forming more effective policies for wetland management.

Contingent valuation studies on the other hand concentrated on eliciting economic values of various wetland functions that have no market (Costanza and Farber, 1985). Many studies also applied contingent valuation method to value the direct benefits of wetlands (Farber and Costanza, 1987; Titre et al., 1988; Hanley and Craig, 1991; Bergstrom and Stoll 1993). It is interesting to note that most of such studies focused on estimating recreational values of wetlands.

[23] Travel cost models have been used extensively to model recreational demand for other ecosystems such as national parks (Beal,1998; Lansdell and Gangatharan, 2001; Mendelsohn et al., 1992), national forests (Englin and Mendelsohn, 1991; Willis and Garrod, 1991), coral reefs (Dharmaratne, 1999; Dharmaratne and Braithwaite, 1998), wilderness (Smith, 1975), improved water quality (Smith et al., 1991) and for recreational activities such as recreational fishing, angling, rafting and canoeing etc. (Amacher et al., 1988; Bell and Leeworthy, 1990; Farber and Costanza, 1987; Whitehead et al., 2000).

Bergstrom et al. (1989) conducted a contingent valuation study to estimate people's willingness to pay to maintain waterfowl hunting, freshwater and saltwater fishing, recreational fishing and crabbing in Louisiana coastal wetlands. Kosz (1996) used the contingent valuation method to estimate Austrians' willingness to pay over 14 years for the 'Donau-Auen' national park as a substitute to the ecological values provided by wetlands. Farber (1996) used the contingent valuation method to estimate willingness to pay for recreational fishing and waterfowl hunting in coastal Louisiana wetland. The main conclusion of these studies was that economic valuation using contingent valuation methods could contribute substantially to transparent decision making and environmental policies. Pate and Loomis (1997) elicited people's willingness to pay to control wetland contamination and maintain salmon fishing and wetland habitat in San Joaquin Valley wetlands, California. Pyo et al., (2001) applied contingent valuation method to estimate non-use values for conserving coastal wetlands of Youngsan River in Korea. During the survey, respondents were asked for the maximum amount of additional household taxes which they would be willing to pay (WTP) monthly for a conservation programme designed to maintain current levels of conservation quality at coastal areas instead of coastal development. Studies that apply contingent valuation (CV) techniques using dichotomous choice models were also popular (Loomis et al., 2000). Zhongmin et al., (2003) applied the contingent valuation method to elicit consumer willingness-to-pay to restore the ecosystem services of Ejina wetlands. The study used a payment card format. The willingness to pay estimated was considerably less than the estimated cost of restoration of the project. Most of these studies were concerned only with valuing the benefits of the wetlands and highlighting the need to incorporate estimated values in any policy considerations for future development of the wetlands.

Many researchers, of late, started using a combination of direct valuation, travel costs and contingent valuation methods for providing better understanding of

economic values of wetlands. They argued that since the benefits provided by wetlands were very diverse, they could only be captures through a combination of different methods. Such studies that used simple aggregation to estimate total economic value were severely criticized by many. However, for want of better alternatives, this methodology was also reluctantly accepted by many. Farber and Costanza (1987) estimated the value of the wetland ecosystems in monetary terms using both conventional economic methods and biophysical methods (energy analysis). Indirect methods were used to estimate the value of commercial fishing and trapping, recreation and storm protection. They used the analysis of an earlier study by Lynne et al. (1981) to estimate the value of shrimp harvest and oyster production for the Louisiana wetlands. The value of storm protection was calculated by means of a wind damage distance decay function. The travel cost method was applied to estimate the recreational value of the wetlands. Bateman and Turner (1993) used the contingent valuation method to estimate willingness to pay for protection from saline flooding from the wetlands of Norfolk Broads. The study used a combination of direct valuation and contingent valuation methods. Lee (1998) looked at the productivity values of coastal wetlands in Korea, including fisheries, habitat functions, waste treatment services and aesthetic functions and concluded that economic valuation had an important role in contributing to well-informed policy decisions.

2.2.2 Total Valuation Studies

Studies attempting total valuation of wetlands assessed the total economic contribution/net benefits to society (Barbier et al., 1997). Gren (1994) conducted a total valuation study of the Danube River floodplains to determine the potential benefits from improved water quality and over all management of the Danube. The study used ecological-economic models and benefit transfer methods. In a highly controversial paper, Costanza et al., (1997) undertook a study on the current economic value of 17 ecosystem services for 16 biomes, based on over

100 existing published studies and a few original calculations. Many of the valuation techniques used in the studies were based, either directly or indirectly, on 'willingness-to-pay' estimates. They estimated the value per unit area of each ecosystem service for different ecosystem types, using either the sum of consumer and producer surplus, the net rent (or producer surplus) or gross value (using price multiplied by quantity produced as a proxy for the economic value of the service). Majority of the value of services identified were outside the market system (indirect services). It is to be noted that such studies claiming to estimate total economic contribution/net benefits to society were relatively few and often subject to controversy.

2.2.3 Indian Case Studies: A Brief Review

Systematic studies on the economic values of Indian wetland ecosystems started way back in early Nineties[24]. These studies concentrated on identification of wetlands of national importance, assessment, promotion of research and development activities and formulation and implementation of Management Action Plans (MAP). Comprehensive wetland valuation studies in the country were conducted later on. Very few studies are conducted on the economic significance of Indian wetlands. Chopra and Adhikari (1999) used a dynamic simulation model in a 'STELLA' environment to understand linkages between underlying ecological relationships and economic values emerging from them. They pointed out that economic values focus on use values in short run, whether within or outside the market, while ecological values provide an underlying long run notion of value. Travel cost method[25] was then used to investigate the nature

[24] Annexure 2.3 gives a summary of the major wetland studies in India.

[25] Survey-data collected on tourists travel and stay expenses, duration of stay, and various socio-economic characteristics, were used to build a semi-log demand function. The study indicated that travel cost was a valid proxy variable for price in determining demand for tourism services. Due to the joint product nature of the services provided by the park, it was considered more appropriate to estimate consumer's surplus from local cost estimates.

of link between these two types and to estimate the value of Keoladeo National Park. In another remarkable study, James and Murty (1999) attempted to estimate non-user benefits from the cleaning up activities of river Ganges using contingent valuation method. Households were asked to reveal their preferences for three levels of water quality namely that before, during and after the clean up. An open ended bidding game was used with a variant of a payment card. Respondents were also asked two closed-ended follow up questions. The payment vehicle chosen was payment to a reputable charitable organization. The Cobb Douglass form was used for econometric estimation.

Another serious attempt of wetland valuation was undertaken by Verma et al., (2001) on Bhoj Wetlands in Madhya Pradesh. Since there were multiple stakeholders, the study did not attempt to calculate a single value for all the benefits. Instead it used a combination of valuation techniques together. The value of benefits accruing to various people whose livelihoods depended upon wetland (fishermen, boatmen, trapa cultivation and road side vendors) was estimated using the principle of market valuation. The value of supplying drinking water to the city and the value of preventive measures that people used to avoid water borne diseases was also estimated. The contingent valuation method was used to estimate the willingness-to-pay for enjoying better recreational facilities from Bhoj Wetland. In addition to this the effect of the presence of the wetland on the value of property prices was also estimated using hedonic pricing method. This study did not attempt to add up individual values to arrive at annual Total Economic Value (TEV) estimates as there could be possibility of overlapping of wetland values. Instead it only estimated various use values generated by stakeholder to reflect the economic importance of the Bhoj Wetland. Kumar (2001) attempted an economic valuation of the ecological functions of wetland along the Yamuna River corridors of Delhi. Four ecological benefits (hydrological functions, biological productivity, nutrient storage and habitat for flora and fauna) of the wetland were valued using a range of valuation techniques. The value of

hydrological functions (Water recharge benefit for agriculture and water supply to households), livestock fodder and nutrient benefits were valued using replacement cost method. Fishery production and thatching grass production were valued using the market price approach. Nutrient storage function was valued using cost of procurement method and the habitat for biodiversity functions and recreational benefits were valued using the contingent valuation method. Parikh and Datye (2003) used a multidisciplinary approach to address the subject of wetland management. Based on a collection of multidisciplinary wetland valuation studies, they argued that estimating economic benefits and values must incorporate traditional knowledge of local users. In other words, the institutional contexts are important in valuation exercises.

There have also been a few attempts to elicit values of wetlands in Kerala. Nayak et al., (2000) attempted to look into the present mode of resource use and the biophysical changes taking place in north Kerala. They reviewed major resource use systems and subsistence patterns in the study area and also assessed the ecological status of the resource base as perceived by the local community. This study did not however, attempt an economic valuation. The first systematic attempt[26] to look at the various issues surrounding wetland resource use and the causes for wetland biodiversity degradation in the Cochin estuary was undertaken by Thomson (2002[a]; 2002[b]). The study identified the major benefits provided by the Cochin backwaters and the different stakeholders who had appropriated the wetland resources over the year. The major causes for the degradation of the backwaters were analyzed in detail. It also estimated the value direct benefits provided by the backwaters. Santhakumar (2000) attempted

[26] Manoharan (1996) undertook a contingent valuation and travel cost study in the Periyar Tiger Reserves to estimate its ecotourism values. He estimated its value as Rs.676 per hectare for locals and Rs.9.5 per hectare for visitors from Kerala. Similarly, Jyothis (2001) draws from the preference elicitation of the people living in and around the Periyar Tiger Reserve in the Western Ghat Regions of Kerala State, using a contingent evaluation questionnaire to measure people's participation in the management of a protected area for biodiversity conservation. These studies do not pertain to wetlands; however, they are the first attempts in using the contingent valuation methodology in Kerala.

valuation of the coastal wetlands in Cochin and Bangladesh, focusing on use values arising from the four major functions of the coastal wetlands namely input to fish production, recreation, protection of coastal land and carbon sequestration using surrogate market prices and indirect methods such as the estimate of avoidance cost, cost of substitutes etc. Jeena (2001) analyzed the economic and institutional factors in the use and management of the Cochin wetlands, concentrating on the fishery sector particularly. Thomson (2003) undertook a detailed study of the Cochin estuary in which the direct, indirect and non-use benefits provided by the estuary were estimated. The study used market-based techniques to estimate the direct benefits from the estuary, the travel cost method to estimate recreational values of wetlands and the contingent valuation method to estimate indirect and non-use benefits provided by the estuary. This study however estimated gross vales and not net values.

A variety of valuation techniques have been reviewed above and some clear patterns emerged. Most studies on temperate wetlands recognized recreation as an important wetland use and applied either travel cost or contingent valuation methods to obtain a measure for its value. In contrast, tropical studies are more concerned with the economic significance of these ecosystems on the livelihood activities of local communities. An interesting issue concerns whether economic valuation ensures prudent uses of these resources among different users and across generations. The theory of economic valuation outlined in the survey of studies does not claim this at all. In fact, right set of institutions and efficient modes of governance are pre-conditions to achieve sustainable uses of resources. The message conveyed in the survey, however, is that valuation studies throw enough light into the manner in which resource specificities and uses are inter-related and are unavoidable if serious interventions have to be made to enhance economic values.

2.3 Scope and Limitations

So far, the study explained various methodological approaches developed and used by various analysts to estimate economic value of wetlands. Most of the earlier studies on economic valuation however, emphasized the fact that estimating economic values of wetlands is essential and the framework of total economic value is probably the first step towards this direction as it captures preferences of present and future generations and guide rational choices of resource uses across generations. At the same time there are major drawbacks in the ways of deducing value. For instance, it is often contested whether market prices do reflect the full social costs of production. Second, most services of wetlands are not presently traded in the market raising challenges for valuation. Much more serious is the neglect of institutional contexts on which the preferences and choices are determined. The role of institutional dynamics on allocations and inter-temporal choices is crucial in the production of values. A much more serious issue concerns the logic and assumptions involved in the additive principle of total economic values. Most often the principle of simple addition adopted for arriving social value is challenged for lack of sensitivity to social differentiation among resource users and the weight they attribute to various outcomes. Standardizing the weights especially in the process of deciding preferences and choices of people differentiated on the basis of class/caste/ethnicity may cause serious errors. However, these limitations are definitely not arguments for rejecting the use of total economic value framework for eliciting economic values of wetland uses/benefits. In fact total economic value provide one of the most accepted starting points to account for the overall benefits of these ecosystems to humanity.

2.4 Summary and Conclusion

The objective of this chapter was to survey the available literature on wetland valuation. The study started out by a review of valuation theories and then examined the major findings of some selected case studies on wetland valuation both from developed and developing countries. The survey reviewed a variety of methodologies and techniques available for valuing wetlands. Different methodologies are useful for different types of environmental amenities or situations. Valuation methodologies useful in all environmental contexts do not exist. The commonly accepted procedure to estimate the total economic value of wetlands is to select one or more valuation methods as the situation warrants. The measurement of the value of various goods and services varies substantially depending on geographical location, ecosystem specificities, flow of benefits, resource appropriation mechanisms of different resource users, their perceptions on economic values and the methods of valuation. In many cases, economic analysis is made on the basis of limited insight into local level perspectives and highly aggregated data.

Studies on wetland valuation rely on market values wherever markets are available for calculating net or gross values. Interestingly enough, such studies do not analyse the ecological base of the benefits and non use values provided by wetlands or the institutional contexts of various resource user groups. Contingent valuations and other supplementary tools are useful under such circumstances. The basis for economic valuation of wetlands is set under these principles. The next chapters analyze these details and subsequently undertake valuation of benefits derived from Cochin wetlands.

ANNEXURE

Annexure 2.1 Methods for Valuing Wetlands

Valuation Method	Relevant wetland benefits	Strengths and Weaknesses
Market Prices: Use data from surveys of producers and consumers, adjusted if necessary, to account for seasonal variation, value-added processing and/or public policy distortions.	Price-based valuation is commonly applied to wetland products which are partly or informally traded, in order to estimate subsistence and/or unrecorded consumption.	Market prices clearly reflect consumer preferences, but often need adjustment to account for public policy distortions or market failures. Seasonal variations and other effects on prices need to be considered when market prices are used in economic analysis.
Change in Productivity or Effect on Production Approach: Values the effect of environmental change on the production of a consumable good, through the market.	Applicable for direct use values	If market distortions exist in output or input markets, market prices should be adjusted appropriately to reflect competitive market prices.
Present Value Generated Per Unit Area : Value of change in production over the time period the environmental change occur, is calculated for each time period and discounted to get the present value.	This approach is suitable for calculating change of benefits from wetlands under subsistence living conditions or when the opportunity cost of labor in extracting or harvesting the resource is close to zero.	Only the gross value of the change in productivity is estimated. This method is applicable when the affected resources enter the consumption process with a minimum additional cost.
Residual Rent Approach: The cost of extracting or harvesting the resource is subtracted from the market value of the resource.	Frequently used to estimate values of directly marked goods and services of wetlands	The data requirement is scant when compared to more advance methods. Simple to apply. Also, when reliable primary data does not exist, this method has the latitude to use expert opinions and make approximations from previous studies in the region or outside the region.
Surrogate Markets: **Travel cost:** Uses survey data on direct cost (e.g. fares, accommodation) and, in some cases, opportunity costs of time spent traveling to and from a site, evaluated at some fraction of the average wage rate.	Widely used to estimate the value of recreational sites in developed Countries. It could be used to estimate willingness to pay for eco-tourism to tropical wetlands in some developing countries.	Travel cost estimates may need to account for various objectives (benefits) in a single trip.

Hedonic pricing : Uses statistical methods to correlate variation in the price of a marketed good to changes in the level of a related, non-marketed environmental amenity	**Hedonic pricing has potential for valuing certain** wetland functions (e.g., storm protection, groundwater recharge) in terms of their impact on land values, assuming that the wetland functions are fully reflected in land prices.	**Hedonic pricing requires large data sets, in order** to isolate the influence of a non-market benefit on market price, relative to other factors. Application of hedonic pricing to the environmental functions of wetlands requires that these values are reflected in surrogate markets. The approach may be limited where markets are distorted.
Substitute goods: Uses market prices of substitutes to measure non-marketed benefits.	Substitute goods approach may be used whenever close market substitutes for benefits exist.	Requires that the relation between the benefit being valued and the surrogate market be correctly specified. Prices in surrogate markets are not generally reliable.
Production Function: Uses data on the physical relation between level (or quality) of non-market benefit and level (or quality) of output of a marketed good/service.	Change in production (or "input-output" or "dose-response") methods are used to estimate both on and off-site impacts of resource use change.	Requires explicit modeling of the 'dose-response' relationship between the resource or function being valued and some economic output. Application is most straightforward in the case of single use systems but becomes more complicated with multiple use systems. Problems may arise from multi-specification of the ecological-economic relationship or double counting.
Stated preference Methods **Contingent Valuation Method**: Uses consumer surveys to elicit hypothetical individual willingness to pay for a benefit, or willingness to accept compensation for the loss of that benefit.	CVM is the only generally accepted way to estimate non-use values for which price data do not exist and/or links to marketed goods cannot easily be established.	Contingent valuation estimates are generally considered reliable if strict procedural rules are followed. Results are sensitive to numerous sources of bias in survey design and implementation.
Contingent Ranking (Focus groups): Uses participatory techniques in group settings to elicit preferences for non-market benefits, either in relative terms (ranking) or in monetary terms.	Contingent ranking may be used where target groups are unfamiliar with cash valuation.	Participatory techniques are more experimental and not widely used to estimate wetland benefits. They are good at eliciting qualitative information, but there are doubts about their reliability for estimating willingness to pay.

Cost-based Approaches: Uses data on the costs of measures taken to secure, maintain and/or replace wetland goods and services.	Cost-based approaches may be used with caution to value any type of wetland benefit.	Approaches are less data and resource-intensive. Usually considered less reliable than other methods. One test of validity is evidence that people are prepared to incur costs to secure relevant benefits.
Indirect opportunity cost (IOC): This method uses wages foregone by labour in production of non-marketed goods.	Useful in evaluating subsistence benefits where harvesting and collecting time is a major input.	May underestimate benefits significantly if there is substantial producer or consumer surplus
Restoration cost (RCM): This method uses costs of restoring ecosystem goods or services.	Potentially useful in valuing particular environmental functions.	Diminishing returns and difficulty of restoring previous ecosystem conditions make application difficult
Replacement cost (RCM): This method uses cost of artificial substitutes for environmental goods or services.	Useful in estimating indirect use benefits when ecological data are not available for estimating damage functions with first- best methods.	Difficult to ensure that net benefits of replacement do not exceed those of the original function. Respondents may overstate willingness to pay if only physical indicators of benefits are available.
Preventive expenditure (PE): This approach uses the costs of preventing damage or degradation of environmental benefits.	Useful in estimating indirect use benefits with prevention technologies.	Mismatching the benefits of investment in prevention of loss of benefits may lead to spurious estimates of willingness to pay.
Damage costs avoided (DCM): This approach relies on the assumption that damage estimates are a measure of value.	First-best methods to estimate damage costs are useful for comparison with cost-based approaches, which implicitly assume damage is worth avoiding.	Data or resource limitations may rule out first-best valuation methods.
Energy Analysis: This method uses ecological modeling to value ecosystem assets by directly relating to their energy processing abilities	The performance of the wetland is measured using physical measures such as energy, biomass etc and to identify linkages with species of the ecosystems.	This method is usually used by ecologist.

Source: Compiled from IIED (2003) and Barbier et al., (1997)

Annexure 2.2

Economic Values of Benefits from Wetlands

Authors	Study Area	Wetland functions noted	Method	Value Per/ ha
Batie et al., 1978.	Accomack Wetlands: (3915 acres), Isle of Wight (6287 acres), James City (5614 acres), Nothumberland (1128 acres), Virginia Beach (436 acres)	The wetland's marginal value of producing oyster on commercial fishing as an input in oyster production	NFI Cobb-Douglas production Model	Accomack ($1.13/acre), Isle of Wight ($13.63/acre), James City ($1.64/acre), Nothumberland (141.5/acre), Virginia Beach (4.24/acre).
Thibodeau and Ostro (1981)	Charles River basin, Massachusetts. Fresh water wetlands 535 acres	Recreational benefits	Contingent valuation method	Total Value: $ 861096.2; Value per acre: 100.89; Fishing: 11.63/acre Game hunting $17.68/acre Waterfowl hunting$15.35/acre Nature study: $ 56.23/acre.
Lynne et al. (1981)	Florida's natural marsh-estuarine system 501, 424 acres	Economic productivity of marine system- - Blue crab economic productivity	Marginal value productivity of marsh	Total Value: $ 137891.6; Value per acre: 0.275;
Bell (1987)	Florida. Estuarine marine wetland 810, 537 acres	Marine commercial fishery.	Marginal productivity theory, Net Factor Income methods	Total Value: $ 28871328 Value per acre: $ 35.62
Farber and Costanza (1987)	South Louisiana coastal wetland 7.3 million acres	Trapping, Commercial fishing	Net Factor Income (NFI).	Total Value : $ 273000000 Value per acre: $ 37.46
Farber (1988)	Louisiana Coastal and Terrebonne wetlands 650000 acres	Recreational value	Contingent Valuation Method Travel cost method	Total Value: $ 6513000; Value per acre: $ 10.02
Amacher, Brazee, Bulkley and Moll. (1989)	Lake St. Clair, Michigan Coastal wetland 6, 000 acres	Recreation fishing for yellow perch	Net Factor Income (NFI)	Total Value: $ 8850000 Value per acre:$ 1475
Bergstrom et al., (1989)	Coastal wetlands Louisiana 3.25 million acres	Waterfowl hunting, freshwater and saltwater fishing, recreational fishing	Contingent Valuation Method	Total Value: $ 27365000 Value per acre: $8.42 annually

Morton (1990)	Coastal estuarine areas in Moreton Bay,	Providing habitat for aquatic animals with shelter and food	Catch fish value caught by block net.	Total Value: $ 1222188 Value per acre: 2068
Whitehead (1990)	Clear Creek wetland, Kentucky 5, 000 acres	Flood control, agricultural production, Ground water recharge, Water quality enhancement, Outdoor recreation, and habitat for wood ducks, mallard ducks and Canada geese.	Contingent Valuation (CVM).Dichotomous choice questions, Mail survey. Logistic error model of linear and log-linear functional forms	Mean WTP (Linear Function): $12.67. Mean WTP (Log-linear Function): $6.31. Value per acre $1896-$3810 and $588-$1182 depending on the function form.
Loomis et al., (1991)	San Joaquin Valley California wetlands 85, 000 acres	Contamination control (water quality relating with water birds), Salmon fishing, wetland habitat and wildlife viewing	Contingent valuation method - WTP survey	Total Value: $62680000; Value per acre: 1567; Total WTP for improvements: $62525/acre; Total WTP to avoid a loss: $26120/acre
Hanley and Crag (1991)	Northern Scotland, Fresh water wetland. 401, 375ha	User and nonuser preservation values for wilderness, Bird breeding replacement. Preservation or conversion to forest plantation	Partial Valuation; Contingent Valuation Method	Total Value 7007741; Value per acre: 14.01548 Preservation benefits: US$ 30 /respondent
Barbier et al. (1993)	Hadejia-Nguru wetlands, Nigeria tropical floodplain	Allocation of flood flows	Partial valuation; loss of productivity, market prices	Net Present Value of agriculture, forestry and fishing benefits: $ 51/ hectare
Bateman and Turner(1993)	Norfolk Broads, wetland system	protection from saline flooding;	Total Valuation; CVM	annual recreation and amenity use: US$ 118 – 247 /year/respondent
Van Vuuren and Roy (1993)	Lake St. Claire, Canada. 1, 161 acres.	Bird Hunting, - Angling, Trapping	Travel cost method	Value per acre: $107.4; Enclosed marsh diked: 20ha : $131/acre; Undiked open marsh : 300ha: $83.55/acre
Barbier (1994)	Fresh water wetland; Hadejia-Jama'are Floodplain, Nigeria 730, 000 hectares	Fishing, Crop production, Fuel wood production	Gross value used. Partial valuation of wetland. The opportunity cost to wetland conversions	Total Value: $ 8850000 Value per acre: $ 1475

Brett and Leitch (1994)	**Nome wetland** prairie pothole wetland, 3 acres	**Flood control, sediment** entrapment, wildlife habitat for recreation, aesthetics, education and research benefits	**-Damage Cost** - The market value of output.	**Total Value: $18.39** Value per acre: $ 6.13
Breaux et al. (1995)	Louisiana Wetlands; 570-acre	Wastewater Treatment and water quality improvement	Cost savings	Value: $ 85557; Value per acre: $ 150.1
Gren (1995)	Gotland, Sweden Riverine wetlands	Nitrogen abatement	Partial Valuation; CVM, Production Function, Replacement Cost	Value of nitrogen abatement using wetlands; US$ 59 /kg N reduction capacity.
Farber (1996)	Coastal wetlands Louisiana wetland	Recreational fishing, Waterfowl hunting.	Contingent Valuation Method	Total Value $ 1.43 millions Value per acre: 31.2
Kosz (1996)	Donau-Auen national park, Austria Fresh water wetlands 28417 acres	Recreational Value	Contingent valuation method	Total Value: $ 5498690; Value per acre: 193.5; Use value 64 million ATS per year, $193.5/acre
Pate and Loomis (1997)	San Joaquin Valley California 90, 000 acres wetlands Fresh water wetlands	Contamination control, salmon fishing, wetland habitat and wildlife programming were considered.	Contingent valuation method	WTP $459-356/acre for wetland improvement; WTP $351-110/acre for contamination control.
Barbier and Strand (1998)	Coastal wetland Campeche, Mexico 860 km	Value for mangrove systems as a breeding and nursing habitat for offshore fisheries	Open access fishing model of mangrove-shrimp linkage Net Factor Income (NFI).	Total Value: $ 34371900 Value per acre: $ 79.7

Source: Complied from various studies

Annexure 2.3

Economic Values of Benefits from Various Ecosystems - Indian Case Studies

Author	Intangible benefit	Location	Methodology used	Annual value
Chaturvedi (1992)	Water supply	Almora Forests	Indirect methods	Annual rental - Rs.4745/hectare
Murty and Menkhaus (1994)	Recreation/ Eco-tourism	Keoladeo National Park	Contingent valuation	Rs.20944/hectare (Rs.519/Indian visitor and Rs.495/foreign visitor)
Manoharan (1996)	Eco-tourism	Periyar Tiger Reserve, Kerala	Contingent valuation and Travel cost method	Rs.676/hectare (for locals) Rs.9.5 per hectare (for local visitor)
Chopra and Kadekodi (1997)	Ecological functions (use value) for local residents	Yamuna Wetland Basin	Contingent valuation	Rs.624/hectare
Chopra and Kadekodi (1997)	Watershed Values (soil conservation)	Yamuna Wetland Basin	Indirect method (reduced cost of alternate technology)	Rs.2.0 lakh/hectare metre of soil
Hadker et. al (1997)	Recreation/ Eco-tourism and other benefits	Boriveli National Park, Mumbai	Contingent valuation method	Rs.23300/hectare (Rs.90 per household per year)
Kadekodi and Ravindranath (1997)	Carbon store	All India	Indirect estimates	Rs.1.2 lakh/hectare
Chopra (1998)	Recreation/Eco-tourism	Keoladeo National Park, Bharatpur	Travel cost	Rs.16197/hectare (Rs.427.04/Indian visitor and Rs.432.04/foreign visitor)
Haripriya (1999)	Carbon store	Indian forests	Species wise forest inventory data	Rs.1,292 billion (total forests) (Rs.20125/hectare)
James and Murty (1999)	Non-user benefits from the clean up of river Ganges	River Ganges	Contingent valuation	Annual incremental benefit Rs. 4021.138 million.

Source: Complied from various studies

CHAPTER 3

Economic Value of Cochin Wetlands: The Framework for Analysis and Methodology

As mentioned in the introductory chapter, valuation is a necessary pre-condition for recognising the economic significance of wetlands, especially when such ecosystems are the subject of economic forces of market based development paradigm. Relying on the insights drawn from previous studies and based on field experiences, the study evolved a theoretical framework for estimating the economic value of Cochin wetlands. This chapter details the framework and methodology of the study. It is divided into 3 sections. The first section provides a framework for undertaking economic valuation of Cochin wetlands. This is followed by a detailed presentation of the methodology in section 2. Section 3 summarises the major conclusion of this chapter.

3.1 Economic Value of Cochin Wetlands: Evolving a Framework for Analysis

Following the popular valuation taxonomy developed by various environmental economists (Barbier, 1994; Turner et al., 2001), the study identified the different resource users of the Cochin wetlands, classified them according to the intensity of resource use and categorised the relevant sets of prices and costs that determine the economic trajectories of their production activities and estimated the monitory values. In cases where certain resource uses had no observable market, the study relied on surrogate markets or conducts a contingent valuation survey to elicit economic values of such uses, to various groups of consumers, whether they used/misused or did not use wetlands. These estimates are added together to provide the total economic worth of wetlands.

This procedure, although sufficient, is partial as it does not explicitly consider or discuss the perceptions of various users behind the whole process of generating "economic values". Valuation theorists argue that the process of value generation is anchored in individual human preferences and determined by the perceptions of these resource users on environment (Turner et al., 2001). In other words, perceptions determine preferences. These human perceptions vary across various resource users, and derive multiple preferences on resource uses and further necessitate crafting of institutions (formal state laws and informal norms, customs, non-state laws, code of conducts etc.) to organize various economic activities. These institutions act as constraints and in turn shape individual preferences. Wetlands being complex commons accommodate multiple property systems and this coexistence generates complex sets of preferences that shape values. This being the case, any serious attempt of value elicitation must begin with unearthing these institutional arrangements and then estimating the monitory magnitudes of various economic activities.

To this end, the analysis of the economic valuation of Cochin wetlands begins by identifying various resource users and examining the structure of property rights that govern their accesses to different wetland services and uses. In the case of wetlands particularly, property right structures are, among others, an important determining factor of various economic values generated and appropriated by different communities. More specifically, it examines the structure of various fishing rights, property rights over agricultural lands, aquaculture fields and ponds, navigation routes, and tourism territories.

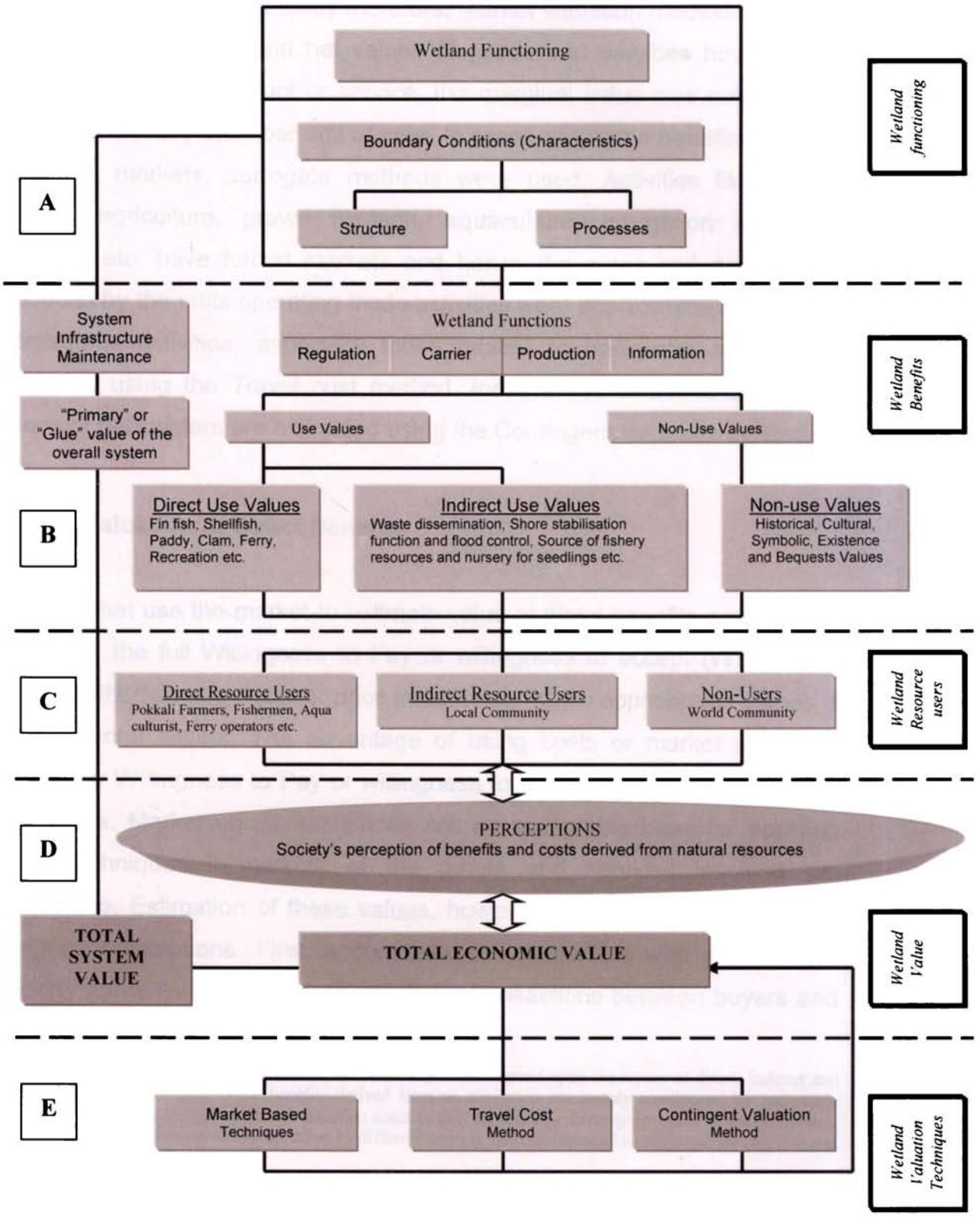
As an immediate follow up, the various direct, indirect and non-users of Cochin wetland ecosystem are identified and the organising practices of their economic activities described. At the heart of the debate on ecosystem use and management lies the vexed question of who constitutes a resource user. In the case of complex multi-stakeholder environments like wetland, a

resource user constitutes all those who affect and/or are affected by policies, decisions and actions on the ecosystem. They can be individuals, communities, social groups, or institutions of any size, aggregation or level in society (Grimble and Chan, 1995)[1]. Most, not all, local users are direct users of wetland resources. Indirect users, on the other hand, are those who benefit from the services indirectly while the non-users are composed of a larger set of population that are concerned with wetlands.

Figure 3.1 below depicts the framework for estimating the total economic value (TEV) of the Cochin wetlands. As indicated, the study first looked at the ecological setting of Cochin wetlands (shown in block A). The peculiar nature of the brackish water ecosystem provides a varied set of resources and services to local communities, (shown in block B) the benefits of which, are derived not only by resource users but by non-users as well (block C). User preferences, perceptions of agents and value are the subject matter in block D. Measurement of these values is attempted (block E) using environmental economics tools like market based techniques, Travel Cost method and the Contingent Valuation methods.

[1] In valuation studies, the term stakeholder is generally used to broadly refer to all those who have a stake in the environment. On the other hand, local users who directly harvest the benefits of the wetland goods and services are referred to as resource users.

Fig. 3.1 Framework for Estimating the Total Economic Value (TEV) of Cochin Wetlands



3.1.1 Choice of Valuation Tools and Methods

The calculation of economic values crucially depends on the selection of appropriate tools[2]. In this study therefore, market valuation methods are used to estimate the gross and net values of goods and services having direct markets. For each product or service, the marginal value was calculated in terms of monetary units per unit of area. In cases where the benefits were not traded in markets, surrogate methods were used. Activities like fishing, wetland agriculture, prawn filtration, aquaculture, navigation and ferry services, etc. have formal markets and hence the gross and net revenue produced by the units operating these activities were approximated. Values of recreational activities, especially those related to backwater tourism are estimated using the Travel cost method. Indirect use values and non-use values of backwaters are estimated using the Contingent valuation method.

3.1.2 Valuation of Direct Benefits

Methods that use the market to estimate value of direct benefits generally do not reflect the full Willingness to Pay or willingness to accept (WTP/WTA). These methods involve cost or price information, which approximate values of environmental assets. The advantage of using costs or market prices as proxies for Willingness to Pay or willingness to accept is that they are easily observable. Market equilibrium prices are an acceptable base for applying these techniques if markets of the goods and services involved are competitive. Estimation of these values, however, is based on a number of stringent assumptions. First, a complete set of markets with well defined property rights exists for smooth economic transactions between buyers and

[2] Clearly, the choice of techniques to value wetlands very much depend upon the nature of direct, indirect and non-use benefits provided. These benefits derived from an ecosystem are largely conditioned by ecosystem specifics. Hence any study on wetland valuation needs to first capture this diversity provided by the ecosystem. In the same vein, the resource appropriation by different users is also conditioned by ecosystem specificities and local ecosystem knowledge.

sellers. Second, economic agents behave competitively and maximise their opportunities. Third, market prices are known to all agents and finally, there are no transaction costs. Assuming further that there is a linear relationship between the area of wetland that contributes to a certain wetland good or service and the use value delivered by that function, the relationship of total use value of direct benefits from Cochin wetlands can be expressed as follows:

$$TUV = \sum_{i=1}^{n} V_i \times A_i \qquad (3.1)$$

Where,

TUV	=	Total use value
V	=	Net value of the product derived from wetland (Rs./ha/year)
A	=	Area of the wetland that contributes to the wetlands goods and services under consideration (ha)
i	=	Wetland activity

Both gross and net revenue per hectare for each of the different direct activities identified are calculated. This is then multiplied by the total area of the activity and summed up to arrive at a value for the direct benefits of the Cochin wetlands[3].

3.1.3 Valuation of Recreation and Tourism Benefits: Travel Cost Model

Another direct benefit provided by wetlands is their recreational services. Recreation benefits of Cochin backwaters are estimated using the Travel cost model[4]. The relationship between a private good x and an environmental

[3] Overlapping of values is unavoidable in valuation of environmental resources. To reduce this problem, care is taken to list as many activities that have some observable market and to value them using market principles. However, the possibility of overlapping values still exists.

[4] The following model has been developed based on Ward and Beal (2000) and Lansdell et al., (2001).

good q may be such that an increase in q results in an increased demand for x. In other words x and q are complements. If x and q are Hicksian complements, the compensated demand function for the private good x is given by $h = h(p_x, q, u)$ with $\partial h/\partial q > 0$. It implies the Marshallian demand function for x, $x = x(p_x, q, M)$ with $\partial x/\partial q > 0$. The travel cost method for valuing an environmental good is developed under the assumption that there is a weak complementarity[5] relationship between the demand for the environmental good and the private good travel.

It is assumed that the individual's utility depends on the total time spent at the site, the quality of the site and the quantity of private good other than travel consumed. The time spent on the site can be represented by the number of visits. Various notations are used to develop the model.

y = Quantity of private good (other than travel) consumed by a person

p_x = Market price of x. M = Exogenous income

P_w = Wage rate C = Monitory cost of a trip

T^* = Total discretionary time T_w = Hours worked

T_1 = Round trip travel time T_2 = Time spent on site

r = Number of visits to the recreation site.

The individual has the following utility function

$$u = (y, r, q) \qquad (3.2)$$

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[5] Mathematically, weak complementarity involves two conditions:

1. x is non-essential in the sense that there is a price p_x^* for x such that the compensated demand is zero. $h(p_x^*, q, u) = 0$ where p_x^* is called the choke price. The choke price is generally an increasing function of q.

2. At or above the choke price, the marginal Willingness to Pay for the environmental good is zero. That means the derivative of expenditure function $e(p_x^*, q, u)$ with respect to q is zero, $\partial e/\partial q = 0$.

Subject to the monitory and time budget constraints

$$M + p_w.t_w = p_y.y + c.r \quad (3.3)$$

$$t^* = t_w + (t_1 + t_2)\, r \quad (3.4)$$

Substituting,

$$M + p_w.t^* = p_x x + p_r.r \quad (3.5)$$

Where p_r is the full price of a visit given by

$$pr = c + p_w (t_1 + t_2) \quad (3.6)$$

$$= f + p_d.d + p_w (t_1 + t_2). \quad (3.7)$$

The above equation shows that the full price of a visit consist of four components: the admission fee, *f*, monitory cost of travel to the site, time cost of travel to the site and the cost of time spent at the site. On the assumption that individuals are free to choose the number of hours worked at a given wage rate, the two time costs are valued at the wage rate.

