SOCIO-ECONOMIC ISSUES AND SUSTAINABLE FISHERY MANAGEMENT A CASE STUDY OF KERALA

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C E R T I F I C A T E

I certify that the work entitled '**SOCIO-ECONOMIC ISSUES AND SUSTAINABLE FISHERY MANAGEMENT- A CASE STUDY OF KERALA'** is a bonafide research done by **Suja Ramakrishnan** for the award of the degree of Doctor of Philosophy in the Department of Applied Economics under my guidance and supervision.

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D. Rajasenan

DECLARATION

I hereby declare that the thesis entitled **SOCIO-ECONOMIC ISSUES AND SUSTAINABLE FISHERY MANAGEMENT- A CASE STUDY OF KERALA** is the record of bonafide research carried out by me under the supervision of **Dr. D. Rajasenan**, Dean, Faculty of Social Sciences, The Head, Department of Applied Economics, Cochin University of Science and Technology. I further declare that this thesis has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar titles of recognition.

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(Suja Ramakrishnan)

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INTRODUCTION

The term 'sustainable development' was first published in 1980 by the International Union for the Conservation of Nature (1980). With the publication of Our Common Future (1987) by the Brundtland Commission gradually achieved the status of the new long term goal for the humanity (Dixon and Fallon, 1989). Sustainable Development has been defined by the World Commission on Environment and Development (1987) as "development that meet the needs of the present generation without compromising the ability of future generations to meet their own needs....At a minimum, sustainable development must not endanger the natural systems that support life on Earth". The FAO Council 1988 defines it as " the management and conservation of natural resource base, and the orientation of the technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves (land) water, plants and (animal) genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable" (Garcia, 1996).

At the 1992 Earth Summit in Rio, the concept of 'sustainable development' was accepted by the entire international community (Sitarz, 1993). By signing this agreement political representatives from all over the world subscribed to the view that environmental damage was caused by two seemingly contradictory causes: unmanaged economic expansion and a lack of economic development.

Lang, (1995) agrees that the term has several plausible interpretations and summarises four slightly different positions covering most of the standpoints in the recent debate. Each is imprecise but they share the general position that "human consumption" must be moderated so that the self regenerating and life sustaining functions of our natural resources are not rendered irreversibly damaged through over exploitation and pollution.

Definition by Bruff and Wood, (1995) consists of four core points: futurity-a concern for the well being of future generations; environment – recognition of the health and integrity of the natural environment; quality of life- the many dimensions of well being; and equity-fairness in the distribution of costs and benefits. Thus goal of sustainability involves simultaneous attainment of

i) Inter-Generation Equity – the resource is being used without compromising the ability of future generations to meet their own needs.

ii) Intra-Generational Equity – basic standards of well being (basic needs satisfaction) given for the worse-off in the current society.

iii) Environmental Security, Protection of Life Support Systems – access to clean water, air, and non degraded soil given

iv) Resilience – the ability of the system to withstand shocks implies that human use will change systems and define the limits to adjustment capacity
Social resilience – equity criteria;

Ecological resilience – eg. Keystone species;

Cultural resilience – eg. Crowding indicators.

Gladwin et. al., (1995) also call attention to the socio-economic aspects of sustainable development. They argue that sustainable development is still most often conceptualised as an eco-efficiency problem, largely involving pollution prevention and resource conservation in rich parts of the world. From their point of view it is not enough to bring industry into harmony with nature. Bringing industry into harmony with humanity is also a necessary prerequisite for reaching sustainable development. The eco efficiency challenge of sustainability appears for them to be the easy part of the necessary transformation, while the socio-economic challenge may be infinitely more intractable.

Since fisheries involve an inherent interplay between humans and the natural world, as both an economic 'industry' and a socio cultural foundation for people and communities, it is necessary to maintain a healthy resource base fundamental to fisheries as to other renewable resource systems over the millennia. Fishery is an ideal case study for those concerned with issues of sustainable development for it is precisely the balance of nature which is critical to their development and fisheries have more than any other industry, experienced the limits to productionists strategies.

THE WORLD SCENARIO

The world is now facing a global fishing crisis of unprecedented proportions (Speer, 1995). FAO reports that 70 percent of the world's commercially important marine fish stocks are fully fished, overexploited or depleted. In a third of the world's major marine fishery regions, the catch has declined by 20 percent or more from the peak years. Fuelled by escalating demand, rapidly advancing technology and marine government subsidies, the global fishing fleet has now reached, and in many areas exceeded the limits of sustainability endangering an instant source of food for the world.

The social repercussions of the problem are severe. In industrial fleet, it is estimated that for every employee on board four or five are employed in support and ancillary activities. In artisanal fisheries, those directly involved in catch provide work for roughly an equal number in support and ancillary activities on shore. Globally 100-200 million people depend directly or indirectly on fisheries for their livelihood. At least 95 percent of them live in developing countries ie., any problem in fishery will endanger the employment and subsistence living in the developing nations more than the developed nations.

Fish are an important element of the human food supply fish in all forms are the source of 16 percent of the animal protein that humans consume. Around 1 billion people rely on fish as their primary protein source. In general people in developing countries rely on fish as a part of their diet much more heavily than those residing in developed countries. For instance, fish accounts for roughly 29 percent of the animal protein in the diet of Asian populations but only 7 percent for North Americans. In the developing countries where fish are particularly important part of the diet and subsistence fishers still make up a sizable portion of the populace, the potential human costs of the current decline in fisheries are even greater. As harvests shrink and exports of fish products from developing nations rise, prices of most of the species will continue to rise, and make fish a less affordable meal among low-income populations.

More than one third of the world's registered fish production, now a days enter into international trade. The share of developing countries in this trade has increased considerably, by 18 percent annually in the 70s and 10 percent annually in the 80s. In 1990-91 the world fish trade accounted to around US. $35 Billion of which an estimated US.$18-19 billion in net foreign exchange earnings went to developing countries i.e. more than half of the earnings from world fish trade goes to developing countries. In other words in this respect also any decline in fisheries is going to affect developing countries more than developed countries.

INDIAN FISHERY

In India fisheries constitute a highly productive sector, a source of nutritious food, employment and a net contributor to export earnings. More than 6 million fishermen and fish farmers are totally dependent on fisheries for their livelihood. With a long coastline of 8129 k.m., 0.5million sq.km. of continental shelf and 2.02 million sq.km. of Exclusive Economic Zone (E.E.Z.), India is a major marine fish producer, ranking seventh in the world. In India the production of marine fisheries had progressively increased, it increased from 0.5 million tonnes in 1950 to 2.7million tonnes in 1997 and thereafter remaining constant. In 2001 India's share in world's fish harvest was about 4.1 percent, being about 2.1 percent of India's GNP.

In the country, the fishery sector provides employment to about 7-14 million people directly and contributes an average annual per capita supply of 7 k.g to some 50 percent of population that eat fish. The contribution of fish to animal protein is 14.6 percent. Marine products continue to occupy an important role in India's export industry. It contributes 3.3 percent of the country's export earnings (Economic Review, 2002).

KERALA

The choice of Kerala as a relevant case study of sustainable fisheries development rests on the fact that Kerala is one of the leading maritime States in India. Fisheries, which play an important role in the Kerala's economy, now face a grim forecast, and government policies and market forces behind the trend towards over fishing remain largely in place.

Resource Base

Kerala located in the southern part of Indian peninsula has a narrow stretch of land with a long surf beaten coast on the western side. With its 590 k.m. coastline it enjoys one of the worlds most productive seas bordering it. The coastal waters of the region are comparatively rich and the potential yield upto 50m depths is 5.71 lakh tonnes. Of this demersal resources constitute 2.29 lakh tonnes and pelagic resources constitute 3.42 lakh tonnes. The continental shelf of the coast is about 40000 sq.km. The total marine resource potential within the continental shelf is 7.5 lakh tonnes. The coastal waters of the region are comparatively rich. It's shelf waters are highly influenced by both the monsoons, the characteristic of the subcontinent. The natural setting of the state with a long coastline, extensive lakes and backwaters, two monsoons and numerous west flowing rivers are the contributing factors of the fishery bounty. The lagoons and the backwaters, which experience the tidal effect even 50 k.m. upstream since much of these land lies below sea level, cover an estimated area of 355000 hectares (Government of Kerala, 1983).

Being a tropical region, Kerala's is a multispecies fishery. Oil Sardine, Mackeral, other Sardines, Whitebaits, Seerfishes, Tunnies, Carangids and Ribbonfishes are the dominant groups among the pelagic resources. Among the demersal resources the dominant ones are Catfishes, Perches, Croakers, Lizardfishes, Elasmobranchs, Flatfishes, Big-jawed jumper, Silverbellies, Goatfishes, Penaeid prawns and Cephalopods.

Importance of the Marine Fishery Sector in Kerala Economy

Fish and fisheries play an important role in the well being of Kerala Economy. Though Kerala's coastline is less than one-tenth of the Indian coastline, the landings constitute 24 percent of the country's total marine fish production.

The ecological setting of the State with a narrow strip of land interlaced with rivers, lagoons and backwaters flowing into a nutrient enriched coastal sea ensured plenty of aquatic resources. This made fish a culturally important and indispensable part of the diet. Even the Hindus who are strict vegetarians in other parts of the country are avid fish consumers. In this most densely populated state of India, it is estimated that 96 percent of the 30 million population eat fish (Srivastava et. al., 1991). With rice as the main source of carbohydrate, fish is an indispensable component of the food intake of both the rich and the poor. Fish provides three-fourth of the animal protein intake of the State's population and for the poor it is the main source of animal protein. For instance in the fishing communities, it ranges between 15-20 k.g. per capita per year whereas the all India average is 4 k.g. per capita per year (Government of India, 1996).

There are about 10 active fishermen for every single sq.km. of coastal waters in Kerala, this figure is over three times the all India average. Though the density of fishermen population is high, the average fishery potential of the inshore see here is 30 tonnes per sq.km. against the all India average of 13 tonnes per sq.km. (Krishnakumar, 1999). The Marine fishery sector of the State provides the main source of income for 1,85,000 active fisherman and almost an equal number engaged in the support and ancillary activities. The marine fishermen population of the State is 8.3 lakhs (Economic Review, 2002). With an average density of population of 2330 per sq.km, the marine fishing villages of Kerala are the most densely populated among the maritime States of India.

The State accounts for 23 percent of the total quantity of marine products exported from the country and 17.6 percent of the foreign exchange earned in this respect. The contribution of the marine products to the total export earnings of the State is 16 percent (Economic Review, 2002).

The Problem

Till the middle of seventies, Kerala contributed as much as a third of the nation marine fish production. This could be attributed to a plentiful marine wealth and a well-developed artisanal fishery. But the uncontrolled expansion of commercial trawlers and purse-seine fleets caused much damage to the artisanal fishermen and the fish resource itself (SIFFS, 1991). In the marine fishery sector of Kerala, by the end of seventies the crisis set in. From a peak of 448000 tonnes of fish in 1973 the average output was down to 332000 tonnes in the beginning of the 1980s. Trawling operations become uneconomical and the export sector was in doldrums. The overall productivity dropped and the share of artisanal sector in the total fall drastically.

Traditional fishermen alleged that they were deprived of their normal catches on account of the extensive fishing carried out by the trawlers in the inshore area. They repeatedly voiced that the indiscriminate destruction of eggs, juveniles and young ones of fishes and prawns by the mechanised trawlers were the main causative factor for the reduction of fishery resources in the sea. In the event of the failure of the government in effectively controlling the indiscriminate exploitation of the resource by the bottom trawlers and maintaining distributional equity, the artisanal fishermen started reacting their own i.e., unionisation and motorisation (SIFFS, 1991). This widespread adoption of new technologies by the artisanal fishermen in an attempt to counter their growing marginalisation in the fishery has only deepened the crisis. As the fish landings in Kerala are almost entirely from the inshore area and the resource potential in this area is estimated as 5.7 lakh tonnes, there is no doubt that the level of exploitation in this zone has exceeded far above the MSY (Government of Kerala, 1994).

Kerala has been often held up as good example of a society that has achieved high levels of human development without the usually accompanied pursuit of increasing economic growth and incomes. This has been achieved by a long history of people's participation in a variety of socio-religious and political movements that shaped public policy towards achieving higher literacy, better health and nutrition and the accompanying increases in life expectancy. On a human development index criterion, Kerala tops the States of India and is at par with many developed nations (Kannan, 1999). These comparisons, however reflect, the average situation. The point has been made that this "central tendency " hides the conditions of certain "outlier communities" which do not conform to these norms for the important reason that they were not part of the mainstream socio-religious and political movements mentioned above. Their socio-economic conditions left much to be desired (Kurien, 2000). The marine fishermen population of Kerala falls into this outlier group.

It is a fact that the State's fishing community has been largely left out of the general development experience. A major reason for this is community's rapid marginalisation in the coastal waters and in the market, following government initiated measures in the State in the early 1960's to promote modern fishing methods. The development programmes actually resulted in the unregulated entry of rich outsiders into what was a caste bound sector. These new entrants took on the roles of boat owners, employers, moneylenders and middlemen traders and ordinary fisher folk were unable to free themselves from their stranglehold (Krishnakumar, 1999).

The traditional fisher people continue to lag behind the rest of the States in all areas of development. The depleting resources, declining productivity, and per capita income of the fisher people and the increasing gap between per capita State Domestic Product and Fisheries Sector Product Per Fisherperson etc warns that our coast is in crisis and successful marine fisheries conservation measures are necessary not only to allow a larger catch but also to keep fish diversity high, to reduce impacts on marine eco systems and ultimately to maximise sustainable employment in the fisheries sector.

Review of Literature

Issues and problems in the control and management of fisheries systems have given rise to an extensive literature of fishery economics. Here an attempt is made to review and classify this literature according to their relevant area of concern. Starting with a few sketches on global overfishing, the review touches themes such as fisheries management and applied management science models, sustainable fisheries development, community participation, Integrated Coastal Zone Management (ICZM), fishery regulations etc., and finally outlines the works done on the process of technological change and modernisation that has been taken place in the marine fishery sector of Kerala. In the end a very brief review on the reports of the expert committees appointed by the government of Kerala to study the conservation issues of the State's marine fishery sector is presented.

World Overfishing

Hinrichsen, (1995) writes population bomb has already been destroying the world's coastlines, gives a list of scientific and policy issues that must be addressed by the scientists and policy makers when they work towards a system of governance of coastal areas. World Resources 1996-1997 reports that marine catch has changed markedly in size and composition over the past 45 years as fishing activity has increased. Though in 1993 the global fish harvest from marine and inland sources inched up to a new record high, the seeming abundance masks, a serious decline in the productivity of many important species (World Resources, 1998). Again World Resources 1998-99 reports that world fisheries face a grim forecast. Forty five years of increasing fishing pressure have left many major fish stocks depleted or in decline (World Resources, 1998). Bailey, (1987) examines some of the social consequences of excess fishing effort, in the context of Southeast Asian fisheries, which are characterised by a dualistic structure with distinct small scale and large-scale subsectors. The negative consequences of excess fishing effort include dissipation of resource rent, gear conflicts leading to broader social conflicts, increased use of destructive fishing techniques, changes in the food supply and distribution channels and increased concentration of economic power within the fisheries sector. Pauly, (1987) gives a brief review of the demersal and pelagic fisheries of Southeast Asia and the particular features of Southeast Asian fisheries that make them particularly susceptible to overfishing. Saeger, (1993) while analysing some of the problems faced by fisheries in Maquada Bay, Samer sea area of Philippines, identifies the operation of the commercial vessels and fixed gears in the coastal waters reserved for the small scale fisheries, widespread dynamite fishing, illegal as well as government sanctioned logging, competition among fishermen etc. as the major reason for the decline in catches. Willman, (1987) examines the economic factors, which have caused and are causing economic and biological overfishing in Southeast Asian countries. Veiel, (1999) explains how overfishing leads to the collapse of Morocco's sardine port Safi, where 35000 inhabitants are struggling to make a living. The sardine schools in the coastal waters have become a rare occurrence that their industrial processing is no longer viable. Kurien and Achari, (1989) while examining the case of a common property resource nature-the coastal ecosystem and the fish there in highlight how a combination of economic, technological and social factors interacting in a specific context results in overuse of the commons leading to it's near ruin and point out that the ensuing economic consequences are by no means equitably distributed.

Indian coasts are also not free from overfishing. Kurien, (1991) gives a brief history of fishery development process in Kerala and documents the ruin of coastal commons caused by over intensive fishing techniques which were encouraged by official development plans and also briefs the response of the commoners to the destruction of their resource base.

Fishery Management

The concern for overfishing and control of fishing effort is not new. Silvestre et. al., (1987) show that the Spanish colonizer, Antonio de Morgawas already concerned with over exploitation and management problems in Philippine's fisheries as early as 1597. Pearse, (1980) indicates that trawling in France was controlled as early as 17th century and most industrial fishing nations have a history of attempts at effort control. From a purely economic point of view fishery management is a new concept. Michael Graham, (1949) was one of the first people to examine both the empirical evidence and the underlying theoretical reasons for the need to control fishing effort. The basic development of the economic ideas is due to Gordon (1954). It was not until this work, research into fisheries management began to take interdisciplinary form. In his classic paper, Gordon used the economic theory of (static) production and generalisations about the collective behaviour of individually competing fishermen to demonstrate that overfishing is rooted in the economic organisation of fisheries. It was Gordon's goal to develop a bio-economic theory of fishery that treated fish and fishermen in an integrated fashion (Gordon, 1954). The applied mathematical works of Clark, (1976) advanced Gordon's plea for an integrated fisheries theory. His work is rich in applied deterministic modelling for problems in population dynamics, stock recruitment, stock exploitation, and mutiplespecies interactions. Clark, (1985) focussed on fisheries management directly. This book extends the treatment of applied mathematical modelling to problems that exhibit uncertainty. In economic research a number of authors have continued Gordon's development of an economic theory of fisheries management. Of note are the papers of Scott (1970), Anderson (1977), Hannesson (1978), Scott and Neher (1981) and Devoretz (1987). Schaefer's model (1957) is the most widely used model of population dynamics. The model describes the biological populations using differential equations and assumes instantaneous response of the population to external forces. The rate of growth of population as a function of its aggregate size is described by a symmetric, parabolic function known as logistic function. Schaefer's model is an example of a continuous-time, lumped-parameter model, also known as a surplus production model (Schaefer, 1957). Beverton and Holt, (1957) present a discrete stock recruitment model to describe stock growth dynamics. Their dynamic pool or cohort model explicitly considers the age structure of the stock and each age's growth, mortality and reproduction potential. This model provides the basis for the commercial ocean fisheries maximum harvesting strategies internationally. Pauly, (1979) while analysing Thailand trawl fishery explains the dual nature of management models for obtaining the MSY. First one is not considering the predation of small fishes and this tends to over estimate MSY and in other by using eumetric fishing of all stocks an overestimation of MSY is demonstrated. Then he proposes an alternative approach to management of stocks in the region which essentially consists of making yield estimates at distinct selected trophic levels and determining appropriate fishing techniques. Charles, (1992) presents a Bayesian updating algorithm, which can be incorporated into fishery management simulation models in order to examine the effects of imperfect knowledge, parameter uncertainty and the role of learning process in fishery systems. Crowley and Palsson, (1992) examines experience with operations research models that have been applied to enforcement issues in Canada's offshore fishery. Lane, (1992) surveys and classifies the literature of applied management science models and methods on issues and problems, in the control and management of fishery systems into areas according to the major problems confronted in fisheries applications. Widely used management science methods are presented and key publications annotated.