Maximizing equation (3.2), subject to the constraint of (3.5) yields the individual's demand function for visits:

$$r = r (p_r, p_x, M, q) \quad (3.8)$$

Given these assumptions the data on the rates of visitation, travel costs and the variation in entry fees (if any) can be used to estimate the coefficient of pr in the travel cost. In the zonal travel cost model[6], to estimate the value of the

[6] Zonal Travel cost method divides the area around the site to be valued into 'zones of origin'. These zones might be concentric zones radiating from the site, or they might be 'local government administrative districts' such as panchayats or districts or State boundaries. Zonal models may include socio-economic variables, averaged for zones. The dependant variable is the visits per year from zone z, per population of that zone (or trips per capita). The population levels of zones must be included in zonal models (Hanley and Spash, 1993). This method implicitly assumes that all visitors from each zone have the same probability of visiting and the same travel cost. There is little consensus in the literature as to which method (zonal or individual) is theoretically preferable.

recreational benefits of wetlands, the travel cost methodology specifies a formal trip generating function (TGF) to estimate the value of benefits generated for each zone. The demand curve is estimated by regressing the dependent variable (visitors per 1000 zonal population, V_K) against the independent variable travel cost (C).

The trip generating function (TGF) was specified as follows:

$$V_k = V(C_k) \tag{3.9}$$

Where,

V_k is the number of visitors from zone k, per 1000 zonal population

C_k is the average travel cost for visitors from zone k,

3.1.4 Valuation of Non-user Benefits: Contingent Valuation Method

The indirect and non-user benefits of Cochin wetlands are estimated using the contingent valuation method[7]. To estimate these values, a contingent valuation method is used. The fundamental assumption is that the value of all goods can be expressed in money equivalent terms and that value is based on a good's utility to humans. An indirect utility function, V (-), is defined that describes the maximum amount of utility a household can derive from their income, Y, given the prices of goods, P, the level of provision of the non-marketed good, Q. It is also assumed that the households' utility will depend upon demographic and economic factors, S. The general form of the Household's indirect utility function[8] is:

$$V(Y, P, S, Q) \tag{3.10}$$

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[7] From the 1980s, the scientific literature relative to environmental evaluation has recorded an increasing interest for the application of this kind of models for the analysis of contingent valuation surveys data (Bishop and Heberlein, 1979). See the survey of literature chapter 2 for details.

[8] This theoretical model was developed following Bateman et al. (2002).

Under normal circumstances, it is assumed that more income or lower prices would enable the household to purchase more goods and realise a higher level of utility. It is also assumed that increasing the provision of the non-market good represents an improvement in utility. Thus the utility enjoyed by the household will be greater at level Q^1 of provision of the non-market good than at level Q^0.

Hence,

$$V(Y,P,S,Q_0) < V(Y,P,S,Q_1) \tag{3.11}$$

Based on these assumptions a contingent valuation survey was organised where households were asked through questionnaires to compare their utility or well being at two levels of provision Q^0 and Q^1. Since they experience a greater well being at the higher level of provision, it seems reasonable to assume that they would be prepared to pay at least something to achieve Q^1. However their maximum Willingness to Pay (WTP) can be formally described as the monetary payment that would ensure that their well being with the higher level of provision is just identical to their well being at the lower level of provision. A quantitative measure is then defined such that:

$$V(Y,P,S,Q_0) = V(Y-C,P,S,Q_1) \tag{3.12}$$

Where, C is the consumption variation measure of a change in welfare.

It is the household's maximum Willingness to Pay to achieve the increase in provision of the non-market good. Manipulating equation (3.13), C can be defined as a function of the other parameters in the model. This function, C (is known as the bid function and can be written in the general form:

$$C = C(Q_0,Q_1,Y,P,S) \tag{3.13}$$

Equation (3.12) and (3.13) provide the basic theoretical framework for the analysis of contingent valuation data.

The next consideration that economic theory provides is that a household's maximum Willingness to Pay (WTP) for any good is bound by their ability to pay. In other words, their Willingness to Pay (WTP) must not be greater than their income. In mathematical notation:

$$C = C(Q_0, Q_1, Y, P, S) = WTP \leq Y \qquad (3.14)$$

For most public goods, negative Willingness to Pay (WTP) is not correct because the good can simply be ignored if it does not provide utility to the respondent. Thus a restriction is imposed that the Willingness to Pay (WTP) value must be non-negative. The final specification of the theoretical bid function can be expressed:

$$0 \leq C = C(Q_0, Q_1, Y, P, S) = WTP \leq Y \qquad (3.15)$$

Many analysts favour the utility difference model[9] because it is explicitly derived from the principles of welfare economics (Hanemann, 1984; Sellar et al., 1985; McFadden and Leonard, 1993). However most contingent valuation studies favoured the Bid function model[10] (Cameron, 1988) in which the bid function is directly modelled without deriving this from any explicit specification of the underlying utility functions. Using this framework, the study assumes that the true bid function denoted C (Q^0, Q^1, Y, P, S) is the result of some underlying utility difference problem that is solved by the

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[9] Respondents to a contingent valuation survey can be assumed to know the exact form of their utility function and the factors that are important in establishing their level of welfare and how these interact in the utility function. The same cannot be said for the analyst. They must make an informal guess as to the structure of the utility function. In general, economic theory gives little guidance as to the form that must be taken by the analyst model of the indirect utility function. It could be argued that such a framework is unnecessarily restrictive (Bateman et al., 2002).

[10] In the Bid function approach, it is assumed that that the true bid function of the respondent is the result of some utility difference problem that is solved by the respondent. Rather than specify the exact form of the utility function the analyst builds a model of the bid function directly. The difference between the analyst's model and the true bid function are captured in the element *e* which is assumed to be that part of Willingness to Pay that is determined by the unobservable tastes of the household for the non-market good (Bateman et al., 2002).

respondent. Rather than specify the exact form of the utility function, a model is build of the bid function directly (bid function model), which is denoted as $c(q^0, q^1, y, p, e)$.

One specification for $c(q^0, q^1, y, p, e)$ is given by the constant only bid function model. The simplest specification of this function is:

$$C = a + e \qquad \text{and } 0 \leq C \leq y \qquad (3.16)$$

This function does not account for the income effect. It can be incorporated into the bid function models through the parameter *a*.

$$a = a_0 + by \qquad (3.17)$$

Or

$$a = a_0 + bIny \qquad (3.18)$$

In this specification, the income effect is captured by the term *by*. *a* was further parameterised to account for five other factors that were deemed important in determining Willingness to Pay (WTP).
A linear specification of this is:

$$Y = a_0 + by + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 \qquad (3.19)$$

where,

Y	= Willingness to Pay		
X_1	= Income	X_2	= Occupation
X_3	= Education	X_4	= Gender
X_5	= Age Group	X_6	= Previous Knowledge of Wetlands

The probability distribution in contingent valuation studies should be lognormal, log-logistic or a Weibull distribution. Unfortunately, such an assumption rules out the possibility of zero Willingness to Pay (WTP) as well.

Consequently, the model was further revised to account for the possibility that respondents may have Willingness to Pay (WTP) of zero. To solve this, a spike was introduced to the probability distribution, falling at zero. The height of the spike represents the probability of having zero Willingness to Pay (WTP). Failure to fit a spike will lead to over estimation of mean Willingness to Pay (WTP). In mathematical notation, a spike can be introduced by including a single parameter, ρ, which_represents the probability of having zero Willingness to Pay (WTP).

Using the log normal, the CDF was written as:

$$F(z;a,\sigma^2,\rho) = \begin{cases} \rho & \text{if C = 0} \\ \rho + (1-\rho)\Phi\left(\frac{Ln(z)-a}{\sigma}\right) \Big/ \Phi\left(\frac{In(y)-a}{\sigma}\right) & \text{if C > 0} \end{cases} \qquad (3.20)$$

and the corresponding PDF as:

$$f(z;a,\sigma^2\rho) = \begin{cases} \rho & \text{if C = 0} \\ (1-\rho)\phi\left(\frac{In(z)-a}{\sigma}\right)\left(\frac{1}{\sigma z}\right) \Big/ \Phi\left(\frac{In(y)-a}{\sigma}\right) & \text{if C > 0} \end{cases} \qquad (3.21)$$

After estimating all the relevant values using the tools mentioned above, the total economic value of Cochin wetlands was estimated by an aggregation of different values.

Based on the above framework, the total economic value of the wetland is then arrived at by summing up the direct, indirect and non-use values. This value is divided by the total geographical area of the wetland to arrive at the per acre value.

3.2 Methodology and Database

Having explained the detailed analytical framework for estimating the total economic value of wetlands, the study now turns to a discussion of relevant methods and the necessary database of this study. This section presents these details. Wetlands comprise two parts, an aquatic part and low-lying marshy terrestrial ecosystem. The aquatic part is often referred to as estuary or locally as backwaters (kayal). The marshy low-lying tracts of land are referred to as wetlands itself.[11]

3.2.1 The Study Areas

The study is conducted on the Cochin wetlands, which lies at the northern part of the Vembanad Lake[12] extending between 9° 40' and 10° 12'N and 76° 10' and 76° 30E w ith its northern boundary at Azheekode and southern boundary at Thannirmukkam bund. This ecosystem is also known as the *Cochin Backwater* or *Kochi Kayal* (See map 3.1). Spread over the three districts of Kottayam, Alleppy and Ernakulam of the State of Kerala, Cochin wetland is a densely populated area. The study area covers 3854.63 sq km (67.99 sq km of low-lying wetlands and 3626.6 sq km of terrestrial land) and 160 sq km of aquatic area comprising 38 panchayats, 3 municipalities and a corporation.

Since water salinity plays a very important role in the production and productivity of most of the economic activities, particularly agriculture, fishery and filtration in the wetlands, the study area is further divided into five zones based on hydro-biological parameters[13] (See maps 3.2).

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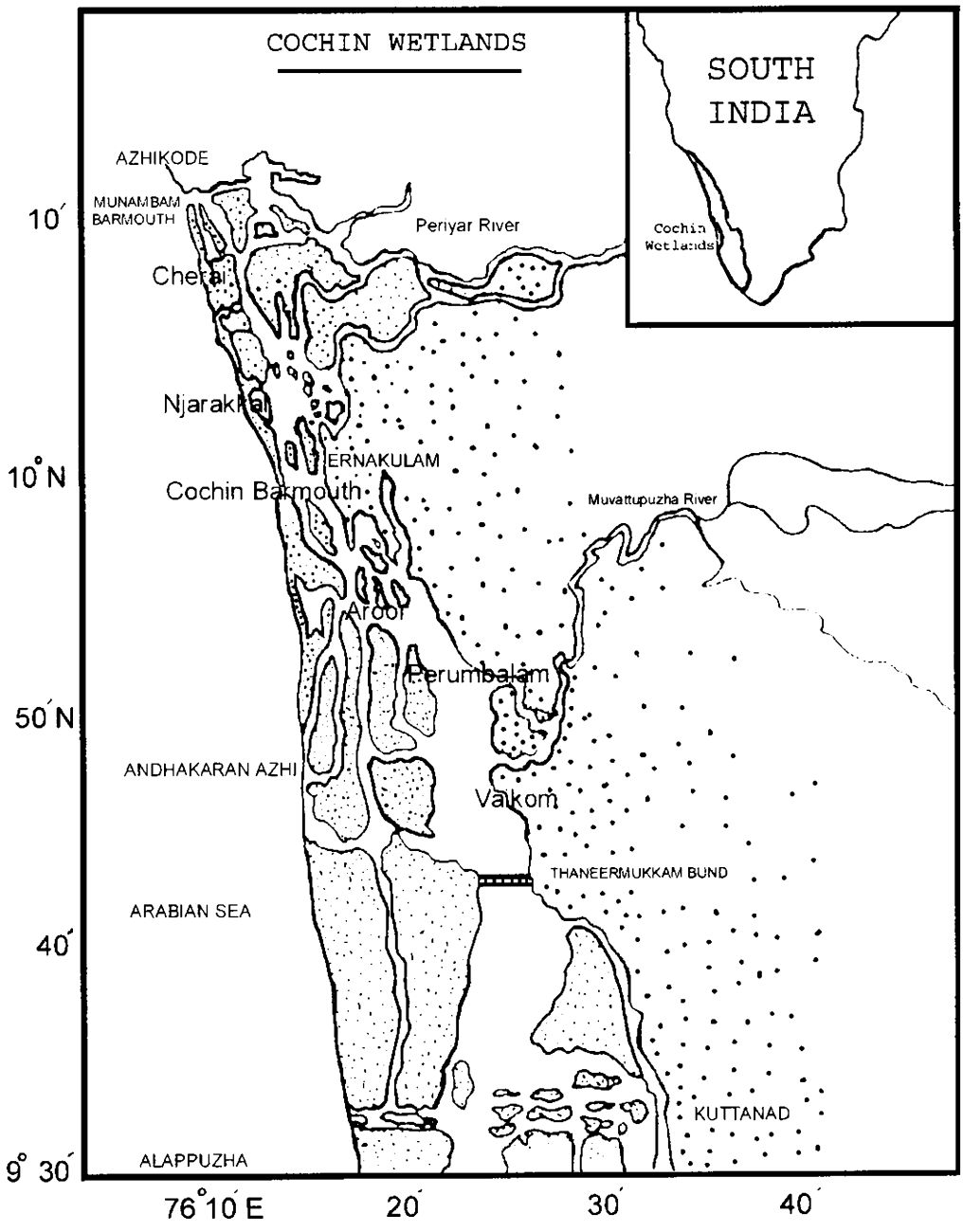
[11] The term wetland has been used throughout the study to refer to the entire ecosystem. The term estuary and backwater have been used interchangeably to refer to the aquatic part of the wetlands that is permanently flooded.

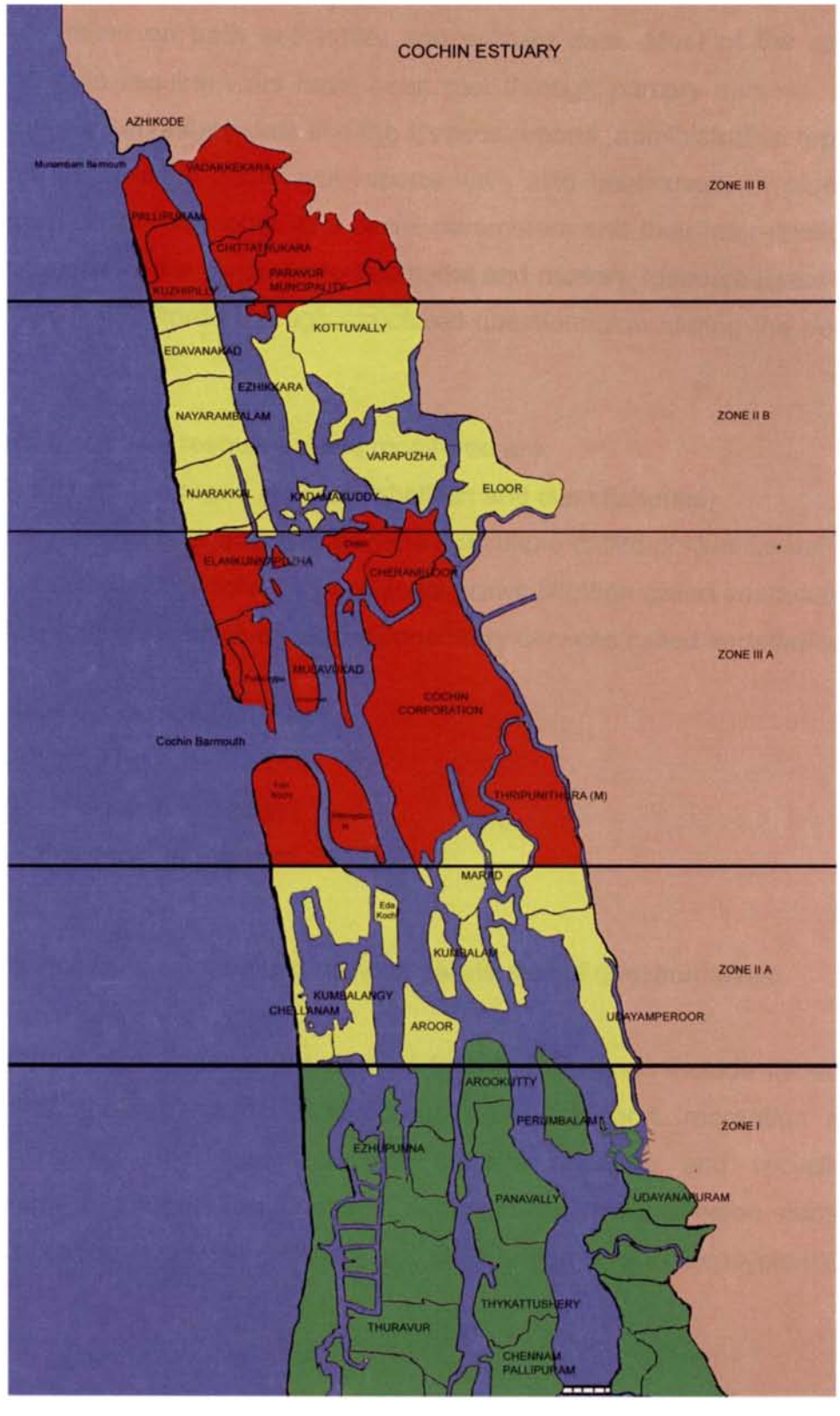
[12] The Vembanad Lake is the largest brackish water tropical wetland ecosystem on the southwest coast of India. It is fed by ten rivers and is typical of large estuarine systems seen on the western coast of India.

[13] The first zone (Zone I) has a salinity distribution between 9.5 - 11.5 ppt. 16 panchayats and a Municipality lie in this zone. Zone II is the zone whose salinity varies between 17.5 and 19.5 ppt and comprises 15 panchayats and a Municipality. Zone III lies close to the bar mouth where the salinity ranges between 21.5 and 25 ppt. This zone contains 7 panchayats, one municipality and a corporation.

Map 3.1 Location Maps of Cochin Wetlands



Map 3.2 Division of Cochin Wetlands by Zones



3.2.2 Sources of Data and Modes of Data Collection

The study relies on both secondary and primary data. Most of the socio-economic data requirements have been met through primary surveys. In a few instances, secondary data like the Census reports, administrative reports and local level village panchayat reports have also been used. In order to collect data on the economic and social parameters and their inter-relations, the communities were divided into traditional and modern resource users and their activities monitored through structured questionnaires during the period 2001-02.

The major traditional resource users monitored are:

1. Fishers (engaged in finfish, shellfish and clam fisheries)
2. Households engaged in wetland agriculture called pokkali farmers
3. Households involved in traditional prawn filtration called *vaattukar*
4. Households involved in traditional ferry services called *kadathukar*

The modern users monitored are:

1. Port Trust
2. Navigation Industry
3. Aquaculture Farmers

Economic activities were valued using separate sets of questionnaires.

The important direct-use values derived from the wetlands include fisheries (finfish and shellfish), agricultural output, water transport, recreation and tourism. Indirect use values include nutrient retention and recycling, groundwater recharge, flood control, sediment retention, erosion control, water purification, ecosystem stability and stabilisation of other ecosystems.

Table 3.1 The Sampling Frame

Zone	Number of Units Sampled			
	Fishery	Pokkali Agriculture	Prawn Filtration	Aquaculture
I	72	38	19	11
II A	54	40	27	5
II B	29	30	31	8
III A	78	24	14	5
III B	57	10	12	9
Grand Total	290	142	103	38

3.2.2.1 Fishery

A stratified random sampling procedure was adopted for estimating fish yields. To this end, the entire study area was divided into different zones and these again into different strata. A representative fishing village/centre was then fixed for each of the strata. Two landing centres in zone I (Vaikom, Murinjapuzha), four in zone II (Paravoor, Thevara, Nayarambalam and Chathanadu) and three in zone III (Devasampadam, Kunjithai and Fort Kochi) were selected for the collection of fish landings data (See map 3.3 for details).

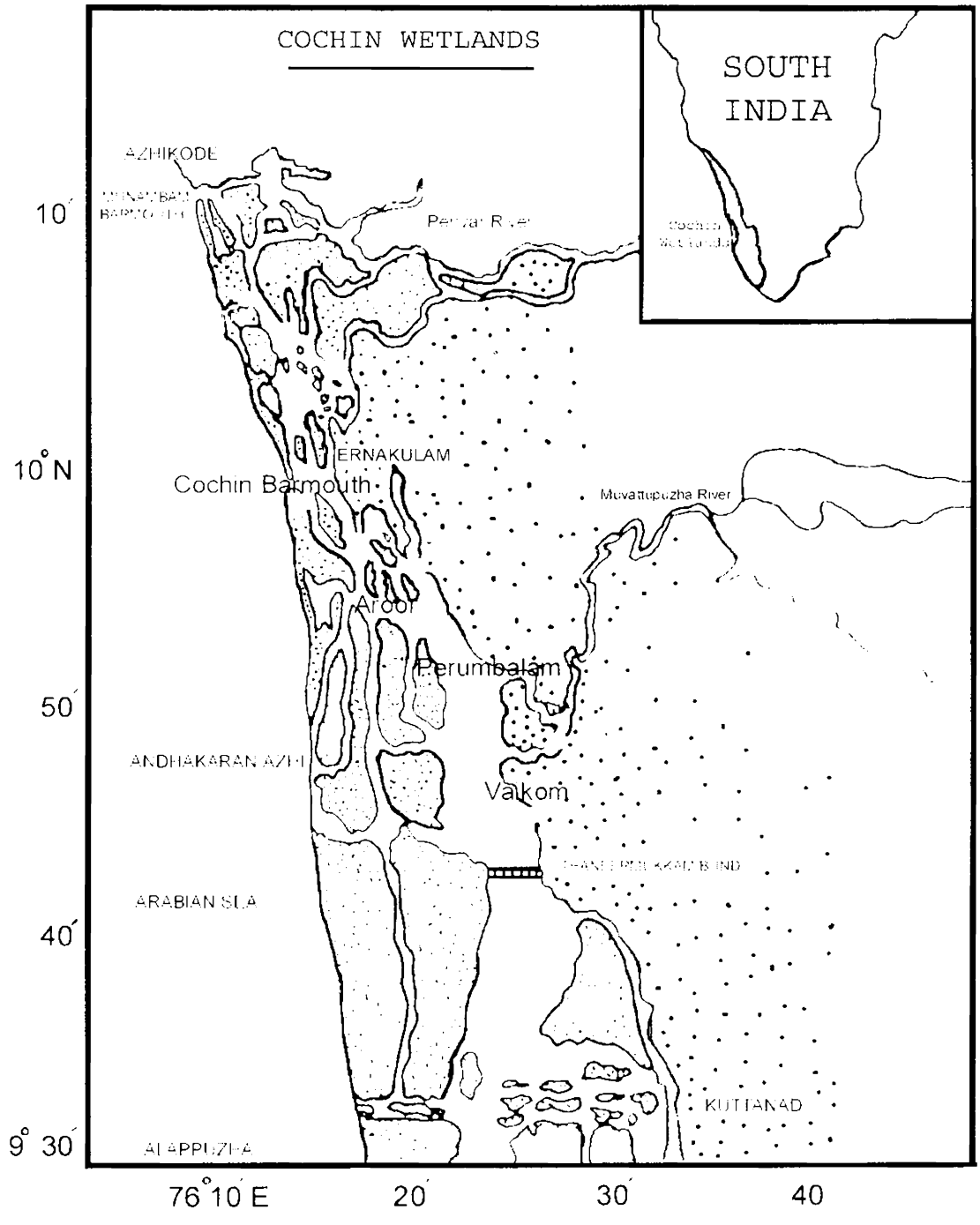
Primary data on fish yields were collected from these landing centres on a monthly basis, which provided estimates of total monthly catches. Sampling days were fixed according to the nature of tides (thakkam and pakkam). Monthly data on catch composition, weight, number and values were collected for 10 major gears in each of these stations for a period of one year from February 2001. This data was used for the calculation of direct economic value from capture fisheries. Station-wise data were compared to

unearth the species diversity at different stations within the same ecosystem. This would enable us to identify the ecologically sensitive zones of the wetlands.

A separate gear survey was conducted for all the panchayats, Municipalities and Corporation in the study area. This questionnaire was intended to survey the total number of gears in each panchayat of the study area. For the socio-economic survey of fishing households, a one time survey was conducted and a two percent stratified random sample was collected. This questionnaire included questions on the cost and earnings of all the ten major, commercially important gears. It also collected data on the socio-economic statistics of fishing households.

Based on the data from the landing centres, total production and productivity per gear per day was calculated for each of the ten commercially important gears in each zone. Based on the cost and earnings survey, the total cost incurred for each of the ten gears was calculated. Cost calculation included both fixed and variable cost and based on this, net values were estimated. The socio-economic survey was tabulated separately.

Map 3.3 Location of Fishery Sampling Stations in Cochin Wetlands



3.2.2.2 Wetland Agriculture

Apart from the secondary data on the distribution of land belonging to the various padashekharams registered with it, a questionnaire was also designed to collect primary data on the area under cultivation, yield and value. The socio economic details of these households were also collected during these surveys. Wetland paddy fields (pokkali fields) on the banks of Cochin estuary are spread over 25 panchayats, 3 municipalities and a corporation. Stratified random sampling was used in the study to collect a one percent sample[14]. The fist section of the question dealt with the socio-economic features of the respondent. The second and third section dealt with the cost and earnings of operational holdings of respondents. Based on the cost and earnings survey, the input cost for a hectare in each zone was calculated. Cost calculation included both fixed and variable cost and based on this, net values were estimated.

To estimate the value of benefits from pokkali wetlands, the yield per ha for each zone was calculated and this was multiplied by the area of pokkali paddy fields in each zone. Similarly, the total and net value generated was also estimated. Finally the production and value generated for all the five zones were aggregated.

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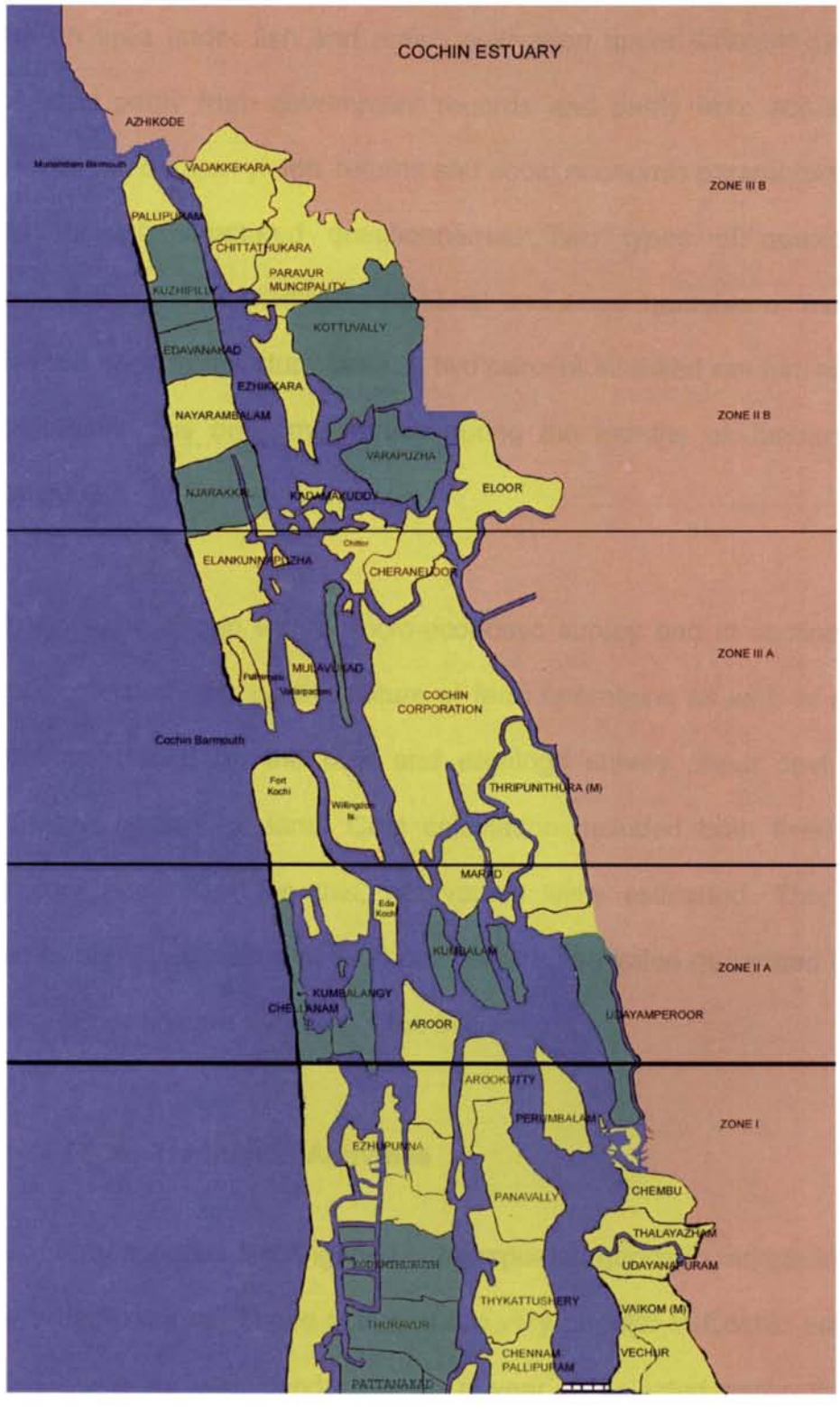
[14] See map 3.4 for details. The areas shaded green represents location of pokkali fields sampled in the study area.

Map 3.4 Location of Pokkali Fields Sampled in Various Panchayats of Cochin Wetlands



3.2.2.3 Prawn Filtration and Aquaculture

The data on area under fish and prawn cultivation under different systems was collected partly from government records and partly from actual field survey, while the data on yields, returns and socio economic parameters were collected through structured questionnaires. Two types of aquaculture systems – traditional or modified traditional and semi intensive or modified extensive are seen in the study area. A two percent stratified random sample was collected in this one time survey during the months of January and February 2002.

The questionnaire began with a socio-economic survey and in section two and three, collected data on the nature of farm operations as well as costs and earnings. Based on the cost and earnings survey, input cost was estimated per hectare of land. Cost calculation included both fixed and variable cost and based on this, net values were estimated. This was tabulated to obtain estimates of yield per hectare and value generated (both total and net) per hectare for each of the five zones.

3.2.2.4 Other Traditional Activities

Traditional ferry services are engaged in transporting goods to remote islands from the urban markets. These activities are very popular in Cochin estuary. Bi-monthly sampling was conducted for a year in selected cargo loading

points to estimate their economic contribution. Based on the tonnage of the boats, value figures were generated for the post monsoon, monsoon and pre monsoon periods.

Landing stations of clam fisheries were selected on the basis of their concentration and seasonal fluctuations. The stations selected for the clam fishery survey were Aroor, Panavally, Perumbalam and Thykattusherry. A separate questionnaire was executed to collect bi-monthly data from each of the four landing centres.

3.2.2.5 Port Trust

The Cochin Port Trust publishes annually the data on its operations from which the necessary data on the cargo handled, income and expenditures were collected for this study. By the Port Trust Act of 1963, certain boundaries of the Cochin wetland were demarcated and came under the administration of the Port Trust. The Trust receives revenue not only from port activities, but also as license fee for Chinese nets and rental from estate originally reclaimed from the wetlands. Since these were all activities that generated revenue using the wetlands either directly or indirectly, they were used in the study. It may therefore be noted that the revenue figures calculated do not constitute the total revenue generated by the Port. Rather, only those generated by Port activities that use the wetland services has been taken into account.

3.2.2.6 Navigation

The navigation industry directly makes use of the water transport potential of estuaries. This activity is highly developed in Cochin. Navigation activities along Cochin estuary are undertaken mainly by two State sponsored enterprises (Kerala Shipping and Inland Navigation Corporation and the State Water Transport Department). Few private boats also operate passenger services in areas where State transport services do not operate. The data on number of passengers, distance travelled, revenue and expenditure incurred during the year etc is published annually by the State Department and was collected for this analysis. The SWTD and KSINC are two modern resource users who generate revenue exclusively by using the backwaters. Hence the assumption was that their operating profits reflect net values generated using the backwaters.

3.2.2.7 Tourism Industry and Recreational Values of Wetlands

Briefly the travel cost questionnaire consists of three parts. In the first section, questions were asked to reveal the nature of use of the backwaters, frequency of visits, time spent, alternative use of the time, cost incurred, purpose of visit etc. The second part included questions to reveal the attitudes of the respondents to various aspects. The third section was devised to gather information on the demographic features of the respondents. An on-site survey was conducted over a period of two months at six different sites along the backwaters. The respondents were randomly selected. Pre-testing was done on 50 respondents before the actual survey was conducted. Questions were asked to reveal the purpose of visit, the type of use and the frequency of such uses. See chapter 7 for details.

3.2.3 Indirect Benefits of Wetlands

The indirect benefits of the Cochin wetlands are estimated using a Contingent valuation methodology. Respondent's Willingness to Pay for the conservation and management of the wetlands is used as a proxy to estimate the value of the indirect benefits provided by the wetlands.

The data on household Willingness to Pay (WTP) for conserving Cochin wetland ecosystem used in this analysis came from a 2001-02 survey of households. In order to draw a representative sample of this population, the village panchayat data was relied upon so that respondents from different income strata were included in the survey. In keeping with the stratification adopted for the rest of the study, the whole study area was divided into five zones and from each zone, panchayats were chosen at random. Respondent households were randomly selected from income groups within each panchayat, reflecting with reasonable accuracy the characteristics of the population of the study area. The survey was restricted to the districts of Ernakulam, Alleppy and Kottayam, which comprised the study area.

In designing a contingent valuation survey, a scenario should offer respondents information about the characteristics of the specific good and a context, which meets the requirements of understandability, plausibility and meaningfulness so that it can enhance the credibility of a survey and make it more likely to produce reliable results. The questionnaire format consists of (i) Respondents' attitude towards various characteristics of wetland diversity management (ii) Respondents' perception on wetland ecosystem services (iii) Valuation questions (iv) Payment Vehicle (v) Description of constructed market and (vi) A personal profile. General background information provided on Cochin wetlands included the definition, nature, function and role. The questionnaire was executed in the local language.

Before the Willingness to Pay and value elicitation questions were asked, an attempt was made through the questionnaire to construct the scenario by means of photographs, newspaper clippings and other visual aids. The questionnaire listed a brief explanation of the purpose and contents of the interviews and clarified the context of the study by providing additional background information on the ecosystem services performed by the Cochin wetlands. A detailed description of what is known about the likely effects of the hypothetical change in management of estuaries and what was likely to happen if nothing was done was also included. A log-normal distribution was fitted to the data. However, this model allowed for Willingness to Pay (WTP) values greater than income. Hence, field enumerators were asked to check the data collected for such inconsistencies. Since those questionnaires with Willingness to Pay estimates greater than income were manually rejected, the model was not truncated. See chapter 8 for details

3.3 Summary and Conclusion

The chapter gives a detailed account of the conceptual framework used in the study and then goes on to explain the methodology employed in estimating values for the different direct, indirect and non-use benefits provided by the Cochin wetlands. It draws from the conclusions of the detailed survey of literature undertaken in chapter two to put together a conceptual framework that would give a clearer picture of wetland ecosystems and human interaction with it as well as to throw some light on the economic rationale that influences the organization of different livelihood activities on this ecosystem and value generated from it.

The framework begins by highlighting the importance of the natural ecosystem and the role it plays in determining the nature and intensity of resource appropriation by various resource users. This is taken up in detail in chapter four.

CHAPTER 4

Ecological and Social Setting of Cochin Wetlands

The first step towards a comprehensive assessment of ecosystem goods and services involves the translation of ecological complexity (structures and processes) into a more limited number of ecosystem functions. These functions, in turn, provide the goods and services that are valued by humans. In ecological literature, the term 'ecosystem function' is sometimes used to describe the internal functioning of the ecosystem (e.g. maintenance of energy fluxes, nutrient (re)cycling, food-web interactions), and sometimes the processes and ecosystem structures while at other times it relates to the benefits derived by human population from the properties and processes of ecosystems (e.g. food production and waste treatment).

As mentioned in previous chapters, from time immemorial, large proportions of the population derived (and still derive) their livelihood from the Cochin wetlands. Since livelihood entitlements and modern economic opportunities depend on the ecological features and environmental quality of the brackish water body, an examination of these features and their linkages to the socio-economic organisation of various production activities and services is essential. The purpose of this chapter is to describe the ecological and social foundations of Cochin wetlands. The chapter is divided into 4 sections. Section 1 details the resource base of Cochin wetlands. Section 2 describes the ecological functions and services. Section 3 introduces the major resource users while section 4 describes various normative arrangements that determined access of various resource users to wetlands. Section 5 summarises the major findings of the study.

4.1 Resource Base of Cochin Wetlands

The peculiar nature of the brackish water ecosystem provides a different set of resources and services to local communities as compared with other types of ecosystems. In fact, the portfolios of opportunity that are provided by other terrestrial or marine ecosystem are very limited when compared with the portfolio of resources that this ecosystem provides. In fact the diversity of resources provided per hectare by this ecosystem is very high (Thomson, 2002[a]) when compared to other terrestrial and marine[1] ecosystems where diversity is confined to a few particular products or service.

Thus these brackish water ecosystems provide a diversified portfolio of resources that have been used by the local populations, their organisation of activities shaped by local ecosystem knowledge. The natural resource base of the Cochin wetlands is diverse. The geographic and hydro-biological features of the different zones are strategic in determining the initial resource base that is available to the local population.

The major hydrological variable in the Cochin backwaters is salinity, similar to the situations encountered in estuaries with a gradual declension of salinity from 30 at the entrance of the estuary to 0.2 at the point of entry of the rivers. Salinity gradient in the Cochin backwaters supports diverse species of flora and fauna depending on their capacity to tolerate oligohaline, mesohaline or marine conditions (Menon et al., 2000). Low lying swamps and tidal creeks, dominated by sparse patches of mangroves with their nutrient rich physical environment, support larvae and juveniles of many economically important species. The depth of the estuary varies considerably. While the shipping

[1] The diversity of marine fishery resources itself is a case in example. According to NIO (1967), although there has been a gradual increase in the fish landing from the west coast of India over the years, this has been contributed by just 5 species. The major components are the various types of Sardines (26%), the Indian Mackeral (11%) and the prawns (15%). Other groups that are economically very important include the *Polynemidae, Stromateldae, several Pericdae, Scienidae, Coryphaenidae, Carangidae, Hemirhamphidae, Pleuronectidae, Exocoetidae* and *Trichiuridae*. But they constitute less than 5 percent of the catch.

channels (10 km long) are maintained at a width of 200m and a depth of 10–13m, the major portion of the estuary has a depth range of only 2–7m. Water from two major rivers viz., Periyar and Muvattupuzha drain into this estuary. During the southwest monsoon, the estuary is virtually converted into a freshwater basin even in areas around barmouth where salt water penetration occurs below 5m depth only.

Geographically, zone I is situated towards the south of the study area away from the Cochin and Azhikode bar mouths. The Thaneermukkam Bund has cut off any direct contact of this region with the open sea and therefore this zone is not subject to extreme high or low tides. The landmass in this zone forms three major strips and very wide water channels between them. In fact this zone comprises of more aquatic area than terrestrial wetlands. Salinity is lower compared to the other zones. Consequently, this region is geographically and hydro-biologically different from the other zones of the Cochin wetlands. Zone II A is an intermediate zone located between the low saline zone I and the highly saline zone III A. Geographically, it is small in size compared to the other zones in the region. Hydro-biologically, the water quality of this zone is fairly good since there are no major polluting industries located here. Along with this, the medium saline nature of the zone is conducive for a healthy distribution of fish species. Zone II B is also a meso-saline zone with hydro-biological conditions conducive for a healthy zone. However anthropogenic influences are very great in this region. The dumping of industrial effluents into the Periyar River greatly affects the productivity of the region. Siltation due to the construction of the Vallarpadom Container terminal and the annual dredging of the shipping channels has made this zone relatively shallow. Consequently, water currents are weak and tidal functions are not performed properly. In addition, the torrential flow of fresh water from dams also affects water currents and prevents to a great extent, the entry of sea water into this zone. All these factors combined have affected the species

and gear diversity of the region and this is reflected in the production and productivity potentials of this zone.

Zone III A is the bar mouth region, highly saline in nature with wide water channels, strong water currents and healthy tidal functions of the estuary. The terrestrial ecosystem attached to this zone forms a greater part of the Cochin city. A number of small islands also constitute part of this zone. Zone III B constitutes the smallest of the five zones with very narrow channels, a bar mouth opening and a distributory of the Periyar river opening into the same area. Consequently although fresh water and brackish water mixing is high in this region, the salinity levels are very high. This zone is a relatively healthy zone with strong water currents and tidal functions.

4.1.1 Fishery

The most vital direct benefit provided by the natural wetlands of Cochin is the diverse fishery resources. It provides a livelihood means to over 1.3 lakh fishers in the area. Wetlands also function as nursery grounds for young fish seedlings that enter it and as a medium for further growth. The tonnage of fish and shellfish that can be harvested in an estuary, or offshore from the estuary, is related to this wetland habitat function. Detailed studies on the relationship between zonal features and fish diversity are rare and most of the studies on species diversity were concentrated on specific pockets of wetlands for specific periods of time.

A comprehensive study on the bionomics of Cochin backwaters was conducted by Kurup (1982) who reported the presence of at least 150 species during the early eighties. The study by Thomson (2003) [2] has attempted to

[2] A detailed primary study on the fishery resources of the Cochin backwaters was designed and executed by Thomson (2003) with funding from IGIDR, Mumbai. The data was collected and tabulated by the scholar when she worked as an economist in the same project and was permitted to use the data for her thesis work. However, the data generated pertained to gross values. For the purpose of the present study, a separate survey on fishery cost and earnings was conducted. The present study uses both sources of data to generate net values

provide this relationship and is the only primary source of information available. Primary monthly surveys during 2001-02 revealed the presence of 73 species of fin fishes and 8 species of shell fishes in the Cochin estuary. Although diverse flows of fishery resources are available from the Cochin backwaters, their availability is highly uneven across space and time. This unevenness may be related to the nature of human interventions and the state of the ecosystem itself. Table 4.1 provides a list of fin fishes and shellfishes recorded in Cochin estuary during 2001-02 while table 4.2 details the availability of finfish and shellfish in selected zones of Cochin backwaters during 2001-02. Wide variations are seen in the availability of individual species across estuarine space during the said year.

Table 4.1 List of Finfishes and Shellfishes Recorded in the Cochin Backwaters during 2001-02

Acanthurus crassipinum, Acathurus bleokeri, Ambasis comersoni, Amblypharygodon mola, Anabus testudineus, Arius platistomus, Caranx nigripinnius, Caranx sexfasiatus, Chaca chaca, Chanda commersoni, Chanos chanos, Chelonodon tauvina, Congresox talabonides, Cynoglossus cynoglossus, Cynoglossus punticeps, Daysiana albida, Drapane penetatus, Dussumieria hasselti, Eleotris carviforms, Eleotris fusca, Epinephalus malabaricus, Esculosa, thoracata, Etroplus maculates, Etroplus suratensis, Euryglossa orientalis, Garra mccalandi, Gerrus filamentosus, Gerrus oyena, Glosigobius guirius, Gobius microlepis, Hemiramphus far, Hemiramphuscaritori, Horabagrus brachysoma, Hyporamphus limbatus, Labeo dussmieri, Latus calcarifer, Leognathus brevirostris, , Leognathus equulus, Leognathus splendens, Liza, acrolepis, Liza parsia, Lobotis surinamensis, Lutianus argentimaculatus, Lutianus fulviflamma, Lutianus jhoni, Lutianus quinquelineeatus, Macrognathus guntheri, Megalops cyprinoids, Mugil cephalus, Mystus malabaricus, Mystuuscembalus armatus, Ompok malabaricus, Ompok pabda, Ophichthys attipinnis, Oreochromis mossambica, Otolithus argentius, Oxyurichthys, ormosanus, Oxyurichthys tentacularis, Pristipoma furcatum, Psseudorhombus javanicus, Puntius dorsalis, Puntius filamentosus, Puntius melanostigma, Seatophagus argus, Silago sihama, Spyraenajello, Stolephorus indicus, Tetradon leopardus, Therpon jarbua, Thryssa malabarica, Tricanthus brevirostris, Tylosurus crocodilus, Wallago attu.
Macrobrachium idella, Macrobrachium rosenbergii, Metapenaeus dobsoni, Metapenaeus monocerus, Penaeus indicus, Penaeus monodon, Scylla serata, Villorita cyprinoides var. cochinensis.

Source: Thomson (2003)

Table 4.2 Availability of Finfish and Shellfish in Selected Zones of the Cochin Backwaters, 2001-02

	Family	Species	I	II A	II B	III A	III B
1	*Acanthuridae*	*crassipinum, bleokeri*	12	7	12	11	9
2	*Ambaisidae*	*Comersoni*	12	7	12	12	12
3	*Anabantidae*	*Testudineus*	12	7	12	8	12
4	*Bagridae*	*Malabaricus*	12	7	8	12	12
5	*Belonidae*	*crocodilus*	1	3	11	2	1
6	*Bothidae*	*Javanicus*	12	0	5	0	1
7	*Carangidae*	*nigripinnius, sexfasiatus*	12	7	6	6	12
8	*Chanidae*	*chanos chanos*	8	7	11	7	12
9	*Cichlidae*	*mossambica, maculates, suratensis*	12	10	8	6	12
10	*Cynoglossidae*	*cynoglossus, punticeps*	12	7	8	10	12
11	*Cyprinidae*	*mola, dussmieri, mccalandi, dorsalis, filamentosus, melanostigma*	12	7	7	9	11
12	*Dorosomidae*	*Chacunda*	0	0	0	0	0
13	*Drepanidae*	*Punctata*	8	0	9	1	0
14	*Dussumieridae*	*Hasselti*	12	7	1	10	12
15	*Eleotridae*	*carviforms, fusca*	12	6	8	0	12
16	*Engraulidae*	*indicus, malabarica*	12	7	12	10	12
17	*Gerridae*	*filamentosus, oyena*	12	6	8	12	12
18	*Gobiidae*	*microlepis, giurius, formosanus, tentacularis,*	12	7	3	4	12
19	*Hemirhamphidae*	*far, caritori, limbatus*	12	7	6	5	12
20	*Latidae*	*Calcarifer*	12	10	2	12	12
21	*Leiognathidae*	*brevirostris, equulus, splendens, commersoni*	11	7	8	10	11
22	*Lobotidae*	*Surinamensis*	2	0	6	4	1
23	*Lutianidae*	*argentimaculatus, fulviflamma, jhoni, quinquelineeatus*	11	7	2	7	11
24	*Mastacembelidae*	*guntheri, armatus,*	12	7	2	1	11
25	*Megalopidae*	*Cyprinoids*	12	7	8	4	12
26	*Mugilidae*	*macrolepis, parsia, tada, cephalus, seheli*	12	7	9	7	12
27	*Ophichthyidae*	*Attipinnis*	1	1	0	0	0
28	*Pomadasyidae*	*furcatum*	1	0	0	1	0
29	*Sciaenidae*	*Argentius*	12	7	3	11	12
30	*Serranidae*	*Malabaricus*	12	6	12	7	12
31	*Sillaginidae*	*Sihama*	11	7	7	12	11
32	*Siluridae*	*malabaricus, pabda, attu*	11	7	1	3	11
33	*Sphyraenidae*	*Jello*	1	0	8	6	1
34	*Tachysuridae*	*Platistomus*	12	7	11	12	12
35	*Tetradontidae*	*tauvina, leopardus*	12	10	5	5	12
36	*Theraponidae*	*Jarbua*	12	7	8	8	12
37	*Tricanthidae*	*Brevirostris*	1	0	5	10	1
	Shell fish						
38	*Penaeidae*	*monodon, indicus, monocerus, dobsoni, affinis*	12	7	12	12	12
39	*Palaeneonidae*	*rosenbergii, idella*	12	7	4	10	12

Source: Thomson (2003)

In order to bring out this variability and its implications to different sections of fishing communities at different locations, the species availability was reclassified over time and space. Table 4.3 gives the monthly availability and table 4.4 gives the year round availability of different species at various locations in the Cochin backwaters.

Table 4.3 Distribution of Monthly Availability of Species at Different Locations in Cochin Backwaters, 2001-02

Zones	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
I	69	70	69	70	69	70	69	70	68	69	69	69
II A	71	69	68	70	71	69	68	70	49	69	68	69
II B	39	41	50	43	37	46	35	53	51	27	31	30
III A	30	30	20	26	20	35	30	20	35	35	30	26
III B	68	68	68	68	68	68	68	68	61	69	69	66
All Zones	74	72	76	80	76	76	77	77	79	79	79	80

Source: Thomson (2003)

Table 4.4 Distribution of Species Availability in Cochin Backwaters during 2001-02

Availability (Months)	I		II A		II B		III A		III B	
12	58	(72.5%)	9	(12.3%)	8	(11.0%)	12	(16.7%)	51	(66.2%)
9-12.	10	(12.5%)	1	(01.4%)	15	(20.5%)	16	(22.2%)	18	(23.4%)
6-9.	3	(03.8%)	51	(69.9%)	15	(20.5%)	18	(25.0%)	0	(0.0%)
3-6.	1	(01.3%)	11	(15.1%)	26	(35.6)	17	(23.6%)	1	(01.3%)
< 3	8	(10.0%)	1	(01.4%)	9	(12.3)	9	(12.5%)	7	(09.1%)
Total species available in 2001-02	**80**	**(100%)**	**73**	**(100%)**	**73**	**(100%)**	**72**	**(100%)**	**77**	**(100%)**

Source: Thomson (2003)

All five zones differ with regard to species distribution and availability[3]. Zone I, situated away from the bar mouth is less saline in nature. Due to the presence of fresh water, the species found in this region are highly diverse and they are available year round. Zone II A is meso-saline in nature and hence the species diversity is high. However the availability of individual species year round is less probably since many of them are marine species that enter the backwaters during breeding season. Zone II B is also a meso-saline zone but the influence of physical stress of industrial pollutants due to its proximity to the Eloor-Manjumal industrial agglomeration could be a reason for very low species diversity and availability round the year[4]. Zone III A is the Cochin bar mouth region, frequently subject to external disturbances due to the Port (channel dredging and ship movements). This would probably explain the low availability and diversity of species through out the year. The highly saline Zone III B is the Azhikode bar mouth region. Here the diversity of species and its availability are high throughout the year.

The best fishing season in Cochin estuary is between December and May. The average number of fishing days ranged between 12 and 20 depending on the phases of the moon (*Thakkam and Pakkam*). In all the zones, the maximum species diversity is seen in the catch of the three major gears - stake nets, cast nets and gill nets. In zones I, IIA and II B, although the number of free nets is greater than that of fixed nets (table 4.10). Greater diversity is seen in the catch of fixed nets. In zones III A and III B, however, fixed nets are more and the species diversity of the catch is greater.

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[3] Species diversity is very important from an ecosystem perspective. It is both a reflection and a simulator of ecosystem health. However, as will be seen from chapter 5 later on, the market value placed on many of the commercially unimportant species does not truly reflect their value. In fact they are often categorised as trash fish and sold off for nominal amounts.

[4] Annexure 4.1 gives details.

4.1.2 Agriculture

Pokkali paddy cultivation is an organic farming system that is common to around 20,000 hectares of land in the low-lying areas of Thrissur, Ernakulam and Alleppy districts of Kerala State. 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.

Pokkali cultivation[5] in the low lying fields of the Cochin wetlands begin in the first week of June before the monsoon starts, and lasts for six months ending November After harvest, these lands are converted for prawn filtration. These activities normally begin in November itself and terminate by mid April This cyclical change in the ecosystem helps maintain the fertility and productivity of the system. Table 4.5 details the zone-wise distribution of pokkali paddy fields in the study area[6].

Although wetland paddy fields are spread in all the five zones, their distribution is highly uneven. It is interesting to note that of the total 6003 hectares in the study area, 67 percent of paddy fields are concentrated in the medium saline zone II while pokkali fields in the highly saline zone III are very few. In fact, most of the paddy fields in zone II and III were formed during the great flood of 1413 A.D (PLDC, 2000).

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[5] During most of the year, these areas are saline in nature, however, just before the rainy season begins, they are kept fallow and free of water for a short period. Mounds of soil, about half a centimeter high and one meter wide 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 mounds. 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 is also used by many farmers who want to either cut cost or are farming only because it is feed for the prawn during the next crop. This practice was not commonly followed in earlier times but has been taken up by many in recent times. Chemical fertilizers and pesticides are not used (Primary survey, 2001-02).

[6] Annexure 4.2 gives a detailed distribution of pokkali paddy fields in each panchayat.

Table 4.5 Zone-wise Distributions of Pokkali Paddy Fields in the Cochin Wetlands

Zone \Area	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha.)
Zone I	1173	96	42	45	3	10	**1369**
	(92.7%)			(3.3%)			**(100%)**
Zone II A	239	1182	15	337	17	10	**1800**
	(78%)			(18.7%)			**(100%)**
Zone II B	304	1409	458	14	8	26	**2219**
	(77.2%)		(20.6%)				**(100%)**
Zone III A	5.0	136.0	63.0	7.0	2.0	0.0	**213**
	(66.2%)		(29.6%)				**(100%)**
Zone III B	306	46	43	2	3	2	**402**
	(87.6%)		(10.7%)				**(100%)**
Grand Total	**2027**	**2869**	**621**	**405**	**33**	**48**	**6003**
	(81.6%)		**(10.3%)**				**(100%)**

Source: Pokkali Land Development Agency, 2000

From October to March, prawn filtration is undertaken in these pokkali fields and adjoining polders. In addition to these seasonal fields, there are relatively deeper brackish water impoundments, which are not suitable for paddy cultivation. Theses fields are used for prawn filtration through out the year and are known as perennial fields. The depth of the water column in certain fields may be unsuitable for pokkali paddy cultivation. In such fields also, prawn filtration is done during the next six months after paddy cultivation. According to George, 1974), this system was described as early as the 1930's by Panicker (1937). As per the data collected by him, the practise was prevalent in about 4400 hectares of fields in Kerala varying in size between 0.5 and 10 hectares (George, 1974).

Table 4.6 gives the distribution of prawn filtration farms and ponds in various zones of the Cochin wetlands.

Table 4.6 Zone-wise Distribution of Prawn filtration Fields in the Cochin wetlands

Zone\Area (ha)	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha.)
I	195.2	8.5	107.1	205.7	14.8	374.2	905.3
	(22.5%)		(11.8%)	(22.7%)			(100%)
II A	257.5	214.2	312.1	331.6	289.2	720.2	2124.8
	(22.2%)		(14.7%)	(15.6%)			(100%)
II B	246.0	258.8	194.3	174.3	105.9	578.3	1557.6
	(32.4%)		(12.5%)	(11.2%)			(100%)
III A	48.5	57.4	72.0	92.2	85.5	297.6	653.2
	(16.2%)		(11%)	(14.1%)			(100%)
III B	48.1	55.3	63.1	107.8	118.9	201.1	594.4
	(17.4%)		(10.6%)	(18.1%)			(100%)
Grand Total	**795.4**	**594.2**	**748.5**	**911.6**	**614.2**	**2171.4**	**5835.3**
(ha)	(23.8%)		(12.8%)	(15.6%)			(100%)

Source: Pan fish books, Dept. of Fisheries, Kerala Government, 2001

It is seen that here too, zone II dominates with respect to area under prawn filtration with 37 percent of the total fields greater than four hectares in size. It may be remembered that this pattern is not observed in the case of pokkali paddy fields. The different types of filtration farming practices undertaken in Cochin wetlands include the traditional/improved traditional, extensive and modified extensive practices[7].

[7] Annexure 4.3 gives a detailed distribution of prawn filtration fields in each panchayat.

Activities Based on Wetland Services

The Cochin wetlands also provide opportunities to organize wetland service based activities on this ecosystem. In fact many of these activities are organized at very low investment levels taking advantage of the natural ecosystem to generate values.

4.1.3 Traditional Ferry

Ferrying of passenger and goods to various destinations in the Cochin backwaters has been undertaken from times immemorial. During the rule of the King, most of the trade routes were across this backwater space. Routes were not nationalized but ferry owners had to pay a tax (*Choukka*) to the king when crossing territorial boundaries. With the development of road and rail transport, most of the interior areas of the backwater were connected to the main land and consequently the importance of this activity gradually declined. However, even today, these ferry activities are still important to the small islands located in the Cochin backwaters that are still inaccessible by roads.

4.1.4 Tourism and Recreational Activities

According to the Department of Tourism (Kerala) 52.4 lakh domestic and 2.1 lakh foreign tourists visited the State during 2001-02. The year 2001 was a bad year for tourism world wide due to the terrorist attacks, but Kerala was not seriously affected. Earnings from tourism showed an increasing trend over the years. Revenue generated by tourism was Rs.535 crores in 2001 and Rs.705.7 crores in 2002. Fifteen countries constituted almost 75 percent of the total foreign tourist arrival to Kerala with United Kingdom and France

dominating. Table 4.7 gives details of foreign and domestic tourist arrivals in the State.

Table 4.7 Details of Foreign and Domestic Tourists Arrival, 2001-02

Tourist Arrival	2001	2002
Foreign	208830	232564
Domestic)	5239692	5568256
Total Tourists	5448522	5800820
Percentage of variation over previous year	4.31	6.47

Source: Economic Review, 2003

Cochin is one of the most sought after destinations in Kerala besides Kovalam, Trivandrum and Thekkady. The Cochin backwaters and surrounding wetland areas have a natural beauty that has paved the way for the development of recreational and tourism activities at various destinations along the backwaters. Cochin estuary is a public site, offering an array of recreational opportunities to the local population and tourist both domestic and foreign, some on a fee basis but most free of cost.

The Cochin estuary and its surrounding backwaters provide different types of boating facilities namely the backwater trips, the estuary sunset rides, canoeing, houseboats (*Kettu vallam*) and speed boats. A large population spends time along the banks of the backwaters, the Marine drive, Subash Park, Rajaji grounds, Wellington Island Drive etc. enjoying its aesthetic beauty. The backwater environment is also used for different purposes such as jogging, recreation, for hosting cultural and religious events, boat races and other festivities etc.

4.1.5 Aquaculture

The wetland is a nursery for seedlings (shellfish and finfish), source of nutrients, water exchange and waste disposal. Land suitable for prawn filtration is sometimes converted to aquaculture ponds where modified semi-intensive and extensive culture is undertaken all year round. Culture farms cover an area of only 664 hectares in the study area. Table 4.8 gives the detailed distribution of operational holdings of Aquaculture farms in the study area[8].

Table 4.8 Distribution of Operational Holdings of Aquaculture Farms in the Study Area, 2001-02

Zone\Area (ha)	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha)
I	8.1	8.0 (18.4%)	5.7 (6.6%)	5.7	3.2	56.5 (64.8%)	87.2 (100%)
II A	31.5	26.1 (27.4%)	14.4	20.2 (9.6%)	3.7	114.4 (54.4%)	210.3 (100%)
II B	105.1	48.1 (39.6%)	58.4	61.7 (15.9%)	20.6	93.3 (24.1%)	387.2 (100%)
III A	49.4	25.5 (32.6%)	39.2 (17%)	38.9	25.2	51.8 (22.5%)	230.1 (100%)
III B	-	15.8 (32.4%)	15.0 (30.7%)	13.0 (26.6%)	5.0	-	48.8 (100%)
Grand Total	**194.1**	**123.5** (33%)	**132.7**	**139.5** (14.5%)	**57.7**	**316.0** (32.8%)	**963.6** (100%)

Source: Panfish books, Dept. of Fisheries, Kerala Government, 2001

It is interesting to note that, unlike the case of pokkali and prawn filtration holdings, the number of large holdings is greater in aquaculture.

[8] Annexure 4.4 gives details of farms in each panchayat.

4.2 Ecological Functions and Services of Cochin Wetlands

Apart from the free delivery of diverse flows of living organisms and resources to the local population, estuaries also provide a variety of useful services to the public at large, mostly free of costs. The major service provided by the wetland includes flood and flow control, shoreline stabilization, sediment retention, nutrient retention, water quality maintenance, storm protection/wind break, external support and aesthetic beauty[9].

Ecosystem services of estuaries are valuable supporting services that influence local economic activities in many ways. 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 (***veliyettam***) a healthy habitat is created for various living organisms.

The changes in the hydrology controlled by the seasons play an important role in regulating the migrant fauna of the wetlands. The Cochin backwater supports a well established endemic fauna (Menon et al., 2000). The nutrients and pollutants introduced into the wetlands affect to a great extent the distribution and abundance of less tolerant species in ecologically sensitive areas in the backwaters.

Similarly, when water recedes during low tide (*Veliyirakkam*) a variety of pollutants and wastes are taken out into the ocean. This function in fact subsidises the cost[10] of cleaning for the local population. Wetlands act as sinks for inorganic nutrients, improve water quality, and serve as filter for waste. For this reason, they are often referred to as *kidneys of the landscape.*

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[9] See Annexure 4.5 for details.

[10] A large number of studies acknowledge the role played by wetlands in waste disposal, recycling and absorption. Following them, the present study assumes that wetlands have pollution adsorption and recycling capacities which are unique, subsidising cost for the Government. The other side of the argument would be that if the wetlands did not exist, waste would go directly into the sea which has a higher adsorption capacity.

Although it is true that these wastes would directly go to the sea in the absence of wetlands, their presence escalates the capacity to recycle wastes. There lies the uniqueness of this complex ecosystem.

Wetlands physically, chemically and biologically remove nutrients and pollutants from the area. Almost all of the 15 medium and large industries to the north of the wetland and most of the nearly 200 smaller production facilities (which together include fertiliser and insecticide plants, rare earth factories, breweries, soft drink manufacturers, distillers, oil and soap factories, fish processors, peeling sheds, paint producers, tanneries, plastic and foam industries, saw mills, battery manufacturers, pharmaceutical industries, leather and paper makers) discharge wastes often without any kind of primary treatment on-site, directly into the Periyar and Chitrapuzha rivers which flows into estuary. The corporation and municipalities have a garbage collection and disposal mechanisms. However, the majority of the low-cost residential settlements surrounding the wetland are not connected to the municipal sewer systems. Similarly, many residents of the low-cost settlements around the wetland still use pit latrines or have their septic tanks empty directly into the wetlands. Almost all of their other domestic wastes also enter directly into the wetland, carried by surface water or as seepages.

For other areas also, the wetlands are the main source of waste disposal, discharging domestic wastes for up to 12.9 lakh households as runoff into the surface waters or through groundwater inflows from the infiltration of rainfall, from coir retting soak pits and leaking waste pipes. The wetland functions as a buffer ensure that a substantial proportion of these pollutants and waste are flushed out by means of its tidal functions (*veliyettam and veliyirakkam*). In fact one of the most important function that adds value to estuaries is its tidal functions since it subsidises the cost of cleaning of the local population and local bodies including the Cochin Corporation directly.

Flood protection for the thickly-populated coastal areas of the three districts of Ernakulam, Alappuzha and Kottayam is considered a major benefit. Groundwater recharge helps to supply well water for the region as well. The Cochin wetlands serve as nursery grounds for the juveniles of marine fin and shellfish. They are known to utilize estuaries because they have calm and shallow waters, good food availability, reduced predation pressure, and their turbid waters offer protection. These juvenile species are retained in the system until they are matured and harvested. It may also be said that the Cochin wetlands serve as a repository for native plants and animals. They provide vital habitat for wildlife especially for migrating, wintering, and breeding birds.

Estuaries stabilise the coastal shores and prevents soil erosion in many ways. Shore stabilization functions and sediment retention functions are useful in many ways to the poor people in this area. Mangroves also play a crucial role in the delivery of the estuarine ecosystem services. Their shore stabilisation function and breeding grounds for juvenile prawn seedlings are very important functions. But today, mangroves in and around Cochin estuary are heavily destroyed, affecting many of the natural functions of the wetlands. Scattered patches of mangroves are now found in Vypeen, 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* and *Bruguiera gymnorrhiza*[11].

[11] See Annexure 4.6 for details.

4.3 Major Users of Wetland Resources and Services

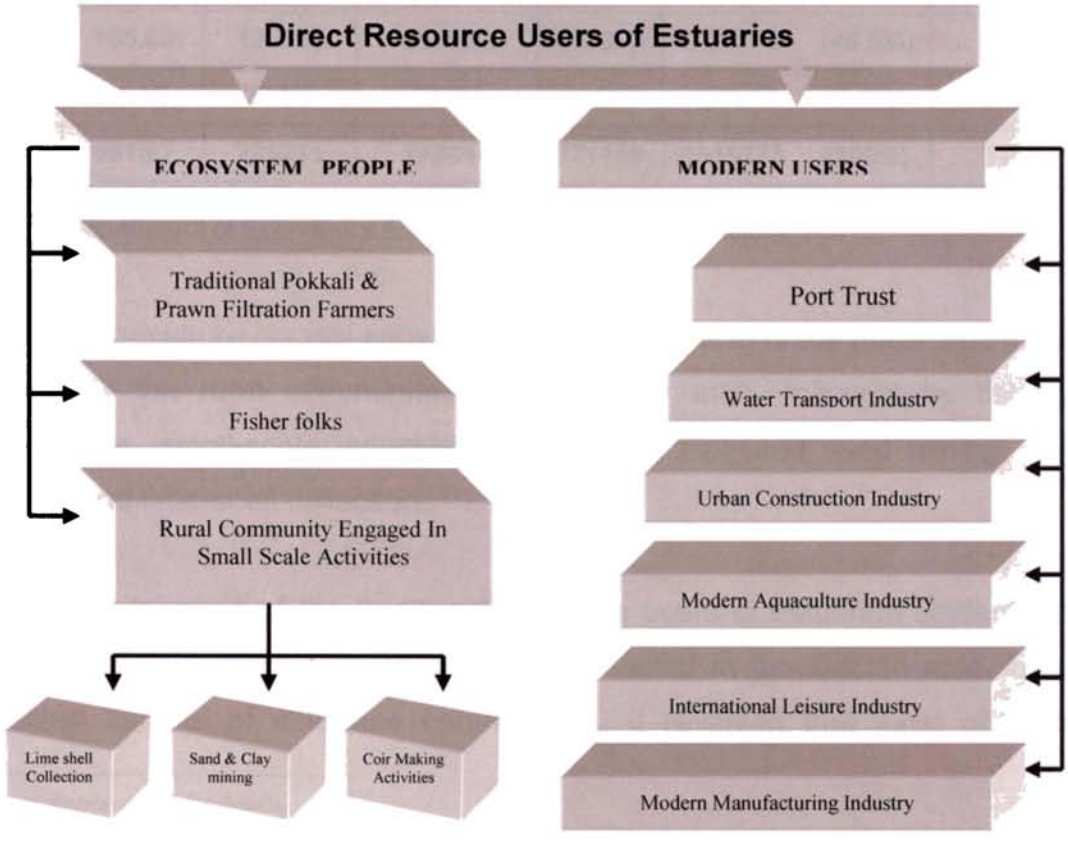
The above mentioned ecological parameters and functions performed by the wetland ecosystem influence and determine the organization of various economic activities on this estuarine space, the property rights regimes under which they are internalised as well as the quality, quantity and productivity of different goods and services. The major resource users of wetlands are divided into two broad categories: the ecosystem people and later entrants. 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 etc. The modern claimants of biodiversity resources are the Cochin Port Trust, modern manufacturing industries, Inland water transport industry, mechanized ferry/jhankar service industry, modern aquaculture industry, the urban construction industry and the international leisure industry. In addition to the above mentioned direct resource users, the national and international communities also use estuarine biodiversity indirectly and in that sense constitute the set of indirect resource users. 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

As mentioned earlier, these ecosystems have been the major source of livelihood for various rural communities since time immemorial. The vast wealth of fish and shellfish resources was the target of local fishermen while traditional agriculture called *Pokkali* has been the source of livelihood for the agrarian farming communities. They have also been engaged in traditional prawn farming in their paddy fields or leased their farms to agents for aquaculture activities soon after the paddy crop was harvested. Relatively poor people in villages, resorted to *coconut husk retting, coir making, sand*

poor people in villages, resorted to *coconut husk retting, coir making, sand mining, ferrying* of passengers to other places (*kadathu),* collection *of lime shell* and other minor produces obtained free from the estuarine environment. Poor households also engaged themselves as *wageworkers* in a variety of activities organised by owner communities.

As the traditional rural communities were poor, the surplus generated by these resource users from economic activities was not sufficient to instigate any major form of investment on modern economic activities. Consequently, it fell on the State to come forward with investments and active participation for the over all development of the region. Hence today, estuaries are used both by the traditional and modern enterprises, increasing the competition for resources and environment.

FIG 4.1 DIRECT RESOURCE USERS OF COCHIN WETLANDS



4.3.1 Distribution of Cochin Wetland Population

According to the 2001 census, the total population settled around the Cochin wetlands was 1519773. Population density declines as we move interior from the high saline zone to medium and low saline zones. The average density of population was 2197 in the study area with zone I recording a density of 1210 and zone II A, a density of 1580 per sq km. Table 4.9 gives the distribution of population around the Cochin wetlands[12].

Table 4.9 Distribution of Population around Cochin wetlands

Zones	Area (Sq Km)	No. of House-holds	Population				Density of pop/sq. km
			Male	Female	Total		
I	273.08	65291	163382	167012	330394	(21.7%)	1210
II A	120.59	38296	89230	101327	190557	(12.5%)	1580
II B	88.79	29309	75600	78910	154510	(10.2%)	1740
III A	155.09	136683	353901	353373	707274	(46.5%)	4560
III B	54.12	26632	66501	70537	137038	(9.0%)	2532
Total	**691.67**	**296211**	**748614**	**771159**	**1519773**	**(100%)**	**2197**

Source: Department of Economics & Statistics, Government of Kerala, 2001

Wetland agriculture (locally known as pokkali in Kerala) is the major economic activity of the rural communities in the study area, followed by fishing, aquaculture, small-scale industrial activities like clay and sand mining, coir making and lime-shell collection.

The social features of the traditional resource users of estuarine settlements was analysed through primary surveys conducted in the Cochin area, on a selected sample of estuarine communities. It revealed that most of them

[12] See Annexure 4.7 for details.

(ninety five percent) have been settled in these villages for more than 20 year. Around 65 percent of respondents in Cochin belong to the age group between 15 and 65. This leaves 35 percent of the population as non-working in Cochin. Average literacy rates are relatively high in Cochin estuarine settlements.

A detailed analysis of the distribution of respondents by their major occupations in the selected areas revealed wide variations. The data, however, confirmed the fact that a large proportion of traditional communities still use estuaries for various income generating activities. The major occupations centred on estuarine resources and environment in the selected stations are agriculture, capture fisheries, aquaculture, sand mining, clam fishing, tourism and ferry services.

4.3.2 Traditional Resource users

4.3.2.1 Fishing Communities

Fishing in the Cochin wetlands has a history of over a thousand years. Iyer (1909) gives a detailed account of the prominent fishing caste of Kochi (Valan, Arayan/Kadalarayans, Mukkuva, Marakkan) who were traditionally involved in this profession.

Fishing in the Cochin backwaters is undertaken by fishing communities using a variety of craft gear combinations. More than 80 percent of the fishing households were staying in these villages for more than 20 years. The proportion of active working population ranged between 74 to 88 percent in the study area while the aged and the children below 15 years ranged from 12 to 26 percent. Similarly, the average level of literacy of inland fishermen especially in the study area was very high. Today, 18593 households are

engaged in active fishing in Cochin wetlands using different types of gears[13] (Table 4.10).

Table 4.10 Distribution of active fishermen by different gears in Cochin backwaters, 2001-02

Zone\ No. of Fishermen	Fixed nets		Free nets		Total	
I	1278	(24.6%)	4036	(30.1%)	**5314**	(28.6%)
II A	1349	(26%)	4064	(30.3%)	**5413**	(29.1%)
II B	324	(6.2%)	1404	(10.5%)	**1728**	(9.3%)
IIIA	1536	(29.6%)	2147	(16.0%)	**3683**	(19.8%)
IIIB	698	(13.5%)	1757	(13.1%)	**2455**	(13.2%)
Total	**5185**	**(100%)**	**13408**	**(100%)**	**18593**	**(100%)**

Source: Primary Survey, 2001-02

4.3.2.2 Farming Communities

Pokkali has always been the variety of paddy that has been cultivated in the Cochin backwaters due to its salt resistant quality and ability to survive without any form of fertilizer. Soon after the paddy harvest in October, the bunds of the fields are strengthened and sluices are installed. The fields vary in size from less than 0.5 hectare to more than 10 ha. Pokkali paddy is harvested by the end of September and subsequently prawn filtration starts from November onwards, continuing till the first week of April. Table 4.10 gives a summary of the pokkali household distribution in each zone.

It is seen from table 4.11 that 32 percent of the households are concentrated in zone I. Comparing with the distribution of pokkali area in table 4.5, it is seen that only 23 percent of the total 6003 hectare of pokkali fields are cultivated by

[13] Annexure 4.8 gives a detailed distribution of gears in each zone.

32 percent of households in zone I. Similarly 67 percent of pokkali paddy land is distributed among only 54 percent in zone II[14].

Table 4.11 Distribution of Pokkali Cultivating Households in the Cochin backwaters

Zone	Area under cultivation (ha)	No. of Households	
I	1369.0	3329.0	(32.3%)
II A	1800.0	2475.0	(24.0%)
II B	2219.0	3073.0	(29.8%)
III A	213.0	215.0	(02.1%)
III B	402.0	1218.0	(11.8%)
Grand Total	**6003.0**	**10310.0**	**(100%)**

Source: Pokkali Land Development Agency, 2000

While the agriculturist owning the land grows the paddy crop, the field is subsequently leased out to shrimp farmers for a period of 5 months, from mid-November to mid-April. The paddy stumps and straw left behind in the fields are not removed, but allowed to decay there to form good organic manure for shrimp culture. Stocking is done by letting tidal water and juvenile shrimp into the fields at high tide. They are attracted to the field by keeping a light at the sluice gate during the night. When the tidal water starts receding during low tide, a closely tied screen made of split bamboo is inserted across the sluice gate and water alone is let out trapping the juvenile shrimp in the field. This type of entrapment is continued at every high tide throughout the period of operation.

Harvesting starts from mid-December. This is done during the low tides by operating a conical net fixed at the sluice gate. Sluice net operation is done at

[14] Annexure 4.9 gives a detailed distribution of pokkali paddy households in each panchayat.

dawn and dusk for 5–8 days around every new moon and full moon during which the maximum tidal amplitude is experienced. Harvesting of prawn by the lessee or owners is over by the end of April. In the panchayat ponds, the lease ends by March 31st, while in the case of private property or Padashekarams the leasing period extends to April 22nd after which the fields are open to the public. Traditionally, it is the fisherfolk of the pulaya community who had customary rights over fishing after this. 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. Kalakkipiditham and Thappiyedukkal stretched till the beginning of the next Pokkali cultivation period in June. The tiger prawn (*Penaeus monodon)* is the major contributor to the brackish water aquaculture. Others such as *P. indicus*, *P. merguiensis P. semisulcatus, Mugil cephalus, Liza parsia, Liza tade, Liza macrocephalus*, *Chanos chanos*, *Etroplus suratensis*, *Lates calcarifer* are the prime culture species in these brackish waters. Table 4.12 gives a summary of households engaged in prawn filtration in each zone. It is seen that just as in the case of pokkali fields, in all zones, size of holdings are small[15].

Table 4.12 Distribution of Prawn Filtration Households by Size of Holdings the in the Cochin Wetlands

Zone\Area (ha)	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total
I	616	366	179	135	8	62	1366
	(71.9%)		(13.1%)	(9.9%)			(100%)
II A	546	262	183	132	70	103	1296
	(62.3%)		(14.1%)	(10.2%)			(100%)
II B	593	353	137	68	31	72	1254
	(75.4%)		(10.9%)	(5.4%)			(100%)
III A	121	71	41	37	26	26	322
	(59.6%)		(12.7%)	(11.5%)			(100%)
III B	196	76	58	54	39	33	456
	(59.6%)		(12.7%)	(11.9%)			(100%)
Grand Total	**2072**	**1128**	**597**	**427**	**174**	**296**	**4694**
	(68.2%)		(12.7%)	(9.1%)			(100%)

Source : Panfish books, Dept. of Fisheries, Kerala Government, 2001

[15] Annexure 4.10 gives a detailed distribution of prawn filtration households in each panchayat.

4.3.2.3 Traditional Ferry Operators

Transport of goods through ferries has been an age old affair in Kerala. Goods from the near by islands and interiors of Kerala were loaded aboard ferries and towed through the backwaters of Alappuzha and Cochin for trade in Cochin. There are 19 traditional ferry operators and 5 motor dingy operators in the Cochin wetlands today. Table 4.13 gives the details of different ferry destinations and their days of operation in the Cochin estuary.

Table 4.13 Nature of Craft Ownership of Traditional Ferry Operators in Cochin wetlands, 2001-02

Sl. No	Ferry To	Nature of Craft Ownership	Days Operated
Type I Ferry			
1	Kadamakudy	Single	Tuesday, Friday
2	Kothad	Partnership	Monday, Wednesday, Saturday
3	Kottapuram	Partnership	Monday, Wednesday, Saturday
4	Kumbalam	Partnership	Monday, Friday
5	Malipuram	Partnership	Wednesday
6	Moolampally	Partnership	Monday, Wednesday, Friday
7	Mulavukad	Single	Monday, Friday
8	Mulavukad	Single	Monday, Wednesday, Friday
9	Paravoor		Monday, Friday
10	Perumbalam	Partnership	Friday
11	Ponnarimangalam	Single	Monday, Wednesday, Friday
12	Vallarpadam		Daily
Type II Ferry			
13	Mattancherry	Partnership	Daily
14	Njarakkal	Partnership	Wednesday
15	Njarakkal	Partnership	Tuesday, Friday
16	Panambukkad	Partnership	Monday, Friday
17	Panambukkad		Monday, Friday
Type III Ferry			
18	Alleppy	Lease	Monday, Wednesday, Friday
19	Alleppy	Company Owned	Tuesday, Thursday, Saturday
Motor Dingy			
20	Fort Kochi	Partnership	Twice a Week
21	Fort Kochi	Partnership	Twice a Week
22	Fort Kochi	Partnership	Twice a Week
23	Mattancherry	Partnership	Twice a Week
24	Mattancherry	Partnership	Daily

Source: Primary Survey, (2001-02)

The Ferry services begin in the early morning from 6 am onwards depending on the destination of the trip. Ferries to distant places like Kadamakuddy and Kottapuram leave early. Near by destinations like Mulavukad and Panambukad have more frequent number of services. Trips from distant areas like Alleppy stay over night taking 3 days per trip. They are still cheaper compared to road transport and are able to carry twice as much goods. Hence many people still opt for this method of transport. The motor dingies ferry food supplies to the ships that dock in the harbour. Hence the number of trips they make a week greatly depends on the number of ships that dock in the harbour a week and on the weather conditions. They charge a specific amount per trip.

4.3.3 Modern Enterprises

As the traditional rural communities were poor, the surplus generated from economic activities by these resource users was not sufficient to instigate any major forms of investments on modern economic activities. Consequently, the State came forward with investments for the over all development of the region. The Cochin Port Trust, a number of large and small-scale industries both in the public and private sectors, firms in the navigation, transport and tourism sectors have all organised activities around the wetlands with Government backing. Apart from promoting the modernisations processes in the estuarine economy, the State was also involved in crafting policies for the governance of estuaries. Being forced to undertake capital-intensive development initiatives, the State started playing a dual role of the custodian and degrader of biodiversity. In fact, the dynamics of development based on resource management in estuaries is set on such a contradicting base.

The Cochin Port Trust is a central Government, public sector company engaged in the export - import business, which started its operations in the Cochin estuary during the early 1930s. Similarly, the inland water transport

operations in the Cochin wetlands are carried out by agencies, which involve Government departments or organizations like the Kerala Shipping and Inland Navigation Corporation (KSINC), State Water Transport Department (SWTD), Inland Waterways Authority of India (IWA) and other private enterprises.

Another important but indirect wetland resource user is the modern industrial establishments on the banks of the wetlands, who use the wetlands to discharge effluents free of cost particularly during the monsoon months when the wetland tidal and waste flushing functions are very active. Both large and small-scale industries are located in the Cochin industrial agglomeration. The line of production ranges from fertilizers, chemicals, leather tanneries, pesticides, wooden industries, minerals etc. to Information Technology based industries.

All these modern entrants use the services provided by the wetlands free of cost to generate economic activities just like the traditional resource users. However, the externalities imposed by these industries on the wetlands are far greater.

4.3.3.1 Aquaculture Industry

With the blue revolution and the boom in exports of prawn and shrimp to international markets, prawn filtration became a lucrative activity. Encouraged by this, many farmers converted their prawn filtration farms into ponds suitable for modified semi-intensive culture. Aquaculture is a lucrative economic activity in the Cochin wetlands today. The perennial fields, which are deeper and not suitable for paddy cultivation, are used for shrimp culture throughout the year. The methods of stocking and harvesting are similar to those adopted in the seasonal fields. The area under the perennial system is only 15.8 percent of the total area under traditional culture. Higher catch rates are generally

observed in the January-March period. The common species of shrimps caught are *Metapenaeus dobsoni, M. monoceros, Penaeus indicus and Penaeus Monodon. M. dobsoni* contributes more than 50 percent of the catch.