Panayotu, (1982) examines management concepts for small scale fisheries, their economic and social aspects, the constraints under which small scale fisheries operate, the likely effects of alternative management regulations and development programmes, in the light of these constraints and the new opportunities to review possible strategies for managing and developing small scale fisheries in the broader context of overall national fishery management and rural development. Mackenzie, (1983) argues that fishery management relates to the total system consisting of the resource base and the industry and the trade off by means of which natural resources are utilised in the product markets. In contrast with other resource industries common property in fishery resource implies there is no market mechanism through which access to the resources could be allocated among the users. Achari, (1987) while examining the reasons for maldevelopment of the fishery in Kerala, expresses the need for a more holistic and judicious approach to the issues of fisheries development and fisheries management, seeing them as two sides of the same coin. Meany, (1987) analyses the interrelation between resource rent, common property, and fisheries management and argues that if fisheries are managed so as to allow these rents to be captured, fisheries have the capacity to contribute significantly to economic growth. If resource rent continues to be dissipated, more and more resources will be sucked into the overfishing vortex, while managers strive to protect declining resources from ever increasing fishing pressure. Rajasenan, (1987) while analysing the reasons for stagnation of marine fish production and uneconomic operation of the fishing industry suggests management regulations for conserving the depleting prawn resources and expanding the catch and production capacity of the artisanal sector. In this study he also examines the possibilities of increasing inland fish production and fish culture. In an FAO study of the role of fishermen's organisations in fisheries management of Indonesia, Philipines and India, Kurien finds that while total recourse to market mechanism can prove to be socio-politically and ecologically suicidal, a centrally planned allocating process based on principles of strict equity is also unworkable (Kurien, 1988). Rao, (1988) in a study of the economic and social implications of the shift from the traditional mode to the mechanised mode of production in the context of Visakhapatnam fisheries shows the need to introduce various management regulatory systems to protect the interests of both the communities without endangering the resource base and it's productivity. Chandrasekharan and Natarajan, (1992) study the fishery operations and the resource of Pichavaram mangrove swamp located 100 k.m. South of Madras city on the southeast coast of India and stresses the need of protecting the swamp since it acts as a nursery for the juveniles. Caddy and Mahon, (1995) review the conceptual background and application of technical reference points in fishery management. Two types of reference points are recognized: target reference points (TRPs) and Limit Reference Points (LRPs), and it is suggested that MSY and other reference points formerly used as targets may be more appropriately applied as LRPs. Speer, (1995) presents an environmental perspective on some of the science and policy issues that must be addressed in order to more effectively manage population and consumption pressures on marine fisheries, which account for more than 80 percent of the world population. Campbell et. al., (1996) explores the issues involved in developing performance indicators to monitor fisheries management. A framework is developed of the groups involved in fisheries management performance, and their likely information needs. Possible procedural requirements in implementing a performance monitoring programme are then identified. Holm, (1996) asserts that a management strategy based on low-tech flexibility and co-management would, hardly do worse. But this is not enough to make it politically viable. Modern fisheries management was established as the State and science entered the fisheries to discipline industrial capitalism, which left unchecked, threatened to destroy the resource. Mckelvey, (1996) addresses the issue why efforts to negotiate management of transboundary marine fisheries tend to be arduous and frustrating leaving fishing communities impoverished and fish stocks decimated and how cooperative agreements might be crafted to overcome the difficulties. The article illustrates these themes through a model of binational "interception fishery".

Sustainable Fishery Development

Charles, (1994) reviews the evolution of sustainability concept and management paradigms in the fishery, draws on this experience to develop an integrated "sustainability assessment" framework involving the evolution of ecological, socio-economic, community and institutional sustainability and analyses potential policy directions for sustainable development. Again Charles, (1995) addressing the fundamental questions 'what makes a fishery system "sustainable"? how can the sustainability of fishery system be assessed and predicted?' proposes a sustainability assessment framework, with checklists of criteria to assess the extent of the sustainability components in practical situations. Each criteria is measured through quantifiable "sustainability indicators". Mechanisms to aggregate the indicators into suitable indices of sustainability are discussed. Doeringer and Terkla, (1995), in the context of New England and Atlantic Canadian fisheries, argue that sustainable fisheries regulation is not simply a matter of providing accurate stock assessments and calculating harvesting revenues and costs within a given economic structure. It must be linked, in addition, to considerations of industry structure, labour market institutions and economic development. Development Cooperation Information Department, Ministry of Foreign Affairs, Netherlands, (1995) sketches an outline of current state of affairs in the fisheries sector on a global level, defines the need for sustainable management of the fisheries sector, describes the options for interventions in the context of Dutch policy, examines the choice of channels for support to the fisheries sector and provides guidelines, which may be used in the appraisal of activities in the sub-sectors of artisanal fishery and small scale aquaculture. Bailey, (1996) while examining fishing in international waters in the light of four alternative property regimes – State, Private, Common and Open access – argues that none of these adequately capture the dynamics of resource exploitation in international waters. Bailey stresses that it is by no means clear that extending the jurisdiction of coastal states will improve management. Instead, the maintenance of genuine common on the high seas is vital for the effective management of marine resources, both in the high seas and areas of state jurisdiction. Drummond and Symes, (1996), by drawing on insights from two strands of social theory: realism and regulation theory, point out that understanding why overly exploitative and degrading practices come about and how they are able to achieve their own social and political legitimacy may well be the key to progressing both the theory and practice of sustainable development. Kurien, (1996) focuses on the small scale fisheries sector in the inshore marine eco-systems of developing countries, sketches out an inter-related agenda of measures, which require committed action, to ensure that small scale fishing communities move towards a just, participatory, self-reliant and sustainable development. Otterstad, (1996) in an analysis based on a clarification of the idea of sustainable development in fisheries and a theoretical model, seeks to discover whether sustainable development concept is achieving significance in practice or whether it remains a hollow of concept paid insincere homage in political circles. Norwegian fishery is taken as a case study. Phillipson, (1996) argues that co-management as a sharing of policy formulation, implementation and monitoring responsibilities between government and fishermen's organisations may be fundamental in alleviating some of the problems through initiating a more legitimate, informed and cooperative policy making and management environment. Sinclair, (1996) examines the collapse of cod stocks of New Foundland in

1992. Efficiency of dragger technology, unacknowledged management problems ranging from imprecise scientific estimates of the stocks to incomplete surveillance of illegal fishing practices, uncontrolled – possibly uncontrollable fishing by foreign vessels the short time-frame of capitalist enterprises that fish for profit and are under pressure to show immediate returns, and fishing patterns that provide skippers with misleading knowledge of fish abundance, etc. are examined as factors accountable for the unsustainability of the cod fishery. Sustainable Fisheries Strategy – Draft (II/96), (1996) attempts to capture the major points raised by conference participants and integrate them into a set of principles and guide lines as Sustainable Fisheries Strategy for restoring Salmonid population to sustainable levels. Garcia et. al., (1997) present the strategy adopted by FAO and the World Bank to facilitate the implementation of the International Code of Conduct For Responsible Fisheries by fishing and coastal nations. Kurien, (1998) in the context of the developing Asian countries, attempts to characterise the small scale fishery sector; provide an explanation for it's continued resilience; examines some dimensions of the impact of the new globalisation on the sector; and provides a framework for suggesting some institutional arrangements and programmes of action to ensure it's secure future. Korakandi, (1999) focuses on the major thrusts to sustainability identified in the present scenario of Indian fisheries and analyses the efficacy of the solutions offered by specialists and international organisations. Kurien, (2000) examines the visible manifestations of deeper social and cultural attributes in the marine fishery sector of Kerala that include the nature of the sharing patterns in the fishery, traditional knowledge and technology, the old and new institutional arrangements in the fishing communities etc with a view to helping fishery managers in making significant contributions to just, participatory and sustainable fisheries management.

Community Participation

Hviding and Baines, (1994) in a case study, examine the traditional fisheries related resource management in Marovo (Solomon Islands) and suggest Customary Common Property Control over the sea and its resource. Customary Marine Tenure (CMT) system that operates in Marovo offers potential for appropriate self-regulation of fishing effort and for direct local level resolutions of resource conflicts. Pomeroy and Williams, (1994) argues that recent lessons point to potential benefits in some fisheries from management partnerships between the government and local fishers and communities-fisheries co-management. At the same time they caution that co-management is not a universal panacea and more experience and research are needed to learn about the conditions leading to successful fisheries co-management. Roy, (1995) points out that fisheries management is not so much about managing fish, it is all about managing the way people and fishers capture fish and affect their environment. Communication and awareness building used in a participatory mode do work and could be the ingredient in fisheries management, which makes the difference between success and failure. Aziz et. al., (1996) examine the question of sustainable fisheries and food security in the Bay of Bengal region. Management approaches that can turn public awareness into durable and sustainable mechanisms for an improved social welfare and eco-system health are examined. Chong, (1996) establishes that to work, fisheries management calls for strong public and political support and commitment. Fisheries management rules, regulations, laws and measures are fruitless unless they are respected by the fishrefolks. It is, therefore, crucial to bring in and actively involve the fishermen and their communities into the management process to ensure success of fisheries management. Nickerson et. al., (1996) reveal that those closest to the resource were the first to see the link between eco-system health, resource sustainability and their livelihood. A more equitable distribution of the costs and benefits of the environmental services from the resources are highlighted as the objective of community based management project. Nickerson, (1996) points out examples of effective public stewardship from the Bay of Bengal region and asserts that to sustain stewardship the public need a mechanism for directing action to get results.

Willmann and Insull, (1993) review the major non-sustainable resource uses and provide an indication of their consequences on fish stocks, fish habitats, fishing communities and fish consumers. The paper also proposes a strategy for Integrated Coastal Zone Management (ICZM), which are applicable to the management of other sectors in coastal areas. Govan and Hambrey, (1995) while expressing the need for a new integrated approach to the management of coastal marine resources, highlight the importance of fully integrating financial socio-economic and environmental criteria. The strengths and weaknesses of participatory management are discussed in the light of local management experience.

Charles and Townsend, (1995) asserts that managers and planners must avoid imposing inappropriate user rights systems, rather they must determine together with the fishers a form of user rights that will work in practice based on understanding the history of the fishery, the attitudes of the fishers and the nature of the resource. Eythorcson, (1996) examines some of the implications of the Individual Transferable Quota (ITQ) management, in practice, as exemplified by empirical data on the recent developments in the Icelandic fisheries. A theoretical model for ITQ management is presented and its effects on fishing communities are discussed. The paper also examines the recent tendencies towards the globalisation of the Icelandic fisheries. Shallard, (1996) while studying management of fisheries by ITQ in the context of New Zealand fishing industry, finds that results of the ITQ system have been very favourable for New Zealand and asserts that the difficulties of conventional fisheries management will continue, unless world fisheries move to some form of quota management system.

Literature on Kerala Fisheries

Mention of the fishery resource plentitude and the fishing communities of this region are found in the early poems of the first to fourth century A.D. called the Sangam age (Pillai and Ludden, 1997) and the writings of Pliny, a geographer and a famous Roman traveller of the first century A.D. (Ray, 1993). A famous treatise of the 12th century called Valavisu Puranam (An Epic of Fishing) contains several references to the method of fishing in vogue and to the arts and sciences relating to fishing (Kurien, 2000). Observation of fish abundance in this region by Friar Ororic who sailed down the Southwest coast of India in 1320 is quoted in Francis Day's "Fishes of Malabar" documented in 1865 (Kurien, 2000). Day, (1865) highlights the development of fishing industry in Malabar compiling information from the pre-historic to the second half of the 19th century. Klausan, (1968) explains the process of modernisation required in the traditional fishery set up to obtain the Maximum Sustainable Yield (MSY) from the virgin biomass. Achari, (1969) while analysing the impact of Indo-Norwegian Project (INP) on the growth and development of Indian fisheries identifies the growth of mechanised fishing, development of new fisheries, improvements in the living standards of fishermen, greater dispersion of the ownership of means of production, growth of the processing sector increase in exports, the boom in employment, etc. as major benefits of the project. Bhushan, (1979) in a preliminary effort to evaluate the effects of technological changes in the fishing industry of Kerala finds that changes in the industry involving greater division of labour, higher skills, ownership pattern and changes in the mode of sharing output.

In the mechanised sector since the second half of the seventies, problems set in. George, (1980) shows concentration of mechanised boats in certain centres, changes in the species composition and size of prawn as major causes of sickness in the mechanised fishing sector of Kerala. Gopalan, (1980) identifies dwindling catches, restrictions imposed by government on mechanised fishing boats from operating within 5 km. from the shore, mounting operational costs due to increased taxes on oil, diesel and spares, high investment and diesel scarcity as causes of sickness in the mechanised sector. Pillai, (1981) argues that if trawling is banned in monsoon, the mechanised sector will not make any profit. Krishna Kumar, (1981) examines the reasons for the failure of mechanised fishing and suggests some measures to solve the problems faced by the sector. Kurien and Willman, (1982) in a study of economics of artisanal and mechanised fisheries in Kerala, find that in spite of certain technical limitations and artisanal sector is, on the whole, atleast as economically viable as the mechanised sector is, at present, and in many cases, more so. Korakandi, (1987) while analysing the process of development in the primary marine fishing industry of Kerala during the period 1951-1985 identifies the factors that have contributed to its growth in the initial at stages of development and the factors that led to its decline in the later stages. Kurien, (1987) attempts to make a broad analysis of the impact of the new technologies introduced into Kerala's fishing industry over the past three decades of fisheries development planning, particularly its ecological and economic impacts. Kurien and Achari, (1988) while analysing the fisheries development policies and fishermen, struggle in Kerala highlight the explicit and implicit policy orientations adopted by the government and examine their effects on the fish economy, the fish workers and the fishery resources and reveal how all these led to upheaval of the fish workers in the state. Achari, (1989) while examining the socio-economic implications of the motorisation of country crafts, identifies little improvement in the catch, shrink in real income from fishing, relegation of fishermen's natural skills, disruption of harmony in the traditional community, increase in level of investment in fishing units, higher level of indebtedness among fishermen owners and the cooperativisation of ownership and management as a major results of motorisation. Balan et. al., (1989) assess the impact of motorisation on production, productivity, earnings of fishermen etc. and recommend that motorisation can be encouraged if it is ensured that the motorised units extends their operations beyond the conventional limit to the region 20-50m depth. Meynen, (1989) discusses the specific forms of capitalistic penetration into artisnal fishery sector in Kerala and its impacts, and explain that even though fish workers collective responses are important in other respects it does not change the transformation process. South Indian Federation of Fishermen Societies SIFFS)/

Programme for Community Organisation (PCO), (1991) in a techno economic analysis of the motorisation of the fishing craft assess the techno economic viability of the new motorised sector and remnants of the nonmotorised artificial fishing units. The study among other things, provides a basis for understanding the reinforcing and economic rationale for investments by the State in support of the artisanal fishery. Ibrahim, (1992) examines the process of mechanisation and capitalist penetration into the labour intensive traditional sector. By examining the various courses of management measures in the evolution of the mechanisation process in fisheries, he highlights its essentialities and importance in various sectoral dimensions particularly output, employment, income and consumption. Nayak, (1993) examines the changes triggered by the motorisation in the socio-economic conditions of artisanal fishing communities on the southwest coast of India, reveals the fishery sector is in a transition which is influenced by the socio-economic forces operating at the macro level. Sehara and Kanakkan, (1993) with the aid of a case study of cost and earnings of trawlers operating in Kochi, conclude that trawlers in this area are running in profit during 1991. State Planning Board, (1993) while analysing the impact of motorisation on the income and employment levels of traditional fishermen points out that though motorisation has made fishing industry more capital intensive it has not resulted in commensurate increase in total landings. Yohannan and Sivadas, (1993) analyse the impact of the introduction of ringnets in 1988 on the mackerel fishery at Calicut and warn that the small mesh size of ring net and their better efficiency, the gear can cause overfishing. Alagaraja et. al., (1994) while examining the recent trends in marine fish production in Kerala finds out that groups such as pearches, sciaenids, ribbonfishes, white baits etc offer scope for more exploitation and deep sea fin fishes such as nemipterods and tunas, and shell fishes such as prawns and lobsters remain under exploited and also suggests avoiding indiscriminate fishing of young fishes and wastage of landings through proper post harvest technology, reducing the stress faced by the exploited resources etc.

Sathiadas, (1996) highlights the economics of different types of fishing units operating along the Indian coast, analyses the exploitation trend of major marine fishery resources, in relation to it's potential yields and suggests policy measures for optimum exploitation of resources, conservation and management. Jose, (1997) reports on the tension building up in the coastal belt of Kerala between traditional fishermen and mechanised boat operators with the onset of monsoon regarding trawl ban. SIFFS, (1998) is a continuation of the previous SIFFS census of 1991 and analyses the classification of the artisanal fishing fleet used in the 1991 census, updates and assesses the number of artisanal fishing craft in use, estimates the number of gear used in the sector according to type estimates the craft and gear combination and the number of out board motors in each H.P. category.

Rajasenan, (2000) in an attempt to study the impact of modernisation programmes introduced in Kerala fisheries in the 50's finds out that uncontrolled mechanisation resulted in the over exploitation of resources which in turn led to conflicts between traditional fishermen and mechanised boat workers. He also brings out the positve trends in output in the seasonal management regulatory phase (1988-1998) of Kerala fishery.

The Government of Kerala has appointed some expert committees to study the marine fishery resources of the State. Reports of these committees are reviewed here chronologically. Babu Paul Committee Report on marine fishery resources, (1982) shows the background of conflict in the State's fishery sector along the different stake-holders and presents the views of these competing groups and scientific community regarding the need for conservation and regulation in the industry. The opinion of the committee is, however, divided on the question of depletion of marine fishery resources and the need for regulation of trawling and the other types of mechanised fishing. Kalawar Committee, (1985) confidently reports that no conservation purpose would be served by banning trawling during the monsoon season nor would it help reserve the stocks until the post monsoon season to be harvested by the indigenous fishing methods. Exclusion of mechanised trawling to waters beyond 20m. depth, limiting the number of trawlers to about 1145, exclusion of purse seiners to outside the territorial sea, etc. are recommended to help artisanal fisherman. Balakrishnan Nair Committee Report, (1989) sights the clashes among different fishing sectors and reduction in the average size of fin and shell fishes caught as clear signs of economic and biological over fishing and suggests that a total ban has to be enforced on trawling by all types of vessels in the territorial waters during June to August, and also stresses the need for an in-depth study with a view to assessing the impact of this ban on the exploited marine fishery resources. Balakrishnan Nair Committee, (1991) on monsoon trawling in Kerala, in the absence of adequate data, fails to arrive at definite conclusions regarding conservation of fishery resources along the Kerala coast, as a result of imposing a ban on trawling. Silas Committee, (1992) recommends a Restricted Fishing Zone out side the line of territorial waters, which will be closed for trawling during the months June, July and August and concurs with the recommendations of the earlier committees on mesh size regulations that the bottom trawl gear code-end mesh size stretched knot-to knot should not be less than 35mm. The committee also stipulates that minitrawls be totally banned in the Exclusive Artificial Fishing Zone (EAFZ) and no operation of ring seines shall be permitted in the EAFZ, where the gear size exceeds 300 m in length and 35 m in depth with restriction of the total horse power of the craft operating such gear not exceeding 15 hp.

OBJECTIVES OF THE STUDY

1. To find out the various socio-economic issues hindering the sustainable development of the State's coastal fishery sector
2. To examine the nature and extend of depletion in the States' marine resources
3. To examine the effectiveness of seasonal trawl ban as a conservation measure on the catch structure
4. To make a preliminary assessment of the overall sustainability status of the State's coastal fishery sector

Methodology

The study makes use of both the data sources-primary and secondary. For collecting primary data, three districts of Quilon, Ernakulam, and Calicut were selected. And from each of these three fishing districts five coastal villages were selected. Contribution to Fishery Sector Product at factor cost formed the basis for selection of the three fishing districts. In this respect, Quilon tops the other districts of Kerala, followed by Ernakulam and Calicut. From each of these fifteen villages a sample of thirty fishermen households was selected for the primary survey. Among them, a total of 450 active fishermen are interviewed. Information on the non-respondent members of the households have also been collected.

Both published and unpublished secondary data were collected from various governmental fishery research institutes such as the Central Marine Fishery Research Institutes (CMFRI), Central Institute of Fisheries Technology (CIFT), Fishery Survey of India etc. Data were also collected from Government Departments like Directorate of Fisheries and State Planning Board and Non Governmental Organisations (NGOs) like South Indian Federation of Fishermen Society (SIFFS), Programme for Community Organisation (PCO).

The data were analysed with the aid of various statistical tools, such as Principal Component analysis, Correspondence analysis, Categorical Multiple Regression with optimal scaling. Data are transformed into log form to avoid the positive skewness in them and also to reduce variability. Principal Component analysis is used to study the effect of different periods on catch. The dermersal fishes and pelagic fishes studied here are 11 and 8 in number. A PC can be used to reduce the dimension without much loss in information. Correspondence analysis is done to study relation between level of income and level of savings and level of income and debt.

Categorical multiple regression with optimal scaling is used to find the effect of per capita expenditure on food/month (X_1), per capita income/month (X_2), per capita debt/month (X_3), occupation category (X_4) and caste (X_5), educational level (X_6) and district (X_7) on per capita savings / month.(Y). The model used is

$$Y= a+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7 + E$$

Some independent variables are treated as nominal and quantifications of these variables are considered for finding the optimal model.

Chapterisation

The study is presented in six chapters. The importance of State's marine fishery sector, the present crisis in the sector, review of literature, objectives of the study, methodology etc form the theme of the introductory chapter. The second chapter examines the socio-economic issues threatening the sustainable development of the State's marine fishery sector and their underlying causes. While the third chapter, deals with the nature and extend of resource depletion, the fourth chapter examines the effectiveness of seasonal trawl ban as a conservation measure. In the fifth chapter, a preliminary attempt is done to assess the sustainability of the marine fishery sector of Kerala. Finally, the sixth chapter gives the conclusions and recommendations of the study.

Significance of the Study

In spite of the various governmental programmes, the living conditions of the traditional fishermen are still dismal and progress in the form of new technology could only result in further marginalisation of poor fishermen. The competition for resource and space along with indiscriminate harvesting technologies has led to severe depletion of the resource base. In the light of these ever-increasing poverty and marginalisation of traditional fishermen on one side and resource depletion on the other side, this study is aimed at conservation of the resource base and attainment of the proposed 'just, participatory, self-reliant and sustainable' development of the State's marine fishery sector.

Limitations

The study forced lot of problems, such as non availability of suitable data relating to sustainable assessments; lack of clear cut Governmental policies, programmes and options pertaining to fishery conservations and management fishermen's perceptions and views emerged from the primary survey are not clearly evaluating the problems in the sector; lack of adequate literature in this area coupled with lack of policy orientation to sustainable fishery management create problems in developing a theoretical base.

CHAPTER-2

SOCIO- ECONOMIC ISSUES FOR SUSTAINABLE FISHERIES MANAGEMENT IN KERALA

The global importance of Environmentally Sustainable Development (ESD) was established with the publication of the Report of the World Commission on Environment and Development (Brundtland, 1987). It was in this context, fishery management which was exclusively concerned with yields, food, economic and recreational values associated with them, till then, has begun to see internationally as an environmental concern in the context of the human life support system. Many social scientists have stressed the socio-economic aspects of sustainable development. All of them confine to the view that the socio-economic challenge of sustainability is more obdurate than the eco efficiency challenge.

In the previous chapter the concept of sustainable development, it's implications in fisheries, the world scenario and why the marine fishery sector of Kerala is chosen as an ideal case study of sustainable fisheries management etc., are made explicit. The issues involved in bringing fisheries into harmony with humanity or the so-called socio-economic challenges of sustainable fisheries management are addressed in detail in this chapter.

In fishery, without individual ownership, there is no market incentive to husband stocks and each fisherman has an incentive to harvest as many fish as is profitable, as quickly as possible, in order to avoid as much resource as possible being taken away by the competing fishermen. The result is that too much input is devoted to the fishing industry and the stocks become over harvested. It is in this context, regulatory measures aimed at achieving maximum profit or economic rent for the society from the fishing industry become inevitable. However, the regulatory measures without taking into account the importance of industrial structure, labour market institutions and local economic development in determining the efficient level of fishery resources will fail to attain the objective of sustainable fishery management (Doeringer and Terkala, 1995). With the help of statistical data and findings from field research, the depth and dimensions of various socio economic issues facing the marine fishery sector of Kerala, are analysed in the following session.

Sticky Labour

In Kerala which is dominated by the small scale fishery sector, where fishing is a caste bound occupation, labour inputs are more or less fixed and labour reallocation occurs more slowly and not necessarily according to productivity in fishing. Stickiness of labour is apparent in the survey results. 83.3 percent of surveyed fishermen with an average age of 44 years have never attempted to change their current occupation in their 25 years of working in the State's small scale fishery sector and 75.8 percent are not willing to change at all (table-2.1). Ownership of fishing assets, poor quality of life available to coastal fishermen, lack of alternative employment opportunities, above all occupational attachment etc., are identified as the basic factors reinforcing labour stickiness in the State's marine fishery sector, and increasing population pressure on the inshore area.

Table-2.1 Labour Stickiness in the Marine Fishery Sector of Kerala

Ever before attempted to change current occupation?		Are you willing to change?	Did you go outside the village last year?	In future your occupation in fishing will be?		Can you take any job other than fishing?		Do you think your children in future should take fishing?		Do you think your children would be forced to take up fishing as their main occupation?
No	375(83.3)	341(75.8)	12(2.7)	Better	56(12.4)	No	382(84.9)	No	389(86.4)	89(19.8)
Yes	75(16.7)	109(24.2)	438(97.3)	Worse	359(79.8)	Yes	68(15.1)	Yes	57(12.7)	134(29.8)
				No change	35(7.8)			Indifferent	4	227(50.4)

Figures in parenthesis are percentage to total

Source: survey data

Ownership of Fishing Assets and Resultant Indebtedness

Fishing asset owners are more sticky to their occupation, since the possibilities of redeploying the capital invested by them is scanty. Moreover, the very nature of the fishery is that, even in the phase of resource depletion, a bumper catch can occur, all on a sudden. The expectation of bumper catch, together with increased indebtedness due to ownership of assets will always hold back fishermen from exiting fishery. In Kerala fishery the number of fishing asset holding owners are increasing day by day. The field data reveal that 62.7 percent of respondents have ownership of fishing assets and nearly half of the asset owners are in motorized sector, doing subsistence fishing (table-2.2).

Occupational category wise indebtedness of fishermen shows nearly 85 percent of motorised fishing operators, 65 percent of mechanised fishing operators, and 63 percent non motorised fishing operators are in indebtedness. The average indebtedness of fishermen belonging to different occupational categories varies between Rs. 8100/- to Rs.30000 in the survey year (table-2.3). Mechanised fishing operators have the highest interest burden per annum followed by motorised fishing operators.

Table-2.2. District Wise Occupational Category

Occupational category	Calicut		Ernakulam		Kollam		Total	
	number	%	number	%	number	%	number	%
Me.F.O.	31	**20.7**	6	**4.0**	23	**15.3**	60	**13.3**
M.F.O.	69	**46.0**	73	**48.7**	64	**42.7**	206	**45.8**
N.M.F.O.	0	**0.0**	16	**10.7**	0	**0.0**	16	**3.6**
Me.F.L.	22	**14.7**	14	**9.3**	27	**18.0**	63	**14.0**
M.F.L.	21	**14.0**	32	**21.3**	35	**23.3**	88	**19.6**
N.M.F.L.	0	**0.0**	9	**6.0**	0	**0.0**	9	**2.0**
Me.&M.F.L.	7	**4.7**	0	**0.0**	1	**0.7**	8	**1.8**

Source: survey data

Me.F.O. - Mechanised Fishing Operators

M.F.O. - Motorised Fishing Operators

N.M.F.O. - Non Motorised Fishing Operators

Me.F.L. - Mechanised Fishing Labourers

M.F.L. - Motorised Fishing Labourers

N.M.F.L. - Non Motorised Fishing Labourers

Me.& M.F.L. - Mechanised and Motorised Fishing Labourers.

Table-2.3 Occupational Category Wise Indebtedness of Fishermen

O.C	Average Borrowings		% of Respondents Borrowed	Average Interest Burden	
	Amount (Rs.)	Rank		Amount (Rs.)	Rank
M.F.L.	13312.5	4	72.7	1542.1	4
M.F.O.	27816.6	2	83.5	3683. 9	2
Me.&M.F.L.	13750.0	3	75.0	1518.8	5
Me.F.L.	11841.3	5	63.5	1596. 3	3
Me.F.O.	29750.0	1	65.0	4517. 7	1
N.M.F.L.	8111.1	7	66.7	1174.4	7
N.M.F.O.	8500.0	6	62.5	1265.0	6

Source: survey data

One of the important problems related to credit is that it is tied to conditions other than merely the paying of interest. Generally, it is linked to the sale of fish and in fact may be seen by the fishermen to be even interest-free. Pressure to use higher fishing efforts are intense among fishermen who are in indebtedness to deal with the middlemen who may charge either higher interest rates or control the price setting of fish.

Credit is one of the most important inputs to ensure a sustainable fishery. But for the fishermen credit is in short supply and thus available only at very exorbitant rates of interest leading to a situation of permanent and increasing indebtedness and thereby automatically creating a situation of labour stickiness in the sector. Table-2.4 provides information on the primary sources of credit.

Table-2.4 Primary Sources of Credit

Source of credit	Rank1	Rank2	Rank3
Prof. Moneylender	48	14	8
Fish Merchant	16	15	10
Fish Auctioneer	30	19	10
Others	14	7	2

Source: Report of the Task Force on Livelihood Security of Fishing Communities, Ninth Five Year Plan 1997-2002, Government of Kerala, State Planning Board, June, 1997.

Lack of Alternative Employment Opportunities

Survey results show that, coastal fishing is seen as an economic activity of last resort in the isolated coastal villages of Kerala, where incomes are low and alternative job opportunities are scarce. Though (table-2.1) 84.9 percent of the respondents in the survey do not want their children to take up fishing as their main occupation, only 19.8 percent are sure that their children will not be forced to take up fishing due to lack of alternative opportunities. Lack of alternative employment opportunities cause both stickiness of existing labour and entry of new fishermen into the fishery even from non fishermen communities (table –2.5).

Araya, Latin, and Muslims have been the main caste groups engaged in fishing in Kerala. Though it is a caste bound occupation, members of other castes like Ezhava, Chettiar, Mooppan, Kudumbi, Pulaya, Syrian etc., are also seen taking fishing as their main occupation. In the survey 4.7 percent are Ezhavas and 3.3 percent are others like Mooppan, Chettiyar, Kudumbi etc.

Table-2.5 Percentage of Respondents in Each Caste Category

Caste	Number	Percentage
Araya	198	44.0
Ezhava	21	4.7
Latin	142	31.6
Muslim	74	16.4
Others	15	3.3

Source: survey data

The high level of dependency among the household members on fishing, as their single source of livelihood also proves the lack of alternative opportunities on shore. In the survey 81.8 percent of the household members who are occupied, are depending on fishing for their primary source of income (table-2.6). Even among Ezhava households dependency on fishing is at par with those of other traditional fishing communities.

Table-2.6. Number in Fishing as a Percentage of Total Occupied

	No. Occupied	No.In Fishing	% of Total Occupied in Fishing	Rank
Araya	367	303	82.6	2
Ezhava	40	32	80.0	4
Latin	260	210	80.8	3
Muslim	161	137	85.1	1
Others	34	23	67.6	5
Total	862	705	81.8	

Source: survey data

Per fisherman fishing income and per worker non-fishing income are compared (table-2.7) to find out the status of alternative opportunities available on shore. In all the villages per fisherman income is higher than per worker income and in as many as 6 villages the difference ranges from 50 to 70 percent. The lower non fishing income per worker substantiate the lower opportunity cost of fishermen and lack of alternative sources of livelihood available for fishermen communities which in turn increase the labor stickiness on fishing by discouraging exit and encouraging entry. But sustainable fisheries management will be easier and can be implemented more rapidly in fishing communities with a broad spectrum of alternatives.

Table-2.7. Comparison of Fishing Income With Non-Fishing Income

	Per Fisherman Income Of HH From Marine Fishing	Per Worker Income Of HH From Non Fishing	% difference	Income Per Person Occupied
Elankunnapuzha	30772.2	9918.2	67.8	23924.6
Malipuram	32368.4	22500.0	30.5	31646.3
Munambam	31211.8	25522.2	18.2	30245.7
Njarackal	36582.6	14421.4	60.6	31411.7
Nayarambalam	23138.9	17022.2	26.4	21609.7
Bepur	27316.3	23314.3	14.7	26816.1
Quilandy	32203.6	29142.9	9.5	31858.1
Madappally	27613.3	17963.6	34.9	25844.2
Puthiyappa North	26773.6	20672.7	22.8	25725.0
Badakara North	28679.3	22000.0	23.3	27782.1
Neendakara	43269.8	12733.3	70.6	37984.6
Pallithottam	32012.8	16022.2	50.0	29014.6
Sakthikulangara	29754.3	20337.5	31.6	28002.3
Thankassery	48428.6	18333.3	62.1	42508.2
Vadi	23747.9	7125.0	70.0	21373.2
Total	31388.5	17276.4	45.0	28818.2

Source: survey data

Occupational Attachment

Occupational attachment is very high among the coastal fishermen of Kerala. Survey results show that fishermen have a strong commitment to fishing as "a way of life" and they prefer to live in villages very near to the shore, where there are few employment opportunities, and where attachment to occupation and community are thought to be highest. Though 79.8 percent of the respondents have the view that in future their occupation in fishing will be worse and 12.4 have the view that any improvement in the current status of their occupation in fishing is impossible, only 24.2 percentage showed willingness to quit fishing (table-2.1). Those who are not willing to quit under any circumstance have the view that fishing is their traditional occupation in which they have more freedom, leisure and adventure than in any other job on shore.

Lack of Control Over First Sale and Marketing

The fishermen's lack of control over the marketing of the fish they caught is the beginning of livelihood insecurity they face and there by increasing their indebtedness which in turn cause labour stickiness in the sector. The fishermen's share of consumer Rupee for the different varieties of fish has been estimated by the CMFRI to range from as low as 18 percent for whitebaits in the Kozhikode region, 51 percent for Tuna in the Ernakulam region, to as high as 74 percent for Sharks in the Thiruvananthapuram regions (See table 2.8).

Table-2.8 Fishermen's Share in the Consumer Rupee for Selected Varieties of Fish During 1996-97.

Seerfish	65
Pomfrets	43
Barracudas	53
Tunas	51
Sharks	63
Catfishes	58
Mackeral	50
Sardines	43
Ribbonfishes	37
Rays	30
Whitebaits	26
Lizardfishes	30
Goatfishes	60
Croakers	31
Silverbellies	35
Big Jawed Jumper	45
Mullets	59
Half&Fullbeaks	61
Cephalapods	71

Source: Devaraj, et. al., (1998).

The most important point on the fish chain (the linkages of the number of intermediaries between fishermen and consumer) for the fishermen is the point of the first transaction – the seashore or the port. The nature of the transaction and the composition of buyers at this point have a crucial role in determining both the price received and the share of the consumer Rupee which this will represent. The survey conducted by The Taskforce on Livelihhod Security of Fishing Communities, State Planning Board, throws some light on both these aspects (table-2.9). In 25 percentage of the villages surveyed only a negligible portion of fish is sold through a fair auctioning process, in 27 percent of the villages less than 50 percent of the fish was subject to auctioning and in 38 percent of the villages over 75 percent are sold through auctioning and in 10 percent of the villages there is no practice of auctioning at all.

Table-2.9 Rapid Appraisal of the Percentage of Fish Auctioned on the Beach

Percent sold through auction	Percentage of villages
Over 75 percent	38
Below 50 percent	27
Negiligible percentage	25
No practice of auctioning	10

Source: Planning Board, (1997).

The composition of the buyers on the beach also plays an important role in determining the market power of fishermen. Other things being equal, a larger number of smaller buyers indicate a higher market power of the fishermen (table-2.10).

Table-2.10. Rapid Appraisal of the Composition of the Buyers at the Beach

Composition of buyers	Percent of villages
Large number of small-scale male	43
Large number of small scale male and female	27
Few large merchants	22
Other combinations of buyers	8

Source: State Planning Board, (1997)

Poor Quality of Life

Poverty is closely related to overfishing and degradation of aquatic ecosystems. Those socially and economically worse-off in the fisheries are, on the one hand, victims of the international plundering of fisheries resources and because of this their livelihoods are under threat. On the other hand, they themselves have contributed, often driven by necessity, to the downward spiral of poverty and environmental degradation, which others initiated (SPDDC, 1995).

Fishermen are leading a very poor quality of life, which has implications on their ability to move out from fishing as away of life. One of the paramount reasons for the poor quality of life and substandard conditions of habitat of the marine fishing communities is the crowding of them within half a kilometer wide from the seafront (Kurien, 1995). Kerala coasts are overcrowded and over exploited. The marine fishing villages of Kerala are the most densely populated (2330 per sq.km.) (Kurien, 2000) not only among the maritime States of India, but even from Shangai – one of the most densely populated (2000 per sq.km.) municipalities in China. (Hinrichsen, 2000). The major impact of crowding is reflected in the holding pattern of homestead plots (table-2.11).

Table-2.11. Holding Pattern of Homestead Plots

Area	0-5 cents	
	Number	%
Kollam	103	68
Ernakulam	66	44
Kozhikkode	54	36

Source. Survey Data

Though, in the survey all households except three are living in their own houses, most of them are beyond the cadastral survey, which is under central government jurisdiction, and therefore come under the Coastal Zone Regulation Act. Since they are under the threat of evacuation and hence the question of exchange or sale of their plots does not arise. This will only make them more confine to the coast and the resultant reinforcement of labor stickiness.

The basic amenities related to housing such as toilet facilities and access to drinking water are at lower standards in the fishing villages. One difficulty in providing toilet facilities in coastal villages is that septic tanks do not function effectively because of the high water table in the sandy soil and leaching of sewage into wells used for drinking water (Kurien, 1995).

In the survey 82 percent depend solely on public taps for drinking water (table-2.12). Because of the acute shortage of water, public taps in fishing villages are erected below the ground level to facilitate smooth outflow of water but in the monsoon season most of these areas will be flooded. Health implications of these circumstances are obvious. Fishing villages are an arena of contagious diseases, particularly in monsoon. A study of health status of Kerala (Panikkar and Soman, 1984), shows that respiratory and skin infections, diarrheal disorders and hookworm infestations are much more prevalent in the coastal areas of the State.

Table-2.12. Access to Drinking Water

O.C.	e	g	c	d,e	b	a,d	f	b,e	d	a
M.F.L.	83.00%	9.10%	1.1%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	4.50%
M.F.O.	84.00%	5.30%	0.00%	0.50%	1.50%	0.00%	1.00%	2.90%	2.90%	1.90%
Me.&M.F.L.	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Me.F.L.	79.40%	4.80%	3.30%	3.00%	1.60%	1.50%	0.00%	0.00%	3.20%	3.20%
Me.F.O.	75.00%	0.00%	0.00%	8.50%	3.20%	0.20%	1.60%	1.50%	8.30%	1.70%
N.M.F.L.	77.80%	22.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N.M.F.O.	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	82.03%	9.49%	0.63%	2.04%	0.90%	0.24%	0.37%	0.63%	2.06%	1.61%

Source. Survey data

a	Water from Canal/ River
b	Public Well
c	Public Pond
d	: Own Well
e	Public Taps
f	House Connection
g	Tanker Lorries

As only three households have house connections of drinking water, dependence on tanker lorries for drinking water etc. prove the acute problem of water shortage faced by the fishermen households. As fishermen conflict for fish in the sea, their women frequently conflict for drinking water on shore.