Table 4.14 Distribution of Aquaculture Households by Size of Holdings in the Cochin wetlands, 2001-02

Zone\Area (ha)	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total	
I	30	10	5	2	1	9	57	(8.4%)
II A	28	28	6	6	0	7	75	(11%)
II B	300	48	34	19	6	8	415	(60.9%)
III A	22	30	15	9	4	3	83	(12.2%)
III B	0	25	12	9	5	0	51	(7.5%)
Grand total	**380**	**141**	**72**	**45**	**16**	**27**	**681**	(100%)
	(55.8%)	(20.7%)	(10.6%)	(6.6%)	(2.3%)	(4.0%)	(100%)	

Source : Panfish books, Dept. of Fisheries, Kerala Government, 2001

Table 4.14 above gives a summary of the distribution of aquaculture farms in each zone of the study area. Very few people are engaged in this type of activity. There are a large number of small holdings in zone II B. From the socio-economic survey, it was seen that most of these farms were recent conversions from prawn filtration.

4.3.3.2 Leisure industry

It was mentioned in the introduction that apart from the direct goods and services to different resource users, the estuarine environment also provides rich potential for the development of the tourism and leisure industry in the State. In fact, modern backwater eco-tourism is built on capitalizing this

opportunity of the environment. This section briefly introduces the major firms/players of this industry.

Tourism in the Cochin estuary is fast developing as an industry with potential for high levels of profit at low investment. Consequently the number of enterprises involved in this business is numerous. The major stakeholder is of course the Government, which plays an active role in backwater tourism promotion. 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. Primary survey of the Cochin backwaters during 2001-02 showed the number of boats owned by the KTDC (Kerala Tourism Development Corporation) as 2, by private package tour operators as 4, and by the private boat owners as 35. A single houseboat also operated in the backwaters. They offer four types of packages mainly[16]. There is the city tour, the sunset tour, Village backwater canal tour and the houseboat ride. A number of 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 activity. Their boats are hired both for tourism and transportation purposes. They have fixed rates per hour but no fixed routes. Table 4.15

[16] Tour packages offered in the backwaters are mainly of 4 types. The first is the Cochin city tour. Passengers are taken on a one and a half-hour round trip of the city, touching historically important places such as St. Francis' Church, Fort Cochin, The Mattancherry Dutch palace, Bolgatty palace and Jewish Synagogue. The second is a trip to the bar mouth during sunset. The third is the Village backwater canal tour. The trip is generally a 30 to 40 minutes Coach drive to a fixed destination, usually some where in the interiors of a village on the banks of the backwaters. From there, the visitors are taken on a canoe ride, manned by two local oarsmen, through the small and narrow canals for about half an hour of peace and quite. Usually, a local guide accompanies, them, giving them an insight of the Kerala culture, traditions, ways of livelihood and flora and fauna. Lastly there is the Houseboat (Kettuvallam). These are traditional wooden boats with bedrooms and bath attached along with a kitchen and living area. Day cruises (12 hours) as well as day and night (24 hours) trips are possible. A cook forms part of the crew to provide the guest with Kerala cuisines.

gives the distribution of ownership of these tour boats in the Cochin backwaters.

Table 4.15 Distribution of ownership of Tour Boats in the Cochin wetlands

	Type of Tour Operated	Number of Firms Operating
1.	Backwater Boats	12
2.	Backwater and Village Tour Canoes	4
3.	Charter Boats	35
4.	Speed boats	15
5.	Pedal and Paddle Boats	2
6.	House Boats	3
7.	Ark Boats	1

Source: Primary Survey, 2001-02

It is seen from the above table that the number of firms operating in the study area is limited. The charter boats are more in number. The Pedal and paddle boats are not very popular. The Houseboats and ark boats require very huge investments and hence are less in number. However, this industry is only in its infancy and attracts more and more investment due to its growing popularity. It is true that the local communities had traditional rituals that recognized the recreational values of backwaters. This is what one experiences in the communal sport "vallamkali". However, commercial ecotourism on estuaries undertaken by modern enterprises is a relatively new experience.

4.4 Access to Cochin Wetlands

It was pointed out that the diverse bundle of natural resources and services of Cochin wetlands provided livelihood to local communities. These resources and ecological services were valuable to local communities and their perceptions of "resource values" were embedded in their property rights institutions. Resource user's knowledge about wetland ecosystem functions and services and other social relations also contributed to these perceptions. Therefore an examination of the institution of property and the socio-economic perceptions of local communities to wetland values is essential to estimate its economic values. These perceptions of various producer groups about wetlands vary considerably across resource uses. These group perceptions, despite contradictions, are recognized locally through various self-adaptive practices and ensured co-existence of different communities.

The development of commercial markets for modern economic activities, have inducted new rules of access and complicated the value perceptions of modern resource users. State created "state property" to develop its own projects and activities while newly evolved manufacturing industries treated wetlands as a property freely accessible to dump their pollutants. Most of the traditional fishers on the other hand still perceive wetlands as common property. It is this conflicting structure of property that drives the value making process of various users today.

4.4.1 Property Rights Governing Traditional Activities

Fishing and agriculture were the traditional economic activities of local communities around Cochin Wetlands. The system was "valuable" for them to the extent that this was the only mode of survival. These value perceptions are reflected in traditional property rights institutions and protected in traditional

knowledge systems of these communities. The study shall now develop the specific nature of these notions and emphasize how these notions influence the processes of value generation by these groups of people.

4.4.1.1 Fishing Rights on Cochin Backwaters

Since the stake net groups and Chinese net groups contribute major proportion of economic value from fishing in Cochin backwaters, traditional fishing rights are cantered mainly on these two gears[17]. Traditional fishing communities had well worked codes of conduct to ensure justice and sustainability in harvesting the bounties of the wetlands. These unwritten rules protected the wetlands as a regulated commons. Most of the fishers perceived (and still believe) the half of the brackish water territory between their shore and the neighbour as their village property. Fixed fishing gears (Oonni vala and Cheena vala) are normally fixed within these territories. Although customary rights have evolved from the above notion, fishers did not always defend local boundaries. In fact, when fishing was over, mostly by early morning, other stakeholders were allowed to use these territories for activities like lime shell collection, sand and clay mining, traditional ferry services etc. Other producers organized these activities without disturbing the fishing activities.

Having defined and excluded other potential uses from the fishing territories, the defended territories were shared by fishing communities themselves. This sharing depended on the type of gears used by individual gear groups.

[17] Evolution of customary fishing rights on Cochin backwaters depended on resource specificities and ecosystem services. As mentioned in chapter 3, Cochin backwaters generate highly diverse ecosystem services that sustain a productive and diverse fishery. The tidal functions (locally known as veliyirakkam and veliyettam), the inflow of fresh water from river systems and the existence of supporting resources 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 these ecosystem services.

A. The Evolution of Fishing Rights around Stake Nets

For instance, fishing rights associated with *"stake nets or Oonni vala"* were the monopoly of the *Vala* community or *Dheevaras*[18]. Historical evidences indicate that the King had issued royal writs (Theethorams) granting fishing rights to the Valans[19] for the services (supply of fish, organize voyages of the king and soldiers etc.) they rendered to the royal household. Certain fishing areas of the estuary were assigned to the Aravans (headman of valan community) even free of tax and others were not permitted to fish there. These fishermen were entitled to fix stake nets in such assigned territories and thus Aravans got the monopoly of fishing in certain pockets (Day, 1863).

Although the King issued fishing rights to Aravans, these rights were redistributed by the Aravans among individual vala households through Ponambans who were the caste leaders of the valan community. Ponambans[20] normally distributed fixing rights to individual households by

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[18] Today, the term Dheevara is used to refer collectively to a group of ten fishing castes that had existed in Travancore-Kochi during the early part of the century. Initially they comprised the fishing castes of Arayan, Nulayan, Arayavathi, Mukkuvan, Vaalan, Mugayan, Bophimukayan, Mukaveeran, Paniyaakaran and Valanjiyan (Day, 1863). In Cochin, the vala community dominated in terms of population size.

[19] The *Valans*, one of the leading partners of the Dheevara Sabha today, had their own tribal organization, which was headed by a headman called *Aravan or Aravar* who was appointed by the King (Raja) through a *'Theettoram'* or royal writ. The *Valans* were expert rowers and possessed the special privilege of rowing the boat of his highness the Raja from Tripoonithura for his installation in the Cochin Palace. The headman, Aravan, provided the necessary security to the royal family's backwater trips, to escort his Highness the Raja through the backwater on the occasion of state functions such as visit of the British Resident, the Governor or other dignitaries and even to supply the requisite number of men for rowing the boats of these high officials and other members of the establishment. He also had to see that during their stay at the Residency, they were furnished with all the necessary fish food for all of which the men were endowed with the privilege of fishing in certain assigned areas of the estuary free of tax. They were later deprived of the privileges and given a wage for the services rendered to the state, which levied a tax on fishing. Aravans 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 (Day, 1863).

[20] The headman could also appoint other social heads called *'ponambans'* for each desom (village) or kadavu (landing place) to collect taxes. 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 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 (Day, 1863).

collecting a fee. They also intervened in fishing disputes and suggested 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 a net on a row of stake nets (called oonni nira) was always allotted in relation to landmarks usually the bank of the estuary. It is reported that stake nets were normally fixed at a minimum distance of 16-18 links from the estuarine banks. This distance, however, varied from place to place depending on the width of the water channel and flow of currents and tides. The fisherman was sole owner of the area allotted to him and no one else could fish there unless royally decreed otherwise.

A row of nets (Oonnipadu) may consist of any number of nets varying from a minimum of five nets to one 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 prevailed among the Oonnipadu fishermen. For instance, the system of gear rotation was practiced among the members of the oonnipadu near the Cochin bar mouth region. Here, the fishermen rotate the position of their nets everyday so that everyone in the team has an equal chance of getting good catches. Similarly earnings of an extra net operated are donated to the common funds of the community. In certain locations like Thevara and Eda Kochi, if a fisherman is not using his Stake nets on a particular day, the Oonni sangham puts up a net and the proceeds go to the common fund. There are also some oonnipadu 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 organize 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 a mutually agreed period.

Sometimes, arrangements are also made to divide the day's catch equally between the contracting members.

Gradually, the rights of these fishermen have been encroached upon by others. Stake nets are also put up by people belonging to communities other than that of the traditional fishermen. These new entrants are commonly referred to as '*Tharachukettukar*'. Such groups of fishers are highly organised, sometimes with political support too. Consequently they put up oonnipads where yields tend to be highest, sometimes even right in front of that of the licensed fishermen.

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 the catch rates of users.

B. The Evolution of Fishing Rights around Chinese Nets

The evolution of fishing rights around Chinese nets[21], on the other hand, is not very clear in historical records. Although Chinese nets were not allocated to any particular cast, the newly converted Christian communities settled around Cochin wetlands owned and operated the majority of these nets. Households who owned landed property adjacent to the brackish water body normally fixed Chinese nets in front of their land. No one could install any nets on the water adjoining the property of a land owner without consent or payment of a rent,

[21] Chinese nets (Cheena vala) are commonly found along the banks of the backwaters. The size of the net varies according to the depth of water channel, the strength of water currents, and the availability of resources. Dip nets towards the bar mouth are huge in size and require a minimum of six or seven fishermen to haul it in. On the other hand, nets seen towards the interior regions of the backwaters are of smaller size, 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 (Primary survey, 2001-02).

which generally varied between 8 and 18 rupees depending on the ignorance of the net owner (Iyer, 1909). A number of Chinese nets were thus erected on the banks of the backwater without affecting the activities of other gear owners and stakeholders.

4.4.1.2 The Evolution of Wetland Rights around Agriculture and Prawn Filtration fields

The agricultural communities on the other hand, had enforced their rights mainly on the wetland territories adjoining the backwater bodies. 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 functions through change of water.

The history of rights on the wetlands adjoining Cochin estuary dates back to the evolution of organised brackish water wetland agriculture, locally called "pokkali krishi". Pokkali agriculture in the low-lying belts of Cochin estuary 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 estuary (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 *Nayar* community. 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 land 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 pattern 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 upper castes like Brahmins and Nampoothiries. Temple Trusts and Devaswoms were constituted for the management of such lands and they leased out land to tenants on rent. Temples became the single largest owners of landed property next to the King.

Each landlord from the Cochin brackish watershed, usually traditional aristocratic families, had a certain number of tenant families attached to his household who cultivated the land for them. Both the men and women of the tenant's household provided the necessary labour for paddy cultivation and harvesting. Owners offered a variety of economic benefits to their labour classes who attach themselves to their fields. The rent was fixed on the basis of the quantity of paddy borrowed from the landlord to be used as seed during the crop period. The agricultural labours mainly constituted the scheduled caste Pulaya community who were bonded to these feudal lords. At the beginning of the agricultural season (*Vishusankranthi day*), these labourers collected the rice and a few other gifts from the landlord. Consumables were symbolic of their bondage to their landlord. This system was very much embedded in the existing caste system of the period.

The first land 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 backwater inlets. This helped them to maintain their control over the resource and its production possibilities to a great extent. In certain regions, the State gained control over such resources. In the new scenario, owners of such water channels gained greater power, access and control.

Land reforms in 1970, gave tenants, ownership of not just land but also ownership of all the living organisms in the water bodies in the land. However, many of these tenants gained control over agricultural lands, but not water channels. It was only subsequently with the disintegration of the joint family system, as well as the emergent political consciousness and unionisation of the agricultural labourers that put an end to this traditional relationship. During the early part of the twentieth century, bunds were constructed as small water control works for dewatering the fields and controlling the water inflow, facilitating improvements in cultivation techniques. Since the control and ownership of these bunds was vested with the big landlords and tenants, it became a source of power for them to influence the small cultivators. During the initial periods, prawn had no local markets and hence agricultural labourers had easy access to the prawn and fish that thrived in these fields. With the development of export markets, more middlemen entered this activity.

The emergence of the harvester in these institutional arrangements changed the cultivation arrangements and led to the development of new contractual arrangements. The number of individuals who had a stake in a particular padashekaram were many. The land falling within the command of a bund was owned by a number of cultivators. Similarly, with the disintegration of the joint family system, many individuals shared rights over the same water channels. Consequently collective action slowly developed and the system of

Padashekarams once again re-evolved. Collective bargaining was employed to lease out the padashekarams after the harvest of paddy to contract harvesters (*Paattakaran*). The contractor was responsible for the re-strengthening and repair of the bund and the sluice. The entitlement to the lease amount depended upon the size of land and ownership rights over water channels. The lease amount was determined by the padashekaram committee based on the yield per hectare of the land, current price in the market and the previous year's lease amount. They then negotiated with the *chemeen* contractor. Once this amount was fixed the bund owners were also entitled to a portion of this amount (rent for the season) if the filtration rights were contracted out to a harvester. This rent was similarly fixed prior to the filtration based on the previous year's catch and an assessment of the market rates for prawn. A part of this amount had to be paid in advance. The summer filtration (*venal kettu*) and the Monsoon filtration (*varsha kettu*) were leased out separately. For the summer filtration, the landowners were responsible for sharing income from fish catch with bund owners as payment for forfeiting their fishing rights for the season. In the absence of contract harvesters, such a payment need not be made. For the varsha kettu, this was an annual right and a part of the lease amounts was to be paid to them.

The importance of the role played by the bund may be gauged from the fact that even panchayats and local self governing administrative units owned and leased out filtration ponds annually. The bund as an institutional arrangement also contributed to the development of other contractual arrangements like the one between chemeen contractors and prawn exports and Sea food processing industries. Chemeen contractors are advanced credit by these agents to pay the lease amount and other associated costs on the agreement that the catch would be sold only to the creditor. When exporters are involved, the negotiation between the chemeen contractors and the bund owners would be influenced by the negotiations between the exporters and the harvesters.

4.4.1.3 Customary Rights of Agricultural Labourers: Kalakkippidutham

The description of traditional property rights on brackish water resources will not be complete until the customary rights of the local agricultural labour classes are mentioned. Pokkali cultivation, being a highly labour oriented activity, 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*[22] are prevalent even today. *Kalakkippidutham* is a social arrangement, an informal institution, by which the land owning classes granted free access to the local working classes for fishing from the pokkali fields during a limited period when prawn filtration farms are brought back to paddy cultivation. It is a reciprocal arrangement of the land owning classes to acknowledge the services offered to them by the agricultural labourers.[23]

As soon as the Pokkali paddy is harvested by the end of September, prawn filtration starts 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 by the third week of April. Each Pokkali field has a group of agrarian labours belonging to the Pulaya caste who were responsible for all the work

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[22] The method of catching fish using *kalakkippidutham* 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. Aluminium pots, and in certain cases a scoop net forms the total of their gear requirements.

[23] 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. Thomson (2001a) reported that large number of women and men earn their living through this activity even today. He estimated that the average revenue per person per day was Rs.360 in 2001.

associated with dyke preparation, planting, replanting and harvesting. As soon as the contract terminates, the owners acknowledge customary rights over these fishing grounds and allow free access to these fisher folk and the female workers from the Pulaya caste.

Kalakkippidutham as an informal institutional arrangement reduced uncertainties and shared risks of crop rotation. First, the arrangement was helpful to the owners because forceful encroachments of the general public and the labour classes on the prawn farms ensured the timely eviction of the lessee so that the land thus regained could be immediately transformed for paddy cultivation. Second, this process reduced a substantial proportion of the transaction costs of the owners in the cultivation of paddy. Thirdly, it ensured timely availability of agricultural workers for the next agricultural season by attaching to each field, at least those workers to whom free access was offered. In the past, labour was sufficient to meet the demand of labour for paddy and prawn cultivation. With the passage of time a gradual reduction in the strength of this labour class saw the coming of migrant labours.

4.4.2 State Property Rights and Property Claims of Modern Stakeholders

It has so far been argued that over the years, different traditional stakeholders developed their own property rights and rules for appropriating wetland resources and making economic values from such activities. Since different kinds of activities had to be organized on the same space, most often by different producer groups, access rights to wetlands were respected and they facilitated the value generating mechanisms. However the State has never really understood the implications of the nature and dynamics of multi-resource user access rights that had traditionally existed over wetlands. Consequently, the State policy toward using estuarine space has never been one of sharing and it formulated policies and legal rules for the entry of

modern stakeholders to undertake activities that increase employment and economic values.

The entry of any new stakeholder was almost always preceded by the creation of new property rights that were favourable for promoting the activities of the new entrant rather than let them evolve naturally. This often meant exclusive use of estuarine space, ignoring the already existing claims on the space and forced eviction of certain users. There after, property rights over that particular space belonged solely to the new stakeholder while access to other stakeholders over that space was often granted either on payment of a fee (license) or as a favour. This was the case in the Cochin wetlands with the arrival of each new entrant. The Cochin Port and the navigation channels of the water transport industry were all created in this fashion. For centuries, the State had always perceived public land and water bodies as State property. According to the provisions made in the Kerala Panchayat Raj Act 1994, article 218, backwaters belong to the village panchayat[24].

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[24] The article states the following:

218 (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, estuary and water courses all standing and flowing water, springs, reservoirs, tanks, cisterns, fountain 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.

218 (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, fountain wells, kappus, chals, stand pipes and other water works vested in the village panchayat under sub section (1) shall from the date of such vesting be the rights and liabilities of the village panchayats.

218 (3) Not withstanding 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.

218 (4) It shall not be lawful for any person to remove or appropriate for himself, any tree, earth, sand, metal, lacerate 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 panchayats ... under this aft 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.

There was active intervention of the State to create property rights on wetlands for the creation of new values started as part of development planning. Two kinds of State interventions are seen during the post independence era.

The first one related to direct interventions by the Central Government over wetland resources, motivated by larger economic interests of the nation. In fact, the State has laid down over the years, a series of rules[25] and regulation[26], pertaining to fishing activities in wetlands that has very rarely been changed or modified to suit new situations and conditions. For instance, According to the Travancore-Cochin Fisheries Act, 1950 and the Travancore–Cochin Fisheries Rules, 1952, the Government specifically laid down regulations regarding fishing activities for fixed nets such as chinese nets[27],

[25] (1.) Regulation to Make Better Provision for the Protection and Preservation of Game Fish, 1914, (2.) Indian Fisheries (Madras Amendment Act, 1927, (3.) Travancore–Cochin Fisheries Act, 1950, (4.) Travancore–Cochin Fisheries Rule, 1952, (5.) Regulation of Fishing with Fixed Engines (Stake nets, Chinese Nets etc), 1973, (6.) Issue of Fishing License Rules, 1974, (7.) Regulation of Prawn Fishing in Private Waters Rules, 1974, (8.) Rules for Management and Control of Fisheries in Government Waters, 1974.

[26] 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 according to the Kerala State Fisheries Department statistics is an indicator of how ineffective these rules are. Enforcement of the rules is also reflected here since the Fisheries Department entrusted with the job of patrolling 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. Transfer of license is not allowed. In cases it is allowed, it requires the sanction from concerned authorities. Unauthorized 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.

[27] In the case of Chinese nets, the State Government laid down the following rules: Fishing by any means within 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 (Kerala Fisheries - An Overview, 1992).

stake nets[28] and free nets[29]. The second intervention was by the State Government. This was also of two kinds. The first involved creation of new sets of rules and regulations in continuation of old policies that were to be adhered to by different resource users in connection with wetland use. The second was in the form of setting up developmental projects for the over all economic development of the State, which involved use of estuarine and wetland space. At one time, noticing large-scale conversion of wetlands for other purposes, the Government issued a directive to all District Collectors, not to sanction any such application under the Kerala Land Utilisation (KLU) Order, 1967 except with the prior approval of the Government.[30]

An important factor, which legitimised the active role of the State take-over of wetlands and the 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

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[28] In the case of Stake nets, the State Government laid down the following rules: Fishermen shall not posses more than 4 Stake nets at a time. No Stake shall be planted within 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 and the Water Transport authorities. Stake net shall not be planted within 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 nets etc) in the area between Stake lines or within 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 (Kerala Fisheries - An Overview, 1992).

[29] 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 due to it destruction of juveniles and spawners, has been completely banned. Use of lights electric bulbs and Petromax Lighters are not allowed according to Government rules (Kerala Fisheries - An Overview, 1992).

[30] Concerned at the large-scale conversion of paddy lands for other purposes, the Government issued a directive to all District Collectors, vide reference as G.O. (Rt) No. 157/2002/AD dated 05/02/02, not to sanction any application under the Kerala Land Utilisation (KLU) Order for conversion of paddy lands for other uses, except with the prior approval of Government. Thereafter, all individual applications for conversion of paddy lands for other uses have been dealt with at the Government level.

to invest in development projects. The development of the modern resource user is to be seen in this context.

4.4.2.1 Port Trust

The first chart[31] of developing Cochin into a deep-sea port was made way back in 1835. The Central Government constituted the Cochin Port Trust formally in 1964. The Property rights of Cochin Port Trust were created and exclusive rights over a large estuarine space with legal titles and power to enforce its property rights entrusted with the Port Trust Authority. The Property rights of Cochin Port Trust were created by an act[32] of the Indian parliament. The Act claims that the boundaries of the Port[33] shall comprise of all areas contained

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31 The idea was constantly developed and in 1920, development works of the harbour started. From 1795 until India's Independence, the outer part of the island and beach was under the British Colonial rule or political control, while the inner part was under the Kochi State and Raja of Travancore. Due to this division of political ruling, the harbour was not developed until around 1920-1923, when the approach channel was dredged to allow ships that passed through the Suez Canal to dock safely, thus opening the harbour to so called 'modern shipping lines'. In 1929, the first approach channel 450 ft. wide was cut and the sediments were used to reclaim parts of the Kayal for the activities of the Port Trust (Compiled from Cochin Port Trust Annual Administration Reports). This was probably the first organised reclamation of the estuarine ecosystems in the country. By 1930-31, the Port was thrown open for vessels and in 1936 the Government of India declared Cochin Port a Major port and took over its administration.

32 The Cochin Port Trust was constituted with effect from 29.02.1964 when the Government of India constituted the first Board of Trustees for the Port under the Major Port Trusts Act, 1963 vide Notification No. G.S.R. 296 dated 28th February, 1964, GOI, Ext., Pt. 11, Sec. 3 (i), p. 79.

33 "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 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 estuary or the sea".

on land lying within 45.76 meters (50 yards) of high water mark, Kerala estuary and the Sea.[34]

The Government of India through the Ministry of Shipping (Ports Wing) also issued a notification extending the port limits up to 30 meters depth and 10 nautical miles, north and south from the old Cochin Light House. The sea wall extension was up to 12 nautical miles in line with the territorial waters of the country. Any activity, which takes place within this area, required the prior permission of the Port Authorities. Hence, the Port Trust emerged as a major stakeholder in the Cochin estuary.

This is the first time, in the history of Cochin estuary 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 many economic activities of traditional resource users. The construction of jetties, the use of Chinese fishing nets, the operation of fishing and passenger boats within the boundaries of the Port all required a license now.

4.4.2.2 Nationalization of Navigation Routes

Two kinds of State intervention took place in the Cochin wetlands through the navigation industry during the post independence era. The first was direct interventions by the State in wetland resources management, motivated by law and order considerations. This resulted in a variety of Central and State

[34] The following were also included in the extended area: (a) All land belonging to the Cochin Port Trust and any areas reclaimed by the backwaters or the sea that may be reclaimed within the limits specified above and accretion becoming within these limits. (b) All waterways connected to the backwaters within these limits.(c) All land forming part of the main land, Island, etc falling within 45.76 meters (50 yard) of the high water mark along the shore of the backwaters and the sea lying within the port limits specified above. (d) All existing port installations and future constructions like wharves, jetties, bridges etc made for port purposes and for public convenience.

Government declarations and crafting of rules aimed at nationalising certain territories of backwater to facilitate transport and trade.

Nationalisation of water channels was undertaken both by the Central and State Governments for enhancing the movement of cargo and improving the transportation facilities to local communities. The major intervention of the Central Government was in the setting up of the Inland Waterways Authority of India (IWA) which identified 3 important waterways[35], all passing through the Cochin backwater system in Kerala and declared them as national waterways as of February 1st, 1993. All activities that were previously organised over this nationalised routes, hence forth required the permission of this body. The movement of cargo along this waterway was 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.

The second type of intervention was to facilitate economic development in the larger interest of the State/Nation. This often meant exclusive use of estuarine space, ignoring the already existing claims on the space and forced eviction of users. The Kerala Government nationalised major waterways in Cochin backwaters through appropriate notifications to develop the 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.

The State Water Transport Corporation (SWTD) was formed in 1968 under the State Water Transport Department with its headquarters at Alleppy to offer cargo and passenger transportation facilities to the people residing in the

[35] 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.

waterlogged areas of Cochin at cheaper rates as well as navigation services to tourists around the Cochin backwaters[36]. 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, in Ernakulam district, the State Water Transport Corporation took over. The details of routes covered and operations undertaken are given in the table below.

Table 4.16 Details of Routes Covered and Operations Undertaken by the State Water Transport Corporation (SWTC)

Route		No. Of Trips	Distance (km)	Total Distance (km)
1	Kumbalm – Arookutty	8	6	48
2	Arookutty – Edakochi	5	4	20
3	Panavally – Panagad - Edakochi	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 : Administrative Report, SWTD, 1994

[36] The Economic Review (2001) also reported that the Kerala State Water Transport Department (SWTD) operated 12 boats and two jhankars in Ernakulam and carried 216.06 lakhs passengers in 45,260 trips.

Kerala Shipping and Inland Navigation Corporation (KSINCO), which works under the Coastal Shipping and Navigation Department was set up in December 1975 with a capital of Rs.1 crore. The company has been in the field of commercial transportation in Cochin estuary since August 1977. 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 a speed launch. With two barges the corporation is transporting drinking water to the islands of Vypeen and Murukkumpadom[37]. The Corporation undertakes ferry services to 2 major destinations in Ernakulam. The property rights of the Department over these navigation routes were created by different Government orders. The Government declared the Thoppumpady-Marakkadavu-Wellington Island-Ernakulam (Irrigation Jetty) route as a line of navigation under the Travancore Public Canals and Public Ferries Act, 1096 (Act VI of 1096) and Cochin Public canals and Backwaters Navigation Act (Act I of 1092) for starting boat services[38]. Similarly, the Government declared the Ernakulam-Vallarpadam route as a line of navigation under the Travancore Public Canals and Public Ferries Act, 1096 and Cochin Public canals and Backwaters Navigation Act for starting jhankar services[39]. The nationalisation of these routes gave clear cut

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[37] According to the Economic Review, the Kerala Shipping and Inland Navigation Corporation (KSINC) operated 12 boats and two jhankars, which conducted 45,260 trips traveling around 3,78,294 kilometers carrying 66.87 lakhs passengers (Source: Economic Review, 2003).

[38] The Government order G.O. (P). No. 1/02/CSIND and S.R.O. No. 479/2002 dated, 13th June 2002 states that "In exercise of the powers conferred by section 5 of the Travancore Public Canals and Public Ferries Act, 1096 (Act VI of 1096) and section 3 of the Cochin Public Canals and Backwaters Navigation Act, 1092 (Act I of 1092), the Government of Kerala hereby declare the following line of navigation to be subject to the provisions of the said Acts with effect from the date of publication of this notification, namely: "Thoppumpady-Marakkadavu-Wellington Island-Ernakulam (Irrigation Jetty)".

[39] Similarly, the Government order G.O. (P). No. 2/02/CSIND and S.R.O. No. 584/2002dated, 22nd July 2002 states that "In exercise of the powers conferred by section 5 of the Travancore Public Canals and Public Ferries Act, 1096 (Act VI of 1096) and section 3 of the Cochin Public Canals and Backwaters Navigation Act, 1092 (Act I of 1092), the Government of Kerala hereby declare the following line of navigation to be subject to the provisions of the said Acts with effect from the date of publication of this notification, namely: -"Ernakulam-Vallarpadam Island.

rights to these organisations over their navigation channels by over riding the existing claims of traditional resource users.

Both these types of interventions changed the structure of property rights that had existed on wetlands for centuries. In addition, they created new rights as well. Value generation by this new set of resource users was at the stake of the traditional resource users.

4.4.2.3 Backwater Recreation and Tourism Industry

Government of Kerala has crafted policies that promote backwater tourism. Each district has District Tourism Promotion Councils that are very active and are doing commendable jobs in the sphere of tourism service. Since this is a new industry, tourism promotion activities on the part of the Government have resulted in tax exemptions for this industry. Licenses are not required for operation in this field[40]. Local Governments, till date 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 types of packages mainly. There is the City tour, the Sunset tour, Village backwater canal tour and the Houseboat ride. A number of travel agencies also arrange tours in the backwaters. This however

[40] However, the boat crew is required to obtain a driver's license from the Port authorities.

comprises a small part of their total business. Speedboat operators also have a stake in this activity. Their boats are hired both for tourism and transportation purposes. They have fixed rates per hour but no fixed routes. 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 it is noted that modern resource users 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 regularly dredges the water body causing dredging externalities. Modern industries on the other hand emit wastes into the water body causing pollution externalities.

4.5 Summary and Conclusion

The purpose of this chapter was to introduce the natural resource base provided by Cochin wetlands and how different users have appropriated these resources and environment. It also aimed at detailing people's perceptions and the conflicting structure of access rights regarding the wetland resource uses and their economic values.

The study began with a detailed description of the natural resource endowments provided by this brackish water ecosystem. It was argued that the very nature of this system has provided a diversified portfolio of resources. Rights to fish over backwater territories were enforced by the respective gear groups and these territories remained open to other stakeholders to organize their 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, access to this backwater body had appeared to be free, exhibiting characteristics of a free-access property regime. In the case of

pokkali cultivation although fields were private property, water channels were often common property. In, addition, during periods of prawn filtration, due to the very nature of the ecosystem, property became indivisible for a short period of time. Consequently, resource users evolved norms and mechanisms of resource use and sharing. Similarly although traditional ferries had no declared navigation routes, their right of way was not encroached upon by others when using estuarine space.

With the passing away of the monarchy and the creation of the State, new sets of rights were defined in an attempt to generate modern economic values and considerable confusion existed in defining and enforcing such property rights on estuarine environments. First, for law and order purposes, the State created a new set of property rights and rules and regulated access to the wetlands without acknowledging or legalizing the existing rights/ customary rights or management regimes of traditional communities. How different groups appropriate resources and generate economic values within the defined sets of property rights are undertaken in chapters that follow. Due to the limited scope of the study, detailed examination of the institutional dynamics is not undertaken.

ANNEXURE

Annexure 4.1

Distribution of Active Fishing Days per Month in the Cochin Estuary, 2001-02

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Chinese Net	14	15	14	14	12	14	15	16	20	18	18	18
Stake net	18	18	14	14	14	14	15	18	18	18	18	18
Free net	20	20	20	12	12	12	12	22	20	20	20	18

Source: Primary Survey, 2001-02

Annexure 4.2 Panchayat-wise Distributions of Pokkali Paddy Fields in the Cochin Wetlands

Panchayats\Area (ha)	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha)
Zone I							
Kodamthuruthu	160	29	-	45	-	-	234
Kutheathodu	220	-	-	-	-	-	220
Panavally	78	20	-	-	-	-	98
Pattanakad	234	-	-	-	-	-	234
Perumbalam	15	-	-	-	3	-	18
Thuravoor	450	26	42	-	-	-	518
Thycattusserry	16	21	-	-	-	10	47
I Total (ha)	**1173**	**96**	**42**	**45**	**3**	**10**	**1369**
Zone II A							
Aroor	134	18		-	-	-	152
Chellanam	15	532		141	-	-	688
Ezhupunna	19	12		-	-	-	31
Kumbalam	-	130	15	46	-	10	201
Kumbalangy	71	296		50	17	-	434
Maradu	-	94		-	-	-	94
Udayamperoor	-	100		100	-	-	200
II A Total (ha)	**239**	**1182**	**15**	**337**	**17**	**10**	**1800**
Zone II B							
Edavanakad	0	72	-	-	-	-	72
Ezhikkara	92	494	-	-	-	-	586
Kadamakuddy	80	16	8	7	-	26	137
Kottuvally	71	191	334	-	-	-	596
Nayarambalam	0	147	95	-	-	-	242
Njarakkal	4	301	-	7	-	-	312
Varapuzha	57	188	21	-	8	-	274
II B Total (ha)	**304**	**1409**	**458**	**14**	**8**	**26**	**2219**
Zone III A							
Cheranalloor	5	51	3	-	-	-	59
Elankunnapuzha	-	48	53	7	2	-	110
Mulavukad	-	18	7	-	-	-	25
Thripunithura (M)		1	-	-	-	-	1
Cochin Corporation	-	18	0	-	-	-	18
III A Total (ha)	**5**	**136**	**63**	**7**	**2**	**0**	**213**
Zone III B							
Kuzhippilly	294	46	-	2	3	2	347
Pallipuram	12	-	-	-	-	-	12
Parur Muncipality	-	-	43	-	-	-	43
III B Total (ha)	**306**	**46**	**43**	**2**	**3**	**2**	**402**
Grand Total (ha)	**2027**	**2869**	**621**	**405**	**33**	**48**	**6003**

Source: Pokkali Land Development Agency, 2000

Annexure 4.3

Panchayat-wise Distribution of Prawn filtration Fields in the Cochin Wetlands, 2001-02

Panchayat\Class	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha)
ZONE I							
Panavally	-	-	4.0	4.4	-	22.2	30.7
Thykattucherry	1.0	2.0	-	16.1	-	4.0	23.2
Pattanakad	190.3	1.6	88.6	125.0	2.0	0.0	407.5
Thuravoor	1.1		3.6	4.3	6.4	30.2	45.6
Kuthiyathodu	0.4	4.1	7.4	2.8	3.1	103.6	121.5
Aroor	2.4	0.8	3.4	53.0	3.2	214.1	277.0
Total (ha)	**195.2**	**8.5**	**107.1**	**205.7**	**14.8**	**374.2**	**905.3 (15.5%)**
ZONE II A							
Kumbalangy	147.8	101.0	75.1	32.5	29.8	110.8	497.0
Chellanam	30.3	77.1	102.2	97.9	136.4	92.0	535.8
Kumbalam	17.4	13.5	12.7	16.1	12.1	51.2	123.1
Marad	7.1	9.9	32.3	30.7	49.9	44.8	174.7
Udayamperoor	0.8	2.4	8.0	4.8	3.3	47.2	66.5
Ezhupunna	54.1	10.3	81.9	149.6	57.7	374.2	727.7
Total (ha)	**257.5**	**214.2**	**312.1**	**331.6**	**289.2**	**720.2**	**2124.8 (36.4%)**
ZONE II B							
Varapuzha	4.9	20.2	53.6	37.8	21.5	323.0	461.0
Kadamakuddy	205.0	196.0	74.9	64.0	36.9	27.3	604.0
Kottuvally	2.1	7.9	16.9	38.6	25.0	168.8	259.2
Edavanakadu	4.0	18.2	29.0	33.9	22.6	27.0	134.7
Nayarambalam	11.5	12.7	15.9	-	-	32.3	72.4
Njarakkal	18.5	3.9	4.0	-	-	-	26.4
Total (ha)	**246.0**	**258.8**	**194.3**	**174.3**	**105.9**	**578.3**	**1557.6 (26.7%)**
ZONE III A							
Cheranelloor	0.4	0.8	3.6	-	-	95.6	100.4
Elankunnapuzha	6.1	20.5	29.1	32.6	20.2	21.8	130.1
Mulavukad	11.7	5.6	-	3.5	8.0	-	28.8
Thripunithura	29.8	28.0	34.3	48.0	57.3	82.5	279.9
Cochin corporation	0.6	2.6	5.0	8.0	0.0	97.7	113.9
Total (ha)	**48.5**	**57.4**	**72.0**	**92.2**	**85.5**	**297.6**	**653.2 (11.2%)**
ZONE III B							
Vadakkekara	5.2	23.0	22.6	4.8	7.3	5.8	68.7
Ezhikara	29.8	19.0	33.7	56.5	28.0	118.7	285.7
Kuzhipilly	13.1	13.3	6.8	46.6	83.7	76.6	240.0
Total (ha)	**48.1**	**55.3**	**63.1**	**107.8**	**118.9**	**201.1**	**594.4 (10.2%)**
Grand total	**795.4**	**594.2**	**748.5**	**911.6**	**614.2**	**2171.4**	**5835.3**

Source : Pan fish books, Dept. of Fisheries, Kerala Government, 2001

Annexure 4.4

Distribution of Operational Holdings of Aquaculture Farms in the Study Area

Panchayat\Class	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total (ha)
Zone I							
Panavally	-	-	-	2.0	3.2	4.1	9.3
Thykattucherry	5.0	3.5	-	-	-	-	8.5
Pattanakad	0.4	0.6	2.1	-	-	52.4	55.4
Kuthiyathodu	0.3	0.9	2.5	-	-	-	3.7
Aroor	0.5	1.3	1.2	3.6	-	-	6.6
Arookutty	1.0	-	-	-	-	-	1.0
Perumbalam	1.0	1.7	-	-	-	-	2.7
Total (ha)	8.1	8.0	5.7	5.7	3.2	56.5	87.2
Zone II A							
Kumbalam	-	-	-	-	-	19.0	19.0
Kumbalangy	-	-	-	7.3	-	30.7	37.9
Chellanam	9.7	18.0	-	-	-	-	27.7
Udayamperoor	1.6	8.1	6.9	6.5	-	-	23.0
Ezhupunna	1.7	-	1.0	-	-	-	2.7
Total (ha)	31.5	26.1	14.4	20.2	3.7	114.4	210.3
Zone II B							
Varapuzha	1.6	2.4	6.9	4.0	6.9	4.0	25.8
Kadamakuddy	12.9	15.6	19.5	4.7	-	19.9	72.6
Kottuvally	13.0	17.0	-	-	-	-	30.0
Edavanakadu	44.5	2.8	3.2	-	-	-	50.5
Nayarambalam	3.0	4.0	3.0	8.0	-	-	18.0
Njarakkal	2.8	6.3	19.0	35.3	12.0	15.0	90.3
Total (ha)	105.1	48.1	58.4	61.7	20.6	93.3	387.2
Zone III A							
Cheranelloor	1.9	0.5	-	-	-	11.7	14.1
Elankunnapuzha	-	4.0	4.5	-	-	-	8.5
Thripunithura	8.0	14.0	11.7	14.0	16.9	16.0	80.5
Cochin corporation	-	7.0	8.0	9.0	3.0	-	27.0
Total (ha)	49.4	25.5	39.2	38.9	25.2	51.8	230.1
Zone III B							
Chittattukara	-	15.8	15.0	13.0	5.0	0.0	48.8
Total (ha)	0.0	15.8	15.0	13.0	5.0	0.0	48.8
Grand total	**194.1**	**123.5**	**132.7**	**139.5**	**57.7**	**316.0**	**963.6**

Source : Panfish books, Dept. of Fisheries, Kerala Government, 2001

Annexure 4.5

Benefits from Services and Functions of Wetlands

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

Source: Costanza et al. (1998)

Annexure 4.6 Diversity of Mangroves in Cochin Wetlands

Panchayat	Extend of Area (ha)	Species
Arookutty	4	*Rhizophora manonata*
Panavally	1	*Rhizophoar apicutala, Avicennia officinalis*
Aroor	4	*Avicennia officinalis*
Thaneermukkom	5	*Avicennia officinalis*
Chellanam	48	*Avicennia acanthus*
Kumbalangi	92	*Rhizophora illibflora, Avicennia officinalis, Avicennia acanthus, Rhizophor micronatzx*
Edavanakaddu	55	*Candalia caudal, Acanthus ilicifolius, Rhizophora micronatzx*
Njarakkal	10	*Candalia caudal*
Nayarambalam	15	*Acanthus ilicifolius, Rhizophor micronatzx, Rhizophoar apicutala*
Mulavukad	96	*Candalia caudal, Rhizophoar apicutala, Rhizophoar apicutala*
Pallipuram	52	*Rhizophora illibflora, Avicennia officinalis, Avicennia acanthus,*
Kumbalam	7	*Avicennia officinalis, Rhizophoar apicutala*
Maradu	30	*Rhizophoar apicutala, Rhizophora illibflora*
Cochin Corporation	36	*Candalia caudal, Rhizophoar apicutala, Rhizophoar apicutala*
Total	455	

Source : Panfish books, Dept. of Fisheries, Kerala Government, 2001

Annexure 4.7
Distribution of Population around the Cochin Wetlands

Panchayat	Area (Sq Km)	No. of Households	Population			Density of population /sq. km
			Male	Female	Total	
Zone I						
Arookuthy	11.1	2828	7840	7853	15693	1414
Chempu	18.42	3662	9490	9338	18828	1022
Chennam-Pallippuram	25.53	5105	12540	12851	25391	995
Kodamthuruth	10.81	3651	8935	9189	18124	1677
Kuthiyathode	9.8	4266	10658	10932	21590	2203
Maravanthuruthu	15.69	4134	10083	10449	20532	1309
Panavally	19.55	5078	13091	13506	26597	1360
Pattanakkad	15.36	5853	14349	14886	29235	1903
Perumpalam	16.38	1833	4651	4701	9352	571
Thuravoor	19.18	5218	12549	13034	25583	1334
Thyccattussery	13.82	3866	9609	9678	19287	1396
Vaikom	8.73	4309	10732	11056	21788	2496
Vechoor	29.13	3271	7963	8050	16013	550
Thalayazham	22.4	3859	9734	9754	19488	870
T.V.Puram	17.03	3610	9226	9631	18857	1107
Udayapuram	20.15	4748	11932	12104	24036	1193
Total	**273.08**	**65291**	**163382**	**167012**	**330394**	**1210**

Zone II A						
Aroor	15.14	6238	16161	16501	32662	2154
Chellanam	17.6	5955	16408	16570	32978	1874
Ezhupunna	14.08	4511	1115	11518	12633	1607
Kumbalam	20.79	4688	11973	12170	24143	1161
Kumbalangy	15.77	4553	11927	12674	24601	1560
Maradu	12.35	6769	17487	17508	34995	2834
Udayamperur	24.86	5582	14159	14386	28545	1148
Total	**120.59**	**38296**	**89230**	**101327**	**190557**	**1580**
Zone II B						
Nayarambalam	12.19	4240	11313	11853	23166	1783
Njarakal	8.6	4350	11188	11790	22978	2672
Edavanakad	11.25	3645	9571	10060	19631	1747
Ezhikkara	15.27	3335	8447	8754	17201	1126
Kottuvally	20.82	6665	16739	17613	34352	1658
Varapuzha	7.74	4372	10993	11521	22514	2909
Kadamkkudy	12.92	2702	7349	7319	14668	1135
Total	**88.79**	**29309**	**75600**	**78910**	**154510**	**1740**
Zone III A						
Cheranalloor	10.59	4106	10606	10801	21407	2021
Elamkunnapuzha	11.66	8971	23560	24318	47878	4106
Mulavukad	19.27	4248	11017	11305	22322	1158
Thripunithure (M)	18.69	10434	25286	25792	51078	2733
Cochin Corporation	94.88	108924	283432	281157	564589	5951
Total	**155.09**	**136683**	**353901**	**353373**	**707274**	**4560**
Zone III B						
Chittattukara	9.46	4830	12244	13076	25320	2677
Kuzhippilly	7.73	2325	5550	5896	11446	1481
Pallippuram	16.66	7831	20107	20993	41100	2467
Vadakkakala	11.25	6196	15004	16262	31266	2779
Paravur (M)	9.02	5450	13596	14310	27906	3094
Total	**54.12**	**26632**	**66501**	**70537**	**137038**	**2532**
Grand Total	**691.67**	**296211**	**748614**	**771159**	**1519773**	**2197**

Source: Department of Economics & Statistics, Government of Kerala, 2001

Annexure 4.8
Distribution of Active Fishermen by Different Gears in Cochin Wetlands, 2001-02

Active Fishing Households													
	Chinese net (Cheena vala)	Stake net (Oonni vala)	Cast net (Veeshu vala)	Gill N et (Vysali vala)	Seine net (Kolli vala)	Hooks & line (Choonda)	Trap net	Scoop net	Drag net	Ring net	Others	Sub Total	Total
			G 1	G 2	G 3	G 4	G5	G6	G7	G8	G9	G1-G9	
I	373	905	772	1025	356	73	508	91	385	407	419	4036	**5314** (28.5%)
II A	404	945	1542	1696	86	68	91	145	115	89	232	4064	**5413** (29.1%)
II B	159	165	278	377	41	43	9	366	158	46	86	1404	**1728** (09.3%)
III A	210	1326	510	910	25	143	47	63	85	129	235	2147	**3683** (19.8%)
III B	204	494	379	875	49	38	52	87	64	61	152	1757	**2455** (13.2%)
Total	**1350**	**3835**	**3481**	**4883**	**557**	**365**	**707**	**752**	**807**	**732**	**1124**	**13408**	**18593** (100%)
	(7.3%)	(20.6%)	(18.7%)	(26.3%)	(3.0%)	(2.0%)	(3.8%)	(4.0%)	(4.3%)	(3.9%)	(6.0%)	(72.1%)	(100%)

Source: Primary Survey, 2001-02

Annexure 4.9

Distribution of Pokkali Cultivating Households in Cochin Wetlands

Zones	Size of holdings (ha)	Area under cultivation (ha)	No. of households
I	0 to .5	1173	3071
	0.5 to 1	96	223
	1 to 2	42	29
	2 to 3	45	2
	3 to 4	3	1
	> 4	10	3
	Total	**1369**	**3329**
II A	0 to .5	239	768
	0.5 to 1	1182	1438
	1 to 2	15	257
	2 to 3	344	0
	3 to 4	17	3
	> 4	10	2
	Total	**1800**	**2475**
II B	0 to .5	304	544
	0.5 to 1	1409	2124
	1 to 2	458	395
	2 to 3	17	0
	3 to 4	8	2
	> 4	26	5
	Total	**2219**	**3073**
III A	0 to .5	5	4
	0.5 to 1	136	110
	1 to 2	63	95
	2 to 3	13	0
	3 to 4	2	0
	> 4	0	0
	Total	**213**	**215**
III B	0 to .5	306	1158
	0.5 to 1	46	2
	1 to 2	43	52
	2 to 3	4	0
	3 to 4	3	2
	> 4	2	2
	Total	**402**	**1218**
	GRAND TOTAL	**6003**	**10310**

Source: Pokkali Land Development Agency, 2000

Annexure 4.10 Distribution of Prawn Filtration Households by Size of Holdings the in Cochin Wetlands, 2001-02

	0 to .5	0.5 to 1	1 to 2	2 to 3	3 to 4	> 4	Total
Zone I							
Panavally	-	-	3	2	-	2	**7**
Thykattucherry	4	3	-	8	-	1	**16**
Pattanakad	600	2	52	103	3	0	**760**
Thuravoor	3	-	5	5	3	3	**19**
Kuthiyathodu	1	360	117	1	1	37	**517**
Aroor	8	1	2	16	1	19	**47**
Total	**616**	**366**	**179**	**135**	**8**	**62**	**1366**
ZONE II A							
Kumbalam	55	18	8	5	4	3	**93**
Marad	15	12	20	12	11	6	**76**
Kumbalangy	319	131	50	15	10	22	**547**
Chellanam	61	86	55	33	25	16	**276**
Udayamperoor	2	3	5	2	1	6	**19**
Ezhupunna	94	12	45	65	19	50	**285**
Total	**546**	**262**	**183**	**132**	**70**	**103**	**1296**
ZONE II B							
Varapuzha	22	23	37	15	6	36	**139**
Kadamakuddy	421	268	43	22	11	6	**771**
Kottuvally	6	9	12	17	7	23	**74**
Edavanakadu	8	27	17	14	7	5	**78**
Nayarambalam	54	20	24	-	-	2	**100**
Njarakkal	82	6	4	-	-	-	**92**
Total	**593**	**353**	**137**	**68**	**31**	**72**	**1254**
ZONE III A							
Cheranelloor	1	1	3	-	-	4	**9**
Elankunnapuzha	8	27	17	14	7	5	**78**
Thripunithura	67	32	18	17	17	10	**161**
Cochin corporation	2	4	3	3	-	7	**19**
Mulavukad	43	7	-	3	2	-	**55**
Total	**121**	**71**	**41**	**37**	**26**	**26**	**322**
ZONE III B							
Vadakkekara	12	33	17	2	2	1	**67**
Ezhikara	95	26	22	22	8	11	**184**
Kuzhipilly	29	17	6	19	21	13	**105**
Total	**196**	**76**	**58**	**54**	**39**	**33**	**456**
Grand total	**2072**	**1128**	**597**	**427**	**174**	**296**	**4694**

Source : Panfish books, Dept. of Fisheries, Kerala Government, 2001

CHAPTER 5

Direct Economic Values of Cochin Wetlands

A number of modern enterprises, in addition to traditional communities like fishermen and farmers, use biological resources and environmental services of Cochin wetlands today to produce various goods and services. These goods and services produced from the wetland are valuable to the society and the objective of this chapter is to provide estimates of the direct values generated by these economic activities from the Cochin wetlands. Following the taxonomy presented in chapter 3, the direct net revenues (values) of traditional activities like capture fisheries, pokkali agriculture, prawn filtration, traditional ferry services and clam fishery are estimated in section 1. In section 2, the revenue generated by modern activities is calculated. Section 3 summarizes the value of total direct benefits generated by the Cochin wetlands for the year 2001-02 and section 4 provides the summary and conclusion. The estimation of tourism values of Cochin backwaters and the indirect benefits are estimated in chapters 6 and 7 respectively.

5.1 Value Generated by Traditional Resource Users

The major traditional users of the Cochin wetlands are the fishing communities and farmers. Some of them are engaged in prawn filtration too. A number of them are engaged in clam fishing while the womenfolk are engaged in clam meat processing and shell sales. All these activities were monitored during the year 2001-02 and the corresponding economic values estimated. The results are presented below.

5.1.1 Economic Value Generated by Capture Fisheries of Cochin Wetlands

Fishery is the single largest traditional economic activity undertaken on the Cochin wetlands. Today, 18593 households are engaged in active fishing in Cochin estuary. 38 percent of this is based in zone II, 33 percent in zone III and 29 percent of households are located in zone I.

5.1.1.1 Production and Productivity of Capture Fisheries of Cochin Wetlands

Wetlands provide diverse species of fin and shellfishes when compared to other ecosystems. As detailed in chapter 4, Kurup (1982) reported the presence of at least 150 species during the early eighties in the Cochin wetlands while the present study identified the presence of 73 species of fin fishes and 8 species of shell fishes in the Cochin wetlands[1]. This diversity is harvest by fishermen using a variety of gears. It is reported that during the sixties, fishermen were using as many as 37 different types of gears[2] for fishing in this estuary, which has now been reduced to about 15 types. The best fishing season in Cochin backwaters is between December and May and the average number of fishing days ranged between 12 and 20[3].

The popular gears used currently are the Chinese net, the stake net, the gill nets, caste net, seine net, ring net, trap net, scoop net, the hook and line etc[4] (Table 5.1). Free nets dominate in zone I, II B and III A. As seen from the gear distribution table above, free nets dominate in zone I, II B and III A. The

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[1] The difference in the number of species identified may be due to differences in sampling methods.

[2] See Annexure 5.1 for details.

[3] See Annexure 5.2 for details.

[4] Annexure 5.3 gives the details of different gears in each of the five zones.

landing per gear was greater for fixed nets compared to free nets. All round, production activities in zone II B seemed to be lagging behind.

Table 5.1 Distribution of Gears in Different Zones of the Cochin Wetlands, 2001- 02

	Chinese Net (Cheena vala)	Stake net (Oonni vala)	Free Nets	Total	
I	510	994	6799	**8303**	(36.8%)
II A	374	1022	2903	**4299**	(19.1%)
II B	316	409	2423	**3148**	(14.0%)
IIIA	316	290	2383	**2989**	(13.3%)
IIIB	374	922	2503	**3799**	(16.9%)
Total	**1890**	**3637**	**17011**	**22538**	**(100%)**
	(8.4%)	(16.1%)	(75.5%)	(100%)	

Source: Thomson (2003)

Average yield per hectare[5] of the brackish water body was estimated as a measure of productivity (table 5.2 and 5.3).

Table 5.2 Distribution of fish landings per Day in Cochin wetlands, 2001- 02 (Kg)

ZONE	Chinese Dip Net	Stake Net	Cast Net	Gill Net	Seine Net	Hooks & Line	Trap Net	Scoop Net	Drag Net	Ring Net	Other Gears
I	4.25	4.54	3.28	3.76	3.13	1.09	1.64	1.24	3.75	2.98	1.48
II A	6.99	14.17	11.24	9.16	3.99	4.50	6.82	2.90	4.74	2.07	1.87
II B	3.08	2.51	3.03	3.60	1.97	1.45	1.37	3.41	3.21	3.01	0.27
III A	9.20	6.76	5.99	6.88	3.69	4.50	7.66	2.90	2.13	2.07	0.45
III B	8.41	7.59	4.05	5.10	4.28	2.73	2.18	0.88	1.68	0.96	2.20

Source: Thomson (2003)

[5] Two simple bench marks were used to measure productivity. First the yield per net per day for the selected zones of the Cochin wetlands was calculated. Average yield per hectare of the brackish water body was also estimated as a second measure of productivity.

Table 5.3 Distribution of Fish productivity by Zones in the Cochin wetlands, 2001- 02

Zone	Production (Tonnes)		Area (ha)	Productivity/ha. (Kg)
I	4331.4	(23.5 %)	6044	716.6
II A	6598.2	(35.8 %)	4150	1589.9
II B	1490.7	(08.1 %)	2363	631.0
III A	2882.6	(15.6 %)	2468	1168.0
III B	3151.4	(17.1 %)	975	3232.2
Total	18454.3	(100 %)	16000	1153.4

Source: Thomson (2003)

It is seen from table 5.2 above that the average catch per day in zone II B is significantly lower than the yield per day per net in other zones. It may be mentioned that this zone receives the largest quantity of industrial effluence. The lowest productivity of Chinese nets was recorded in zone II B and the highest in zone III A. Chinese nets performed much better than the Stake nets in zone II B, III A and III B. Cast net and gill net catch per net were highest in zone II A and lowest in zone II B. In the case of other gears also, zone II B performed much worse than other zones.

Although total production was highest in zone II A, productivity per hectare was highest in zone III B (table 5.3). The lowest productivity is recorded in Zone II B, which again reinforces the earlier findings that fishing has been affected directly by the activities of industries that pollute the brackish water body. Table 5.4 below gives the detailed distribution of total fish landings (by gear) in the Cochin wetlands. Total fish production in the Cochin wetlands during the year 2001-02 was 18454 tonnes. Zone II A contributes the most and zone II B marginally.

Table 5.4 Distribution of Fish Landings by Gear in the Cochin Wetlands, 2001- 02

ZONE	Chinese Dip Net	Stake Net	Cast Net	Gill Net	Seine Net	Hooks & Line	Trap Net	Scoop Net	Drag Net	Ring Net	Other Gears	Total (Tonnes)
I	364.2	758	721.6	1115.8	308.4	16.3	170.7	24.1	373.5	425.5	53.3	**4331.4** (23.5%)
II A	439.3	2432.7	1877.8	1401.3	65.6	40.5	95.5	56.5	94.5	47.9	57.1	**6608.7** (35.8%)
II B	163.3	172.5	269.7	602.2	28.1	16.6	2.1	99.9	50.4	80.5	5.4	**1490.7** (8.1%)
III A	488.5	329.5	358.1	1470	3.7	90.2	27.6	27.5	8.2	65.6	13.8	**2882.7** (15.6%)
III B	528.4	1175.1	404.6	780.9	70.5	24.5	27.2	17.2	33.4	22.2	67.4	**3151.4** (17.1%)
Total	**1983.7** (8.4%)	**4867.8** (24.2%)	**3631.7** (22.7%)	**5370.2** (33.5%)	**476.3**	**188.1**	**312.8**	**225.2**	**560**	**641.7**	**197**	**18455 (100%)** (100 %)

Source: Thomson (2003)

5.1.1.2 Economic Value Generated from Fishery Resources

The price of different species varied according to their availability. In the case of commercially important fin fishes, its weight determined the price while in the case of shell fishes, the count determined price.

Total value generated from fish production in the Cochin wetlands during the year 2001-02 was Rs.9825 lakhs[6]. Of the value generated, zone I contributed the most followed by zone II A. Table 5.5 and 5.6 give a summary of the gross and net value generated by estuarine capture fisheries of the Cochin wetlands during the survey year.

Total value generated in the Cochin wetlands from fish production, net of all cost during the year 2001-02 was Rs.8356 lakhs. Of this zone I contributed the most. All the other gears contributed marginally to the total output. The contribution of fixed nets when compared to that generated by free nets can be explained by the high value species that are caught by fixed nets. Free nets in zone I and fixed nets in zone II A contributed the most.

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[6] The price data collected for the present study were monthly landing centre prices. Economic value of individual species with corresponding price data were collected and then aggregated to arrive at the total value generated by fishery in the Cochin wetlands.

Table 5.5 Distribution of Gross Value Generated by Gear in the Cochin Wetlands, 2001-02 (Rs Lakhs)

ZONE	Chinese Dip Net	Stake Net	Cast Net	Gill Net	Seine Net	Hooks & Line	Trap Net	Scoop Net	Drag Net	Ring Net	Other Gears	Total (Rs. Lakhs)
I	445.8	576.2	489.7	738.7	182.9	23.6	173.4	29.9	221.3	201.6	54.3	**3137.4**
II A	308.5	992.8	449.4	550.7	38.2	17.4	33.2	30.2	30.6	30.9	40.4	**2522.3**
II B	217.9	99.0	157.2	373.9	23.6	5.4	1.8	96.4	6.5	27.8	14.6	**1023.8**
III A	294.1	70.2	129.1	865.9	1.8	22.7	4.5	8.8	1.6	14.9	7.8	**1421.3**
III B	343.0	631.3	274.1	340.3	20.7	2.5	10.4	11.4	12.7	14.4	58.9	**1719.7**
Total	1609.3 (16.4%)	2369.5 (24.1%)	1499.4 (15.3%)	2869.6 (29.2%)	267.2	71.5	223.2	176.6	272.7	289.6	176.0	**9824.6** (100 %)

Source: Thomson (2003)

Table 5.6 Distribution of Net Value Generated by Gears in the Cochin Wetlands, 2001-02 (Rs. Lakhs)

ZONE	Chinese Dip Net	Stake Net	Cast Net	Gill Net	Seine Net	Hooks & Line	Trap Net	Scoop Net	Drag Net	Ring Net	Other Gears	Total (Rs. Lakhs)
I	343	512	374	631	155	23	142	24	192	162	45	**2603** (31.2%)
II A	245	937	373	507	34	17	30	26	25	25	33	**2252** (27%)
II B	134	79	108	328	20	5	2	91	3	22	12	**804** (9.6%)
III A	224	56	89	752	2	21	3	6	1	8	4	**1166** (14%)
III B	290	594	234	306	17	3	7	8	8	8	56	**1531** (18.3%)
Total	**1236** (14.8%)	**2178** (26.1%)	**1178** (14.1%)	**2524** (30.2%)	**228**	**69**	**184**	**155**	**229**	**225**	**150**	**8356** (100%) (100 %)

Source: Thomson (2003), Primary Survey, 2001-02

Table 5.7 Distribution of Productivity and Performance Indices of Different Fishing Zones in the Cochin Wetlands 2001-02.

Zone	Net Revenue (Lakhs Rs.)	Fishing Area (ha)	Value/ha/year (Rs.)	Value/net	Active Fishermen	Fishing days	Value/net/ day	Value/ ha/year (Rs.)	Value/ ha/day (Rs.)
I	2602 (31.1%)	6044	43052	4129.52	5314	146	214	43052	295
II A	2253 (27.0%)	4150	54286	5700.33	5413	146	358	54286	371
II B	804 (09.6%)	2363	34025	4247.73	1728	150	170	34025	227
III A	1166 (14.0%)	2468	47241	7500.01	3683	145	269	47241	326
III B	1531 (18.3%)	975	157013	7631.64	2455	146	276	157013	1074
Total	**8356 (100%)**	**16000**	**52226**	**29209.22**	**18593**	**147**	**253**	**52226**	**356**

Source: Thomson (2003), Primary Survey, 2001-02

The summary statistics on value per hectares in different zones of the Cochin wetlands (table 5.7) revealed that net revenue was highest in zone I although the value generated per hectare was highest in zone III B. As expected, the lowest revenue generated was in zone II B.

A comparative analysis of the activities of different fishing zones (table 5.8) revealed that the value per net per day for the whole region was estimated as Rs.253. Higher values are realized in zone III B and in zone II A. The lowest value/ha/day was recorded in zone II B which is the area experiencing the highest level of fish and shellfish diversity degradation

Although species diversity is important and has non-use value to many, market values do not reflect these in most cases. Commercially non-important fish species (by-catch) carry very low prices. They have a market either as feed or dry fish and hence it is not very difficult to arrive at a value figure for them. They are sold in assorted bulks at rates as low as Rs.10 per kilo. Certain species are even discarded. It has to be acknowledged that this does not reflect the true value of the fish species. Illegal gears, small mesh size, and external intervention often damage the ecosystem and kill juveniles. Hence, the contingent valuation study was also used to elicit the economic significance of this loss (see Annexure 8.1, question number 4).

5.1.2 Economic Value Generated by the Agricultural Community

From times immemorial, agriculturists have always been the most prominent users of the low-lying fields adjacent to the backwaters that were suitable for the cultivation of a salt resistant variety of paddy known as the Pokkali paddy[7]. Pokkali cultivation is undertaken during the months of April to September when the low-lying fields are drained of brackish water and the bunds strengthened to prevent saline water intrusion. The fields are prepared for the rains, which wash away the salinity of the soil and make it suitable for pokkali cultivation. As mentioned earlier, Pokkali cultivation requires no fertilisers or additional inputs. The natural manure from the prawn filtration activities is sufficient for this crop. Thus, pokkali farmers were able to organise this activity with a minimum of investments and with the help of the tidal and nursery functions performed by wetlands, generate decent economic surplus from the system.

5.1.2.1 Production and Productivity of Pokkali Paddy Cultivation Around the Cochin Wetland Settlement

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, an attempt was made to value the revenue generated from this activity in the study area. The study was conducted during the pokkali season from May/June onwards.

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, an attempt was made to value the revenue generated from this activity in the study area.

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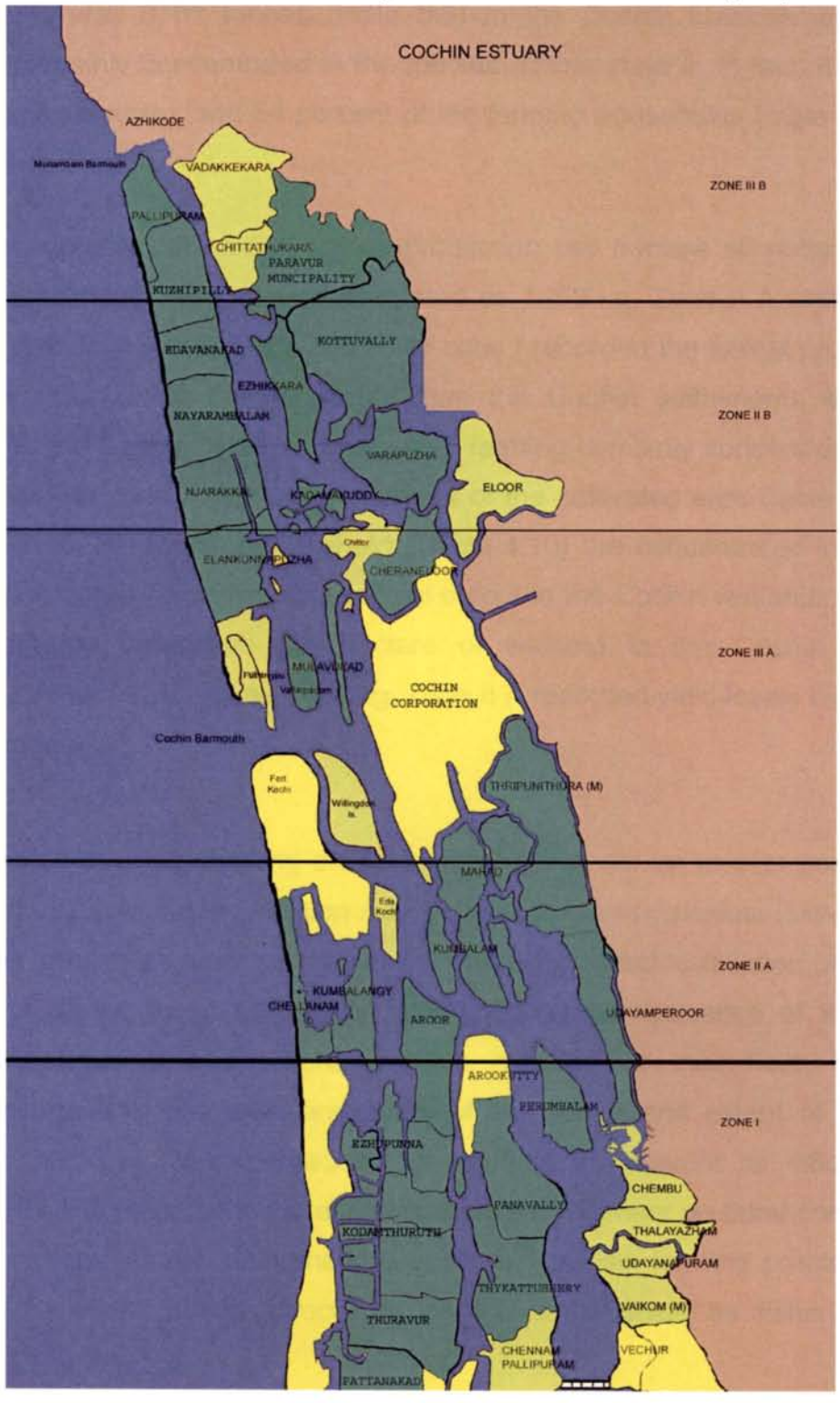
[7] See map 5.1 for details. The areas shaded green represents distribution of pokkali paddy fields in different panchayats in the study area.

Map 5.1 Distribution of Pokkali Paddy Fields in Different Panchayats, 2001-02



The study showed that the annual production of pokkali paddy from the Cochin settlements was 8781 tonnes (table 5.8) In the Cochin brackish watershed, farming is mainly concentrated in the medium-saline zone II. In fact, 67 percent of the cultivated area and 54 percent of the farming households (table 4.10) are concentrated in this belt.

The average level of pokkali paddy production per hectare of wetland in the Cochin brackish watershed was estimated as 1463 kg. Zone II A recorded the highest yield followed by zone II B while zone I recorded the lowest productivity. *Annual production* of pokkali paddy from the Cochin settlements was 8781 tonnes. In the Cochin brackish watershed, farming is mainly concentrated in the *medium-saline zone II. In fact, 67 percent of the cultivated area (table* 5.8) and 54 percent of the farming households (table 4.10) are concentrated in this belt which contributed 70 percent of the total output in the Cochin wetlands. Average pokkali paddy production per hectare of wetland in the Cochin brackish watershed was estimated as 1463 kg. Zone II A recorded yield levels higher than the average[8].

The practise of group farming and local institutional set up to over come the ill *effects of industrial water pollution may be the reason why pokkali cultivation still* manages to produce such high yields in zone II B. Pokkali cultivation particularly in zone II B seems to be largely unaffected by the presence of the Eloor-Manjumal industrial belt. There are two reasons for this. First, the local padashekarams of this area are aware of the nature and extent of industrial pollution and have taken adequate precautions to prevent its influence on farming. This is reflected in increased collective investment on bund construction and its prompt annual maintenance. Secondly, pokkali farming practise is not affected by water quality directly or on the same scale as fishery. Hence

[8] Annexure 5.4 gives a detailed table on production and revenue generated in each zone by size of operational holdings.

collective action to monitor water quality to detect excessive levels of pollutants that may affect farm productivity helps. They even organise agitations against large polluting industries and mobilise public voice which prevents the polluters to accumulate effluents in this zone. This may not stop pollution, but constant monitoring does help the farmers to organise production activities when pollution levels are comparatively lower.

Table 5.8 Distributions of Production and Revenue Generated By Pokkali Paddy in the Cochin Wetlands, 2001-02

Zone	Area under cultivation (ha)	Production (Tonnes)	Production per hectare (Tonnes)	Total revenue (Lakhs Rs.)		Net Value Generated (Lakhs Rs.)		Net Value per hectare (Rs.)
I	1369	1771.8	1.29	123.90	(20%)	64.89	(22.1%)	4740
II A	1800	3024.6	1.68	211.52	(34.2%)	132.47	(45.1%)	7359
II B	2219	3141.2	1.42	224.99	(36.3%)	67.96	(23.2%)	3063
III A	213	296.6	1.39	20.53	(3.3%)	10.37	(03.5%)	4868
III B	402	547.3	1.36	38.31	(6.2%)	17.73	(06.0%)	4410
TOTAL	**6003**	**8781.4**	**1.46**	**619.25**	**(100%)**	**293.42**	**(100%)**	**4888**

Source: PLDA (2000), Thomson (2003), Primary survey, 2001-02

5.1.2.2 Economic Value Generated by Pokkali Paddy Production

Annual gross value generated by pokkali paddy from the Cochin wetlands was Rs.619 lakhs, three fourth of which was contributed by zone II. Pokkali cultivation in the bar mouth zone III generated very low values. This is not very surprising given that the area under cultivation is less and the geographic and hydro-biological conditions of the region are not conducive for very high yields. The *annual net value* generated by pokkali paddy from the Cochin wetlands was Rs.293 Lakhs. Reclassifying this data by different class holdings in the Cochin wetlands, it is seen that land holdings between 0.5 and 1 hectare contributed more than half of the total value generated.

Table 5.9 Distribution of Value of Paddy Generated by Different Class Holdings in the Cochin Wetlands, 2001-02

Size of Holdings (ha)	Total Value Generated (Rs. Lakhs)					
	I	II A	II B	III A	III B	Total
0 to .5	58.6	6.5	5.6	0.2	13.2	**84.1** (28.7%)
0.5 to 1	3.3	93.7	49.5	6.7	1.2	**154.3** (52.6%)
1 to 2	1.1	1.5	11.9	3.0	3.0	**20.5** (7.0%)
2 to 3	1.6	28.7	0.3	0.3	0.1	**31.0** (10.6%)
3 to 4	0.1	1.4	0.2	0.1	0.1	**1.8** (0.6%)
> 4	0.2	0.8	0.6	0.0	0.1	**1.7** (0.6%)
Total	**64.9**	**132.5**	**68.0**	**10.4**	**17.7**	**293.4 (100%)**
Value per ha. (Rs.)	4740	7359	3063	4868	4410	4888

Source: PLDA (2000), Thomson (2003), Primary survey, 2001-02

Although the production, productivity and earning study above shows pokkali cultivation to be reasonably profitable, pokkali farmers often complain that this

activity is not a very profitable one. Most often the reason is that compared to prawn filtration, its profitability is very low. Still majority of the farmers undertake this activity for a number of reasons. First of all, the Government of Kerala through its Punja Act[9] has made it compulsory for pokkali cultivators to cultivate both crops (paddy and prawn filtration) during a year. Failure to comply often means suspension of subsidy or such other forms of assistance from the Government. Secondly, prawn cultivation as is shown later in the chapter is an immensely profitable enterprise and any profit made is more than enough to compensate for low profits made during pokkali cultivation. Thirdly, pokkali cultivation subsidises the cost of production of prawn filtration particularly that of prawn feeds to a great extent. Due to a combination of all these reasons, crop rotation is still undertaken in the study area.

5.1.3 Economic Value Generated by the Prawn Filtration Farmers

During the six months from October to March, these seasonal fields 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, these fields are suitable for prawn filtration and the process of tidal functions delivered a large quantity of prawn and fish seedlings, nutrients as well as waste dissemination through change of water. These services are provided by the wetlands free of cost and helps organise an economically profitable activity at very low levels of investments.

Shell fishes are abundant during December to March and less during September to October. The production level often depends on factors such as geographical

[9] With cultivation of paddy in low lying wetlands around the backwaters facing a lot of difficulties, the majority of agriculturists are turning their lands to prawn culture round the year. Many people keep land barren due to externalities and lack of incentives for collective farming. In order to resolve this crisis, the Government passed the Punja Act according to which paddy cultivation had 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 was vested with special powers to take action against farmers who violated this rule.

position of the backwater, nearness to open backwater channels, the physico-chemical properties of the tidal waters, tidal amplitude, quality of bottom soil etc. According to George (1974), average prawn yields from fields in the Cochin wetlands through the 1950's had been over 1180 kg/ha. In the 1960's and 1970's, production levels declined to 600-700 kg/ha and by the 1980's and 1990's it had fallen to 300-600 kg/ha. In addition, to this decline in production, the decrease in contribution of *P. indicus* to the total catch also affected this economic activity greatly. Therefore farmers today do not depend on the estuary alone for seedlings during the period of prawn filtration. They also resort to stocking hatchery-reared seedling of *Penaeus monodon* and *Penaeus indicus*. In the pokkali fields of Cochin, *Metapenaeus dobsoni* constitutes more than 50 percentage of total catch although *Penaeus monodon* is the major species cultured with *Penaeus indicus* in second place.

5.1.3.1 Production and Productivity of Prawn Filtration Farms in the Cochin Wetlands.

As mentioned earlier, the six months after pokkali paddy harvest, prawn filtration is undertaken in the paddy fields. 5835.29 hectare of prawn filtration fields and ponds were cultivated during the period 2001-02.

In order to assess the economic importance of this activity, an attempt was made to value the production and revenue generated from this activity in the study area. *Annual production* from prawn filtration in the Cochin settlements was 2702 tonnes (table 5.10) more than half of which was contributed by zone II. *Average production per hectare* of prawn filtration farms was estimated as 463 kg. Zone II A recorded the highest yield per hectare, while zone II B recorded the lowest. As in the case of pokkali cultivation, here also, strong institutional arrangements may be the reason why prawn filtration productivity has not been seriously affected by industrial pollution.

5.1.3.2 Economic Value Generated by Prawn Filtration Activities in Cochin Wetlands

The study also showed that the *annual value*[10] generated by prawn filtration from the Cochin wetlands was Rs.1341 lakhs majority of which was contribute by zone II (table 5.10). The *annual net value* generated was Rs.575.08 Lakhs. Here also zone II accounted for most of it. The *average net value* generated per hectare was estimated at Rs.9855. Zone I and II A generated per hectare values above average.

[10] Annexure 5.5 gives details on prawn filtration production and revenue generated in each zone by size of operational holdings.

Table 5.10 Distribution of Production and Revenue Generated By Prawn Filtration in the Cochin Wetlands, 2001-02

Zone	Area used for filtration activities (ha)	Production (Kg)	Production per hectare (Kg)	Total revenue (Lakhs Rs.)	Net Value Generated (Rs. Lakhs)	Net Value per hectare (Rs.)
I	905.33	404820.8 (15.0%)	447.2	203.10	106.70 (18.55%)	11785
II A	2124.75	1124075.3 (41.6%)	529.0	591.71	262.41 (45.63%)	12350
II B	1557.64	632315.6 (23.4%)	405.9	302.71	112.40 (19.54%)	7216
III A	653.17	288328.3 (10.7%)	441.4	121.34	50.88 (8.85%)	7789
III B	594.40	252315.1 (9.3%)	424.5	122.18	42.70 (7.43%)	7184
TOTAL	5835.29	2701855.0 (100%)	463.0	1341.04	575.09 (100%)	9855

Source: Master Pan Fish book I, Dept. of Fisheries, Kerala, 2002; Thomson (2003), Primary survey, 2001-02

Reclassifying this data by different class holdings in the Cochin wetlands (table 5.11) it was interesting to note that land holdings of size either less than half a hectare or more than 4 hectares contributed greatly to this.

Table 5.11 Distribution of Value Generated from Prawn Filtration Activities by Different Class Holdings in the Cochin Wetlands, 2001-02. (Rs. Lakhs)

Size of Holdings (ha) \Zones	I	II A	II B	III A	III B	Total (Lakhs Rs.)
0 to .5	11.3	96.9	14.2	13.1	6.5	**141.9** (24.7%)
0.5 to 1	0.1	64.8	2.9	6.1	3.1	**77.1** (13.4%)
1 to 2	4.8	11.3	19.4	5.4	4.7	**45.6** (7.9%)
2 to 3	12.2	11.6	11.7	6.8	5.7	**48.0** (8.3%)
3 to 4	1.2	28.8	4.9	5.0	8.3	**48.2** (8.4%)
> 4	77.1	48.9	59.4	14.4	14.5	**214.2** (37.3%)
Total	**106.7**	**262.4**	**112.4**	**50.9**	**42.7**	**575.1** (100%)

Source: Thomson (2003), Primary survey, 2001-02

5.1.4 Economic Value Generated by Traditional Ferry Services in the Cochin Wetlands

Ferry services have provided direct employment and useful navigation services to the local population from time immemorial. The value generated in traditional ferry services is given in Table 5.12. It is seen from the table that the total revenue generated by the traditional ferry services in the Cochin wetlands was Rs 83.7 lakhs[11].

[11] Annexure 5.6 gives details of the distribution of Clam Production in the Cochin wetlands during 2001-02.

Table 5.12 Distribution of Value Generated by Traditional Goods Ferry Services in the Cochin Wetlands, 2001-02

	Revenue / *trip*	No. of *trips*	No. of Boats	Total Revenue (Rs. Lakhs)	Total Cost	Net Revenue (Lakhs Rs.)
Type I Ferry	1532	289	21	31.63	102787	30.60 (38.0%)
Type II Ferry	1633	371	15	29.90	136559	28.53 (35.4%)
Type III Ferry	5000	92	6	09.24	34192	8.90 (11.0%)
Motor Dingy	2513	103	15	12.88	38815	12.49 (15.5%)
Total	**10678**	**855**	**57**	**83.65**	**312353**	**80.52 (100%)**

Source: Thomson (2003), Primary survey, 2001-02

The net revenue generated was Rs. 80.52 lakhs and of this, 73 percent was generated by the small ferry boats (type I and II) of less than 8 Kv (*Kevubharam*) in size.