The poor quality of life, where females are more affected than males is apparent in the sex ratio of these coastal fishermen communities. The caste wise, occupational category wise and village wise Sex ratios of coastal fishermen, prove unfavourable conditions of females prevailing among all cast groups except Ezhavas, in all villages, except Malipuram, Munambam and Nayarambalam of Ernakulam district, irrespective of the occupational category to which they belong (tables, 2.13_a, 2.13_b and 2.13_c).

Table-2.13_a Sex Ratio-Caste Wise

Araya	Latin	Muslim	Ezhava	Others	Total
917.81	932.11	728.26	1089.29	804.88	886.57

Source. Survey data

Table-2.13_b Sex Ratio- Occupational Category Wise

O.C.	M.F.L.	M.F.O.	Me.&.M.F.L	Me.F.L.	Me.F.O.	N.M.F.L	N.M.F.O.	Total
Sex Ratio	914.73	869.281	833.333	940.541	871.658	956.522	803.922	886.567

Source. Survey data

Table-2.13c Sex Ratio – Village Wise

	Village-1	Village-2	Village-3	Village-4	Village-5	Total district
Calicut	842.105	650.943	794.39	959.6	849.06	816.764
Ernakulam	905.88	1107.14	1000	891.566	1025.6	985.51
Quilon	898.73	962.5	901.23	872.093	747.13	874.09
Total sample						886.567

Source: Survey data

Footnote- village codes

	Ernakulam	Calicut	Quilon
Village-1	Elankunnapuzha	Bepur	Neendakara
Village-2	Malippuram	Koilandi	Pallithottam
Village-3	Munambam	Madappally	Sakthikulangara
Village-4	Narakkal	Puthiyappa	Thankassery
Village-5	Nayarambalam	Vadakara Vadi	

This is quite contrary to the renowned Kerala model, where females out numbered males by 32 per 1000 in 1981 by 40 per1000 in 1991 and by 58 per1000 in 2001. In fishermen communities, girls die at higher rates than boys because they are less well fed and cared for than male children (Kumar, 1989). This is because male members are indispensable in the fish harvesting operations at sea. Nevertheless, the lack of privacy and the unhygienic sanitary conditions, result in morbidity and mortality from a plethora of reproductive system infections, make sex ratio more adverse even at higher age groups (Kurien, 1995).

Level of educational attainment is another area where quality of life is reflected. Average level of education of fishermen is 6^{th} standard (table-2.14). Lower level of educational attainment also plays as a major hindrance in their move out from fishing not only as a source of livelihood but also as a way of life.

Table-2.14. Average Level of Education of Respondent Fishermen

	Village-1	Village-2	Village-3	Village-4	Village-5	Total District
Calicut	6.03	5.9	6.03	5.5	4.2	5.5
Ernakulam	5.5	6.7	5.9	5.8	5.1	5.80
Quilon	7.2	6.9	5.9	6.5	6.1	6.4
Total sample						5.95

Source. Survey data

Field data on expenditure, saving and borrowing pattern of fishermen households also give a mirror image of the quality of life accessible to them. Among the fishermen households, 77.4 percent of a family's total expenditure (table-2.15) is to ensure food for its members – one of the most basic requirements of living beings next to air and water. Since 10 percent of their income outflow goes as interest burden, the remaining 13 percent is available to choose between other necessities such as clothing, medical care, education of children etc.

Table-2.15. Expenditure Pattern of Households

Village	Expenditure on food	Clothing	Medical	Festival	*Interest Burden	**Others	Total
Bepur	73.62%	3.63%	0.92%	1.30%	14.33%	6.21%	100.00%
Koilandi	79.23%	4.21%	0.98%	1.56%	8.24%	5.76%	100.00%
Madappally	85.39%	3.35%	0.83%	1.29%	2.78%	6.35%	100.00%
Puthiappa	73.38%	3.20%	0.83%	1.29%	15.27%	6.03%	100.00%
Vadakara	80.15%	4.56%	1.61%	1.72%	5.27%	6.68%	100.00%
Calicut	**78.20%**	**3.81%**	**1.04%**	**1.44%**	**9.30%**	**6.21%**	**100.00%**
Elankunnapuzha	78.59%	3.48%	0.72%	1.29%	10.05%	5.87%	100.00%
Malippuram	72.13%	2.99%	0.78%	1.14%	17.09%	5.87%	100.00%
Munambam	80.38%	3.52%	0.87%	1.42%	7.76%	6.06%	100.00%
Narakkal	79.19%	3.39%	2.78%	1.31%	6.91%	6.42%	100.00%
Nayaramb-alam	79.51%	3.60%	0.99%	1.77%	6.62%	7.52%	100.00%
Ernakulam	**77.90%**	**3.39%**	**1.20%**	**1.38%**	**9.78%**	**6.35%**	**100.00%**
Neendakara	73.96%	3.04%	2.39%	1.41%	12.16%	7.04%	100.00%
Pallithottam	77.24%	2.61%	4.51%	0.85%	6.84%	7.95%	100.00%
Sakthiku-langara	79.24%	2.94%	1.17%	1.15%	10.09%	5.40%	100.00%
Thanka-ssery	74.99%	3.57%	0.98%	1.35%	12.70%	6.41%	100.00%
Vadi	74.04%	2.56%	0.71%	1.22%	14.77%	6.71%	100.00%
Quilon	75.86%	2.95%	1.93%	1.20%	11.37%	6.70%	100.00%
Total	**77.36%**	**3.40%**	**1.38%**	**1.35%**	**10.11%**	**6.41%**	**100.00%**

Source. Survey data

* Interest burden is also included in the total expenditure of households, since fishermen borrow money not only to own fishing assets but also to meet other non consumption expenses like marriage of daughter, repair and maintenance of house etc.

** The item others include, expenditure on education of children, repair and maintenance of house etc.

All the above indicators prove the poor quality of life available to fishermen communities. The consequences of poor quality of life include heavy stress on the coastal ecosystems resulting in ecological imbalance, increased health hazards caused by water pollution and socio-political unrest. Moreover, the instruments of sustainable resource management such as control on the use of resource are more easily implemented and the goals of sustainability are more easily attained in a community where quality of life is reasonably good. For instance, in the event of such poor quality of life available to fishing communities government cannot all on a sudden implement regulatory measures like control on catch quotas, area or seasonal closures without protest from the members of the community itself. Even if alternative employment opportunities are created, low educational standards, low- income levels, clustered settlement pattern isolated form the rest of the world etc., will put limits on their ability to move out from fishing, causing more and more labor stickiness in the sector.

Implications for regulation

Labour stickiness is causing population pressure on the inshore area. The active fishermen population has been increasing (table-2.16). Given the Kerala's inshore area of 12570 sq.km., with this increase in the number of active fishermen, area available per fisherman to fish has decreased from 17 hectares in 1961 to six hectares in1997-98 (table-2.17).

Table-2.16 Growth of Active Fishermen Population in Kerala

Year	Total number of fishermen	Number of active fishermen	Index
1961		80700	100
1985	650143	134000	166
89-90	733728	147875	183
90-91	747668	153570	190
91-92	756000	155000	192
92-93	761104	156574	194
93-94	763387	157348	195
97-98	771020	175000	216
98-99	797227	182000	226
99-00	809000	185000	229

Source. Economic Review, (1961-2000)

Table-2.17.Area (in ha) of Inshore and Offshore Shelf Available per Active Fisherman and Fishing Crafts During Successive Time Periods From 1961 to 1990

	Inshore (0-50 m)				offshore (50-200 m)			
	1961-62	1973-77	1980	1990	1961-62	1973-77	1980	1990
area in ha / active fisherman	17	16	9	6	36	33	20	13
Area in ha/ boat	59	57	44	40	123	118	92	84

Source. Sathiadas, et. al., (1995).

Sticky labour is important for regulation in two ways. First it makes the social opportunity costs of fisheries labour (as measured by forgone onshore production) lower than if fishermen readily moved between fishing and comparable onshore jobs (Terkla, Doeringer, and Moss, 1988). Economically efficient regulation involves setting the catch level where the marginal social opportunity cost of harvesting is equal to the marginal social value of harvest. The social cost of harvesting will be lower in the case of sticky labour than with perfect labour mobility. This means that the efficient level of catch is higher with sticky labour than with mobile labour.

A corollary of labour attachment is that labour mobility responds asymmetrically to fluctuations in output. Rising revenue draws labour into the industry relatively quickly, but labour is less readily released. It is, therefore important that regulatory policies control the entry of labour into the industry to constrain harvesting capacity to efficient levels.

To attain the goal of sustainable fishery management the economic development efforts should be made compatible with regulatory policy (Doeringer and Terkla, 1995). For instance in the event of poverty and lack of alternative employment opportunities, efforts to control fishing effort by regulations will only adverse the situation of marginal fishermen who may turn to riots and agitations. The conflicts among different gear users will also increase and thus the social and cultural fabric of fishing communities are disrupted, though the narrow goal of conservation is achieved. Regulatory measures to limit labour inputs in the fishery, without accompanied by economic development efforts have an element of compulsion in them. But the goal of sustainable fishery management is the attainment of a just, participatory, self reliant and sustainable fishery. Thus regulatory efforts ignoring the most difficult criterion of sustainable development – social sustainability and the survival of different forms of fishing communities – are not a move towards sustainable fisheries management.

One way to make economic development efforts more compatible with regulatory policy would be to increase the incentive for surplus labour to leave the industry by focusing on expansion of high wage onshore jobs. Low wage economic development strategies only make sense if they are used as a counter seasonal alternative to unemployment allowance. The effectiveness of these policies are however limited by the characteristics and job preferences of the fishermen. Their earnings in good fishing seasons are considerably higher than those received by fellow workers in other sectors. The expectation of bumper harvests in seasons, when coupled with the non-pecuniary attractions of fishing as a way of life, means that alternative employment must pay relatively high earnings to induce sticky labour to leave fishing.

Over Capacity and Excess Capital

Overcapacity, its dynamics and control are the most pressing economic issues faced by the sustainable management of Kerala fishery as any fishery in the world. It has implications for all other issues of fishery management. The crux of the problem lies in public economic incentives supporting the initial take off and development stages of the fisheries development cycle tending to remain even after development has been completed facilitate over fishing. Subsidized public investment in fishing harbours and marketing infrastructures, subsidized credit and investment incentives, and trade and investment incentive policies are among the factors that lead to over fishing (Garcia et. al., 1999). These factors by controlling mobility of capital are playing as incentives for over fishing in the context of Kerala fisheries as well.

The mobility of capital into the fishery is generally easy while exit is often difficult. Once a fishing vessel has been acquired in response to one or several good fishing seasons, the vessel will continue to be used during its entire life span of 15 years or more years even if catches fall to unprofitable levels. The owner will only then cease operation when fishing revenues are lower than operational costs. For that reason unprofitable fleets may continue to operate in spite of overall losses.

Technological development enhances mobility of capital into the fishery. Once a new technology has been proven to be more productive and results in higher profit, all the vessel operators will strive to acquire such technology. This will continue even when fishery resources are fully exploited. No single owner could afford to stay back from adopting these technological changes as otherwise he would lose his competitiveness as evinced from the inboard and board motorisations happened in the traditional small- scale fishery sector in the 80s onwards . The factors that ease the entry of excess capital into the marine capture fishery sector of the State are scrutinised in the forthcoming session.

Modernisation Impact on Excess Capital

In spite of its open access nature the element of excess capacity stepped into Kerala fisheries only with the advent of modernisation attempts of the fishery sector by the government. Until the 1960s fishing in Kerala was almost entirely dominated by the non-mechanised traditional country crafts – kattumarams, plank and dugout canoes – using a variety of tackle and gear. These traditional technologies had evolved over the centuries to suit the specific ecological context of the seas as well as the distinct characteristics of the various fish species. Most of these fishing gears were passive in nature and ecologically benign. With the coming of nylon nets and better marketing infrastructure the artisanal fishermen started harvesting more fish (table-2.18).

Table-2.18. Marine Fish Landings of Kerala (1950-1970)

Year	Quantity (tones)		
	Traditional sector	Mechanised sector	Total
1950	202	-	202
1951	191	-	191
1952	129	-	129
1953	111	-	111
1954	117	-	117
1955	105	-	105
1956	151	1.3	152
1957	307	2.8	310
1958	293	2.6	295
1959	191	1.7	193
1960	345	2.1	347
1961	268	1.1	269
1962	192	1	193
1963	202	0.9	203
1964	318	0.3	318
1965	334	5	339
1966	338	8.3	346
1967	345	4.3	349
1968	328	3.2	331
*1969	267	28.2	295
*1970	340	52.6	393

Source: compiled from Ibrahim (1992).
*PCO/SIFFS (1991).

The overall picture of Kerala fisheries was one of abundant fish availability in the inshore waters, easily accessible to the large number of artisanal fishermen. There seemed very little scope for significant improvements to the productivity of their craft and gear. The common property nature of the fishery also did not appear to pose any major threat. The technological barriers (the need to have fishery specific skills) and social barriers (artisanal fishing being the occupation of a lower social caste) prevented free entry of capital and labour from outside traditional fishing communities. It was in this context government started attempts to modernize the fishing industry under the Indo-Norwegian Project by introducing mechanized boats. Between 1956-63 the number of boats issued in the project area increased three fold (Table-2.19).

Table-2.19. Distribution of Mechanized Boats Issued to Fishermen Typewise in Neendakara. 1956-63.

Year	22ft	23 1/2ft	25ft	25ft	total	Cumulative Total
	(4-5HP)	(8-10HP)	(8-10HP)	(16HP)		
1956	49				49	49
1957	18				18	67
1958						67
1959			9		9	76
1960			12		12	88
1961		13	15		28	116
1962		10	3	7	20	136
1963				2	2	138
	67	23	39	9	138	138

Source: Govt. of Kerala (1969), State Planning Board, Agriculture Division Studies.

Mechanization during this phase was largely confined to fishing of non-prawn species. It was for the first time in 1962, the 25ft-16HP boats specially designed to operate shrimp trawls were introduced in Kerala. This coincided with the fast expanding market for prawns in developed countries, the high market price for prawns and the government's interest in promoting export gave a further boost to trawling and 70s saw a mad rush to own trawlers. During earlier years, trawling remained mainly seasonal extending from about November to May. The increasing demand from the world market prompted the trawlers to venture into sea during the southwest monsoon period of June to August at Sakthikulangara and Cochin from about the beginning of 70s. The rush to own trawlers continued even in periods of declining catches and by 1980 Kerala had over 3000 small trawlers (Table-2.20). In this mad rush a new class of capitalist owners from non fishing communities entered the sector who have no long term stake in the fishery but to reap as much resource as possible before its ruin.

Table-2.20. Growth of Trawlers in Kerala (1961-1980)

Year	1961	1963	1966	1969	1972	1975	1977	1979	1980
Number	172	206	788	1505	1944	2105	2641	3000	3019

Source: Rajasenan (1987)

Excess Capital as Response to Lopsided Development Efforts of Government

The efforts of the government to provide mechanized boats to the artisanal fishermen failed. About 1200 small trawlers distributed through cooperatives went into the hands of middlemen and outsiders who had no long term stake in the fishery but were after profit only. By 1980 Kerala had over 3000 small trawlers and more than 30000 traditional crafts competing for the resource. From a catch of about 400000 tones in 1971, the artisanal sector catches had fallen to about 150000 tones in 1980 (table-2.21).

Table-2.21. Marine Fish Landings of Kerala 1971-1980 (in tonnes)

Year	Total	Mechanised Sector		Artisanal Sector	
	Landings	Landings	% Share	Lndings	% Share
1971	445347	47291	10.6	398056	89.4
1972	295618	38648	13.1	256970	86.9
1973	448269	93659	20.9	354610	79.1
1974	420257	101412	24.1	318845	75.9
1975	420836	180111	42.8	240725	57.2
1976	331047	58717	17.7	272330	82.3
1977	345037	107424	31.1	237613	68.9
1978	373339	117571	31.5	255768	68.5
1979	330509	94779	28.7	235730	71.3
1980	279543	134783	48.2	144760	51.8

Source. PCO/SIFFS (1990)

That year there was a sharp decline in both total fish catch and share of the artisanal sector threatening the very survival of the sector. Motorisation and adoption of more active fishing gears were one kind of response from the artisanal fishermen to this lopsided development efforts of the State and thus further entry of capital and excess capacity into the fishery (table-2.22 and 2.23).

Table-2.22.Change in Overall Craft Population:1991-1998

District	Non-motorised			Motorised			Total		
	1991	1998	%change	1991	1998	%change	1991	1998	%change
Kasaragod	189	276	**46.0**	1128	1095	**-2.9**	1317	1371	**4.1**
Kannur	467	613	**31.3**	828	963	**16.3**	1295	1576	**21.7**
Kozhikode	1258	960	**-23.7**	1680	1877	**11.7**	2938	2837	**-3.4**
Malappuram	702	684	**-2.6**	1187	1712	**44.2**	1889	2396	**26.8**
Thrissur	386	537	**39.1**	649	740	**14.0**	1035	1277	**23.4**
Ernakulam	680	918	**35.0**	362	360	**-0.6**	1042	1278	**22.6**
Alapuzha	622	857	**37.8**	1652	2661	**61.1**	2274	3518	**54.7**
Kollam	1970	1955	**-0.8**	774	905	**16.9**	2744	2860	**4.2**
Trivandrum	14271	8179	**-42.7**	1654	2906	**75.7**	15925	11085	**-30.4**
Total	20545	14979	**-27.1**	9914	13219	**33.3**	30459	28198	**-7.4**

Source: Compiled from SIFFS(1998)

Table-2.23. District wise Changes in Population of Artisanal Gears:1991-1998

District	Gillnet		Shore Seine		Boat Seine		Trammel net		Hook & Line		Ring Seine		Mini Trawl		Others		Total	
	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998
Kasaragod	2292	2514		13					12	33	303	227	6	12			2613	2799
Kannur	1879	1917	17	31		366			18	41	132	113	133	465	83	1	2262	2934
Kozhikode	3940	4870	32	14		689			131	84	198	261	464	909	1233		5998	6827
Malappuram	4340	4886	7	28	197	38				21	313	296	399	1067			5256	6336
Thrissur	2074	2252	8	38	90	94			17	18	255	187		185			2444	2774
Ernakulam	1137	2679			15	12			5	2	136	99	2	104			1295	3028
Alappuzha	2420	2962	90	28					27	49	756	925	644	1589	82		4019	5553
Kollam	3411	3875	136	91	61	26	721		679	400	166	169		20			5174	5252
Trivandrum	10872	10597	610	872	1298	1169	2858		5200	3647							20838	20209
Total	32365	36552	900	1115	1661	2394	3579		6089	4295	2259	2277	1648	4351	1398	1	49899	55712

Source: SIFFS (1998)

Governmental Subsidy and Credit Schemes

Government subsidies meant to encourage development of the fishing industry may keep the fishing enterprise profitable even after the resource base begins to erode. Indeed as long as enough fish are caught to cover operating cost, there will be little economic incentive to stop fishing once a vessel is built. Eventually however, greater and greater effort will be needed to catch the dwindling fish supply, and revenues will fail; by the time however there will also be a serious decline in fish stocks (World Resources, 1996).