5.1.5 Economic Value Generated by Clam Fishery and Lime Shell Collection

Clam fishery is not a dominant activity in the Cochin wetlands. *Villorita cyprinoides var. cochinensis is the most dominant species* of clam from the lake. In the Cochin backwaters, it is found in areas, where the annual variation in salinity is between zero and twenty three percentage. The exploitation of clams is a year round practice particularly during the post monsoon and pre monsoon periods. The December to June (January being the peak season) is the ideal harvest period as far as the domestic consumption is concerned. This is the period when the clams have high protein or lipid contents and comparatively little water content. The model class of the clams exploited from the lake is represented by 15-19 mm or 20-24 mm. The average annual catch per hectare of the lake worked out as 334 kg. Almost half of the clam exploited from the lake is

accounted for from the southern region (Thannermukkom to Allepey) and the rest from the northern region (Allepey to Cochin). The major clam fishing centres along the study area are Kumbalangy Kallenchery, Aroor, Ezhupunna, Udayamperur, Perumbalam etc. Table 5.13 shows clam production in the Cochin wetlands during the year 2001-02.

Table 5.13 Distribution of Clam Production in the Cochin wetlands, 2001-02

	Qty *Landed* (Tonnes)	Qty of Meat *Sold* (tonnes)	Revenue Received from Meat (Lakhs Rs.)	Qty. of Shell Sold (Tonnes)	Revenue Received from Shell (Lakhs Rs.)	Gross Revenue Generated (Lakhs Rs.)	Net Revenue *Received* (Lakhs Rs.)
Pre Monsoon	4452.8	1113.2	76.8	151.1	3.8	81	61
Monsoon	5056.7	769.3	52.3	216.0	7.6	60	31
Post Monsoon	7743.1	1490.6	107.3	282.6	7.1	114	83
Grand Total	**17252.6**	**3373.0**	**236.4**	**649.7**	**18.4**	**255**	**174**

Source: Thomson (2003), Primary survey, 2001-02

The total value generated from clam fishery activities in the Cochin estuary net of all cost was Rs. 174 lakhs. Half of this was generated during the post monsoon period. Clam fishery during the monsoon season is comparatively not as productive.

5.1.6 Value Generated by the Traditional Resource Users of the Cochin Wetlands.

So far, the study explained the activities of the traditional resource users and calculated the gross livelihood potentials of these groups using simple calculations of the economic value realized by these groups by selling their products in the already existing markets.

Table 5.14 Total Net Value generated by the traditional resource users of the Cochin wetlands, 2001-02

Fishery	Agriculture	Prawn Filtration	Clam & Lime Shell collection	Traditional Ferry	Total (Rs. lakhs)
8356	293.42	575.1	174	80.53	9479.05
(88.2%)	(3.1%)	(6.1%)	(1.8%)	(0.9%)	(100%)

Source: Thomson (2003), Primary survey, 2001-02

Despite the limitations of this methodology, the results are revealing on many grounds. As Table 5.15 above shows, these activities are still valuable to traditional communities and the tendencies towards degradation have to be regulated immediately.

The study will now discuss how the modern resource users generate values using resources and environment of the wetlands.

5.2 Value Generated by Modern Entrants

As pointed out in chapter 4, the entry of new resource users and the subsequent creation of property rights for organizing new sets of activities affected the resource appropriation and value generation processes of traditional users. This section looks at the value generation by different modern users. Three activities (aquaculture, port trust and navigation) are selected for detailed examination.

5.2.1 Value Generated by Aquaculture Activities

Aquaculture has developed rapidly over the last three decades to become an important economic activity in this region. The exploitation of a natural or artificial body of water for the growth of food products such as fish, molluscs and seaweed is referred to as aquaculture[12]. Most of the farms in this region are under traditional/ modified prawn filtration practices, locally known as *Chemmeen kettu*. In remaining pockets, aqua culture activities are undertaken. Shrimps are generally cultured in land based ponds/impoundments which are initially prepared by drying and tilling (to remove the pests and predators and metabolise the organic matter) and then liming (to correct the pH and to keep the bottom free from microorganisms). Inorganic fertilizers such as urea and sulphur phosphate are then applied to develop the natural food organisms known as planktons and benthos. After these preparations, shrimp post larvae are stocked at varying densities (numbers per square meter) depending on the level of production. The feed is provided in three different sizes depending on the size of the shrimp - starter, grower and finisher. The feed quantity is monitored using feed trays and is adjusted according to the level of growth. Water quality is continuously monitored and the optimum levels of important parameters such as dissolved

[12] FAO (2000) has defined aquaculture as "the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc." FAO (1992) in its Guidelines for the "Promotion of Environmental Management of Coastal Aquaculture Development" has collectively termed the land-based and water-based brackish and marine aquaculture practices as 'coastal aquaculture'.

oxygen, pH and salinity are regulated by periodical exchange of water. Some farmers resort to aeration of the ponds using mechanical/ electrical aerators. After continuous monitoring of the stock, they are generally harvested when they reach marketable size of 30–35 g. It normally takes about 4-5 months to achieve this size in tropical conditions.

5.2.1.1 Production and Productivity of Aquaculture Farms

As mentioned earlier, aquaculture is undertaken in fields, polders and ponds round the year. In order to assess the economic importance of this activity, an attempt was made to value the production and revenue generated from this activity in the study area. *Annual total production* from aquaculture in the Cochin settlements was 554.1 tonnes (table 5.15). Surprisingly, almost half of this was contributed by zone II B. Zone III B recorded the highest *average production* per hectare while zone III A recorded the lowest productivity[13].

5.2.1.2 Economic Value Generated by Aquaculture Activities

Aquaculture activities in the Cochin wetlands generate high values mainly because the prawn species cultured are commercially important. *Annual total value* generated by aquaculture activities from the Cochin wetlands was Rs.281 lakhs (table 5.15). Almost half of this was contributed by zone II B and. The *total net value* generated per hectare by aquaculture activities in the Cochin brackish watershed was estimated at Rs.112 lakhs. Zone II B recorded the highest net value generated followed by zone III A while zone III B recorded the lowest value. The *average net value* generated per hectare was estimated at Rs.63239. Zone II A recorded the highest net value generated per hectare followed by zone III B while zone I contributed the lowest per hectare value.

[13] Annexure 5.7 gives details on production and revenue generated in each zone by size of operational holdings.

Table 5.15 Distribution of Production and Revenue Generated By Aquaculture Farms in the Cochin Wetlands, 2001-02

Zone	Area under cultivation (ha)	Production (Kg)	Production per hectare (Kg)	Total revenue (Lakhs Rs.)	Net Value Generated (Rs. Lakhs)	Net Value per hectare (Rs.)
I	87.17	70873.69 (12.8%)	813.1	35.48	11.53 (10.3%)	54826
II A	110.28	94955.35 (17.1%)	861.0	43.75	13.71 (12.3%)	63003
II B	287.25	255812.87 (46.2%)	890.6	137.93	47.76 (42.8%)	55882
III A	130.09	88202.10 (15.9%)	678.0	45.94	27.86 (24.9%)	60261
III B	48.81	44259.71 (8.0%)	905.8	17.82	10.85 (9.7%)	62381
TOTAL	663.59	554103.73 (100%)	835.0	280.91	111.7 (100%)	63239

Source: Master Pan Fish Book I, Dept. of Fisheries, Kerala, 2002; Calculations based on primary survey, 2001-02

Taking the distribution of net value of aquaculture activities generated by different class holdings in the Cochin wetlands (table 5.16), it is interesting to note that land holdings less than 0.5 hectare contribute more than one third of the total value generated. Holdings greater than 4 hectare contributed 14.5 percent of the total value generated.

Table 5.16 Distribution of Value Generated from Aquaculture Activities by Different Class Holdings in the Cochin Wetlands, 2001-02.

Size of Holdings (ha)	I	II A	II B	III A	III B	Total Value (Lakhs Rs.)
0 to .5	2.8	4.9	25.5	3.8	0.0	**37.0** (33.1%)
0.5 to 1	0.4	2.5	5.8	3.0	0.5	**12.2** (11.0%)
1 to 2	0.1	0.9	6.7	5.3	4.7	**17.6** (15.8%)
2 to 3	0.8	1.2	6.2	5.8	4.5	**18.4** (16.5%)
3 to 4	0.3	0.0	2.9	6.0	1.1	**10.3** (9.2%)
> 4	7.2	4.3	0.7	3.9	0.0	**16.2** (14.5%)
Total	**11.5**	**13.7**	**47.8**	**27.9**	**10.8**	**111.7** (100%)

Source: Thomson (2003), Primary survey, 2001-02

5.2.2 Economic Values Generated by the Cochin Port Trust

The Cochin Port Trust is a central Government public sector company that facilitates the export-import business of the country. During 2001-02, 1100 number of ships and 82.17 lakh tonnes of cargo were handled by the Port. The revenue generated by Port Trust in this process is given in Table 5.17.

It is seen that during the year 2001-02, the port trust generated Rs 1587.4 lakhs, from services it rendered, using the backwater environment.

Table 5.17 Gross Revenue Generated by the Cochin Port Trust, 2001-02

The Cochin Port Trust	2001-02 (Rs. Lakhs)
Cargo handling & Storage Charges	9439.82
Estate rentals (Wetland Reclaimed land)	1963.67
Port and Dock charges	7859.85
Others	736.90
Total revenue income	20000.2
Total revenue Expenditure	18412.8
Net Revenue Generated	1587.4

Source: Calculated from Port Trust Annual Administrative Reports and Primary Survey, 2002-03

5.2.3 Economic Values Generated By The Navigation Industry

As indicated earlier, both public and private sector enterprises participate in modern navigation industry in the Cochin backwaters. The State has nationalised certain routes and provided a clear economic advantage to the public sector activities over the private sector in this industry. The State Water Transport Department (SWTD) provides the passenger services and the Kerala State Inland Navigation Corporation (KSINC) 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 revenue generated by the Kerala State Inland Navigation Corporation (KSINC) and the State Water Transport Department (SWTD). Table 5.18 shows the distribution of gross revenue generated by Kerala Shipping and Inland Navigation Corporation.

Table 5.18 Gross Revenue Generated by Kerala Shipping and Inland Navigation Corporation, 2001-02

Particulars	2001-02
Total No of boats/ Jankars in operation	12 +2
No of trips	45260
No. of passengers carried	66.87
Gross route distance (Km)	378294
Total revenue received (Rs Lakhs)	626.06
Total Revenue Expenditure (Rs Lakhs)	604.06
Profit (Rs Lakhs)	22

Source: Economic Review, 2002

Table 5.19 shows the distribution of values by the State Water Transport Department.

Table 5.19 Gross revenue generated by the State Water Transport Department, 2001-02

Particulars	2001-02
Total No of boats/ Jankars in operation	12 +2
No of trips	45260
No. of passengers carried (Lakhs)	216.06
Total revenue received (Rs Lakhs)	488.85
Total Revenue Expenditure (Rs Lakhs)	1257.74
Loss (Rs Lakhs)	768.89

Source: Economic Review, 2002

It can be seen from the tables above that the Kerala Shipping and Inland Navigation Corporation generates Rs.22 lakhs while the State Water Transport Department generates a loss of 768.89 lakhs annually.

5.3 Total Direct Values of the Cochin Wetlands for the Year 2001-02

Table 5.20 below summarises the calculations of the direct values generated by the Cochin wetlands.

Table 5.20 Direct Economic Values Generated from Wetland Based Activities of Traditional and Modern Resource Users, 2001-02.

Activity	Value Generated (Rs Lakhs)			
	Gross Value		Net Value	
TRADITIONAL ACTIVITIES				
Fishery	9824.60	(29.31%)	8356.00	(74.61%)
Agriculture	619.25	(01.85%)	293.42	(02.62%)
Prawn Filtration	1341.04	(04.00%)	575.10	(05.13%)
Clam & Lime shell collection	255.00	(0.76%)	174.00	(01.55%)
Traditional Ferry	83.65	(0.25%)	80.53	(0.72%)
Sub Total	**12123.54**	**(36.17%)**	**9479.05**	**(84.63%)**
MODERN ACTIVITIES				
Aquaculture	280.91	(0.84%)	111.70	(01.0%)
Port Trust	20000.20	(59.67%)	1587.40	(14.17%)
Navigation	1114.91	(03.33%)	22.00	(0.20%)
Sub Total	**21396.02**	**(63.83%)**	**1721.10**	**(15.37%)**
Grand Total	**33519.56**	**(100%)**	**11200.15**	**(100%)**

Source: Thomson (2003), Primary survey, 2001-02

From the above table, it is seen that total net direct value generated both by the traditional and modern resource users from the Cochin wetlands for the year 2001-02 was Rs.33520 lakhs while direct values generated net of all expenses was Rs.11200 lakhs.

A comparison between the gross and net value generated by both traditional and modern users throws a lot of insight into why the wetlands even today play an important role in the livelihood of communities that depend on them. Comparing gross values, it would seem modern activities made more sense as they generated more than half of total value generated. However, net of cost, around 85 percent of the value generated is the contribution of traditional resource users and only the rest is contributed by modern resource users.

The difference between gross and net value generated by fishery is not very large. This might be explained by the fact that traditional wetland fishery operates at low levels of investment and operational cost. On the other hand, in the case of the Port activities there is a huge difference between gross and net value generated. The scale of operation of the Port is very large. Hence the gross value generated inclusive of cost is higher than the contribution of the traditional activities combined. However, net of cost, this contribution falls very low.

The contribution of prawn filtration and agriculture was very low when compared to other activities. Similarly, traditional small scale activities like lime shell collection and ferry services also contributed marginally to total value generated. However, even today, such activities are still meaningful to ecosystem people as they provide subsistence living to thousands at very low costs.

These calculations reveal that the traditional sector still has a meaningful role to play in the daily livelihood and sustenance activities of the people living in and

around the wetlands. However, they are slowly loosing their economic importance as new modern enterprises encroach into the backwater environment, affecting the productivity and profitability of their activities. This mad rush to commercialize 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 management with people's participation.

5.4 Summary and Conclusions

Estimation of the economic value of wetlands is useful for environmental planning and governance. Unfortunately, this exercise is not very popular in developing countries. This study undertakes such a task for advising the resource governors and various resource users on the need for a rational use of wetlands for making a sustainable living from wetland ecosystem. This chapter made an attempt to estimate the different components of the direct use value of the Cochin wetlands. The activities undertaken by the traditional and modern resource users have formal markets for their goods and services and therefore market valuation is used to estimate the value generated in traditional activities like fishing, paddy production, clam fishing, meat processing, lime shell sales, prawn filtration and traditional ferry services.

The above calculations reveal that traditional activities undertaken on wetlands are meaningful even today to the millions of people from the marginalized and lower strata of the society who depend on these resources for livelihood. The wetlands have important roles to play in their lives and they have devised simple but effective tools by which to cull out low cost livelihood activities. Fishery generates a huge value every year and most of this goes as subsistence livelihood. The practice of crop rotation (pokkali and pawn filtration) also generates huge amounts every year to farmers. Traditional navigational services

are loosing their importance gradually with the development of modern transportation facilities, but for the many living in remote corners around wetlands, these are still meaningful.

The study revealed noticeable differences between gross and net values in the traditional activities particularly fishery, pokkali agriculture and prawn filtration in all the zones. It can be seen that, the percentage of net value/gross value is different in different zones. It was noted that this difference in values is due to variations in environmental quality and its impact on costs. In zone IIB for instance it was observed that reduced environmental quality enhanced input costs for most of the traditional resource users.

Many of the modern activities on the other hand have entered wetlands disrupting already existing mechanisms of sharing. In addition, huge amounts of capital which they invested are not justified by the net values generated. They also generate externalities affecting traditional activities in significant ways. However, it is true that no modern society can exist without such developmental activities.

Valuation could therefore provide useful insights and simple prescriptions for the better use of estuarine resources and environment. This however constitutes only a part of the total economic value of Cochin wetlands. Recreational benefits and indirect benefits of the Cochin wetlands also contribute to the total economic value. This is taken up in subsequent chapters.

ANNEXTURE

Annexure 5.1 Different Types of Fishing Gears in the Cochin Backwaters

Adakkamkolli	Koru Vala	Nylon Vala	Theruni Vala
Chemmeen Vala	Kozhu Vala	Odak Vala	Thirutha Vala
Choonda	Kuruthola Vala	Oota Vala	Vadi Vala
Dappa Vala	Kuthu Vala	Pattu Vala	Valli Vala
Kaka Vala	Kutti Vala	Pattukanni	Valu Vala
Kamba Vala	Mathi Vala	Payth Vala	Vatta Vala
Karimeen Vala	Meen Vala	Peru Vala	Villu Vala
Kolli Vala	Merug Vala	Scoop Net	
Konchu Vala	Neetuvala	Thappal	
Koori Vala	Noolu Vala	Thelinja Vala	

Source: Primary Survey

Annexure 5.2 Distribution of Active Fishing Days per Month in the Cochin Backwaters, 2001-02

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Chinese Net	14	15	14	14	12	14	15	16	20	18	18	18
Stake net	18	18	14	14	14	14	15	18	18	18	18	18
Free net	20	20	20	12	12	12	12	22	20	20	20	18

Source: Thomson (2003)

Annexure 5.3 Distribution of Gears used in Cochin Backwaters, 2001-02

	Fixed Nets		Free Nets										
	Chinese net (Cheena vala)	Stake net (Oonni vala)	Cast net (Veeshu vala)	Gill N et (Vysali vala)	Seine net (Kolli vala)	Hooks & line (Choonda)	Trap Net	Scoop Net (Koori Vala)	Drag net	*Ring net*	Others	Sub Total	Total
			G 1	G 2	G 3	G 4	G5	G6	G7	G8	G9	G1-G9	
I	510	994	1310	1766	586	125	869	162	831	850	300	6799	**8303**
II A	374	1022	994	911	98	75	104	162	166	138	255	2903	**4299**
II B	316	409	529	997	85	95	13	244	131	159	170	2423	**3148**
IIIA	316	290	356	1271	6	167	30	79	32	189	253	2383	**2989**
IIIB	374	922	594	911	98	75	104	162	166	138	255	2503	**3799**
Total	**1890** (8.4%)	**3637** (16.1 %)	**3783** (16.8%)	**5856** (26.)	**873**	**537**	**1120**	**809**	**1326**	**1474**	**1233**	17011 (75.5%)	**22538** (100%)

Source: Thomson (2003)

Annexure 5.4

Production and Revenue Generated by Pokkali Paddy in the Cochin Wetlands, 2001-02

Size of holdings (ha)	Area under cultivation (ha)	Yield Per ha (Kg)	Production (tonnes)	No. of house holds	Total revenue (Lakhs Rs.)	Cost per Ha (Rs.)	Net Value Generated (Rs.)	Net Value per ha. (Rs.)
Zone I								
0 to .5	1173	1327	1557.0	3071	92.25	4292	5864294	4999
0.5 to 1	96	1114	107.0	223	6.70	4412	325128	3387
1 to 2	42	1042	43.7	29	0.87	4438	108886	2593
2 to 3	45	1121	50.4	2	0.06	4342	157730	3505
3 to 4	3	1095	3.3	1	0.03	4048	9218	3073
> 4	10	1040	10.4	3	0.09	4875	24050	2405
Total	**1369**	**1123**	**1771.8**	**3329**	**100.00**	**4310**	**6489305**	**4740**
Zone II A								
0 to .5	239	1734	414.5	768	29.02	9438	646088	2703
0.5 to 1	1182	1717	2029.6	1438	142.07	4095	9367386	7925
1 to 2	15	1626	24.4	257	1.65	1192	146767	9784
2 to 3	337	1522	513.0	7	35.91	2150	2866651	8506
3 to 4	17	1643	27.9	3	1.82	2686	135921	7995
> 4	10	1507	15.1	2	1.05	2174	83732	8373
Total	**1800**	**1625**	**3024.6**	**2475**	**211.52**	**4392**	**13246545**	**7359**
Zone II B								
0 to .5	304	1476	448.6	544	33.64	9240	555573	1828
0.5 to 1	1409	1485	2092.6	2124	146.48	6884	4948426	3512
1 to 2	458	1195	547.1	395	41.04	6356	1192395	2603
2 to 3	14	1221	17.1	3	1.28	7120	28491	2035
3 to 4	8	1149	9.2	2	0.69	6723	15157	1895
> 4	26	1022	26.6	5	1.86	4985	56394	2169
Total	**2219**	**1258**	**3141.2**	**3073**	**224.99**	**7076**	**6796436**	**3063**
Zone III A								
0 to .5	5	1534	7.7	4	0.54	6164	22876	4575
0.5 to 1	136	1406	191.2	110	13.39	4918	669831	4925
1 to 2	63	1362	85.8	95	5.79	4431	299976	4762
2 to 3	7	1317	9.2	6	0.65	4431	33513	4788
3 to 4	2	1324	2.6	0	0.17	3285	10642	5321
> 4	0	0	0.0	0	0.00	0	0	0
Total	**213**	**1389**	**296.6**	**215**	**20.53**	**4772**	**1036839**	**4868**
Zone III B								
0 to .5	306	1314	402.0	1158	28.14	4881	1320145	4314
0.5 to 1	46	1267	58.3	2	4.08	6192	123132	2677
1 to 2	43	1799	77.4	52	5.42	5594	301053	7001
2 to 3	2	1710	3.4	2	0.24	6038	11866	5933
3 to 4	3	1348	4.0	2	0.28	5833	10801	3600
> 4	2	1124	2.2	2	0.16	4863	6006	3003
Total	**402**	**1427**	**547.3**	**1218**	**38.31**	**5120**	**1773004**	**4410**
Grand Total	6003.0		8781.4	10310	619.3		29342128	4888

Source: Pokkali Land Development Agency, 2000 Calculations based on primary survey, 2001-02

Annexure 5.5 Distribution of production and revenue generated by Prawn Filtration in the Cochin wetlands, 2001-02

Size of holdings (ha)	Area under cultivation (ha)	Yield/Ha (Kg)	Production (Kg)	No. of house holds	Total revenue (Lakhs Rs.)	Cost per Ha (Rs.)	Net Value Generated (Lakhs Rs.)	Net Value per ha. (Rs.)
Zone I								
< .5	195.18	488	95247.51	616	31.75	0.105	11.26	5767
.5--1	8.49	695	3344.27	366	1.29	0.142	0.08	957
1--2	107.07	1188	52838.64	179	18.22	0.125	4.84	4518
2--3	205.68	1000	97970.58	135	33.78	0.105	12.19	5925
3--4	14.75	995	6990.10	8	3.88	0.182	1.20	8157
> 4	374.16	833	148429.69	62	114.18	0.099	77.13	20615
Total	**905.33**	**866**	**404820.80**	**1366**	**203.10**	**0.13**	**106.70**	**11785**
Zone II A								
< .5	257.52	1444	177055.59	546	126.47	0.12	96.85	37610
.5--1	214.16	1875	191218.11	262	81.34	0.08	64.85	30280
1--2	312.05	859	127715.35	183	56.93	0.15	11.34	3636
2--3	331.64	802	198889.38	132	79.54	0.20	11.65	3511
3--4	289.16	887	128263.36	70	67.73	0.13	28.82	9966
> 4	720.22	877	300933.55	103	179.71	0.18	48.90	6789
Total	**2124.75**	**1124**	**1124075.34**	**1296**	**591.71**	**0.14**	**262.41**	**12350**
Zone II B								
< .5	246.04	704	82444.21	593	63.42	0.20	14.21	5776
.5--1	258.77	748	92202.93	353	23.64	0.08	2.94	1136
1--2	194.34	616	56993.76	137	27.14	0.04	19.37	9965
2--3	174.25	830	68830.16	68	36.23	0.14	11.66	6690
3--4	105.91	966	48708.72	31	19.48	0.14	4.87	4596
> 4	578.33	1028	283135.79	72	132.80	0.13	59.36	10263
Total	**1557.64**	**815**	**632315.58**	**1254**	**302.71**	**0.12**	**112.40**	**7216**
Zone III A								
< .5	48.52	1364	22936.80	121	19.11	0.12	13.15	27096
.5--1	57.45	1163	31821.60	71	7.23	0.02	6.14	10689
1--2	71.98	731	25067.24	41	10.90	0.08	5.36	7442
2--3	92.17	970	42586.02	37	20.28	0.15	6.82	7395
3--4	85.48	1009	41080.92	26	15.80	0.13	5.03	5884
> 4	297.57	881	124835.67	26	48.01	0.11	14.39	4835
Total	**653.17**	**1020**	**288328.26**	**322**	**121.34**	**0.10**	**50.88**	**7789**
Zone III B								
< .5	48.14	866	16800.93	136	12.00	0.12	6.46	13429
.5--1	55.33	920	20533.56	76	5.55	0.05	3.06	5530
1--2	63.05	1020	25939.49	45	13.65	0.14	4.70	7453
2--3	107.84	1188	51655.88	43	19.19	0.13	5.71	5293
3--4	118.91	1084	51999.15	31	20.80	0.11	8.31	6989
> 4	201.13	1053	85386.06	25	50.99	0.18	14.46	7189
Total	**594.40**	**1022**	**252315.06**	**356**	**122.18**	**0.12**	**42.70**	**7184**
Grand Total	**5835.29**		**2701855.04**	**4594**	**1341.04**	**0.12**	**575.08**	**9855**

Source: Master Pan fish Book, Dept. of Fisheries, Kerala, (2002); Thomson (2003); Primary survey, 2001-02

Annexure 5.6 Distribution of Value Generated by Traditional Goods Ferry Services in the Cochin Wetlands, 2001-02

	Revenue / trip (Rs.)	No. Of trips	No. of Boats	Total Revenue (Rs.)	Total Cost (Rs.)	Net Revenue (Rs.)
Pre monsoon						
Type I Ferry	1545	100	7	1081733	30067	1051667
Type II Ferry	1692	101	5	854460	30459	824001
Type III Ferry	5000	32	2	320000	9536	310464
Motor Dingy	2513	31	5	389438	9340	380098
Total				**2645631**		**2566229**
Monsoon						
Type I Ferry	1354	69	7	657141	20800	636341
Type II Ferry	1275	144	5	917640	43128	874512
Type III Ferry	4500	28	2	252000	8400	243600
Motor Dingy	2575	32	5	412000	9600	402400
Total				**2645631**		**2156853**
Post Monsoon						
Type I Ferry	1696	120	7	1424360	51920	1372440
Type II Ferry	1933	126	5	1217475	62972	1154503
Type III Ferry	5500	32	2	352000	16256	335744
Motor Dingy	2450	40	5	486938	19875	467063
Total				**3480773**		**3329750**
Grand Total				**8365185**		**8052832**

Source: Primary Survey 2001-02

Annexure 5.7 **Distribution of Production and Revenue Generated by Aquaculture Activities in the Cochin Wetlands, 2001-02**

Size of holdings (ha)	Area under cultivation (ha)	Production (Tonnes)	Production per ha. (Tonnes)	No. of house holds	Total revenue (Lakhs Rs.)	Cost per Ha (Rs.)	Net Value Generated (Lakhs Rs.)	Net Value per ha. (Rs.)
Zone I								
< .5	8.1	5731.2	707.6	30.0	5.2	0.3	2.8	34325.3
.5--1	8.0	6239.7	782.3	10.0	2.8	0.3	0.4	5289.5
1--2	5.7	4336.6	759.5	5.0	2.2	0.4	0.1	1762.8
2--3	5.7	4900.2	865.8	2.0	1.9	0.2	0.8	13298.8
3--4	3.2	3933.6	1217.8	1.0	0.9	0.2	0.3	8321.7
> 4	56.5	45732.4	809.6	9.0	22.5	0.3	7.2	12762.6
Total	87.2	70873.7	813.1	57.0	35.5	0.3	11.5	13232.1
Zone II A								
< .5	13.0	10816.0	829.8	28.4	9.8	0.4	4.9	37437.7
.5--1	26.1	23497.5	901.7	28.0	5.6	0.1	2.5	9468.3
1--2	7.9	7184.4	914.1	6.0	3.3	0.3	0.9	10929.0
2--3	13.7	12928.9	943.0	6.0	5.7	0.3	1.2	8664.0
3--4	-	-	-	-	-	-	-	-
> 4	49.6	40528.4	816.8	7.0	19.3	0.3	4.3	8692.5
Total	110.3	94955.4	861.0	75.4	43.7	0.2	13.7	12429.0
Zone II B								
< .5	77.8	62533.9	804.2	300.0	56.8	0.4	25.5	32805.6
.5--1	48.1	41579.7	863.9	48.0	9.7	0.1	5.8	12091.1
1--2	51.5	50196.4	974.2	34.0	22.8	0.3	6.7	12982.6
2--3	52.1	50079.0	961.4	19.0	25.0	0.4	6.2	11856.3
3--4	18.9	24738.3	1312.0	6.0	9.5	0.4	2.9	15163.2
> 4	38.9	26685.5	686.3	8.0	14.0	0.3	0.7	1821.9
Total	287.2	255812.9	890.6	415.0	137.9	0.3	47.8	16627.8
Zone III A								
< .5	9.9	6297.5	638.6	22.0	6.3	0.3	3.8	38860.5
.5--1	25.5	20708.1	811.2	30.0	5.1	0.1	3.0	11785.0
1--2	24.1	20947.5	868.5	15.0	9.8	0.2	5.3	21773.2
2--3	23.0	15598.0	678.2	9.0	7.4	0.1	5.8	25293.9
3--4	19.9	11211.9	564.3	4.0	8.4	0.1	6.0	30309.0
> 4	27.7	13439.2	485.1	3.0	9.0	0.2	3.9	14175.7
Total	130.1	88202.1	678.0	83.0	45.9	0.1	27.9	21416.6
Zone III B								
< .5	-	-	-	-	-	-	-	-
.5--1	15.8	13835.6	875.1	25.0	3.4	0.2	0.5	3344.4
1--2	15.0	13557.6	903.8	12.0	6.4	0.1	4.7	31433.7
2--3	13.0	12701.0	977.0	9.0	6.4	0.1	4.5	34350.2
3--4	5.0	4165.4	833.1	5.0	1.7	0.1	1.1	22768.0
> 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	48.8	44259.7	906.8	51.0	17.8	0.1	10.8	22224.4
Grand Total	663.6	554103.7	835.0	681.4	280.9	0.2	111.7	22824.1

Source: Master Pan fish book I, Dept. of Fisheries, Kerala, 2002; Thomson (2003)

CHAPTER 6

Recreational Value of Cochin Backwaters

Recreational values contribute a major share to wetland direct values. Although they are recognized and estimated by planners and policy makers in the developed countries for designing appropriate price mechanisms and rules that regulate access, very few attempts have been made in developing countries to recognize and estimate these values. Many of these countries follow a free-access policy to promote international leisure industry, which consolidates the largest proportion of such values generated. The estimation of recreational values of backwaters is therefore a necessary pre-condition to understand their economic significance. The objective of this chapter is to estimate recreational values of Cochin backwaters. The chapter is organized as follows. Section 1, presents the nature of recreational activities in Cochin backwaters. Section 2 highlights the major conceptual and methodological issues in estimating recreational values using travel costs and the assumptions made to overcome these difficulties. Section 3 gives the estimates of recreational values. Section 4 provides a summary and conclusion to the chapter.

6.1 Recreational Activities in Cochin Backwaters

Cochin estuary is a public site, offering many recreational activities to individuals, some on a fee basis but most free of cost. The Cochin estuary and its surrounding backwaters provide an array of recreational opportunities to the local population and tourist both domestic, as well as foreign. Different types of boating facilities are offered namely the backwater trips, the estuary sunset rides, canoeing, paddle and peddle boats, houseboats (*Kettu vallam*) and

speed boats. A large population spends time along the banks of the backwaters, the Marine drive, Subash Park, Rajaji grounds, Wellington Island Drive etc enjoying its aesthetic beauty. The backwater environment is also used for different purposes such as jogging, recreation, for hosting cultural and religious events, boat races and other festivities etc.

Recreational services are mainly supplied both by the public and private sector enterprises. The State sponsored activities are directly offered and supervised by the State Tourism Departments of the Government of India and the Kerala Tourism Development Corporation of the Government of Kerala. Different types of tour packages are provided by tour operators in the Cochin backwaters (Backwater Boats, Backwater and Village Tour Canoes, Charter Boats, Speed boats, Pedal and Paddle Boats, House Boats and Ark Boats). Of this, only two types of packages are provided by the State Tourism Department. The others are innovative ideas taken up by the private sector. In fact, a vibrant private sector is fast evolving at different locations of the backwaters[1]. Since starting a tour operating unit in the private sector requires no special license other than a boat license and a route license, it is relatively easy for private operators to enter this field of activity.

The visitors to the Cochin backwaters comprise local visitors, domestic and foreign tourist on multi-destination trips. Domestic visitors are mainly from the southern states of Tamil Nadu, Karnataka and Andhra Pradesh (including Kerala) as well as from northern States such as Maharastra, Chattisghar, Gujarat, Jammu and Kashmir, Utter Pradesh and New Delhi. Foreign tourists are mainly from the United States, United Kingdom, Europe and Australia. Others comprise only a negligible part. December to March is the foreign

[1] It is very difficult to obtain an exact number of all tour operators in this region due to the wide scatter and ill organised nature of these activities. However, primary survey of the Cochin estuary gives the number of boats owned by the Kerala Tourism Development Corporation (KTDC) as 4, by private package tour operators as 11, speedboat owner as 15 and by the private tourist boat owners as 35. An Ark boat and a houseboat also operates in the estuary as opposed to a hundred, which operate in the Alappuzha region.

tourist seasons while domestic tourists come round the year, particularly during festival seasons and the Sabarimala Pilgrimage season.

6.2 Travel Cost Model and Estimation of Recreational Value of Cochin Backwaters

As mentioned in chapter two, the total economic value generated by Cochin wetland ecosystem includes the value of its recreational services. Recreational values are reflected in the perceptions of individuals who visit the site by spending time and/or money on recreational activities in the backwaters. Many of these benefits provided by wetlands are not traded in conventional markets and so estimates of their value are not easily and directly obtained. Moreover, people who use the site's resources do not pay for these services and hence it is impossible to use market prices directly to value these recreational benefits provided by the site. Therefore, this study used the Travel Cost Method to estimate the recreational value of Cochin backwaters[2].

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. It uses actual behavior and choices (revealed preference) to infer values. It assumes that the value of the site or its recreational services is reflected in how much people are willing to spend on the trip. This is analogous to estimating peoples' willingness to pay for a marketed good based on the quantity demanded at different prices.

[2] From a survey of literature, it was seen that a large number of studies have attempted to estimate the recreational value provided by different types of ecosystems. However, relatively little research has been devoted to quantifying the outdoor recreational value of public amenities like wetlands which are provided free of cost.

6.2.1 Conceptual and Methodological Issues of Estimating Recreation Values

The travel cost method is relatively uncontroversial, because it is modeled on standard economic techniques for measuring value, and it uses information on actual behavior rather than verbal responses to hypothetical scenarios. However, there are conceptual and methodological issues that arise in any travel cost study which has to be treated according to the specific nature of the study and the characteristics of the population. It is based on these issues that are listed below that the assumptions of the model are built upon.

The most controversial aspects of the travel cost method include calculating travel cost and accounting for the opportunity cost of travel time as well as how to handle multi-purpose and multi-destination trips.

Visitors to the Cochin backwaters use various modes of transportation. Local people either walk or use bicycles. Others use public transportation system, motorcycles, private cars, taxi etc. Hanley and Splash (1993) argued that the cost of transportation is the 'cost of distance traveled' and so the cost of the trip must be calculated either by using petrol costs only as an estimate of marginal cost, or using full cost of motoring figures to include an allowance for depreciation, insurance, etc. Ideally, one should use the marginal cost of the trip, but calculating the full marginal cost of motoring (as opposed to average cost) is often prohibitively difficult.[3] Most studies argue that the costs used in a travel cost method should be consumer perceived costs rather than the actual costs (Sellar et al. 1985; Beal 1995[b]; Ward and Beal, 2000). Hence, this approach is used in the present study.

[3] Many studies have used the cost of petrol plus insurance, depreciation and maintenance costs, in calculating the cost associated with visiting a park. Stoeckl (1993) noted that individuals may believe that they are paying less than what a researcher would calculate as their economic cost. Stoll and Chavas (1985) used only the cost of fuel among the range of possible vehicle cost on the basis that travelers most easily recognize these cost as the relevant cost. However, they also included in their demand equation other variable cost such as accommodation and food cost additional to those that would have been incurred had the travels stayed at home.

The calculation of travel time and on-site time however, is subject to a variety of problems. For instance, Cesario and Knetsch, (1970) pointed out that distance and travel costs ration visits of individuals and the opportunity cost of scarce time acts as an impediment to visiting more distant sites. Regarding recreational travel and on-site *time pricing*, the economist's theoretical answer is given by the conventional labour supply model[4], according to which there is a continuous trade-off between work and recreation. Since wage rate reflects the opportunity cost of time, it could be used as an approximate shadow price of time. However, what proportion, has to be decided arbitrarily by the researcher. For practical purposes, the travel cost literature has tended to scale wage rates by one-fourth to one-half to derive an opportunity cost for travel time (Brown and Henry, 1989; Smith and Kaoru, 1990; Hanley and Spash, 1993; Navrud and Mungatana, 1994; Bockstael, 1995; Smith and Mansfield, 1997, Ward and Beal, 2000). Cesario (1976), for example, has suggested that since the cost of travel time involved in urban transportation decisions likely falls between one-fourth and one-half the wage rate, one-third might be used as a reasonable approximation for travel cost models. McConnel and Strand (1981) developed this theme further by suggesting that the cost would be some proportion (k) of each individual's wage rate and the value of k could be determined by the usual estimation methods within regression analysis where travel time multiplied by the individual's income per hour is selected as a the relevant variable. They estimated the value of k to be 0.6 of the wage rate.

But this trade-off fails when applied to retirees, students, housekeepers, unemployed persons etc. There are many employment categories (carpenters, masons, laborers, and agricultural laborers) that may use their

[4] If the individual is trading off travel time for work time, and if there is no marginal utility (or disutility) associated with work time and travel time, then it seems plausible to value travel time at the foregone wage rate. But other concerns arise if the traditional work leisure trade-off is accepted. What happens if the visitors gain utility or benefit from the travel itself, particularly in those cases where travel occurs through scenic or other desirable areas or if the visitor gains utility from working?

time for recreation due to lack of continuous employment. Similarly, it is not plausible in many societies where many people work fixed hours and are provided with, sometimes, large weekends, and paid holidays. People who actually substitute time for money constitute only a small portion of the population. Work contracts of most employed people do not allow for such a substitution either. People who use the backwaters or estuary during weekends, evenings or early mornings are not foregoing any income. There are also employment categories like business people, whose direct involvement is not necessary to ensure their income. In these cases the conventional theoretical trade-off notion is often irrelevant, and it seems much more likely that the trade-offs are between time for travel and time for leisure activities. Hence, in the present study, two sets of time price was calculated. For those on unpaid leaves and vacations, the value of one-third of the hourly wage rate was calculated as the opportunity cost of time. For those on paid leave or unemployed, the opportunity cost of time was calculated as zero.

The second fundamental concern relates to *time rationing*. The time rationing question makes the Cochin Backwater visitor to value time differently on a workday, versus a weekend or a vacation. Besides, time value may vary deeply across the individuals of the same sample, because they have different time constraints. Deaton and Muellbauer (1980) cited by Hanley and Spash (1993), argued that if individuals give up working time in order to visit a site, the wage rate is the correct opportunity cost. If individuals maintain they have 'nothing else to do', the opportunity cost of the time spent on the visit was taken as zero. If however, they had foregone other recreation activities to enjoy this particular site, it meant an opportunity cost was involved. In the case of the Cochin Backwater, however, since there are no perfect substitutes for the site, this aspect does not arise.

In the case of opportunity cost of *on-site time*, McConnel, (1992) argued that it should be included in the price of recreation variables. Failure to do so would bias downward consumer surplus estimations. Ward (1984) also defended inclusion of on-site time but as an endogenous demand determinant. Time spent on-site provides visitors with benefits and it must be presumed in the absence of evidence to the contrary that the benefits are at least equal to the time cost and probably exceed it by a significant amount because visitors are willing to incur additional cost to travel.

Cesario and Knetsch (1976) advocated, on the contrary, that on site time must be excluded. (Wilman, 1987; Bockstael et al., 1987) also omitted on site time from their model although they showed the opportunity cost might be greater than the wage rate in such case. Desvousges et al. (1983) suggested the value of on-site time is relevant and related to the wage rate only indirectly through the income effect, if recreation time cannot be traded for work time. They found *k to* vary considerably between individuals. Ward (1984) proposed that on-site time be included as an endogenous demand determinant. McConnel (1992) concluded that valuation of on-site time has more relevance for estimates of the value of retaining natural areas in substantially unchanged condition than for estimation of demand for predictive purposes, because of the problem of the differential perception of costs by consumers. In such cases, on site time is not a relevant variable. An acceptable solution to this would be to consider the opportunity cost of on-site time only in the case of individuals who give up working time in order to visit the Cochin backwaters.

Multiple destination trips have received some consideration in literature. Most travel cost models assume that individuals take a trip to visit a specific recreational site. Thus, if a trip has more than one purpose, the value of the site may be overestimated. Bennet (1995) divided visitors to a site as either "purposeful visitors" or "meanderers"; the latter groups visit the site in the

course of a larger trip that includes visits to a number of nearby sites. Ideally, only a portion of the total travel cost for meanderers can be attributed to any particular site visited. There is no single theoretically acceptable method of dealing with multiple destination visitors. Thus, any method including them must be arbitrary.

Smith (1971) recommended that only the cost of traveling the marginal distance from a previous site be included but, as Ulph and Reynolds (1981) noted, this method can result in negative bias as a highly recorded site might be only a short distance from another stop-over site. Hanley and Splash (1993) suggested that "meanders" be excluded from the travel cost model.

The Cochin Backwaters is often visited by people who are on holiday for an extended time period, or who stop at the site without necessarily making the trip exclusively for the purpose of visiting it. Given that the recreational activities were concentrated on the banks of the estuary in the Cochin city limits, it was considered highly unlikely that the estuary was the only reason for their visit. Excluding multi-destination visitors with very large travel cost and extremely high probabilities of visiting many other destinations would solve this problem but it would considerably underestimate the value of the recreational benefits of the site. Therefore, following Smith (1971), the cost of traveling the marginal distance from the previous site visited was included. In most cases, since Cochin was the primary destination in Kerala for visitors from other parts of the country, this was considered acceptable.

The backwater is often visited by tourists from outside the districts, businessmen, people who visit the city to meet relatives or friends and people who come for many other purposes such as court visit, hospital, training etc. who while-away time by visiting the backwaters. Such respondents were not included in the study.

Demand theory postulates that the demand for a good is related to the prices and qualities of substitutes as well as its own price and other factors. Ideally, the cost of visiting close substitute sites should be taken into account in deriving a demand for visits to any particular site. Some recreation researchers have attempted to incorporate the prices and qualities of substitute sites in their models. Caulkins et al. (1985) found that the omission of substitute prices biased the estimation of the slope of the demand curve and that the algebraic sign of the bias depended on the correlation between the on price and the prices of the substitutes. Similarly, Rosenthal (1987) reported that prices of substitutes were necessary for the estimation of demand curves, omission causing bias in the estimated consumer surplus. Kling (1989) found omission of the substitute price does not bias the estimates of a single price coefficient, if own and substitute prices are uncorrelated. Ribaudo and Epp (1984) deleted substitute prices from their demand function for a given site on the basis of near-perfect colinearity of the substitute sites with the price of the given site. Had they kept the substitute site price variables in the regression equation, the near perfect correlation with the price of the given site would have made it impossible to disentangle statistically the separate effects of the given sites from that of the substitutes. On the other hand deleting the substitute site prices produces biased but stable price elasticities. Freeman (1993) approached the substitute site dilemma by suggesting researchers ask visitors which single site is visited frequently and include only that site's price as the relevant substitute price.

Apart from these technical considerations related to the statistical estimation of the coefficients in the demand equation by regression analysis, there is the related issue of whether wetlands encompassing unique ecosystems or outstanding natural features have any substitutes. Visitors with a keen interest in nature based recreation and the more technical aspects of ecology may believe that each wetland is unique and has no substitute. In the present

study, 87.6 percent of the respondents pointed out that there were no substitute site to the Cochin backwaters. Hence price of substitutes sites were not included in the analysis.

A question of how to best deal with 'zero visit problem' raises very lively debates among practitioners and theoreticians and a definitive solution is yet to be seen. The present study omitted zones with zero visitation rates to avoid having a range of observation along the cost axis with zero demand. In order to overcome all these problems in specifications and estimations therefore, the following assumptions are made in this study.

6.2.2 Assumptions of the Model

The travel cost model is based on the following assumptions.

1. The total travel cost is the sum of the monetary value of round trip travel (consumer perceived cost of travel and value of time spent on travel), value of on-site time and out of pocket expenses (other expenses).
2. Extra costs of travel, other than those perceived by the individual, are not relevant to visitor decisions and hence not considered in the analysis.
3. Opportunity cost of time is considered only in the case of individuals who give up working time in order to visit the Cochin backwaters. (In such cases, the shadow price of travel time and on-site time was valued at one-third of the hourly wage rate. For others, the opportunity cost of the time spent on the visit was assumed to be zero).
4. Other cost such as 'Out of Pocket' expenses incurred during the trip for food and beverage, photographs, passes, sight seeing and recreational activities, etc. are included in the total cost.
5. Respondents from outside the country are not considered in the study.
6. Prices and quality of substitute sites are not considered for want of perfect substitutes.
7. Zones with zero visitation rates are omitted from the analysis.

6.2.3 The Model

A zonal Travel Cost model was used in the present study. According to the respondent's place of origin and distance from the backwaters, they were classified into different zones. The basic travel cost model used to estimate recreation values is specified through the following sets of equations:

$$V_k = V(C_k) \qquad (6.1)$$

Where,

V_k is the number of visitors from zone k, per 1000 zonal population.

C_k is the average total cost for visitors from zone k; include the time spent in traveling to the site, the time spent inside the site and the value of the individual's time.

6.3 Estimation of the Model

6.3.1 Sample Size

The population for a travel cost method research consists of either those who visited the site during a given period or people expected to visit the site within a stipulated period from a defined region (Ward and Beal, 2000). Visitors are broadly defined as those who use the backwaters for various recreational activities. Thus an individual who lives by the backwater is treated as a visitor if he takes a walk or spends some time there deliberately for recreation, exercise or to participate in some cultural events hosted in and around it. However passersby, people who depend on boat service for travel, employees in the navigation industry and those who visit the site for business purposes etc are not counted. The visitors to the Cochin backwater are classified as local tourists, visitors from other districts of the State, those from other States and foreign nationals. However, foreigners were not included in the survey. A

distinction was made between residents and non-resident visitors to account for visitors on multi- destination trips.

6.3.2 Sampling

An on-site survey was conducted over a period of two months during weekends, holidays and week day evenings in all the major selected sites along the backwaters to gather information required for estimating recreational value of the estuary.

Only adult visitors, who had a definite source of income, were interviewed since they were considered to be more realistic in making personal valuation of their recreational experiences at the site vis-à-vis their budget constraint. The visitors were randomly chosen for the interviews and asked to complete the travel cost questionnaire. The interview was conducted over a period of two months, at six different sites along the backwaters. Questions were devised taking into consideration the characteristics of visit patterns to the backwaters. A pre-testing was done on 50 respondents before the actual survey was conducted. Recreation values were estimated from these data. Among the 450 questionnaires prepared and executed, 395 were returned, of which only 361 were used, as the rest were incomplete. Thus a sample size of 361 was selected. However, the actual survey produced information on 1083 respondents as single questionnaires were used to interview groups with one earning member. A summary of the data by place of origin is given in table 6.1 below.

Table 6.1 Percentage of Respondents from different Zones, 2001-02

Zones		Percentage of Respondents
1	Ernakulam dist.	51.5
2	South Kerala	10.8
3	North Kerala	13.3
4	South India	10.5
5	North India	13.9
	Total	100

Source: Travel cost survey, 2001-02

Data from the questionnaires were entered into a spreadsheet to calculate travel costs for each visitor. Administrative districts of the Government of Kerala and States were selected as the zones for the model. The districts of Ernakulam, Alleppy and kottayam were taken as the first zone. The southern districts of the State were taken as the second zone and the northern districts as the third zone. The sample included visitors from 13 of the 14 administrative districts of Kerala. The remaining three States of south India formed the fourth zone while the north Indian states (Maharastra, Chattisghar, Gujarat, Jammu and Kashmir, Utter Pradesh and New Delhi) formed the fifth zone. Number of visitors per district, income groups represented by the visitors and travel costs were calculated. A summary of the data by district is given in the table below.

Table 6.2 Distribution of Respondents by Origin of Travel

Zone	Districts/States	No. of Visits	Population of Zone
1	Ernakulam	574	3098378
2	South Kerala	211	10849385
3	North Kerala	186	14261216
4	South India	142	190572000
5	North India	110	231587000
	Total	**1223**	**450367979**

Source: Travel cost survey, 2001-02

6.3.3 Actual Visits from Zones

As mentioned earlier, this model was developed using administrative divisions as zones and this resulted in fifteen different travel zones. In the case of public recreational sites like the Cochin backwaters where many facilities are offered free of cost and where there are no entrance or admission fees, there are no official records of number of visitors to particular sites, hence it is very difficult to obtain an estimate of total number of visitors to the site during a year. Therefore, this number was approximated based on calculations followed in a study conducted by IUCN (Shammin, 1999). The total number of visitors to the site over the seven day survey period was 1217. Therefore the sample was converted to real data by multiplying the observed number of visitors[5] by a factor of (1217/7)/1223= 0.14. The TCM data compiled for these zones are shown in the table below.

[5] The survey yielded information on 1223 respondents from 361 questionnaires.

Table 6.3 Distribution of Visits per Population by Travel Zones

Zone	District/State	Observed Number of Visits (V)	Actual Number of visits[6] (V_R)
1	Ernakulam	574	29783
2	South Kerala	211	10948
3	North Kerala	186	9651
4	South India	142	7368
5	North India	110	5708
	Total	**1223**	**63458**

Source: Travel cost survey, 2001-02

6.3.4 Travel Cost Estimates

The total travel cost estimated consists of three components: cost of travel, time cost and other expenses. In the survey undertaken for the present study, most respondents from within the State did not consider the time spent traveling to the site and at the site as a cost since it was part of a trip undertaken on a holiday. Hence no salary was lost. On the other hand, for many visitors from outside the State, the trip involved lost wages. Table 6.4 provides the travel costs of respondents by zones for visiting the Cochin backwaters.

[6] Actual number of visits per day was multiplied by 365 to get the total number of visitors a year.

Table 6.4 Zone-wise Total Travel Cost for Visiting the Cochin Backwaters, 2001-02

Zone	Travel costs	Other costs	Time Cost	Total cost Rs.
1	31	31	-	62
2	200	104	-	304
3	233	332	-	565
4	213	251	99	563
5	1099	249	140	1488

Source: Travel cost survey, 2001-02

6.3.5 Consumer Surplus

An important measure of consumer's welfare changes (benefits) from outdoor recreation is called the "consumer surplus", which is defined as the amount of welfare consumers receive over and above the price paid in the market[7]. It is a good measure[8] under a variety of conditions since its value approximates both *willingness to pay* and *willingness to accept*[9].

The demand function consists only of exogenous variables and can be estimated using ordinary least square (OLS) regression techniques. In order to estimate the consumer surplus of consumers visiting Cochin backwaters, the

[7] Consumer surplus is a traditional measure of net benefit to a consumer. Compensating variations and Equivalent variations are two other measures of welfare changes developed by Hicks in the 1940s.

[8] Hicks pointed out in his treatise 'Revision of Demand Theory', that for the consumer surplus to be a good measure 'One thing alone is needed .... that the income effect should be small'.

[9] The travel cost model is based on the assumption that consumer surplus criteria could act as a proxy to estimate economic benefits of outdoor recreation sites. Consumer surplus associated with any recreation site is defined as the relevant portion under the demand curve for the site or the services of the site. Harold Hotelling first proposed this approach when he wrote: "Let concentric zones be defined around each park so that the cost of travel to the park from all points in one of these zones is approximately constant. The persons entering the park in a year, or suitably chosen sample of them, are to be listed according to the zone from which they come. The fact that they come, means that the service of the park is at least worth the cost incurred for and during the journey and this cost can presumably be estimated with fair accuracy. If we assume that the benefits are the same no matter the distance, we have, for all those living near the park, a consumer's surplus consisting of the differences in transportation costs..."

study specifies the visit rate of consumers as depending on costs of travel including other allied expenses. The consumer surplus for each trip is then calculated using the travel cost method as follows:

$$V = V(C) \qquad \textbf{(6.1)}$$

Where, V represents the number of trips made to the backwaters and C represents the travel cost which includes travel costs to the site, other costs incurred and opportunity cost of time. Since theory states that price and quantity are inversely related, as the price of a trip increases, the number of trips decreases. The empirical relationship is detailed in annexure 6.2.can be written as a linear function.

The output shows the results of fitting a linear function to describe the relationship between zonal travel costs and number of visits. The results of the regression are shown below (see table 6.5).

Table 6.5 Results of Regression Analysis

	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	R	R Square
	B	Beta				
(Constant)	25835.111		3.314	.045	.657	.432
Total Cost	-16.461	-.657	-1.96	.049		

[a] Dependent Variable: Visit rate
[b] Predictors: (Constant), Total Cost

Here the β coefficient is negative showing that when independent variable (price/cost) increases, the number of visits decreases.

The results of the regression analysis are used to construct the demand function for visits to the site. (see Table 6.6).

Table 6.6 Consumer surplus of visitors from various zones in Cochin backwaters

Zone	No. of Trips	Cost per trip (Rs.)	Consumer Surplus (Rs.)
1	24816	62	752
	24651	72	747
	24486	82	742
	24321	92	737
	24156	102	732
	23991	112	727
2	20823	304	631
	20658	314	626
	20493	324	621
	20328	334	616
	20163	344	611
	19998	354	606
3	16510	565	500
	16345	575	495
	16180	585	490
	16015	595	485
	15850	605	480
	15685	615	475
4	16543	563	501
	16378	573	496
	16213	583	491
	16048	593	486
	15883	603	481
	15718	613	476
5	1286	1488	39
	1121	1498	34
	956	1508	29
	791	1518	24
	626	1528	19
	461	1538	14

Source: Travel cost survey, 2001-02

The first point on the demand curve is the total visitors to the site at current cost (including an access cost which in this case is zero since there is no entry fee to the site). The other points are found by estimating the number of visitors with different hypothetical entrance fees (Rs.10, Rs.20, Rs.30, Rs.40 and Rs.50) assuming that an entrance fee is viewed in the same way as travel costs. Detailed estimation[10] was attempted to calculate consumer surpluses of visitors from various zones.

Having estimated the consumer surplus of visitors from various zones, recreational values are estimated and the results are summarized in table 6.7 below. The recreational value of the Cochin wetlands was Rs. 380.5 lakhs. It may be noted that this value approximates, the environmental value corresponding to the recreational services offered by wetlands.

Table 6.7 Recreational Value of the Cochin Backwaters, 2001-02

Zone	No. of Trips	Cost per trip (Rs.)	Consumer Surplus (Rs.)	Actual Number of Visits	Net value (Rs. Lakhs)
1	24816	62	752	29783	224
2	20823	304	631	10948	69.1
3	16510	565	500	9651	48.3
4	16543	563	501	7368	36.9
5	1286	1488	39		2.2
Total				**63458**	**380.54**

Source: Travel cost survey, 2001-02

[10] See also annexure 6.3 for graphical representations.

6.3.6 Socio Economic Features of visitors

Questions were included to get the demographic factors such as sex, age, income, education and profession. To make it convenient for the respondents, age and income were asked in ranges. A question on the type of ownership and structure of housing pattern was used to infer whether the spending pattern of the respondents matched income and other characteristics stated[11]. A look at the socio-economic features of the respondents revealed that most of the visitors were from lower to middle income groups (Table 6.8 gives details). This may be due to the fact that wetlands and backwaters are accessible free of cost to everyone.

Table 6.8 Distribution of Backwater Visitors by Levels of Income, 2001-02

Income Group	Percentage
< 2500	22.16
2500-5000	24.10
5000-10000	31.58
>10000	22.16
Total	100

Source: Travel cost survey, 2001-02

A look at the occupational distribution of the population further cements this. Professionals, traders and those in the service sector constituted about 57 percent of the sample. More than 54 percent of the respondents were graduates or highly qualified people. (Table 6.9 gives the distribution of visitor's occupations).

[11] See annexure 6.1 for the travel cost survey questionnaire used in this study.

Table 6.9 Distribution of Backwater Visitors by Occupation, 2001-02

Occupation	Percentage
Agriculture/Fishery	18.0
Govt. Service	16.3
Professionals	14.7
Others	21.6
Private sector	29.4
Total	100

Source: Travel cost survey, 2001-02

Table 6.10 gives the distribution of respondents by education level while table 6.11 shows that a sizeable percent of the respondents were less than 30 years of age. The age composition of the sample revealed that majority of respondents belonged to the working category.

Table 6.10 Distribution of Respondents by Education Levels, 2001-02

Qualification	Percentage
Pre degree	46.0
Graduation	27.7
PG/Professional	26.0
Total	100

Source: Travel cost survey, 2001-02

Table 6.11 Distribution of Respondents by Age Group, 2001- 02

Age	Percentage
< 30	42.4
30-40	28.3
40-50	16.1
50-60	13.3
Total	100

Source: Travel cost survey, 2001-02

6.3.7 Environmental quality

In standard travel cost analyses, environmental quality is a consideration only if it influences a person's decision to visit one site over another. Respondents were therefore asked to rate and compare the Cochin backwaters with that of the Alleppy backwaters, which was considered the nearest substitute site. The survey revealed that water quality, congestion, lack of public utility services, infrastructure, security, cleanliness etc are the major problems facing the recreation seekers. About 60 percent of the sample population felt the sites were congested. However, 86.3 percent of the respondents pointed out that they did not find Alleppy a substitute for the recreational amenities provided by the Cochin backwaters. Both were observed to provide recreational facilities of a different nature. This proved that the model assumption of no substitute site for the Cochin Backwaters was a correct one. Respondent's reflections on water quality of the site are given in table 6.12.

Table 6.12 Responses of Respondents on the Water Quality of the Cochin Backwater, 2001-02

	General Water Quality	Cochin Water quality
Extremely Good	4.02	8.98
Quite Good	15.05	30.34
Fairly Good	14.05	23.6
Good nor Bad	27.42	15.73
Fairly Bad	7.69	4.49
Quite Bad	13.38	7.87
Extremely Bad	18.39	8.99
Total	100	100

Source: Travel cost survey, 2001-02

Only a small minority rated water quality in the backwaters as bad. This was important as the backwaters, which are in close proximity to urban centres, are often dumping yards for wastes.

The increasing congestion along the wetlands also accounts for pollution of the backwaters with plastics, papers and other waste materials. Respondent's reflections on level of congestion in the site are given in table 6.13.

Table 6.13 Responses of Respondents on the level of Congestion of the Cochin Backwater, 2001-02

Level of Congestion	Percent
Extremely Congested	29.39
Quite Congested	36.54
Slightly congested	34.07
Total	100

Source: Travel cost survey, 2001-02

6.4 Summary and Conclusion

The Cochin wetlands and backwaters provide direct and indirect recreational benefits to domestic and foreign visitors. However, most of the recreational benefits provided by wetlands do not have markets and hence the value of the recreational service it provides is often discounted to zero. Similarly, in most calculations on the direct benefits provided by the wetlands, recreational values are not included. Those recreational benefits that do have markets, contribute only a small part of this total value. This always leads to an underestimation of the total value provided by the wetlands.

An attempt was made in this chapter to estimate the contribution of recreational value of the Cochin backwaters using the travel cost method. This value was found to be Rs.380.5 lakhs. This value approximates a portion of the environmental value of Cochin backwater. It must be remembered that almost all of this value is provided by the wetlands free of cost. Another set of benefits that are provided by wetlands free of cost are its indirect services and functions. The study shall now turn to the estimation of these values of the Cochin Wetlands in the next chapter.

ANNEXURE

Annexure 6.1

THE COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Questionnaire for Eliciting Recreational Value of Cochin Backwaters

The Cochin backwaters are one of the most valuable coastal environments in this part of the world, which provide a variety of recreational potentials to visitors and tourists. This study aims to understand the environmental value of the Cochin backwaters. The objective of this survey is to estimate the recreational value of the backwaters. I request you to co-operate with us by filling up this questionnaire.

1. **How many trips have you made to the Cochin Backwaters within the last 12 months for the purpose of**

   (a) Sight seeing and recreation ----------
   (b) Boating ----------
   (c) Cultural Events ----------
   (d) Exercising ----------
   (e) others(specify) ----------

2. **Where do you live?**

   Panchayat
   District :
   State
   Country:

3. **If you were not on this trip today, what would you most likely be doing?**

   (a) Working
   (b) Watching TV
   (c) Housework or shopping
   (d) Others

4. **How many hours did you spent in the backwaters today?**

   Hours ( )

5. **Please estimate the time and distance it takes you to get to the backwater from your home?**

   Hours ( ) kilometers ( )

6. **Please state the cost incurred for undertaking a travel to the Cochin Backwaters**

Items	Rs
(a) Travel from hometown to the Cochin Private car(fuel cost) Motorcycle Train Bus Taxi Other (specify)	
(b) Boarding and lodging(no. of days) (c) Food and Beverage (d) Sight seeing and recreating (e) Photographs (f) Others	

7. **If you are not from Kochi you came to Kochi for**

(a) Conference attendance
(b) Business
(c) Visiting friends or relatives
(d) Tour and travel
(e) Other purposes (please specify)

8. **Have you visited any other site/s before coming to the Cochin**

□ Yes □ No

(If yes, specify the site/s)

9. **Name the sites you visited and planning to visit in Kochi during this tour?**

Visited	Planning to visit
1.	**1.**
2.	**2.**
3.	**3.**

10. **Which are the other sites you plan to visit during this tour?**

(a)
(b)
(c)

11. **Are you willing to extend your stay in Kochi to visit the backwaters again**

□ Yes □ No

SECTION B

12. Have you visited the backwaters of Alappuzha

□ Yes □ No

If yes ,

13. How do you rate the Cochin Backwaters with that of Alappuzha

(a) Extremely Good (b) Extremely Bad
(c) Quite Good (d) Quite Bad
(e) Fairly Good (f) Fairly Bad
(g) Neither Good nor Bad

14. How do you rate the water quality in the Cochin Backwaters?

(a) Extremely Good (b) Extremely Bad
(c) Quite Good (d) Quite Bad
(e) Fairly Good (f) Fairly Bad
(g) Neither Good nor Bad

15. From your experience in visiting various sites in the Cochin Backwaters how do you feel the congestion in those sites

(a) Extremely Congested (b) Quite Congested
(c) Slightly Congested (d) Not Congested

16. Please state the nature of your visit to this site today.

(a) Break during working hours (b) Off-day
(c) Leave (d) Holiday (e) Vacation

SECTION C

To help us analyse the results, I would like to have the following information.

17. Sex: □ Male □ Female

18. Age:

< 15	15-25	25-35	35-45	45-55	55-65	> 65

19. Education:

Primary	High School	Secondary	Graduate	Post Graduate	Professional	Others

20. Occupation:

Professional	Service	Traders	Farmers	Laborers	Others

21. Length of Vacation:

22. What is the status of ownership of your house?

□ Own □ Rented

23. What type of housing do you live in?

	Bedroom	H all
a. Independent house		
b. Flat		
c. Joint family		
d. Housing colony		
e. others		

24. What is the size of your family

25. What is the approximate monthly income of your household?

(a) Less than Rs. 5000
(b) Between Rs. 5000 and Rs. 7500
(c) Between Rs. 7500 and Rs. 10000
(d) Rs. 10000 and above

DO YOU HAVE ANY COMMENTS TO MAKE ABOUT THIS SURVEY? IF SO, PLEASE USE THIS SPACE.

THANK YOU VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS SURVEY. IT IS GREATLY APPRECIATED.

Annexure 6.2 Estimation of the Model

The empirical relationship is detailed as a linear function.

$$V = a - \beta C \quad (6.2)$$

If the number of trips is zero, $-a = \beta C$ (6.3)

At, V > 0,

$$X = a - \beta C$$

and

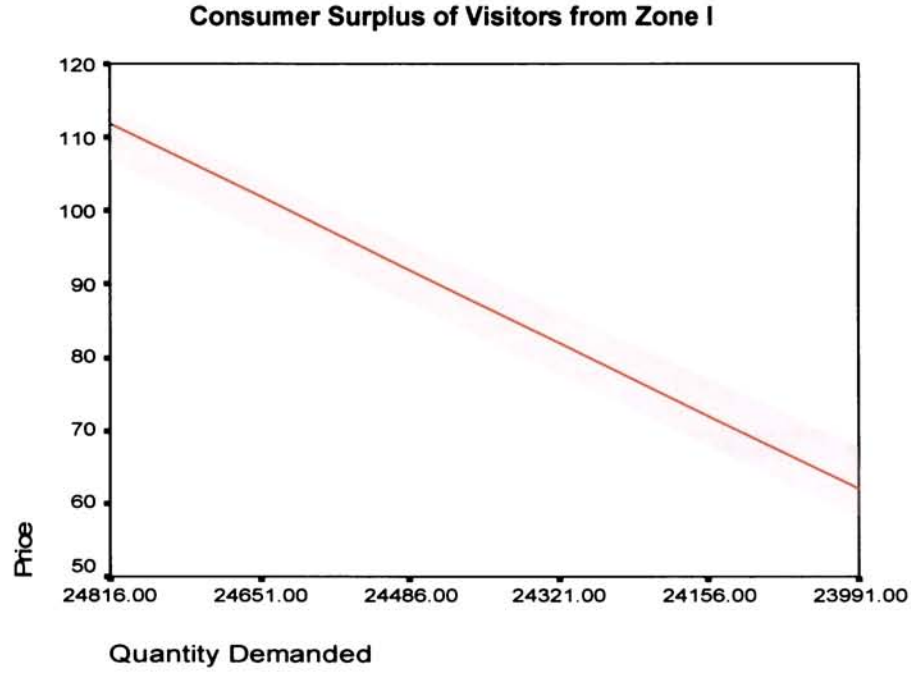
$$C = \left(\frac{a}{\beta}\right) - \left(\frac{V}{\beta}\right) \quad (6.4)$$

$$= 1566 - \left(\frac{V}{\beta}\right) \quad (6.5)$$

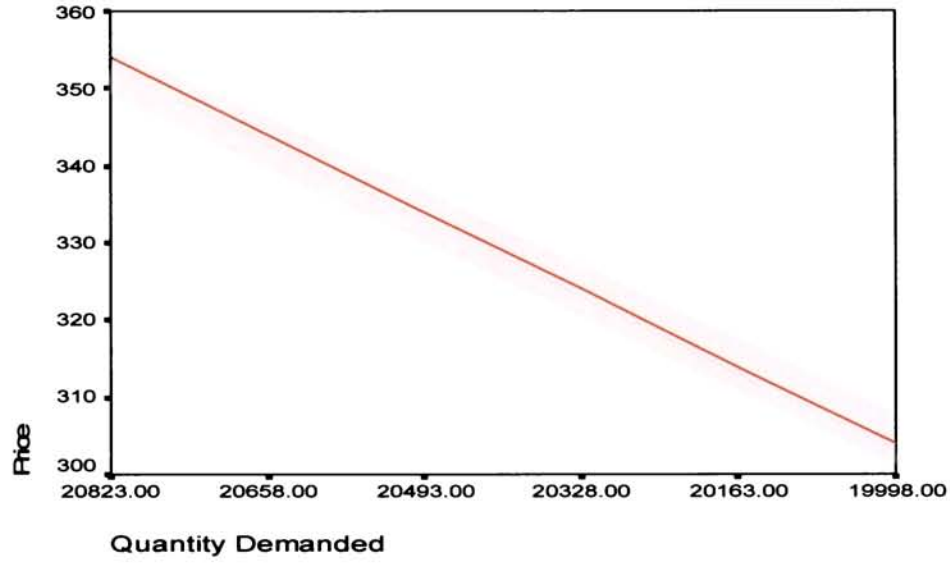
Since consumer surplus associated with a price change is measured as the area beneath the demand curve that lies between these two prices,

Consumer Surplus per trip $= \frac{V}{2\beta}$ (6.6)

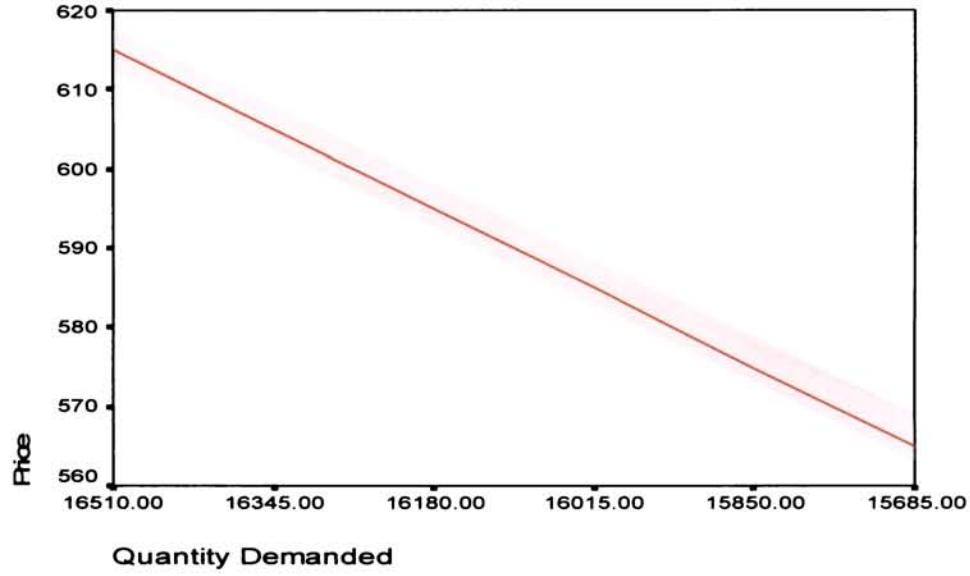
Annexure 6.3 Consumer Surplus of Visitors from Zone I to Zone V



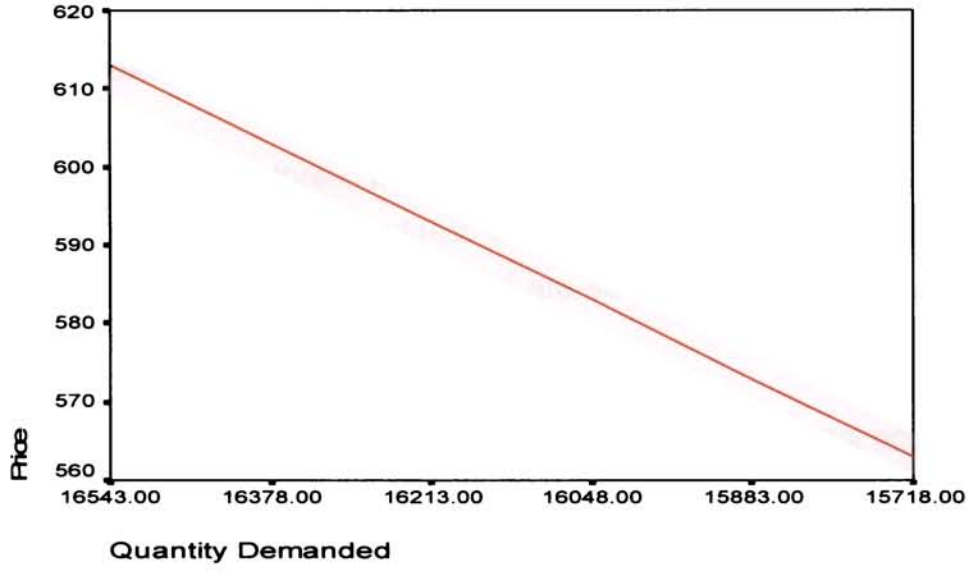
Consumer Surplus of Visitors from Zone II



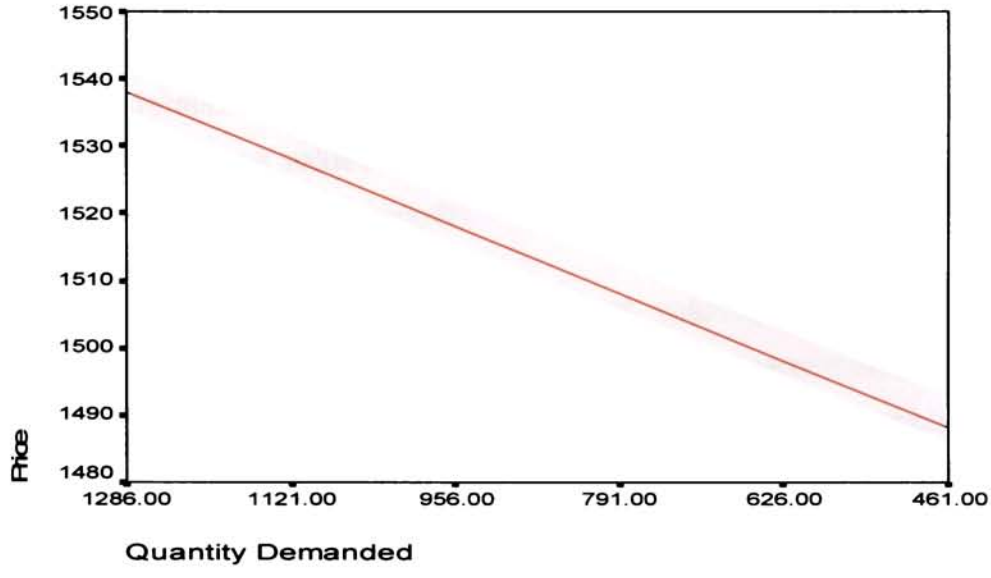
Consumer Surplus of Visitors from Zone III



Consumer Surplus of Visitors from Zone IV



Consumer Surplus of Visitors from Zone V



CHAPTER 7

Indirect Values of Cochin Wetlands

As mentioned in chapter three, wetlands provide a wide range of invaluable benefits to society. However, indirect and non-use benefits provided by wetlands do not have markets and hence are seldom valued or considered important in the decision-making process.

The major objective of this study is to measure the value of indirect economic benefits provided by the Cochin wetlands. This objective is carried out using a survey approach called the Contingent valuation (CV) method. As mentioned in chapter 2, contingent valuation is the only standardised and widely used survey method for estimating Willingness to Pay (WTP) for use, option, existence and bequest values of environmental assets. It is the best approach to get at the Willingness to Pay/Willingness to Accept for the Total Economic Value (including non-use values) of an environmental improvement. This is an important consideration since some contingent valuation studies have shown that indirect and non-use values in certain cases can be 40 to 60 percent of total economic value of wetland benefits.

The values expressed by people in contingent valuation interviews are contingent upon such factors as the description of the environmental good, whether it is provided, and the way it would be paid for. The central problem in the application of this valuation technique is whether the Willingness to Pay (WTP) for an environmental asset that people indicate, accurately describes their true value for the good, when faced with no penalty or cost associated with its use. As seen from chapter three, most studies point out that the Contingent valuation technique does so, with a fair degree of accuracy.

This chapter is structured as follows: Section 1 reviews the methodological issues on questionnaire design and survey. Section 2 presents the estimating results of conservation values for Cochin wetland ecosystem and section 3 contains some discussion on the study. The final section contains some concluding remarks.

7.1 Methodological Issues

7.1.1 Definition of the Good being valued

The hypothetical nature of the contingent valuation method permits it to obtain monetary values for goods and services rendered by a natural resource, including that for non-use benefits provided (Hoevenagel, 1994). The Cochin wetlands provide diverse forms of livelihood opportunities for a large section of the population both directly as well as indirectly. However, over the years population and developmental pressures have led to huge areas of the wetland being lost. Added to this, the over use and often misuse of the wetland space has contributed to the gradual degradation of the wetlands. Local populations, directly depending on wetlands have voiced concern over the declining state of the wetlands whenever it affected their livelihood activities. Nevertheless no one seems concerned enough to do anything concrete about it. Respondents were told that presently, a Consortium of different State agencies and people's representatives were willing to initiate a conservation programme for the Cochin wetlands with the help of the people. The design, therefore, of the contingent valuation questionnaire, was guided to evaluate the value of wetland conservation for the people by asking respondents for the amount of money that they would be willing to pay to maintain current levels of wetland functions and service provided in contrast to allowing the wetlands to degrade further. This would give an indication of the

value of the indirect benefits performed by the wetland ecosystem to the people.

In order to estimate the consumer's willingness to pay for the indirect benefits of Cochin wetlands, a scenario and a hypothetical market was envisaged that would ensure a better wetland management programme and improved quality of ecosystem services delivered by estuaries to the people living in the study area. This management programme was to be undertaken by a Consortium consisting of representatives from the State (central, state and local), various wetland resource users, environmental groups and non-governmental organisations. The contingent valuation questionnaire was structured to value the indirect benefits of wetland ecosystems and executed in Cochin to direct, indirect and non-users[1]. The major task of the Consortium would be to rejuvenate four important wetland functions (improved waste disposal functions of estuaries, shoreline stabilization and flood control, improved water quality and fishery rejuvenation function) such that it would improve the water quality of the Cochin wetlands and prevent further deterioration in the environmental goods and functions provided by the Cochin wetland ecosystem. To give credibility to this scenario, a time frame was fixed (the year 2015) within which this scenario would be achieved.

7.1.2 Sampling and Survey Methods

The data on household Willingness to Pay (WTP) for conserving Cochin wetland ecosystem used in this analysis came from a 2001-02 survey of households. The survey was conducted for heads of households or housewives whose age ranged from 25 to 65. The survey was restricted to the districts of Ernakulam, Alleppy and Kottayam, which comprised the study area. In order to draw a representative sample of this population, the village

[1] Annexure 8.1 gives a detailed questionnaire executed in this study.

panchayat data was relied upon so that respondents from different income strata were included in the survey. In keeping with the stratification adopted for the rest of the study, the whole study area was divided into five zones comprising panchayats, municipalities and Corporations in the districts of Ernakulam, Alleppy and Kottayam. From each zone, panchayats were chosen at random. Respondent households were randomly selected from income groups within each panchayat, reflecting with reasonable accuracy the characteristics of the population of the study area.

The survey was conducted as personal interviews for practical reasons. Since this survey was the first of its kind conducted in the study area, it was assumed that respondents were less likely to supply unprompted values for environmental services if confronted by any other method such as telephonic interviews, mail questionnaires etc. A Person-to-person interview with well-trained interviewers offers the best scope for detailed questions and answers. The interviews were administered in respondents' home during the months of May to August, 2001. Interviewers visited the homes selected for sampling until the required quota was filled. Completed questionnaires were checked. Questionnaires with contradictory or erroneous responses were rejected and new sets executed through different interviewers again.

7.1.3 Survey Development

Before the willingness to pay and value elicitation questions were asked, an attempt was made through the questionnaire to construct the scenario by mean of photographs, newspaper clippings and other visual aids. The questionnaire listed a brief explanation of the purpose and contents of the interviews and clarified the context of the study by providing additional background information on the ecosystem services performed by the Cochin wetlands. A detailed description of what is known about the likely effects of the

hypothetical change in management of estuaries and what was likely to happen if nothing was done was also included. This was expected to create an awareness of the beneficial effects from the conservation of the wetlands and the time period when those benefits would occur. Respondents were then asked whether they were willing to participate in the programme.

> "If by 2015, the Consortium is to achieve the desired environmental quality explained in section B of the questionnaire, we will have to start taking many additional environmental measures now both in and around the Cochin wetlands and at the State and National level. The additional environmental measures that we will have to take in the country to achieve this environment are going to cost money. Would you be willing to share this cost?"

In order to identify the technical information and attributes of wetlands, a detailed survey of literature was undertaken. Focus group sessions were also held with village panchayat heads, environmental Non-governmental Organization (NGO) representatives, local leaders, ayalkuttams and such informal organizations to evaluate the participants' perception of the wetlands and to describe its characteristics in ways that were understandable and realistic to the public. As a result of the pilot study, questionnaire and visual aids were modified with better understanding words and the general information about wetlands was simplified because participants' perception about the importance of wetland functions was high. Interviewers were trained to conduct pre-test personal interviews on a hundred residents in the study area. Open-ended value elicitation questions were asked in the pre-test to obtain a benchmark preservation value. These values were then used in the closed ended contingent valuation questionnaire as the range of the starting and final bid. Questionnaires and visual aids were again modified according to the feedbacks received from the pre test.

7.1.4 Survey Structure

In designing a contingent valuation survey, a scenario should offer respondents information about the characteristics of the specific good and a context, which meets the requirements of understandability, plausibility and meaningfulness so that it can enhance the credibility of a survey, and make it more likely to produce reliable results. The questionnaire format consisted of (i) Respondents' attitude towards various characteristics of wetland diversity management (ii) Respondents' perception on wetland ecosystem services (iii) Valuation questions (iv) Payment Vehicle (v) Description of constructed market and (vi) A personal profile. General background information provided to respondents included the definition, nature, function and role of the Cochin wetlands. The questionnaire was executed in the local language (Malayalam).