In Kerala entry of more capital into the fishery is also encouraged through governmental subsidy and credit schemes. Initially the subsidy was as high as 25 percent of the cost of the hull and 50 percent of the cost of the engine. The remainder was given as loans to be repaid in 64 installments spread over a period of 8 years (Kurien, 1989). This reduced the capital cost to the private sector. Though the State subsidies to the mechanised boats were completely withdrawn in 1973, government started providing incentives to the traditional fishermen to motorise their country crafts by using out board engines and to obtain more fishing gear (table-2.24). So far 44695 fishermen have benefited from this.

Table-2.24. Details of Production Inputs Distributed to Fishermen Under IFDP as on 31-03-2000

Scheme Period		No.of Benefi-ciaries	Crafts		OBMs		Webbings		Access-ories	Total Investment
			No.	Cost	No.	Cost	Quantity (m.t)	Cost		
IFDP I	1985-91	4577	395	94.61	819	144.51	64.79	110.1	24.72	406.04
IFDP II	1991-95	7223	406	175.3	816	242.4	148.92	293.8	85.81	803.68
IFDP III	1996-98	20795	1962	1977	3687	630.33	289.61	818.5	111.38	3457.71
IFDP 98	1998	6336	803	402.3	1192	679.53	70.99	242.5	41.54	1365.87
IFDP 99	1999	1760	196	120.8	274	187.49	37.52	103.8	11.52	423.59
TOTAL		40691	3762	2670	6788	1884.3	611.83	1569	274.97	6456.89

Source. Matsyafed (Various years)

Under Phase I the loans are subsidised to an extend of 40 percent and the rate of interest was only 11.25 percent per annum. The loans are to be repaid by the beneficiary fishermen with a period of five years. By 1999-2000 there has been a decline in both the number of beneficiaries and the amount of subsidy (table-2.25).

Table-2.25.Details of Subsidy and Mode of Repayment Under IFDP

	Subsidy	Rate Of Interest/Annum	Repayment Period
IFDP I	40.00%	11.25%	5
IFDP II	25.00%	14.25%	5
IFDP III	25.00%	14.25%	5
IFDP 1998-1999			
IFDP 1999-2000	22.50%	15.00%	

Source. Matsyafed (2000)

Apart from various developmental and welfare schemes under IFP, Matsyafed is also implementing various other central government and state government sponsored schemes for fisherfolk.

i) CENTRALLY SPONSORED SCHEME FOR MOTORISATION OF COUNTRY CRAFTS. The scheme envisages distribution of outboard motors below 10 HP to the traditional fishermen with Rs.10000/-or one half of the cost of engine whichever is less as subsidy per unit on cash sale. 50 percent of the subsidy amount is met by the central government and 50 percent by the state government.

ii) BANKABLE SCHEME. To encourage institutional credit in this sector, the state government has subsidized loans sanctioned by commercial banks for the purchase of fishing inputs to an extend of 25 percent of the loan amount. Matsyafed has been able to convince the banks on the credit worthiness of the fishermen and as a result there has been evident strides in implementation of this scheme.

It has been unfortunate that such subsidies have historically been used with little consideration of the long term damage to the resource that they foster or the potential alternative uses these funds might have in State's development policies.

Such development support measures should be minimized over time, and accompanied by effective management of fishing effort. This is difficult because strong economic, social and political incentives exist to maintain the development support policies and further increase fishing efforts, even when stocks are being over fished. When catches decline withdrawal of the public support measures become politically and socially more difficult. Financial institutions urge their borrowers to repay loans or invest in new, more powerful and profitable equipment, further decreasing resource abundance and production; increasing fish prices; and providing a strong incentive to individual fishermen to expand fishing effort rather than reduce it. Moreover, publicly subsidised investments tend to have long lead-time (eg. fishing harbours) or a long working life (fishing vessels) and little alternative uses. Adjusting fishing efforts in the short term, when stocks decline rapidly become difficult as it often involves decommissioning or repositioning of large capital investments.

Rise in Population, Change in Consumption Pattern and Entry of Foreign Capital

Fish provide a vital source of food for hundreds of millions of people worldwide. Overall, the marine catch accounts for 16 percent of global animal protein consumption. The figure is higher for those living in developing nations. For instance fish accounts for roughly 29 percent of total animal protein in the diet of Asian people. The use of fish as a source of food rose from 40 million tonnes in 1970 to 72 million tonnes in 1993. Population is by far the most important factor in this burgeoning demand, accounting for roughly two thirds of total change in demand. At current rates of world population growth, the total world supply of food fish would have to grow from roughly 72 million tonnes in 1993 to 91 million tonnes by 2010 to maintain today's per capita fish supplies, according to FAO.

Developed nations now account for 85 percent of world fishery imports by value. The average consumption of fish per person in industrial nations is roughly three times that of developing countries. Escalating demand for fish in developed countries combined with steep decline of major northern fisheries in recent years has led developed nations to turn increasingly to developing countries in search of fish. At one fell swoop, the need for foreign exchange exerts tremendous pressure on developing countries to export fish or auction off the right to fish, thus encouraging further inflow of capital into the sector. For instance the enhanced growth of United States and Japanese economies and former's loss of access to supply from China caused burgeoning demand for prawn from India (Kurien, 1991). The resultant price escalation played an incentive for harvesting and depletion of the stock. As already mentioned in the previous session government encouraged the entry of more capital into the fishery through subsidies. It may also be noted that more recently government had permitted joint ventures in Deep sea fishing following the announcement of the Deep Sea fishing policy in March, 1991.

In the survey, the traditional fishermen report that many of the commercially important species which were once abundant in the near shore waters are now not seen in these areas due to the indiscriminate day and night fishing of mechanised trawlers. It is also noted that when most of the motorised crafts function like mini trawls, they are as equipped as mechanized boats to tap their resources. This is further aggravated with the advent of deep sea fishing. This does not mean that deep sea fishing is something redundant. Deep sea fishing is important in sustainable fishery management in the sense that it reduces stress on coastal fisheries. It is in this context the claim of mechanised boat operators that their boats have the potential to go for deep sea fishing and their fishermen have the skill required of that, become relevant. In other words the activities of large-scale foreign fishing vessels that operate in deep sea should be limited and the fishery development efforts of government should be channelised towards enhancing both the skill of mechanized fishermen and capacity of their gear to tap deep sea fishery potential so that the coastal fishery of the state is more relieved both in terms of distributional justice and conservational goal. Not only that it will also allow value addition and hence more employment opportunities on shore and more export earnings, by increasing the catch of coastal fishermen, and thereby ensuring local availability of fish, the balanced diet requirements of local people are met.

Pollution and Coastal Habitat Loss Due to over Population

The population bomb has already been detonated along the world's coastlines. Coastal areas nearly everywhere are now sagging under a human onslaught (Hinrichsen, 1995). Kerala coasts are also over crowded and over exploited. The marine fishermen population of 827953 (Economic Review, 2002) live along a wafer thin slice of our coastline. Population growth and urbanisation along shorelines lead to greater muncipal and industrial, waste discharge and pollution. In Kerala, the population density has tended to increase towards the coastal region. Out of a total area of 38,863 sq.km.,3355 sq.km. falls in the coastal area supporting a population of 72.72 lakhs. The density of coastal urban population is 4228 per sq.km. as compared to the average urban density of 2097 in the

State. The coastal rural population density is 1700, far above the State average rural population density of 603.

Rivers bring in more pollutants including fertilizers, pesticides, synthetic organic chemicals, untreated sewage along with increasing loads of erosion sediment torn from the hinterlands. Sedimentation due to logging is affecting marine resources not only in Kerala but in other tropical countries too. A study on Philippine island of Palawan revealed that the amount of sediment discharged by a river in a logged watershed was 100 times greater than the amount discharged by an unlogged watershed (The World Wide Fund For Nature, 1996). As sediment is washed into the sea it smothers sea grass beds and coral reefs, and can also carry chemical pollutants in the water.

In Kerala, the fish mortalities in the Chaliar river and in the Periyar estuary due to industrial effluents are by now well known. There are 16 major industries in the region, which contribute to large scale industrial pollution. These include fertilizer, pesticides, radio active mineral processing, chemicals, petroleum refining and heavy metal processing industries. The reports submitted by Pollution Control Board and Central Institute of Fisheries Technology (CIFT.), regarding the mortalty of fishes occurred in Chitrappuzha, Chambakkara canal and adjacent waters of Cochin Esturine system found the presence of a high concentration of free ammonia and ammonial nitrogen which entered the water sources as an industrial effluent, discharged by the Cochin Division of FACT. CIFT detected that the level of ammonial nitrogen in the effluents from FACT CD was very much higher than the level prescribed by PCB. Some other major industries that discharge waste materials into the coastal zone are Western India Plywood, Mavoor Rayons, Cochin Refineries, Lakshmi Starch Factory, Hindustan Insecticides, Indian Rare Earth and TTP. Long term monitoring of the pollution of the coastal waters is being carried out under COMAR Project in which, Kerala coastal zone is studied by CESS and NIO. This study indicates that the threshold values exceeded nowhere in Kerala. However, if precautions are not taken pollution can reach dangerous levels at several locations (State Planning Board, 1998). Apart from the effluent discharged from industries, domestic and community sewage, drainage from agricultural lands (containing fertilizers, pesticides, fungicides etc.), coconut husk retting areas and spillage of oil and kerosene in the vicinity of major commercial and fishing harbours also contribute to pollution of water bodies.

Pollution and coastal habitat loss have crucial implications for marine fisheries and their ability to provide food and employment for both present and future generations. Land reclamation, effects of oil spills, construction of dams on the rivers that discharge into the backwaters, diversion of water flows by the construction of spillways such as the one at Thottapally and barriers to estuarine circulated by the construction of salt water barrier at Thannermukkam etc, are altering the aquatic environment of the State's coastal waters. The concentration of chemical industry and the intensification of agriculture in Kuttanad region, closely linked to Cochin Backwater System, have increased the pollution loads in the backwaters. Unsound land use practices lead to siltation of coastal waters. The building of dams not only alters the flow of fresh water and nutrients into the marine system, it also reduces the free movement of fish in rivers and lakes. The effects of these that discharge waste materials into the coastal zone are Western India Plywood, Mavoor Rayons, Cochin Refineries, Lakshmi Starch Factory, Hindustan Insecticides, Indian Rare Earth and TTP. Long term monitoring of the pollution of the coastal waters is being carried out under COMAR Project in which, Kerala coastal zone is studied by CESS and NIO. This study indicates that the threshold values exceeded nowhere in Kerala. However, if precautions are not taken pollution can reach dangerous levels at several locations (State Planning Board, 1998). Apart from the effluent discharged from industries, domestic and community sewage, drainage from agricultural lands (containing fertilizers, pesticides, fungicides etc.), coconut husk retting areas and spillage of oil and kerosene in the vicinity of major commercial and fishing harbours also contribute to pollution of water bodies.

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Development along the coast has destroyed an estimated 50 percent of all coastal wetlands world wide. In Kerala, as per the early survey records on water resources of Kerala, the total extend of backwaters was about 55,000 hectares (1958). Now owing to indiscriminate reclamation and other activities for developmental purposes, the water spread area of the backwater system has shrunken to less than 35,000 hectares, thus recording a remarkable reduction, say to about 1/3 of its original extend in the past thirty years. Depth of the backwaters has also been substantially reduced, there by minimising the fishable area (Balakrishnan Nair, 1989). In Ernakulam district almost 62 percent of the backwaters has been reclaimed in the name of development.

There are only vestiges of mangroves in Kerala, today. However it is on record that there once existed a string of these amphibious coastal vegetation all along the estuaries and backwaters of Kerala. Existence of mangroves on the fringes of backwaters and estuaries has great importance and relevance in giving the fishery resources appropriate feeding grounds, shelter and nourishment as well as in enriching the productivity of brackish water areas. Destruction of mangrove forests, reclamation of shallow mud flats and swamps have denied the natural feeding grounds of commercially important penaeid shrimps (Balakrishnan Nair, 1989). Table-2.26 indicates how much seriously the ongoing non fishing human activities in the coastal, terrestrial and marine zones impose considerable stress on the coastal environment and the coastal fish stocks.

Table-2.26. Non Fishing Human Activities in the Coastal Area of India and Their Possible Effects on the Fisheries

Activity	Possible Effects	Seriousness level of Effect
Dense human population; increasing urbanisation	Habitat degradation such as high levels of faecal coliform in water and soil	4
Discharge of large quantities of untreated domestic waste water	High BOD levels leading to eutrophication; incidence of red tide causing fish mortality	4
Terrestrial runoff of silt due to land reclamation and deforestation	Change in marine environment affects juvenile population	2
Runoff of agro-chemicals and industrial discharge	Hazardous chemicals and solid wastes are lethal beyond certain level	4
Heavy phosphorus loading in estuaries	Lethal beyond certain level	3
Removal of mangroves for wood; mining of coral reefs for lime	Destruction of nursery grounds	2
Fishing by using cyanide and other lethal chemicals	Detrimental to a whole range of organisms in the area	1
Unplanned tourism development	Beach erosion and habitat disturbance	1
Impacts of ports	Soil erosion and habitat destruction; ingress of seawater	2
Oil pollution by ships and fishing vessels	Shadowing effect and reduction in dissolved oxygen leading to mass mortality	2

**seriousness level of impact represented as: 1, least serious; 2, moderately serious; 3, highly serious; 4, most serious.*
source: Devaraj and Vivekanandan, (1999)

Sustainable management of marine fishery sector of the State is necessary not only to allow a higher total catch, but also to keep fish diversity high, to reduce impacts on marine eco systems and ultimately to maximise sustainable employment in the fisheries sector. But, to quote Dixon and Fallon, (1989) it would be easy if sustainability were a "motherhood" issue, clearly defined and clearly desirable. Clearly we favour a socio-economic definition of sustainability – one that revolves around social and economic well being for the present generation and retention of future options for our children.

Having discussed the various socio-economic issues challenging the sustainable development of the State's coastal fishery sector, the various unsustainable fishery practices which are to be wiped out from the sector for its very sustenance and both the current and future well being of its primary and end users form the theme of the next session.

CHAPTER-3

EVIDENCES OF UNSUSTAINABLE FISHERY PRACTICES IN KERALA COASTAL WATERS-THE NEED FOR SUSTAINABLE FISHERY MANAGEMENT

The socio-economic issues of sustainable development of the State's marine fishery sector being the core of the previous session, proving the existence of unsustainable fishery practices and the need for the sustainable management of the State's fishery resources become the crux of the present session.

Kerala has all the natural endowments for building a strong and vibrant fisheries economy. The natural setting of the State with a long coastline (590 km.), extensive lakes and backwaters, two monsoons and numerous west flowing rivers are the contributing factors to the fishery bounty. The marine resources of the State sprawl over 36000 sq.km. fishable area on the continental shelf up to 200m. depth, almost equivalent to the land surface of the State. The coastal region within the 50m. depth is 12570sq.km. and the remaining is the offshore/deep sea area (50m. – 200m.depth). Of the total inshore potential in the south west coast of India the share of Kerala is placed at 5.71 lakh tones (against 4 lakh tones in 1977), as given in table 3.1.

Table-3.1 Marine Resource Potential 1991('000 tones)

	Demersal		Pelagic		Shelf Region Total	300-500m depth Resource	Total
	0-50m	Beyond 50m.	0-50m	Beyond 50m.			
Indian EEZ	1036	649	1174	742	3601	299	3900
SWC	361	112	589	245	1307		1307
Kerala	229	56	342	124	751		751

Source: Achari, (1994)

Over the last 5 decades the fishing industry in Kerala witnessed many changes. The fluctuations in landings can be due to both the fishery independent factors like climatic changes and fishery dependent factors like type of gears, size of their meshes, and the fishing effort put in. In Kerala the mechanization of craft and gear was started in the early fifties under the Indo-Norwegian Project in the Quilon area. During the sixties, nylon webbings supplant cotton webbings and purse-seining was introduced in the late seventies. Extensive motorisation of country crafts began in early eighties. There were significant changes in the gear used by the artisanal sector also. Boat seine has been converted into mini purse seine (ring seine) and country crafts converted into mini trawls. Post 1991 changes include introduction of plywood boats. Out of 13219 motorised crafts in the time as per SIFFS' survey (between December1997 and February 1998), 5701 (43 percent – the largest constituent) are plywood boats (SIFFS,1999). The two changes occurred in the marine fishery sector of the State are the introduction of mechanized winches to haul the net and substitution of OBMs with diesel inboards. The use of winches has already spread to six of the eight ring seine districts by 1999. The 85 HP diesel inboards which have been introduced by the fishermen in Ernakulam districts are widespread now so rapidly to such an extend to enter into the trawling ban issues and the allied conflicts among different fishermen categories regarding their ban in monsoon.

Periodisation in The Study

From a more or less a steady increase of 202047 tonnes landings in 1950 to 420836 tones in 1975, the marine fish landings of the State showed a downward trend from 1976 till 1987, and by 1988, the catch has got rising up again and settled around the MSY level of 5.71 lakh tonnes through out the 90s (table-3.2). Accordingly, for the purpose of analysis the periods are classified into three broad time spans. For the 8 commercially important pelagic species and 11 demersal species both annual and quarterly landings are available from 1960. In this chapter, the years from 1971-1999 are taken to show overfishing and resource depletion. The 1971-75 period is denoted as the ' ***initial peak period*** ' since this period is the period of initial fishery upsurge through out the years from the early attempts of development of the fishery sector since independence. This is true both in terms of total landings and landings of the commercially important species. The remaining 24 years are divided into two equal parts on the basis of introduction of trawl ban in 1988 and there after. The first 12 year period ie., 1976-1987 is denoted as ' ***the pre-ban period*** ' and the period 1988-1999 is termed as ' ***the post-ban period*** '. The periodisation used here is wide enough to nullify the effect of fishery independent factors like climatic changes (temperature, rainfall, salinity and currents) whose effect will remain only for two or three years. Any long term change in the catches can be attributed to the fishery dependent factors like man made changes in the nature, size and shape of the gear and its mesh size and the number of gears used in tapping the resource. According to Balakrishnan Nair committee (1989),

> *" Since variations in the factors identified under fishery independent factors normally do not undergo violent changes for a considerable time any changes in pattern of landings, size variations, species composition of the resources may, to a very large extend , be attributed to fishery dependent factors. "*

To test the depletion in the mechanized prawn fishery these two 12 year periods are again split up into two equal parts containing six years each. Here the period 1976-81 is phrased as ***' the first pre-ban period '*** and the phase 1982-1987 is phrased as ***' the second pre-ban period '***. Similarly the period 1988-1993 is the ***' first post-ban period '*** and the phase 1994-1999 is ***' second post-ban period '***. The mean figures of this initial peak period are taken as the base for comparison of the catch in the next two periods.

In the literature it is customary to distinguish between biological overfishing and economic overfishing (Clark, 1976; Waugh, 1984). Biological overfishing is any level of effort, which prevents the population stock from generating the maximum sustainable yield, while economic overfishing takes place when the additional cost of effort over and above the minimum required harvesting a certain amount of fish dissipate the potential rents from the exploitation of that resource.