Before the key willingness to pay questions were asked, the questionnaire was used to attempt to construct the contingent market scenario. It did so by showing the specific areas along the wetland and explaining their characteristics and situations under development pressure for agricultural, industrial and other uses by reclamation and the negative and positive aspects of this development. Also included in the presentation was a detailed description of what is known about the likely effects of the hypothetical policy change and importantly, what was likely to happen if nothing was done. Among other things, this description could spell out the beneficial effects expected to result from the conservation of the wetlands and where and when those benefits would occur.

Examples of benefits included improved waste disposal functions of estuaries, shoreline stabilization and flood control, improved water quality, fishery rejuvenation function etc. Moreover, this study strove to present the sample households with the best information possible about where the negative

effects of landfill or reclamation would be felt by providing several well-illustrated visual cards. The material presented to respondents also included a description of how the proposed policy intervention would work. Attitudinal and perception questions were asked to develop a picture of people's environmental awareness. For instance, they were asked "The environmental services that the backwaters perform for us are invaluable and cannot be replaced if destroyed". They were asked to rate these statements on a scale of seven. Finally, household information on income, age, education, gender, occupation and membership of environmental organizations were also collected.

7.1.5 Elicitation Method

Several formats may be used to elicit the subject's willingness-to-pay. The two main variants of the contingent valuation questionnaire are the open-ended and dichotomous choice[2] (DC) formats. Each method has its advantages and disadvantages[3]. The former involves letting respondents determine their "bids" freely and is easier to implement, while the latter format presents respondents with two alternatives among which they are asked to choose. In the present study an open ended question format was used in the pre-testing survey.

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[2] In a *closed-ended survey* (discrete choice surveys) the respondent is asked to choose from a discrete set of possible values. Studies found that the discrete-choice contingent valuation method yielded higher willingness to pay estimates than the open-ended format and were very sensitive to assumptions made about the random utility.

[3] An *open-ended survey* asks the respondent to state his maximum willingness to pay (or less commonly, his minimum WTA) for a change in environmental quality. The advantage of this method was that there was no anchoring bias and it was very informative since maximum willingness to pay could be identified for each respondent. However, open-ended contingent valuation formats typically generate lower estimates of willingness to pay than dichotomous choice designs (Bateman et al. 1995). They often lead to large non-response rates, protest answers, zero responses, outliers and generally unreliable responses (Mitchell and Carson, 1989).

Mitchell and Carson (1981, 1984) developed the *payment card approach.* Here, the respondent is asked to select the amount that represents his maximum Willingness to Pay (WTP) from a list of amounts presented on a card. O' Conor et al. (1999) and Reaves et al., (1999) found that the single and double-bound dichotomous choice questions resulted in an estimated mean about twice as high as the actual value and the open-ended mean due to an anchoring effect leading to 'yea-saying' behaviour but the payment card format exhibited desirable properties relative to the open-ended and double-bounded dichotomous choice formats. Hence, in the present study a close ended, payment card format was employed in the actual Contingent valuation survey.

Before the actual valuation questions were asked, the respondent was first asked their Willingness to Pay (WTP) for the programme. Those who expressed a negative Willingness to Pay (WTP) were excluded from the value elicitation process. Those who expressed a positive Willingness to Pay (WTP) were then taken through the payment card to arrive at a value figure that would reflect with reasonable accuracy, the value of the indirect functions of the Cochin wetland ecosystem to the respondent. Each respondent was presented with a bidding card that started at Rs. 25. The question was framed as follows:

> "Suppose the management programme would mean that your household would have to contribute a one time payment of Rs. 25/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, would you be willing to contribute this amount?"

The second bid was conditional on the respondent's response to the first bid. The bid amounts used in this study were: Rs. 25, 50, 100, 200, 300 and 500. He was asked to give a yes or no vote depending on whether his willingness to pay equaled or exceeded each bid. Once a value was arrived at, the

respondent was once again asked as to whether the arrived at figure was the maximum amount that he was willing to pay. It was observed that, in most cases respondents stuck to the original figure they quoted.

7.1.6 Payment Vehicle

The payment vehicle is a crucial element in the application of the Contingent valuation method because it provides the context for payment. The payment vehicle used for this study included a one time voluntary donation to a consortium and a green tax. Despite its high level of familiarity and obvious connection with the good being considered, taxes may encourage respondents to restrict their willingness to pay amounts to the range associated with a fair or customary expenditure (Mitchell and Carson, 1989). Besides, in countries like India, a large percent of the population do not come under the taxable limits, especially marginalized societies who live on the banks of wetlands and have diversified livelihood opportunities that are not taxable. Consequently, using tax as the only payment vehicle option did not seem a good option and could lead to payment vehicle bias. Therefore, donation to a consortium was included as an additional payment vehicle. The willingness to pay question was "Would your household be willing to make a one time payment in a green tax, voluntary payment or donating to a conservation fund, provided the success of this programme is guaranteed"?

Regarding the definition of the costs that the households themselves were likely to bear, they were told that, "The amount you indicate will tell us what it is really worth to your household to have the programme implemented. If the programme actually costs less than people are willing to pay, you would only have to pay what it would cost. If the policy turned out to cost more than what people are willing to pay, it would not be implemented."

7.1.7 Bias

Bias is an aspect of a study that consistently skews responses in one direction, thereby leading to results that diverge from the true Willingness to Pay (WTP) of the population. Bias may arise in any of the four steps in survey design and implementation: construction of the market scenario; development and application of the method and vehicle for eliciting responses; sample design and implementation; and drawing inferences from the results. It is difficult to determine the extent of bias the elicited contingent valuation value may have, since typically a traditional economic market does not exist for the good in question. Critics of the contingent valuation method question its validity and reliability in many respects. However, at the moment the contingent valuation method is the only technique at hand for the assessment of non-use values of environmental goods. Therefore, it seems worthwhile to have a closer look at some of the criticism raised in this debate

Among the most serious difficulties for practitioners of the contingent valuation method are the problems of hypothetical, strategic, and compliance biases. To overcome hypothetical bias, the respondents were reminded of their budget constraints. Samuelson (1969) believed that free-riding behavior would always be the individual's best response, regardless of the questioning format. To avoid strategic bias, the contingent valuation survey was designed so that the payment vehicle was plausible as far as the respondents were concerned. Care was also taken not to over-emphasize the importance of the individual's response. To avoid compliance bias, the survey participants were not provided with any additional instructions beyond those that were carefully prepared in advance and given to all survey participants. To avoid strategic bias, the open ended question format was used in the pilot survey to estimate the range of values that the respondents bid. Based on this, an initial bid level was chosen, sufficiently low as to avoid starting point bias. The possibility of range bias was mitigated by using a payment card elicitation method where the upper bound

of willingness to pay values listed were sufficiently high as to allow the respondent to choose from a large number of monetary values. Relational, question order and position bias were not applicable to the current study.

Scenario misspecification bias occurs when the respondent perceives some aspect of the contingent market incorrectly. In the present study, this was discounted as most of the respondents were familiar with the good being valued. *Payment vehicle bias* occurs if the means of payment for the hypothetical good influences the stated Willingness to Pay (WTP) of the respondent. In many countries, higher taxes and voluntary donations are relatively neutral payment vehicles and therefore can be used without fear of bias (Morrison et al., 2000). Budget constraint bias may result from respondent confusion about whether the constraint is personal or household income. It can also occur when the respondent is asked to provide a good at a higher level than he is currently providing, via higher taxes or donations. Mitchell and Carson (1989) advocate the use of respondent pre-tests to avoid problems with budget constraint bias.

Empirical examples suggest that *'embedding effect'* or warm glow motive may be present in the majority of contingent valuation studies, although its presence does not necessarily preclude scope sensitivity to the quantity or quality of an environmental good. This was therefore ignored in the study. The contingent valuation study estimates were judged sensitive to the scope of the environmental amenity being offered since the payment card, when constructed had taken into account the income range of the respondents. Mitchell and Carson (1989) reject the concept of informational bias pointing out that they are required, to certain extends, in contingent valuation studies since the scenario presented to respondents is a hypothetical one. Therefore, they were not considered to be present in the current study.

7.2 Analysis of Contingent Valuation Responses

According to Blue Ribbon panel's testing protocol that, a sample size of at least 1,000 respondents is required for a dichotomous choice method, a total of 1,127. personal interviews were administered by trained interviewers in respondents' home during May to August, 2001. The survey yielded 1,023 usable interviews. Enumerators rated 104 as being of poor quality. Thus, the findings from the survey are based on the analysis of 1,023 interviews.

7.2.1 Willingness to Pay Responses

Table 7.1 presents the distribution of responses to the valuation question, indicating the total number of respondents who stated that they would be willing to pay for the conservation program at each bid level, ranging from Rs. 25 to Rs. 500.

Table 7.1 Distribution of Responses by Bid Amount, 2001-02

Income\ WTP (Rs.)	0	25	50	100	200	300	500	Total
< 1000	32 (3.1%)	14 (1.4%)	11	5	2	2	-	**66** (6.5%)
1000-2500	23 (2.2%)	41 (4.0%)	23	22	1	5	3	**118** (11.5%)
2500-5000	68	94 (9.2%)	86 (8.4%)	51	13	9	12	**333** (32.6%)
5000-10000	78	1	144 (14.1%)	94 (9.2%)	21	20	11	**369** (36.1%)
> 10000	2	-	20 (2.0%)	77 (7.5%)	15	9	14	**137** (13.4%)
Total	**203** (19.8%)	**150** (14.7%)	**284** (27.8%)	**249** (24.3%)	**52** (5.1%)	**45**	**40**	**1023** (100.0%)

Source : Contingent valuation survey, 2001-02

Focusing on the column of 'yes' responses, it is seen that eighty percent of the 1023 sample said 'yes' to the first question, implying that their willingness to pay was Rs.25. Sixty six percent said 'yes' to an amount of Rs.50, thirty eight percent to an amount Rs.100, thirteen percent to an amount Rs.200, eight percent to an amount of Rs. 300 and four percent to an amount of Rs. 500.

7.2.2 Protest Bids

Respondents to contingent valuation (CV) surveys give a variety of reasons for not wanting to pay money. As discussed above, a zero response could be consistent with economic behaviour, indicating that the individual faced income constraints or derived no benefits from the good. This variability is likely to be reflected in people's attitudes toward paying for a public good change, paying for public goods in general and a component that is independent of these attitudes but unique to particular beliefs about paying (Jorgensen et. al., 2001). Carson et al. (1998) refers to them as those with "would-not- vote" option. A primary concern then is how to interpret zero value response.

Protest responses and their meaning may vary according to the type of good being valued, the elicitation format, and the interaction between these elements and external factors (Jorgensen et al., 1999). To the extent that protest beliefs are dependent on matters such as survey design, they may be alleviated through changes in contingent valuation methodology. However, when protest beliefs are a reaction to the act of paying, due to an individual's rejection of some aspects of the valuation scenario or their engaging in "free-riding" behaviour, methodological remedies may not be effective. Jorgensen and Syme (2000) observed in their study that protest attitude were present in different samples of a survey despite methodological differences between the contingent valuation surveys.

As mentioned above, 19.8 percent of the total 1023 samples were unwilling to pay anything towards Cochin wetland management although 95.7 percent of them agreed that wetland functions were of value to mankind. The reasons stated and the percentage responses for those not willing to pay are given in the following table.

Table 7.2 Reasons Stated for Negative Willingness to Pay and the Percentage Responses, 2001- 02

Reason	%
1. I do not believe my payment will help in stopping the degradation of the wetlands	17.2
2. It is not worth anything to me	3.3
3. I can't put a rupee value on improved water quality	5.6
4. It is the Government's duty to pay for such expenses	51.6
5. Such expenses are to be undertaken by those who use the wetlands.	16.3
6. Other reasons	6.0
Total	**100**

Source : Contingent valuation survey, 2001-02

Table 7.2 gives the percentage distribution of Willingness to Pay (WTP) of respondents classified on the basis of their educational qualification.

Table 7.3 Percentage Distribution of Willingness to Pay Responses by Educational Level, 2001-02

Education \WTP (Rs.)	0	25	50	100	200	300	> 300	Total
Professionals	25.1	38.7	29.2	14.1	13.5	15.6	20.0	24.3
Post Graduation	31.0	40.7	31.7	25.7	23.1	22.2	22.5	30.2
Graduation	9.4	8.7	14.8	14.5	25.0	11.1	7.5	12.8
Technical Course	7.4	2.0	5.6	7.6	7.7	8.9	10.0	6.4
Pre Degree	25.1	10.0	13.7	29.3	19.2	35.6	22.5	20.8
Primary Education	2.0	0	4.9	8.8	11.5	6.7	17.5	5.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Contingent Valuation survey, 2001-02

It was observed that the maximum number of respondents with a willingness to pay for a better management of Cochin wetlands were those who had completed at least their primary education. Graduates also showed a higher Willingness to Pay (WTP).

7.2.3 Estimation Results

A lognormal distribution with a spike falling at zero was fitted to the probability distribution. The spike model was estimated using the Maximum likelihood estimation method, the height of the spike representing the probability of having zero willingness to pay (WTP). It was calculated as 0.38 which is very negligible. A probability density function was worked out[4].

A regression was fitted to the data using a Multinomial Logit Model with marginal effects. The statistical package *limdep* was use to run the regression and estimate values. In the result (table 7.4), it was seen that education was not significant (as the probability column shows). Coefficients of all income dummies were significant at 1 percent level. At middle income (INCOME1) and high income (INCOME2) strata, probability of WTP was high compared to low income groups. Gender was also insignificant. Age had very little impact on WTP and was negatively related to probability of Willingness to Pay (WTP). As age increases by 1 unit, the probability of WTP decreases by 0.27 percent. Previous knowledge of wetlands is significant and has a positive influence on WTP. Little previous knowledge of wetlands (PRKNOW1) and greater previous knowledge of wetlands (PRKNOW2) strata, probability of WTP is high compared to no previous knowledge.

[4] The probability density function worked out for the WTP variable was:

$$f(y) = \frac{1}{\sqrt{2\Pi}\,(1.8610\quad)} e^{-\frac{(y-3.4563\quad)^2}{2(1.8610\quad)^2}}$$

Table 7.4 Results of Regression of Estimated WTP on Selected Environmental and Socio Economic Variables

Multinomial Logit Model	
Maximum Likelihood Estimates	
Dependent variable	WTPDUMMY
Weighting variable	ONE
Number of observations	1023
Iterations completed	8

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z significance	Mean of X	Marginal Effect
EDUDUM1	0.139621	0.25655623	0.544	0.5863	.30009775	- 0.0186023
EDUDUM2	0.212156	0.23883074	0.888	0.3744	.54740958	0.02747885
INCOME1	1.242759	0.35401273	3.510	0.0004	.11534702	0.16096432
INCOME2	1.175632	0.29874700	3.935	0.0001	.32551320	0.15226991
INCOME3	1.118167	0.29576514	3.781	0.0002	.36070381	0.14482694
INCOME4	4.126324	0.76378746	5.402	0.0000	.13391984	0. 5344486
GENDER	- 0.19160	0.19961879	- 0 .96	0.3371	.74389052	- 0.0248170
AGE	- 0.02217	0.00700515	- 3.17	0.0015	39.356794	- 0.0028726
PRKNOW1	1.477433	0.30223311	4.888	0.0000	.28152493	0.19135970
PRKNOW2	1.151442	0.26542275	4.338	0.0000	.64027370	0.14913680
OCCUDUM	0.565269	0.25741512	2.196	0.0281	.13782991	0.07321475

Log likelihood function	- 453.4743
Restricted log likelihood	- 509.6858
Chi-squared	112.4229
Degrees of freedom	11
Significance level	.0000000

Source: Regression results

Probability of WTP of the people with little prior knowledge is 19 percent more, compared to people without prior knowledge, where as, probability of WTP of the people with high prior knowledge is 15 percent more compared to people without prior knowledge. That is probability of WTP of people with little knowledge is more, when compared to people with high knowledge. If the occupation of people is directly dependent on wetlands, then there is a 7

percent higher probability of WTP than people with occupation that are independent of wetlands. All the coefficients explained above are based on the marginal effects coefficients obtained in the last column.

Goodness of fit of the model is explained using *pseudo* R^2. This was obtained using the formula (1-(log unrestricted/log restricted). It was estimated as 0.11. The significance of *pseudo* R^2 is given by significance of Chi square statistic (112.423).

7.2.4 Total Willingness to Pay Estimates

Mean was estimated as Rs. 80.84 while Median willingness to pay (WTP) was estimated as Rs. 50. As is commonly seen in contingent valuation studies, mean took on a higher value than median. To test the validity of contingent valuation responses, it was checked whether the estimated parameters had signs that conformed to prior expectations and found to be so.

As a final exercise, the sample values were expanded to the population estimates in order to obtain at least a preliminary evaluation of the proposed program. The appropriateness of the expansion relies on the representativeness of the sample frame. As described earlier, the sample frame was a stratified sample to represent demographic aspects.

From the 1023 questionnaires collected, the Mean Willingness to Pay for each income group was calculated. The Total Willingness to Pay was then generated by multiplying the Mean willingness to pay of each income group with the population belonging to that particular income group. This was summed up to obtain the Total Willingness to Pay of the people of the study area for an improved management of the Cochin wetland system, which reflects the value of the ecosystem services of the Cochin wetlands.

The 2001 Census of Population recorded 12.9 lakh households in the three districts of Ernakulam, Kottayam and Alleppy. Several factors were considered in calculating the expanded annual Mean willingness to pay values, which are presented in Table 7.5. The Total WTP estimate was calculated by multiplying the Mean willingness to pay estimate by the total number of households in the study area.

Table 7.5 Total Willingness to Pay for the Non-use Values of Cochin Wetlands, 2001- 02

Income	Population * (Lakhs)	Total WTP (Rs. Lakhs)
< 500	4.77	385.61
500 - 1000	9.91	801.12
1000 - 2500	23.39	1890.85
2500 - 5000	25.2	2037.17
5000 -10000	10.14	819.72
> 10000	2.27	183.51
Total	**75.68**	6117.97

Source: Contingent Valuation survey, 2001-02 * Thomson (2003)

Thus the Total willingness to pay for the non-use values of the Cochin wetland services are estimated at Rs. 6117.97 lakhs.

7.3 Summary and Conclusion

The major objective of this chapter was to estimate the indirect benefits provided by the Cochin wetlands to direct, indirect and non-user populations. This chapter gives the details of the Contingent valuation survey that was executed in the study area. Section one described the actual survey and its execution. Section two undertook a detailed discussion of the methodological issues involved in the survey. Section three contained some discussion on the study.

This analysis has demonstrated the feasibility of extending the use of contingent valuation methods to local populations in developing countries like India. Certain issues emerge from these applications. Income is strongly related to willingness to pay in these surveys, yet income levels are often low. Secondly, education is not a factor that influences willingness to pay in the coastal belt very much. Rather, relation of individual occupation to any wetland based activity very much influenced their willingness to pay. The study revealed that people very much valued the indirect function performed by wetlands, in fact as much as they valued the direct benefits provided by the system. There still exist differences of opinions among experts when undertaking such valuation studies. However, in the absence of a better technique for valuing environmental services that have no markets, this is definitely a first step.

ANNEXURE

Annexure 7.1

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

CONTINGENT VALUATION QUESTIONNAIRE FOR THE VALUATION OF ECOSYSTEM FUNCTIONS OF COCHIN WETLANDS

I. Panchayat : Date :
Time of interview : Interviewer :

II. ATTITUDINAL QUESTIONS

1. The environmental services that the backwaters perform for us are invaluable and cannot be replaced if destroyed.
   (1) Neutral (2) Strongly disagree (3) Disagree
   (4) Agree (5) Strongly agree

2. The Government should not pursue developmental programmes that damage the biodiversity of the Cochin Wetlands.
   (1) Neutral (2) Strongly disagree (3) Disagree
   (4) Agree (5) Strongly agree

3. It is the duty of the people to protect their environment. Hence they should take the initiative.
   (1) Neutral (2) Strongly disagree (3) Disagree
   (4) Agree (5) Strongly agree

4. The Cochin Wetlands supports 150 species of fish and shellfish, different species of *planktons* and birds. It does not matter if a few of these species are lost.
   (1) Neutral (2) Strongly disagree (3) Disagree
   (4) Agree (5) Strongly agree

5. It does not matter if the wetland is reclaimed for development activities.
   (1) Neutral (2) Strongly disagree (3) Disagree
   (4) Agree (5) Strongly agree

6. What according to you is the best agency to conserve biodiversity in the Cochin Wetlands
   (a) State Government (b) Fisheries Department
   (c) Pokkali Land Development Agency (d) Village Panchayat
   (e) A coalition of State agencies, ayalkuttams and other stakeholders who use the wetlands.

III. RESPONDENT'S PERCEPTIONS

3.1 Environmental quality degradation in Kerala will become more widespread in years to come.
(1) Extremely likely (2) Quite likely (3) Slightly Likely (4) Neutral
(5) Slightly Unlikely (6) Quite Unlikely (7) Extremely Unlikely

3.2 To you, how serious is the current state of environment in backwaters/Wetlands?
(1) Extremely likely (2) Quite likely (3) Slightly Likely (4) Neutral
(5) Slightly Unlikely (6) Quite Unlikely (7) Extremely Unlikely

3.3 Deterioration in the quality and services provided by the backwater ecosystem will affect indirect users of this resource.
(1) Extremely likely (2) Quite likely (3) Slightly Likely (4) Neutral
(5) Slightly Unlikely (6) Quite Unlikely (7) Extremely Unlikely

3.4 In the absence of any concrete bids or initiatives to conserve biodiversity, the people will take up the initiative.
(1) Extremely likely (2) Quite likely (3) Slightly Likely (4) Neutral
(5) Slightly Unlikely (6) Quite Unlikely (7) Extremely Unlikely

3.5 I may donate money to conserve biodiversity of the backwater ecosystem.
(1) Extremely likely (2) Quite likely (3) Slightly Likely (4) Neutral
(5) Slightly Unlikely (6) Quite Unlikely (7) Extremely Unlikely

(Please show the Charts and Diagrams to the Respondent)

State of the Backwater ecosystem and its delivery of services in 2015 if current environment management remains the same.	State of the Backwater ecosystem and its delivery of services in 2015 if managed by a Backwater Protection Consortium.
1.A Household/Industrial Waste dissemination function ▪ Congested water channel ▪ Accumulated waste ▪ Contamination of water ▪ Spread of communicative diseases via. Mosquitoes, etc ▪ Non degradable plastic and industrial pollutants ▪ Increased pollution	1.B Household / Industrial Waste dissemination function ▪ Cleaner water channels & canals ▪ Prompt disposal of wastes ▪ Good water quality ▪ Free from communicative diseases. The people of Cochin will be safe from attacks of mosquitoes and such insects. ▪
2.A Shore stabilisation function and flood control ▪ Increase in land reclamation ▪ Increased sedimentation and flooding	2.B Shore stabilisation function and flood control ▪ Dredging undertaken on a small scale to clean up clogged channels and canals ▪ Conserving mangroves to preserve banks
3.A Tidal Functions (Veliyettam & Veliirrakam) ▪ Reclamation and sedimentation causes salinity intrusion ▪ Reduced inflow of fresh water from river bodies	3.B Tidal Functions (Veliyettam & Veliirrakam) ▪ Monitor and discourage backwater reclamation and other activities that affect tidal functions

4.A Source of Seedlings and fishery resources ▪ Destruction of mangroves and pollution affecting juvenile seedlings. ▪ Weak tidal functions and destructive levels of seed collection for commercial aqua culture	4.B Source of Seedlings and fishery resources ▪ Conserve mangrove forest in the Cochin Wetlands ▪ Organise methods to reduce pollution in the region
5.A Recreational value ▪ Influx of tourism at the expense of the environment	5.B Recreational value ▪ Encourage eco-friendly tourism activities

3.6 Please rate the consequences of the two scenarios

Situation A
Situation B

IV. Valuation Questionnaire

4.1 If by 2015, the Consortium is to achieve the desired environmental quality explained in section B, we will have to start taking many additional environmental measures now both in and around the Cochin wetlands and at the State and National level. The additional environmental measures that we will have to take in the country to achieve this environment are going to cost money. Would you be willing to share this cost?

□ Yes □ No

4.2 Assume that a body, reputed for doing efficient and honest work undertakes the task of protecting the Cochin Wetlands from further degrading activities like Pollution, large scale Backwater land reclamation, waste dumping and such other external activities so that we can at least maintain the current Scenario A from further degradation will you be willing to support such a move?

□ Yes □ No

4.3 If no, proceed to question 4.5

4.4 If yes, please go to question 5.1

4.5 If you are not willing to contribute, which of the following reasons best describes why you would not be willing to pay anything?

(a.) I don't believe my payment will help in stopping the degradation of the Backwater.
(b.) It is not worth anything to me
(c.) I can't put a rupee value on improved water quality
(d.) It is the Government's duty to pay for such expenses
(e.) I oppose this type of question
(f.) Other, please specify_____

IV. DESCRIPTION OF THE METHOD OF PAYMENT

(Please hand out the Payment Card to the Respondent)

5.1 Suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs. 25/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, would you be willing to contribute this amount?

☐ Yes ☐ No

5.2 If yes, suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs. 50/-, given your budget constrain, would you be willing to contribute this amount?

☐ Yes ☐ No

5.3 Suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs.100/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, given your budget constrain would you be willing to contribute this amount?

☐ Yes ☐ No

5.4 Suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs. 200/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, would you be willing to contribute this amount?

☐ Yes ☐ No

5.5 Suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs. 300/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, given your budget constrain would you be willing to contribute this amount?

☐ Yes ☐ No

5.6 Suppose that the additional environmental measures would mean that your household would have to contribute a one time payment of Rs. 500/- to achieve the environment which can be expected as a result of a more stringent environment policy by the year 2015, given your budget constrain would you be willing to contribute this amount?

☐ Yes ☐ No

5.7 What is the maximum amount of money that your household would be willing to contribute to achieve the environmental quality which can be expected as a result of a more stringent environment policy initiated by the Environment Protection Consortium by 2015? Would you b willing to pay more than the amount stated above?

The MAXIMUM amount is Rs .....

5.8 Please explain the main reason, which played an important role in determining your maximum amount.

5.9 Suppose the situation B can be achieved by the year 2008 rather than 2015, would that affect the maximum amount that you have just mentioned?

□ Yes □ No If yes, specify to what extend? _____

VI. DESCRIPTION OF THE CONSTRUCTED MARKET

6.1 In order to construct and monitor this programme, the consortium will begin functioning next year. Which of the following methods would you prefer as a mode of payment of this amount to the consortium?

- A one time green tax
- Voluntary donations
- Voluntary donation to the conservation fund floated by the consortium.

VII. PERSONAL PROFILE

7.1 Have you any previous knowledge of wetlands and their function?

(a.) Not yet/ Will be visiting in the near future
(b.) Just once or twice
(c.) Very often

7.2 Age Gender :

7.3 Occupation :

1. Agriculturist/Fisherman/Prawn Filtration (Wetland based Activity)
2. Govt. Employee
3. Private sector employees and Others

7.4 Educational Qualification

1. Under Graduation or less
2. Graduate
3. Post Graduation/ Professional

7.5 Number of members in your family :

7.6 What is your family's net monthly income?

(1). Rs. 500 and below (2). Rs. 500 -- Rs. 1000
(3). Rs. 1000 – Rs. 2500 (4). Rs. 2500 – Rs. 50000
(5). Rs. 5000 – Rs. 10000 (6). Rs. 10000 and above

7.7 Are you a member of an environmental organisation?

□ Yes □ No

7.8 If yes, please explain in detail

DO YOU HAVE ANY COMMENTS TO MAKE ABOUT THIS SURVEY OR THE ENVIRONMENT IN THE COCHIN WETLANDS? IF SO, PLEASE USE THIS SPACE.

THANK YOU VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS SURVEY. IT IS GREATLY APPRECIATED.

Chapter 8

Summary and Conclusion

Economic valuation of coastal wetlands is an essential pre-condition for environmental planning and management. It suggests strategies and measures that ensure prudent use of coastal resources and services. In this thesis, an attempt was made to estimate the economic value of the Cochin wetland ecosystem of Kerala, India to highlight its direct, indirect and non-user benefits to various users. Two concerns guided the choice of this ecosystem for intensive examination. First, these systems, although known for their biological diversity through large-scale delivery of global services, have been showing signs of degeneration due to various externalities produced by the modern resource users. The neo-liberal economic policies pursued by the country aggravated this crisis further. Second, there is a growing need to guarantee livelihood securities to the poor communities by promoting sustainable uses of resources and avoiding various kinds of social conflicts. However, the struggle of local communities for sustainable livelihood on the one hand and the aspirations of modern resource users to draw wetland resources for enhancing their wealth on the other, have complicated efforts towards good environmental governance. It is in such a background, that this study of valuation was organised on a highly commercialised wetland ecosystems of Kerala, India.

The theoretical and empirical studies/ inquiries of economic valuation of wetlands were briefly surveyed and presented in chapter two. Using the insights provided in these studies and by considering the special features of developing countries, a conceptual framework and the corresponding methodology were then developed to analyse the dynamics of wetland uses

and to estimate economic values of the Cochin wetland ecosystem in chapter three.

The purpose of chapter four was to introduce the natural resource base provided by Cochin wetlands and the different users who have over the years appropriated these resources and the environment. The study began with a detailed description of the natural resource endowments provided by this brackish water ecosystem. It found that the ecosystem was biologically diverse and such diverse forms of direct and indirect economic benefits depended on a wide variety of ecosystem functions and services of wetlands. This diverse distribution of resources in turn supported the co-existence of various social groups that were mutually inter-dependant, despite their specialisation in choosing a particular livelihood activity. These socio-economic groups recognised the economic values of the wetland ecosystem services on which they relied for livelihood and evolved a variety of customs and social practices for upholding these values. This was undertaken in chapter four. The fishery diversity of the Cochin wetland ecosystem and the ecological services that supported this diversity were examined in detail. It was argued that value of such systems crucially depended on the structure of property rights and enforcement strategies apart from diversity of natural resources, production, productivity, prices and the organizing practices of various economic activities.

From an analysis of this natural resource base and the traditional property rights structures that governed resource appropriation and value generation, the study then looked into the new resource users that emerged and how their emergence affected the existing social, political and ecosystem equation. Post independence economic development initiatives complicated the appropriation of wetland resources and environment very badly. A number of modern users entered into wetland uses and produced new economic values through enhanced material production and employment. The value perceptions of

these new entrants, apart from generating new sets of management problems like industrial pollution and environmental degradation, directly contradicted traditional values and ethos of resource conservation and soon sharpened the internal contradictions of the system. Surprisingly, most of the State sponsored programs initiated on this environment spurred very similar tendencies and results.

Since these conflicting notions of economic values are often entangled in informal institutions and non-state laws (North, 1992), a detailed examination of these social relations was then undertaken as the next step towards understanding the value generating processes in wetland economies. Due to lack of time, the analysis considered only the nature of the conflicting structure of access rights that existed in Cochin backwaters. An analysis of the customary rights of traditional communities was also undertaken. Rights to fish over backwater territories were enforced by the respective gear groups and these territories remained open to other stakeholders to organize their 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, access to this backwater body had appeared to be free, exhibiting characteristics of a free-access property regime. Due to this, with the passing away of the monarchy and the creation of the State, considerable confusion existed in defining and enforcing property rights on the environments. First, the State created a new set of property rights, and rules and regulation to control access to the wetlands without acknowledging and legalizing the existing rights/customary rights or management regimes of traditional communities. This ultimately influenced people's perceptions of the resources and their production practices that generated economic values.

After laying the social foundations that shaped perceptions of economic values of various resource users, the study then proceeded to calculate the direct and indirect benefits of Cochin wetlands using three major techniques namely the

market based techniques, Travel cost methodology and the Contingent valuation method in chapter five, six and seven[1].

In chapter five, an attempt was made to estimate the different components of the direct use values of the Cochin wetlands. The activities undertaken by the traditional and modern resource users have formal markets for their goods and services and therefore market valuation is used to estimate the gross and net sales proceeds of traditional activities like fishing, paddy production, clam fishing, meat processing, lime shell sales, prawn filtration and traditional ferry services. Economic values generated by modern resource users from the backwaters were also estimated.

The basic estimates of direct economic values are as follows: The traditional wetland based activities generated a net value of Rs.9479 lakhs. Of this, Rs.8356 lakhs was the contribution of the fishery sector while Rs.575 was the contribution of the prawn filtration activities. The agriculture sector contributed Rs.293 lakhs and the traditional small-scale activities, Rs.255 lakhs. Modern industries based on the wetlands generated a value of Rs.1721 lakhs. Of this, Rs.112 lakhs was the contribution of the aquaculture activities while Rs.1587 lakhs was generated by the Cochin Port Trust and Rs. 22 lakhs by the navigation industry. This however constitutes only a part of the total economic value of the Cochin wetlands. Recreational benefits and indirect benefits of the wetland also contribute to the total economic value.

A portion of the total environmental economic value of wetlands is reflected in the market for backwater tourism and an estimation of recreational values is

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[1] Estimation of the economic value of wetlands is useful for environmental planning and governance. Unfortunately, this exercise is not very popular in developing countries. This study undertakes such a task for advising the resource governors and various resource users on the need for a rational use of wetlands for making a sustainable living from wetland ecosystem.

essential to establish the economic significance of wetlands. The Cochin wetlands and backwaters provide direct and indirect recreational benefits to domestic and foreign tourists. Those recreational benefits that do have markets contribute only a small part of this total value. However, most of the recreational benefits provided by wetlands do not have markets and hence the value of the recreational service it offers is often discounted to zero. An attempt was made in chapter six to estimate the recreational value of Cochin backwaters using the travel cost method. This value was estimated to be Rs.381 lakhs. It is interesting to note that almost all of this is enjoyed by the public free of cost.

Chapter seven attempted to estimate the indirect benefits provided by Cochin wetlands to user and non-user populations indirectly. The chapter detailed the contingent valuation survey that was executed in the study area. The analysis demonstrated the feasibility of extending the application of contingent valuation methods to study the indirect benefits of environmental resources to local populations in developing countries like India. The study revealed that the total Willingness to Pay (WTP) for the non-use values of the Cochin wetland services was estimated at Rs.6118 lakhs.

The study revealed that people valued the indirect functions of wetlands strongly, as much as they valued the direct benefits provided by the system. The present study revealed that the net total economic value generated by the Cochin wetland system by the direct, indirect and non-use values that it provides, was close to Rs. 17698 lakhs for the year 2001-02. It was seen that traditional activities still manage to contribute 54 percent of this value, which is an indication of the enormous potential of the system. On the other hand, modern activities with their huge investment and state-defined property right structures have managed to contribute only 10 percent of this value.

Recreational services contributed only 2 percent of this value while the indirect services provided by the wetlands contributed 37 percent.

This inquiry of wetland valuation reasserts the importance of integrating ecological, hydrological and economic approaches in valuation studies. This requires, more than complex mathematical techniques, an understanding of the ecological specificities of the wetlands and the human interaction with the system based on them. As is seen throughout the study, wetlands in developing countries are important because they provide a diversified portfolio of livelihood options to the weak and marginalized sections of the society that directly depend on them.

As was revealed by the survey of literature undertaken in chapter two, most of the wetland valuation studies in developed countries are on temperate wetlands. As far as they are concerned, such ecosystems have greater indirect and non use values when compared to direct values. In fact, most of these studies estimate non-use values to be double that of direct values. On the other hand, as revealed through studies on tropical wetlands in developing countries and this study as well, although indirect and non-use values are important, it is the direct values that really matter since they are directly related to people's livelihood.

The analysis revealed that although the value generated by traditional user population is very large, the State and modern entrants have never really understood the importance of the ecosystem specificities that the wetlands provide or the huge economic costs that these wetlands subsidise or provide freely each year. Rather almost all new activities that the State initiated (although necessary in respect of the economic development of the region) have been by investing huge amounts of money, altering the natural system (such as in the case of the Port and aquaculture activities) and disrupting

many of the other traditional activities either through environmental externalities or by dismantling traditional resource sharing mechanisms and right structures. In fact, traditional resource use systems greatly acknowledged the importance of the indirect and non-use values provided by the wetland systems, which as mentioned earlier, are reflected in their perceptions of the system and their organising practices. This is also reflected in the huge proportion of recreational and non-use values to the total economic value. Altering the system greatly affects the provision of these indirect and non-use values, however modern entrants do not consider these values due to the lack of formal markets.

As the study reveals, ecology is a very important variable in the Kerala model of development. Knowing values are essential for better management of such ecosystems. The increasing awareness among both local population who directly depend on this system and academicians regarding resource depletion and concern over the non use and option values of wetland ecological functions provides ample proof of this.

When natural ecosystems are drawn into development processes, ecosystem complexities along with partial knowledge of wetland structures and processes, often lead to a misallocation of resources. This gives rise to a variety of problems such as wetland degradation, social exclusion, over exploitation and other economic and ecological instabilities. A solution to this would be to attribute a higher value to the various benefits provided by the wetlands particularly by accounting for the indirect and non-use benefits offered by wetlands.

It is often argued that decisions affecting wetland uses are frequently made on economic and financial grounds. If prudent wetland use is to be realistic and socially acceptable in terms with alternative land and water uses, a quantitative value for wetland components, functions and attributes needs to

be calculated. Defining the direct, indirect and non-use values of wetlands and estimating the people's willingness to pay for these services is one of the most practical methods. Hence, economic valuation is a useful approach at a number of levels including assessing the impact of specific developments, making choices between options and setting regional or national policies. The proposed framework, could thus, serve as a more integrated cost-benefit analysis that greatly enhance balanced decision-making for the optimal depletion, sustainable use and conservation of natural ecosystems.

Another advantage of economic valuation revealed in this study is that it can guide appropriate combinations of sustainable economic activities. It is often argued that uses of wetlands are often misguided and misallocated for want of information on non market exchanges. For instance, one of the issues that came up during the present study was that of whether to take up full time prawn filtration and aquaculture in paddy fields or to continue the current pattern of mixed crop (paddy and prawn) as is legally stipulated. In terms of economic gains, the former is definitely a more attractive option. On the other hands, analysing the entire system in terms of its ecological specificities, the rationale and perception of individual resource users that shaped the social organization and property rights structures of resource use would show this in an entirely different light. In such contexts, valuation has an important role to play in decisions of alternate resource uses.

Who actually gains and looses from a particular wetland use is not part of the valuation studies. But in developing countries where livelihood is an important national goal, such concerns are always the guiding principles of political processes and social action. In such contexts, using environmental valuation tools in a framework that considers all these factors help to generate a better understanding of the system based on which management and development of new economic activities could be devised. At the same time it must be

remembered that valuation is only one of the essential analysis to improve the management of wetlands. The study therefore suggests the following for the benefit of planners and managers.

Recommendation 1

Environmental economic valuation studies of wetlands should be undertaken before development projects are drawn and implemented in the area. This must necessarily include a study of indirect and non-use benefits that do not have markets.

Recommendation 2

Economists, ecologists, hydrologists, agronomists, engineers and other experts should work together as a multidisciplinary team in deciding issues related to development of wetland ecosystems rather than base them solely on economic or biological considerations.

Recommendation 3

Special training should be given to economists, planners and decision-makers in wetland valuation techniques so that they may be incorporated meaningfully into policy decisions.

Critics of valuation raise various objections to attempts to estimate non-market values in monetary terms, but the reality is that human societies put price tags on nature every day. Every resource use decision involves implicit assumptions about value, even when no value figure is assigned. In the context of a developing economy like Kerala, this assumes greater meaning. The value of services provided by the wetland's ecological infrastructure does not fit into current economic equations, partly because most of the benefits fall

outside the marketplace. This often results in underscoring the all round contribution of wetlands to society.

In cases where valuation figures are used in conjunction with other tools of economic analysis, and with due consideration and analysis of the resource base, ecological specificities or user population perceptions and logics, such studies help in throwing light on many aspects of resource use and management, which are important but often ignored in decisions regarding natural resource management. It is most useful when a proposed alternative use has a highly perceived economic value. Estimates of the value of environmental services provide insights into the trade-offs between market activity and environmental quality that are implicit in the process of economic growth and choice of development path for the region. Such efforts can promote informed debates concerning the achievement of sustainable development. Economic valuation, however, is only one element in the efforts to improve management of coastal wetlands. Who actually gains and loses from a particular wetland use is not part of the efficiency criterion per se. It is more important that, apart from the arithmetic of economic value, the value generating process is better understood and proposed investments or policies for wetland management are assessed not only in terms of their efficiency but also their distributional implications.

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