Table-3.2 Marine Fish Landings From 1951-1999 (Quantity in tones)

Year	Quantity	Year	Quantity	Year	Quantity	Year	Quantity	Year	Quantity	Year	Quantity
		1951	191032	1961	267494	1971	445347	1981	274395	1991	564161
		1952	129345	1962	191421	1972	295618	1982	325367	1992	560742
		1953	111999	1963	202380	1973	448269	1983	385817	1993	574739
		1954	117034	1964	317974	1974	420257	1984	393472	1994	540813
		1955	105457	1965	339173	1975	420836	1985	325536	1995	531646
		1956	152213	1966	346744	1976	331047	1986	382791	1996	572005
		1957	309926	1967	364829	1977	345037	1987	303286	1997	574774
		1958	294655	1968	345301	1978	373339	1988	468808	1998	542696
		1959	191375	1969	294787	1979	330509	1989	647526	1999	507287
1950	202047	1960	344605	1970	392880	1980	279543	1990	662890	2000	604113

Source: 1) C.M.F.R.I

2) Economic Review (various years), Government of Kerala

Biological Overfishing

A quick look at catch data in the period 1950-1999, itself provide the impression that unsustainable fishery practices and the resultant overfishing have stepped into the coastal fishery sector of the State by the latter half of 70s From a peak of 448000 tones in 1973, in spite of increased fishing effort, the years 1976-1987, witnessed the reduction of landings below 400000 tones and even below 300000 tones in some years. Increasing fishing effort can be inferred as the major unsustainable practice contributed to stock collapse in this period. With the ever-increasing number of active fishermen and mechanized boats, the area available per fishermen declined from 17 hectares in 1960 to 6 hectares in1990 and that of a boat declined from 59 hectares to 40 hectares in the same period (table-2.17, chapter-2). The period witnessed enormous increase in the number of trawlers, introduction of purse seiners, introduction and massive growth of motorized fishing and more efficient gears. The declining catches in the event of increasing effort provide basic evidence of overfishing and unsustainable fishery practices in the coastal waters. Even though the catch has exceeded 600000 tones in 1989 and 1990, it could not be sustained beyond 1990 and in the 90's landings are maintained more or less near the MSY, but only with a far more increase in fishing effort.

Table-3.3 Increase in Fishing Activity (1961-2000)

	1961	1966	1972	1973	^1980	1982	*1987	*1989	#1999-2000
Number of trawlers	@172	729		1325	2630	2747	2510	3497	
Number of purse-seiners	-			>90	37	60	51		
Number of gill netters		196		200	362	567	846	728	
Others		18			9	59	141		
Total Mechanised crafts		943			3038	3433	3548	4225	4194
Total motorised crafts	-				0		9657	10858	28829
Total non motorised crafts	**21000		23708		30000		26137	18931	21751
Number of active fishermen	**80700		$ 110492		131101	$$ 125008		147875	185000

Source@: Rajasenan(2001).
Source$: Dept. of Animal Husbandry, XI Quinquennial Livestock Census 1972, Annexure VI, Schedule III, (Govt. of Kerala, Trivandrum, 1973) ,p.3.
Source ^: CMFRI, 1987
Source$$: Dept. of Animal Husbandry, XIII Quinquennial Livestock Census 1982, Annexure VI, Part III, (GOVT. OF KERALA, Trivandrum, 1984), P.29.
Source: Balakrishnan Nair Committee, 1989.*
*Source**: Kurien and Achari, 1990.*
Source #: Economic Review, 2000

Table-3.4 Annual Catch Potential of Important Species (0-50m Depth) and Actual Catch from 1971-1999 (quantity in '000 tonnes).

Name of species	*Pot-ential	Initi-al peak period 71-75	1st pre-ban period 76-81	2nd pre-ban peri-od 82-87	1st post-ban period 88-93	2nd post-ban period 94-99	% change over71-75: 1st pre-ban period 76-81	% change over71-75: 2nd pre-ban period 82-87	% change over71-75: 1st post-ban period 88-93	% change over71-75: 2nd post-ban period 94-99
PELAGIC										
Oil Sardine	111.274	123.3	115.79	101.63	105.79	60.01	-6	-18	-14	-51
Other sardine	12.637	29.1	16.89	6.47	17.14	22.32	-42	-78	-41	-23
Anchoviella (White Bait)	25.214	12.3	9.99	31.69	43.49	30.27	-19	158	254	146
Ribbon Fish	18.58	19.4	14.18	11.82	6.92	15.68	-27	-39	-64	-19
Carangids	55.506	9.3	9.41	25.01	67.08	64.12	1	169	621	590
Mackerel	48.656	34.9	19.85	14.20	59.77	90.86	-43	-59	71	160
Seerfish	9.958	3	4.32	6.21	7.22	4.90	44	107	141	63
Tunnies	19.123	4.2	9.61	9.06	18.40	14.76	129	116	338	252
Pelagic Total		254.82	214.70	221.68	355.08	323.45	-16	-13	39	27
DEMERSAL										
Elasmobranches	7.579	8.3	6.84	6.50	4.93	4.35	-18	-22	-41	-48
Cat Fish	8.817	22.3	10.77	9.15	3.36	0.31	-52	-59	-85	-99
Lizard Fish	10.646	4.818	4.94	5.84	12.03	9.67	2	21	150	101
Perches	51.051	10.4	14.80	25.79	52.46	51.51	42	148	404	395
Croakers	13.416	9.6	7.75	8.16	11.64	12.57	-19	-15	21	31
Big jawed jumper		3.315	0.80	1.24	1.11	1.73	-76	-63	-66	-48
Silver Belly	7.41	11	4.01	6.27	5.77	4.80	-64	-43	-48	-56
Goatfish		1.995	0.52	0.24	8.61	0.21	-74	-88	332	-90
Flat Fishes	17.42	8.6	5.06	12.15	18.37	18.62	-41	41	114	116
Penaeid Prawns	64.482	58.8	37.35	34.79	54.28	53.00	-36	-41	-8	-10
Cephalopods	18.852	1.3	3.66	7.02	23.57	35.57	182	440	1713	2636
Demersal Total		151.25	107.61	131.10	224.73	238.18	-29	-13	49	57
Total	**571.317**	**406**	**322.312**	**352.7115**	**579.811**	**561.663**	**-21**	**-13**	**43**	**38**

*Source; * Compiled from JAMES (1993)*

A closer analysis of the landings, provides, evidence of biological overfishing in coastal waters. In terms of total landings and landings of most of the commercially important species, in all the years from 1950, the period 1971-75 can be identified as the initial peak period. The marine fish landings in Kerala witnessed an increasing trend from 1962-1975, with an exception of two or three years and the landings in all the years in the period 1971-75 except in 1972 rose above 400000 tonnes. In table 3.4, the 24 years from 1976-1999 are split up into 4 equal compartments containing 6 years each ie, two pre-ban periods and two post-ban periods. Average landings in 1976-81, 1982-87, (pre-ban periods) 1988-93 and 1994-99 (post-ban periods) are compared with that of the initial peak period 1971-1975. In the period 1971-75 with around 1944 trawlers (table-2.20, chapter-2) and less than 30000 non motorised traditional crafts the fishery was able to harvest as high as 448000 tones of fish. The period 1976-81 and 1982-87 witnessed erosion in both pelagic and demersal species landings. Among the pelagic varieties all except carangids, tunnies and seerfish experienced depletion. Among the important demersal varieties all except perches, lizard fish and cephalopods showed remarkable decline. In the 1st pre-ban period the maximum depletion found is in bigjawed jumper followed by silverbelly and catfish. The most important commercial specie peneaid prawns declined by 36 percent. Another important commercial specie of pelagic variety mackerel dropped by 43 percent. The overall total landings in this period declined by 21 percent.

The downward trend in total landings continued in the period 1982-87 also. In this period the depletion in pelagic varieties, such as oil sardine, other sardine, ribbonfish, mackerels etc are much higher than that in the first pre-ban period. Among demersal species elasmobranches, goatfish, catfish and peneaid prawn showed further decline. Landings of penaeid prawns, silverbellies, goatfish, catfish etc became half of 1971-75 level – that too with further increase in the size of fishing fleet and modernisation in the types of fishing gears used. The percentage decline in total harvest was 21 in the 1st pre-ban period and 13 in the 2nd pre-ban period.

Although total catch increased by 1.4 times in the first post-ban period ie., 1988-93, many of the important commercial species like oil sardine, other sardine, ribbonfish, elasmobranches, catfish, big jawed jumper, silver belly, penaeid prawn etc., could not restore their 1971-75 level, not only in 1976-81 and 1982-87 but also in 1988-93 and 1994-99. It can be said that oil sardine, other sardine, and ribbonfish among the pelagic varieties and elasmobranches, catfish, silverbelly, big jawed jumper and peneaid prawn among the demersal species are showing the tendency of depletion, since through out this four time periods their average landings have never crossed their peak level average of 1971-75. Together with this, the fact that none of these species, except other sardine are able to restore their MSY level of landings in most of the years, even with the enormous increase in both the efficiency of gears and efforts put in, substantiate the overfishing and depletion of these species and hence unsustainable fishery practices in our coastal waters. Catch data from 1983-1999, MSY and peak period landings of these species are given in table-3.5. It can be seen that for all species except other sardine, actual landings lie much below the MSY level in most of the years.

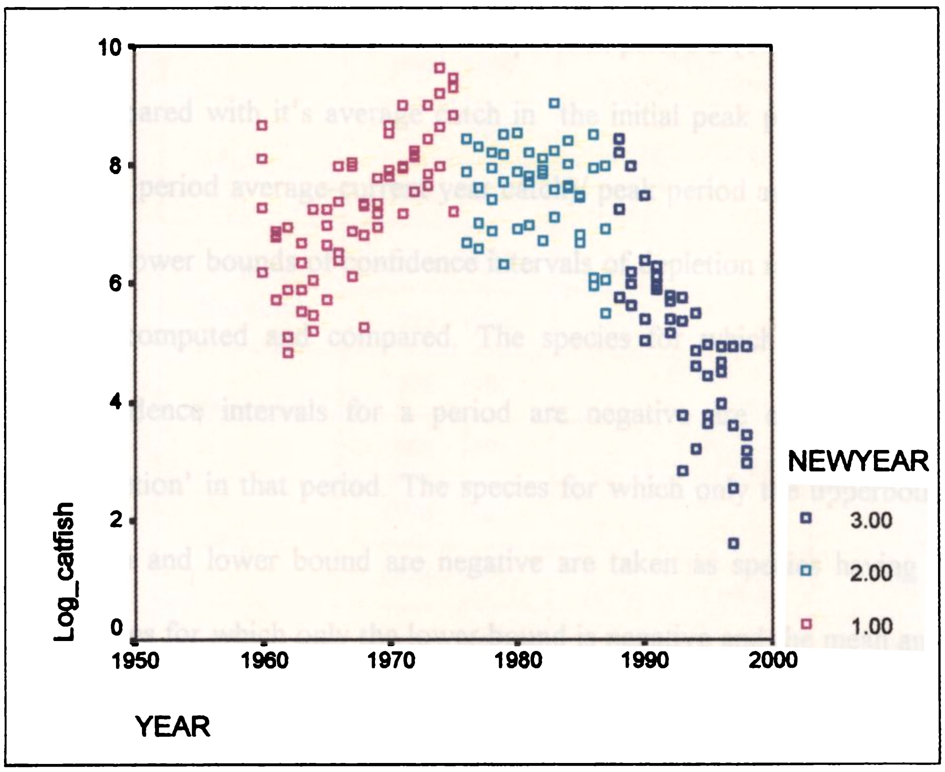
Table-3.5. Year Wise Landings, MSY and Peak Period Landings of Depleting Species (quantity in millions tonnes)

	Oil sardine	Other sardine	Ribbon fish	Elasmobranches	Catfish	Big-jawed Jumper	Silver-belly	Penacid-prawn
MSY	111.274	12.637	18.58	7.579	8.817	NA	7.41	64.482
1971-75	**123.3**	29.1	19.4	8.3	22.3	3.315	11	58.8
1983	**154.879**	5.315	1.112	**8.537**	**15.332**	1.099	**9.504**	29.754
1984	**147.139**	6.022	6.464	**7.637**	**11.582**	1.645	3.911	35.529
1985	79.225	2.473	**25.142**	5.972	5.17	1.041	3.417	26.684
1986	40.613	8.934	11.88	6.034	8.594	1.438	6.007	37.188
1987	44.717	8.697	15.295	4.473	4.66	0.618	6.027	52.866
1988	60.508	**12.701**	8.952	6.761	**9.96**	0.821	6.493	**67.494**
1989	**184.879**	**13.752**	7.179	4.68	4.097	1.32	5.354	53.317
1990	**179.276**	**12.9**	9.751	6.968	2.739	2.34	6.195	45.483
1991	106.263	**23.73**	2.167	3.441	1.744	0.623	5.643	60.318
1992	16.967	**54.118**	6.162	3.323	1.029	0.675	4.48	51.067
1993	49.675	**22.819**	7.29	4.432	0.597	0.907	6.548	47.988
1994	1.554	**16.482**	15.435	5.887	0.499	1.135	4.238	**71.871**
1995	13.328	**46.131**	4.641	4.109	0.308	0.561	4.005	43.224
1996	30.607	6.737	**21.884**	4.422	0.39	2.208	4.536	46.143
1997	93.636	**15.573**	**18.976**	3.915	0.192	1.791	4.732	56.131
1998	77.795	**19.889**	16.579	4.11	0.213	3.016	5.118	58.523
1999	**143.152**	**29.09**	16.542	3.677	0.248	1.645	6.154	

Source: Compiled from C.M.F.R.I. data

The years with landings higher than the MSY are highlighted in table-3.5. The depletion of catfish is showed with the help of Scatter diagram in figure-3.1. It can be seen that most of the points in period 2 and 3 lie much below those in period 1.

Figure-3.1 Depletion of Catfish



Note: 3 = post ban period (1988-2000)

2 = pre-ban period (1976-1987)

1 = initial period (1960-1975)

Extend of Depletion

In the following session, to study the extend of depletion in species in different time periods annual catch data of each specie in period 2 (1976-87) and period 3 (1988-99) are compared with it's average catch in the initial peak period or period 1 (1971-75) ie., (peak period average-current year catch)/ peak period average) . The mean and the upper and lower bounds of confidence intervals of depletion ratio for each specie in each period are computed and compared. The species for which the mean and upper and lower confidence intervals for a period are negative are considered as species having 'no depletion' in that period. The species for which only the upperbound is positive and the mean and lower bound are negative are taken as species having 'mild depletion'. The species for which only the lower bound is negative and the mean and the upper bound are positive are termed as species having 'moderate depletion' and the species for which all the three coefficients are positive are termed as species having 'heavy depletion' (table-3.6). In the analysis it is clearly seen that oil sardine is only moderately depleting in period 1976-87 has heavy depletion in the period 1988-99, while croakers, which have moderate depletion in period 1976-87, have no depletion in 1988-99. Other sardine, ribbonfish, catfish, elasmobranches, bigjawed jumper, silverbelly, etc are having heavy depletion in both the periods. Similarly, tunnies, seerfish, perches and cephalopods are species having no depletion in both the periods. In table-3.6 status of depletion of each specie in each period is given.

Table –3. 6. Depletion Status of Important Species in Period 2 and Period 3 on the Basis of the Initial Peak Period (1970-75) Landings

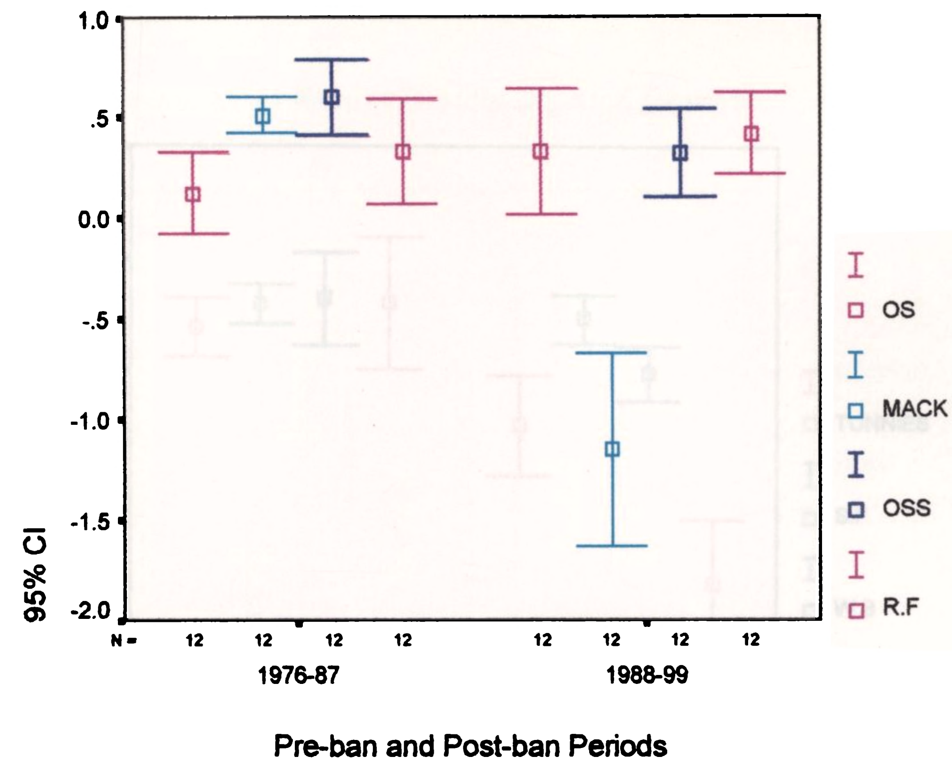
Fish	Period	Mean and C. Interval	Remark
Oil Sardine	1976 - 1987	0.1254 (-.0807 0.3316)	Moderate Depletion
	1988 - 1999	.3331 (0.0224 0.6437)	Heavy Depletion
Mackerel	1976 - 1987	.5128 (.4242 .6014)	Heavy Depletion
	1988 - 1999	-1.1552 (-1.6352 - 0.6752)	No Depletion
Other Sardine	1976 -1987	0.5989 (.4104 .7874)	Heavy Depletion
	1988 - 1999	.3224 (.097 .5452)	Heavy Depletion
White Bait	1976 - 1987	-.6982 (-1.5282 .1318)	Mild Depletion
	1988 - 1999	-2.0058 (-2.4881-1.5236)	No Depletion
Carangids	1976 - 1987	-0.7627 (-1.9243 .399)	Mild Depletion
	1988 - 1999	-5.7184 (-6.8399 - 4.5968)	No Depletion
Tunnies	1976 - 1987	-1.2079 (-1.7425 -.6733)	No Depletion
	1988 - 1999	-2.922 (-3.818 - 2.0259)	No Depletion
Seer Fish	1976 - 1987	-.7731 (-1.1235 -.4227)	No Depletion
	1988 - 1999	-1.0412 (-1.4761 -.6063)	No Depletion
Ribbon Fish	1976 - 1987	.3307 (.0653 .596)	Heavy Depletion
	1988 - 1999	.4183 (.2118 .6249)	Heavy Depletion
Catfish	1976 - 1987	.553 (.4608 .6451)	Heavy Depletion
	1988 - 1999	.9176 (.8369 .9984)	Heavy Depletion
Perches	1976 - 1987	-.9524 (-1.6896 -.2152)	No Depletion
	1988 - 1999	-4.008 (-4.8187 - 3.1829)	No Depletion
Croakers	1976 - 1987	.1721 (-.0516 .3959)	Moderate Depletion
	1988 - 1999	-.2598 (-.4862 -.0324)	No Depletion
Lizardfish	1976 - 1987	-.1183 (-.3512 .1146)	Mild Depletion

	1988 - 1999	-1.2522 (-1.5977 -.9068)	No Depletion
Elasmobranches	1976 - 1987	.1937 (.0859 .3015)	Heavy Depletion
	1988 - 1999	.4386 (.3438 .5334)	Heavy Depletion
Flatfish	1976 – 1987	.00334 (-.3145 .3211)	Moderate Depletion
	1988 – 1999	-1.1418 (-1.5144 -.7691)	No Depletion
Big Jawed Jumper	1976 – 1987	.6916 (.6036 .7797)	Heavy Depletion
	1988 – 1999	.5716 (.4204 .7228)	Heavy Depletion
Silverbelly	1976 – 1987	.5314 (.3922 .6707)	Heavy Depletion
	1988 – 1999	.518 (.4661 .5699)	Heavy Depletion
Goatfish	1976 – 1987	.8071 (.5803 1.034)	Heavy Depletion
	1988 – 1999	-1.2098 (-3.0471 .6275)	Mild Depletion
Penaeid Prawn	1976 – 1987	.3759 (.2656 .4862)	Heavy Depletion
	1988 – 1999	.0718 (-.0318 .1767)	Moderate Depletion
Cephalopod	1976 – 1987	-2.99 (-4.8118 -1.1797)	No Depletion
	1988 – 1999	-21.1374 (-24.932 -7.3431)	No Depletion
Total	1976 – 1987	.1688 (.106 .2317)	Heavy Depletion
	1988 – 1999	-.4055 (-.4836 -.3275)	No Depletion

Source: Workout from CMFRI data

The error bars on the basis of the above analysis, are also plotted, for species whose landings show similar catch pattern, to get a quick look at the extend of depletion happened in them in the pre-ban and post-ban periods. It can be easily identified from the error bars of depleting species, catfish is found to be the most depleted specie in terms of absolute depletion. The error bars are given in figures- 3.2, 3.3, 3.4, 3.5. and 3.6.

Figure-3.2. Error Bars of Depleting Pelagic Species*

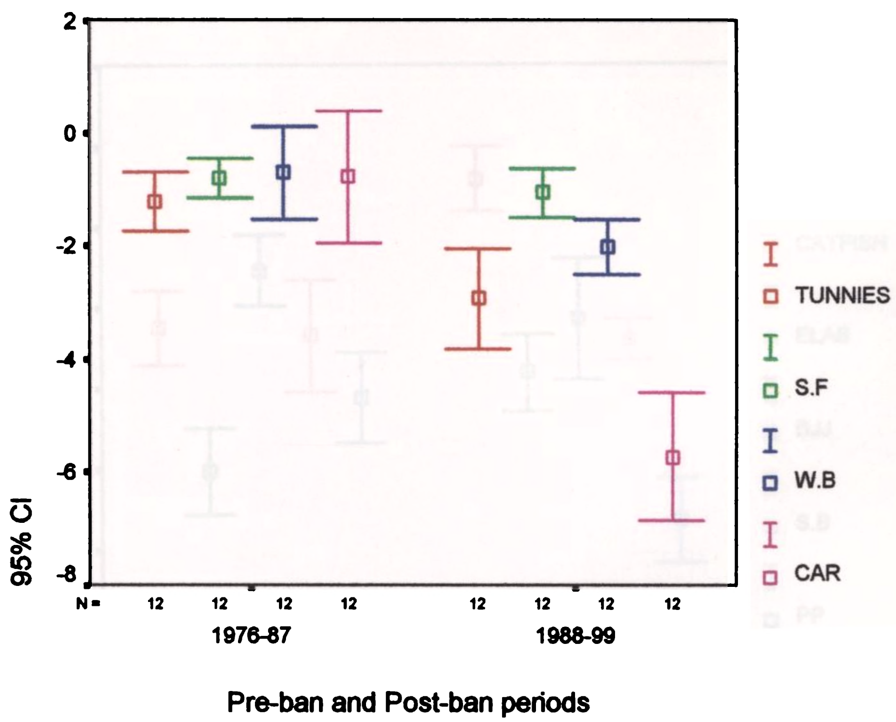


*Note :-

OS	Oil Sardine
MACK	Mackerel
OSS	Other Sardine
R.F	Ribbon Fish

In figure 3.2 most of the points in all the error bars except that of mackerel in the post-ban period (1988-99) are lying above zero indicating their depletion where as in figure 3.3 it can be seen that all the points in all error bars except some points in those of carangids and white bait in pre-ban period (1976-87) are lying below zero indicating that they are not depleted.

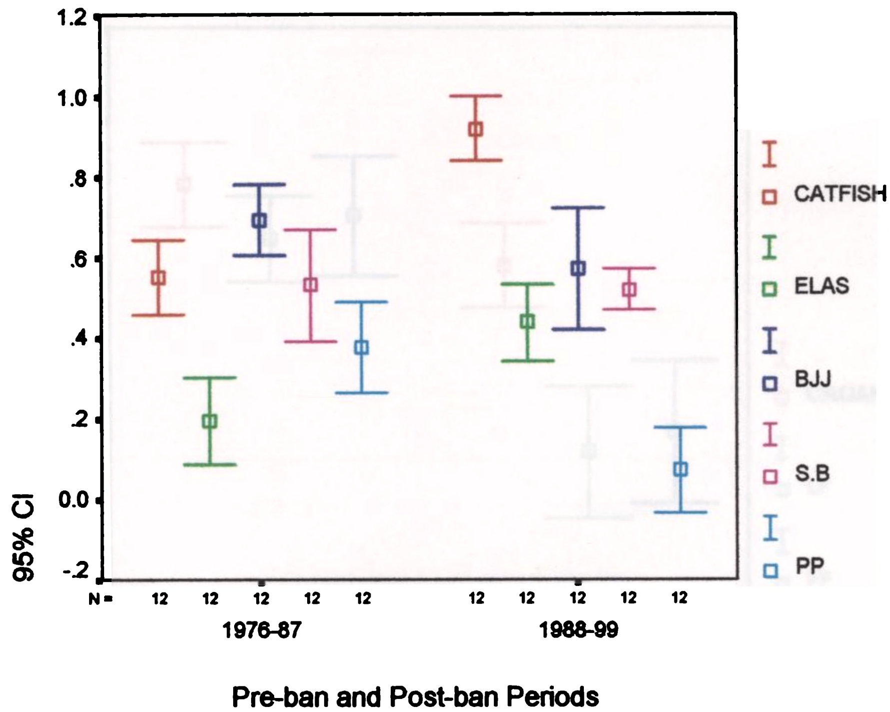
Figure-3.3 Error Bars of Non Depleting Pelagic Species*



*Note :-

S.F	Seer Fish
W.B	White Bait
CAR	Carangids

Figure-3.4. Error Bars of Heavily Depleted Demersal Species*

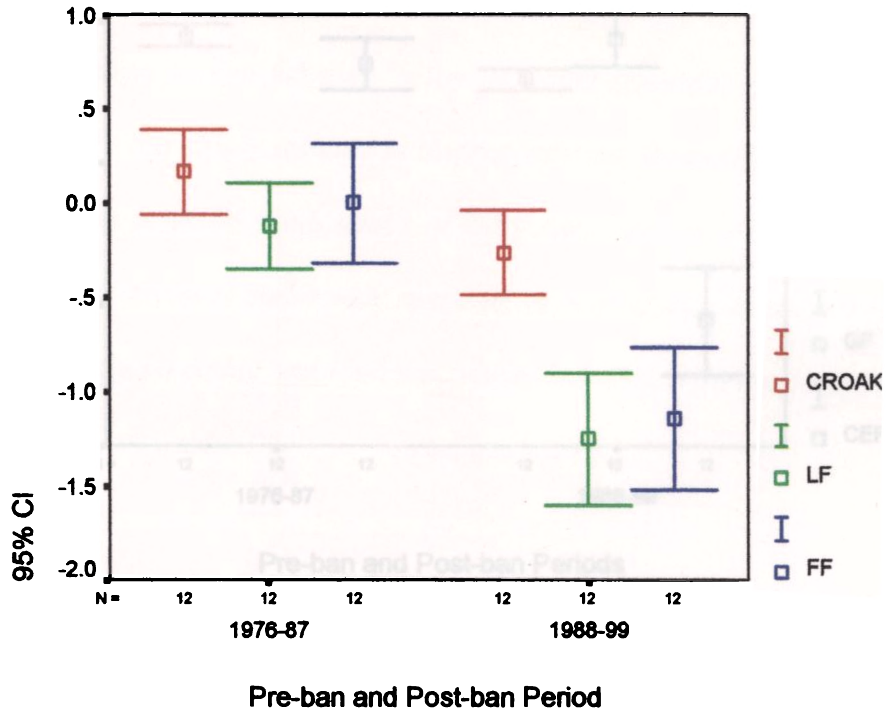


*Note :-

ELAS	Elasmobranches
BJJ	Big Jawed Jumper
S.B	Silverbelly
PP	Penaeid Prawn

In figure 3.4 it can be seen that all the points in all error bars in both periods, except some points in error bar of penaeid prawn in the post-ban period (1988-99) are lying above zero indicating their heavy depletion in these periods. Similar explanation can be given to figure 3.5 and 3.6 also.

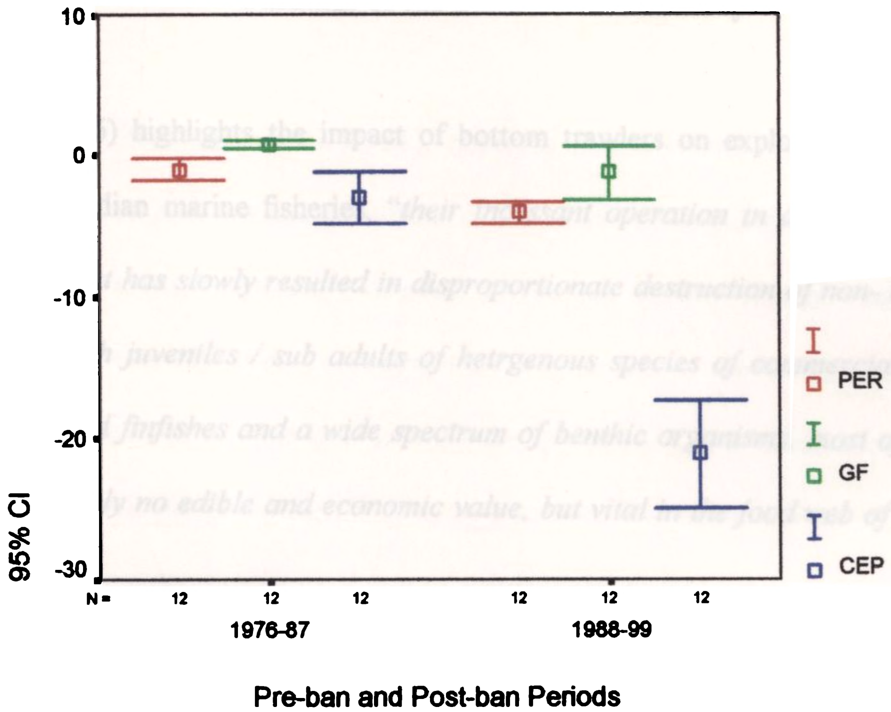
Figure-3.5 Error Bars of Croakers, Lizard Fish and Flat Fish*



*Note :-

CROAK	Croakers
LF	Lizard Fish
FF	Flat Fish

Figure-3.6. Error Bars of Perches, Goat fish and Cephalopod*



*Note :-

PER	Perches
GF	Goat Fish
CEP	Cephalopod

Decline in the demersal species particularly support the occurrence of biological overfishing, since these bottom dwelling species are more influenced by man-made interventions in the ecosystem than by nature-induced changes. The sharp decline in the harvest of these species can largely be attributed to the existence of unsustainable fishery practices, such as bottom trawling in the coastal waters.

The Brunt of Bottom Trawling and Purse Seining on Resource Depletion – The Findings of the Scientific Community

Menon, (1996) highlights the impact of bottom trawlers on exploited resources in the context of Indian marine fisheries, "*their incessant operation in a climatically limited coastal habitat has slowly resulted in disproportionate destruction of non- target groups too along with juveniles / sub adults of hetrgenous species of commercially important shellfishes and finfishes and a wide spectrum of benthic organisms, most of which have low or currently no edible and economic value, but vital in the food web of all exploited resources.*"

This reveals that in addition to target species (shrimps or cephalopods) the bottom trawling yield shellfishes and fin fishes of economic importance to the tune of 1:3.6 ratio (average of 1985-90 in Karnataka, Kerala and Tamilnadu) and in edible biota and juveniles of shellfishes and fin fishes at a ratio of 1 : 0.15. The finfish component which account for the major share in the bottom trawl landings is caught unintentionally, and being a less priority item it is usually discarded invariably, particularly in the cases of stay-over fishing, extending to two or more days. The per day bottom area scraped by one trawl unit is estimated to be around 0.3 - 0.5 sq. km. In the total trawl landings of Karnataka, Kerala and Tamilnadu, the target groups like shrimps (16 percent) and cephalopods (4 percent) together constitute only 20 percent and the remaining 80 percent is constituted by 65 percent of finfishes and 15 percent of benthic organisms. Since target resources are embedded within a complex web of interrelated species from different groups coexisting in an environment, isolating any desired animal for exploitation is impossible. Thus by-catch is an inevitable component in trawl fishing.

Balakrishnan Nair committee (1989), observes that, *"Indiscriminate bottom trawling during the recent past has caused serious disturbance of living animal communities of the benthos. The excessive pressure exerted on the sea bottom through intensive bottom trawling will naturally affect recoupment and regeneration. Another disturbing factor is that great quantities of eggs and young ones of bottom living fishes are hauled up by trawl nets, particularly during the monsoon season. The committee is of the view that during the monsoon months total ban of mechanized fishing efforts violently disturbing the sea bottom is necessary in the interest of conservation of resources."*

A closer look at the annual percentage contribution of trawl to the landings of important species will make it clear that among the 14 species where more than 20 percent of landings are contributed by trawl, 11 are either moderately or heavily depleted (table-3.7). In other words, for all the thirteen heavily or moderately depleting species identified in the current analysis except oilsardine and mackerel, trawl net is the major gear used in catching them. Their depletion can be attributed to the deleterious impact of trawl gear, particularly on the bottom dwelling species due to its incessant and indiscriminate scraping method of sea bottom. In 1991 more than 50 percent of the catfishes was caught by the trawl net. It is the near shore trawling in the pre monsoon period damaging new recruitment of catfishes by removing the juveniles and sub-adults from the feeding grounds which caused a steady decline in their landings in the later years (Alagaraja, et al., 1994).

Table-3.7 Percentage Contribution of the Mechanised Trawl Net to the Landings of Major Groups of Fishes (1983-1997).

Name	% Contribution
Elasmobranches	43
Catfishes	32
Oil sardine	1
Other sardine	1
White bait	20
Lizard fish	98
Perches	88
Goat fish	85
Croakers	59
Ribbonfish	59
Carangids	31
Silverbelly	56
Big jawed jumper	41
Mackerel	4
Seer fish	8
Flat fish	70
Peneaid prawn	76
Cephalopod	83

Source. Compiled from annual catch data of CMFRI.

Commercial purse-seining started in Kerala by the end of 1979 with a small fleet of 20 and by 1980 the number rose to 70. The sudden introduction of large number of purseseiners though boost up the production of many pelagics and demersals, especially catfishes has brought in indiscriminate harvest of spawners and egg carrying male brooders of them. It is after purse-seining became massive in Karnataka, the steady increase in catfish yields in Kerala began to show a decreasing trend. More than 73 percent of catfish landings of this gear in Karnataka was realized during September to March, when fishes migrate into shallow fishing grounds for breeding (James, et. al., 1989). Mass harvest of brooders is repeated in every year during February to March and September to October. About 64 percent of purse-seine catfish catch was composed of gestating males of *T.dussumieri* and *T. tenuispinis* with annual average (1979-1987) landings 502 and 1905 tonnes respectively. An estimate of the quantum of destruction of eggs/embryos/ larvae, indicated that on an average every year, within a period of two months (September-October), 8.2 million eggs /embryos /larvae of *T. tenuispinis* are destroyed, which is equivalent to 13.4 tonnes eggs during the period 1980-86 (Menon and Pillai, 1996).

Artisanal Gears and Resource Depletion

Ring seines have started operating towards the end of 1985. Studies conducted by CMFRI from selected centers provide information on young fishes and juvenile prawn caught by various gears operated from the centers during selected periods of time. In Cochin and Calicut, crafts fitted with outboard motor using ringseines with a mesh size of

7-10mm landed juvenile oil sardine and mackerel in large quantities during the monsoon and post monsoon months every year. The juvenile oil sardine landing by this gear at Calicut during 1988 was estimated to be 118 tonnes. Similarly the outboard mini trawls (code-end mesh of 10-20mm) in coastal waters up to 10m off Central Kerala coast caught juvenile prawn and young fishes. This destructive fishing is though local in nature, also harmful to fish stocks and ultimately lead to recruitment overfishing. The boatseines and shore seines (6-8mm mesh) operate along Trivandrum coast caught an average 11 tonnes of young fishes every year (Menon and Pillai, 1996).

Declining size of the harvested species and catch per unit effort also prove biological overfishing. Studies conducted by fishery scientist George (1988), have proven reduction in the size of P. Stylifera and M. Dobsoni in 1983 compared to 1978. Name of major depleting species in the respondent's point of view and extend of their depletion and their conceptions regarding depletion are given in the table-3.8. Reduction in the size of species like prawns, sardine, mackerel, big-jawed jumper etc. are apparent in the survey. Species which are now out of reach of the small scale fishermen are also given in the table. Reasons for depletion from the respondent's point of view are given in table -3.9.

Table-3.8. Name of Depleting Species.

Name of Species	Fishermen's conceptions regarding reduction in their sizes
Vallisrave	Getting big fishes has become a rare occurrence
Venginikoori(neelakoori)	fuel emissions from motorised boats has badly affected the taste of fishes
Ray	fish will not grow upto its maximum size in the kerosene polluted waters
Palsrave - sharp nosed shark	
thodi*	
Big jawed jumper	maximum size of big jawed jumper getting 12 years back was 300g.m. whereas now it is 5-20 g.m.
Pathavaala	
etta*	
Kannathi	in earlier days sardines were getting in 38mm mesh size net, but now they are getting only in 32 mm and mackerels which were getting in 52mm are now getting in 48 mm.
Sardine	
Mackerels	
Silver belly	
Kili varanda	20 =1 kg, now 75-80 = 1 kg
Karikkumkutty	
Naran chemmeen	prawns- 40 to 50 counts earlier - now 60-65 and 80-85
Villan chemmeen	sardine from 12cm to 8 cm
Pomfret	sardine 36mm to 33mm
Paanjukadian	
Pachathi	
Kuthirachonkan	
Paalavu	

Source: field survey

Table-3.9 Reasons for Depletion From the Respondents' Point of View

	Reasons for depletion from the respondents' point of view
1,	Trawling
2,	Deep sea fishing by foreign trawlers
3,	Night trawling
4,	Dynamite fishing
5,	Pollution from mechanized boats and motorised boats
6,	Climatic changes
7,	Increasing operating cost (12 hrs operation requires Rs 150 but generates only Rs 200)
8,	Depletion of mangrove swamps
9,	Over exploitation of resources
10,	Sound pollution due to mechanised & motorised fishing
11,	Trawling is indiscriminate 75% of trawl catch is discarded to the sea
12,	Gillnet fishing
13	Reclamation of backwaters

Source: field survey

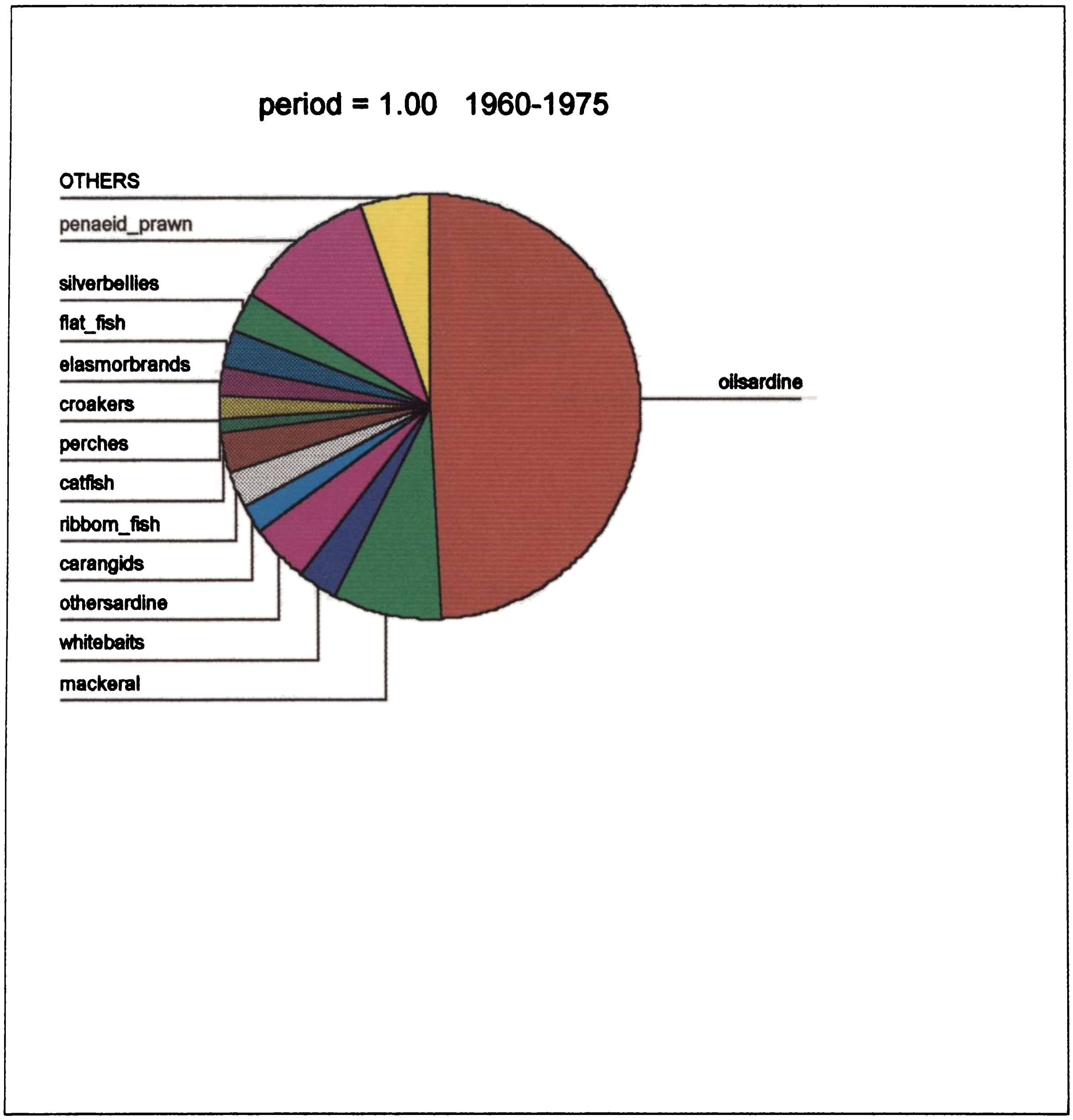
Though, compared to 1961-62, total catch has increased in eighties and nineties, it is due to change in the species composition of the catch (table-3.10) and not due to increase in the catch of species which are traditionally being considered as commercially important. Carangids, whitebait, perches, cephalopods and others are the groups that maintained the total catch in several years in period 2 and period 3 in spite of considerable decline in the catch of oil sardine, which contributed nearly half of the total landings in 1960-75, along with decline in the landings of catfish, silverbellies, cephalopods, other sardine etc. The period wise percentage shares of different species in the total landings are given as pie diagrams in figure 3.7. The drastic changes happened in the species composition are explicit in the figure.

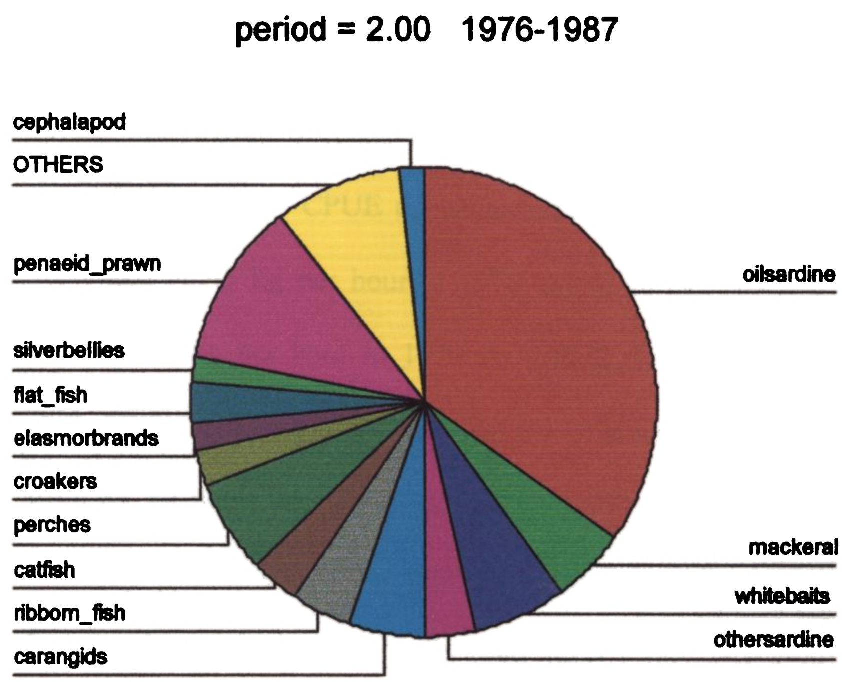
Table-3.10 Period Wise Percentage Contribution of Different Species in the Total Landings

Period	1960-1975	1976-1987	1988-1999
Oil sardine	47.6	32.4	14.1
Mackerel	8.09	5.09	13.15
White bait	2.97	5.89	6.55
Other sardine	4.31	3.50	3.51
Carangids	2.25	4.92	11.59
Tunnies	0.79	2.81	2.86
Seerfish	0.66	1.56	1.08
Ribbonfish	2.65	3.93	1.99
Catfish	2.91	2.98	0.34
Perches	1.15	5.96	9.07
Croakers	1.50	2.32	2.13
Lizardfish	0.43	1.62	1.93
Elasmobranches	2.26	1.97	0.82
Flatfish	2.70	2.50	3.24
Bigjawed jumper	0.77	0.30	0.25
Silverbellies	2.87	1.52	0.93
Goatfish	0.31	0.12	0.78
Penaeid prawn	10.49	10.86	9.52
Cephalopod	0.17	1.56	5.21
Others	5.14	8.22	10.96
Total	100.00	100.00	100.00

Source: Compiled from annual landings data of CMFRI

Figure-3.7 Pie Diagrams Showing Period wise Change in Species Composition

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OTHERS
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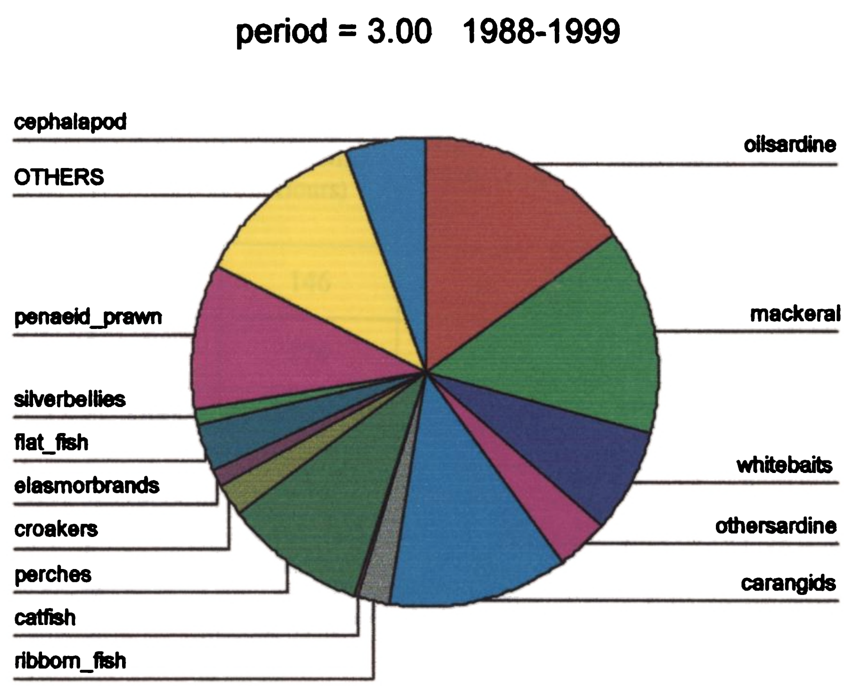
silverbellies
flat_fish
elasmorbrands
croakers
perches
catfish
ribbom_fish
carangids
oilsardine
mackeral
whitebaits
othersardine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OTHERS
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silverbellies
flat_fish
elasmorbrands
croakers
perches
catfish
ribbom_fish
oilsardine
mackeral
whitebaits
othersardine
carangids

The declining Catch Per Unit Effort (CPUE) is another symptom of biological overfishing. The studies conducted by Babu Paul et.al. (1985). Kurien and Achari (1989) etc. prove, overfishing has set in the Kerala fishery by the latter half of seventies. During 1971-75 the CPUE of mechanised boats ranged between 25.96 kg. per hour in 1971 and 96.45 kg per hour in 1975, while during 1976-80 after touching the highest level 56.75 kg per hour in 1979 the CPUE declines to 22.48 kg in 1980 (Babu Paul et.al.,1985). In Neendakara, the main prawn landing center in Kerala, the CPUE declined from 83 kg per hour of fishing effort in 1973 to 20 kg per hour in 1984 (Kurien and Achari, 1989). CPUE for the total catch has also declined from a maximum of 186 kg per hour in 1971 to 17 kg per hour in 1980 (table-3.11).

Table-3.11 Catch Rates for Trawlers Operating in Sakthikulangara (1970-1980)

Year	Total Effort ('000 Man Hours)	Total Catch ('000 Tones)	CPUE Of Total Catch Kg./ Hour	Prawn Catch 000 Tones	CPUE Of Prawn Catch Kg. / Hour
1970	146	27	183	2	13
1971	276	51	186	11	40
1973	550	66	120	45	83
1975	1332	151	113	57	43
1980	4843	75	17	37	8

Source: (Sathiadas and Venkataraman, 1981)

Table-3.12 Catch and CPUE of Prawns in Mechanised Trawling Sector of Kerala

	Mechanized Prawn Catch	Mechanised Effort (in unit operation)	CPUE(kg./day)
*1971	15904	124960	127
*1972	13617	73103	186
*1973	52102	113696	458
*1974	32084	152465	210
*1975	64520	218766	295
Average for the period	35645	136598	255
1st pre-ban period			
*1976	18028	112512	160
*1977	29761	224392	133
*1978	35533	375284	95
*1979	18262	143466	127
$1,980	40439	659130	61
$1,981	16309	345538	47
Average for the period	26389 (-26)	310054 (127)	104 (-59)
2nd pre-ban period			
$1,982	27403	656955	42
$1,983	2309 9	393000	59
$1,984	24941	319000	78
$1,985	23402	370000	63
$1,986	25065	402000	62
$1,987	47421	586000	81
Average for the period	28555 (-20)	454493(233)	64(-75)
1st post-ban period			
$1,988	49608	863000	57
$1,989	35402	595000	59
$1,990	34158	532000	64
$1,991	44515	553000	80
$1,992	39782	542240	73
#1993	35046	605727	58
Average for the period	39752(12)	615161(350)	65(-74)
2nd post-ban period			
#1994	62096	724675	86
#1995	31220	508853	61
#1996	31024	474248	65
#1997	44093	689524	64
#1998	47261	606992	78
#1999	33666	486898	69
Average for the period	41560 (17)	581865 (326)	71(-72)

Note. Figures in parenthesis are percentage change over the initial peak period
*Source * :compiled from Kalawar, A.G. et. al., (1985).*
Source$:compiled from Alagaraja, K. et. al. (1994).
Source# : compiled from unpublished data CMFRI

Here a period wise comparison of catch, effort and CPUE data of mechanised trawl landings of the commercially most important specie – prawn – is done (table-3.12). The fall in CPUE of prawn landings in mechanized trawl gear in the event of increasing fishing effort visible in this sector through out the four periods after the initial peak period, indicate biological overfishing of the specie. Though, in the first and second post-ban periods total prawn landings rose above the initial peak period landings, CPUE in these periods are 74 and 72 percent below the mean figure of 1971-75 giving the evidence of biological overfishing and hence existence of unsustainable fishery practices in the coastal waters of Kerala.

Although in the long run (seasonalities and short run fluctuations are considered) declining CPUE of specie is a clear indication of its biological overfishing, it may also lead to erroneous conclusions if other factors are not considered. For example total catch of certain species may drop as a result of changes in target species in response to new market conditions (Aquero, 1987). But it is apparent in table-3.13 that it has not happened in the case of prawn fishery in Kerala, as the continuous increase in both the indices of local price of prawn and export price of prawn show that there has not been any decline in the market preferences for prawn in both the local and international markets over the years.

Table –3.13 Average Beach Price of Shrimp and Export of Shrimp From Kerala

Year	Beach Price (Rs. Per k.g)		Shrimp exported					
			Qty(tones)		Value(Rs crores)		value/qty (Rs per kg)	
1971	1.8		20328		28.45		14	
1972	1.9		23790		40.07		17	
1973	3.0		27989		50.46		18	
1974	3.6		22762		40.96		18	
1975	4.2		30569		55.49		18	
Average for the period	**2.9**		**25087.6**		**43.086**		**17**	
	amount	Index (1971-75=100)	amount	Index (1971-75=100)	amount	Index (1971-75=100	amount	Index (1971-75=100)
1976	6.2	214	28466	113	81.44	189	29	171
1977	7.8	269	24824	99	67.71	157	27	159
1978	8.8	303	26805	107	75.10	174	28	165
1979	9.6	331	26886	107	97.96	227	36	212
1980	10.0	345	24034	96	78.31	182	33	194
1981	11.3	390	26854	107	109.77	255	41	241
1982	12.7	438	27242	109	123.97	288	46	271
1983	12.8	441	27235	109	128.34	298	47	276
1984	13.5	466	25658	102	127.08	295	50	294
1985	15.3	528	23443	93	120.88	281	52	306
1986	18.3	631	23789	95	136.59	317	57	335
1987	20.7	714	26834	107	166.42	386	63	371
1988	22.2	766	26453	105	157.78	366	60	353
1989	25.8	890	25002	100	152.97	355	62	365
1990	30.5	1052	29607	118	212.42	493	73	429
1991	34.5	1190	38275	153	351.24	815	92	541
1992	37.3	1286	30738	123	302.91	703	103	606
1993	40.5	1397	28164	112	339.06	787	121	712
1994	45.5	1569	37701	150	567.92	1318	151	888
1995	48.5	1672	31228	124	486.29	1129	156	918
1996	50.5	1741	32710	130	512.89	1190	157	924
1997	53.5	1845	32650	130	587.72	1364	180	1059
1998	55.5	1914	26234	105	501.00	1163	191	1124
1999	N.A.		28486	114	548.20	1272	192	1129
2000	N.A.		34199	136	702.11	1630	205	1206

Source: shrimp exported 1971-79, Facts and Figures 1980
Source: shrimp exported 1980-1990, compiled from Facts and Figures 1990.
Source: shrimp exported 1992 & 1993, compiled from Marine Fisheries of Kerala at a Glance, (1994).
Source: 1994-2000 MPEDA
Source: beach price of shrimp 1969-1984, Korakandi, 1994
Source: beach price of shrimp 1984-1988, compiled from Facts And Figures 1990.
Source: beach price of shrimp 1991-1998 compiled from various issues of Marine Fisheries of Kerala at a Glance

Correlation matrices of catch, effort and CPUE worked out for different time periods reinforce the findings of depletion of prawn, particularly in the period 1976-87. Negative correlation between year and CPUE (-.670), positive correlation between catch and effort (.669) and negative correlation between effort and CPUE (-.775) are the features of the pre-ban period. The positive correlation between catch and effort indicate that catch is increasing because efforts are increasing and not due to the increasing abundance of the resource. The negative correlation between effort and CPUE indicate that with the increase in effort the fishery is not able to reap additional harvest sufficient enough to keep the CPUE from decline i.e., the proportion of increase in effort is higher than the proportion of increase in catch, which can be attributed to the severe depletion of the resources in this time period.

Table-3.14 Correlation Matrix for Different Time Periods

	Initial peak period	Pre-ban period	Post-ban period
Year - catch	.820	.252	-.089
Year - effort	.781	.503	-.369
Year -CPUE	.443	-.670	.293
Catch -effort	.739	.669	.744
Catch -CPUE	.759	-.152	.621
Effort -CPUE	.137	-.755	-.054

Source. Compiled from raw data of prawn landings of mechanised trawlers.

With a comparison of the profitability of the trawlers in different time periods, it can be seen that economic overfishing has also set into the Kerala coastal waters. In table 3.15 it can be seen that there is a steep fall in the profitability of the mechanised boats since 1980, thereby marking the end of the era of lucrative mechanised fishing and the beginning of economic overfishing.

Table_3-15. Coast and Earnings of Trawlers in Kerala Coast

Year		Number of Fishing Days	Revenue/Day	Total Cost/Day	Net Profit/Day
+	1968-69	160	215.625	166.875	48.75
*	1971	215	1073.14	322	751.14
*	1972	215	1768.36	341.73	1426.63
*	1973	215	3499.14	385.11	3114.03
*	1974	215	1987.28	443.77	1543.51
*	1975	215	3332.41	517.72	2814.69
*	1976	215	3355.8	587	2768.8
*	1977	215	2807.62	711.49	2096.13
*	1978	215	1989.85	831.31	1158.54
*	1979	215	3990.63	991	2999.63
*	1980	215	1364.94	1116.81	248.13
*	1981	215	2019.82	1283	736.82
*	1982	215	2171.84	1450	721.84
	1989-90	180	2933	2418	515
#	1991	253	3363.97	3097.21	266.76
@	1993-94	253	4442.69	4110.67	332.016

Source +: Government of India (1971), Evaluation of the Programme of Mechanisation of Fishing Boats, Programme Evaluation Organization, Planning Commission, New Delhi.
Source: Kalawar, A.G. et. al., (1985).*
Source#: Panikkar et.al., (1992).
Source @: Sathiadas, R. et. al., (1995).

It was in this context of severe resource depletion and heavy loss to the fishery and the consequent conflicts among resource users that government forced to introduce trawl ban - the only regulatory measure existing in the State. The context of introducing trawl ban and its impacts on catch structure are examined in the forthcoming chapter.

CHAPTER-4

MONSOON BAN ON TRAWLING IN KERALA AND ITS IMPLICATIONS

In the previous session, it has been made clear that depletion of several species has occurred in the coastal waters of the State by the latter half of seventies itself. The overall decline in the total fish landings in general, and the continuous decline in the share of artisanal sector which could accommodate more than 88 percent (PCO/SIFFS, 1991) of the workforce in particular, (table 4.1) resulted in growing conflicts between the fishermen belonging to the mechanised and artisanal sectors for fishing time, space and resources leading to violence, bloodshed and burning of boats. Thus it has become a serious social, law and order problem in the coastal villages of the State.

Table-4.1 Sector wise Contribution to the Total Landings

Year	Total Landings	Mechanised Sector		Motorised Sector		Non Motorized Sector	
	Tonnes	Tonnes	%Share	Tonnes	%Share	Tonnes	%Share
1969	294787	28177	9.56			266610	90.44
1970	392880	52571	13.38			340309	86.62
1971	445347	47291	10.62			398056	89.38
1972	295618	38648	13.07			256970	86.93
1973	448269	93659	20.89			354610	79.11
1974	420257	101412	24.13			318845	75.87
1975	420836	180111	42.80			240725	57.20
1976	331047	58717	17.74			272330	82.26
1977	345037	107424	31.13			237613	68.87
1978	373339	117571	31.49			255768	68.51
1979	330509	94779	28.68			235730	71.32
1980	279543	133783	47.86	1522	0.54	144238	51.60
1981	273978	73056	26.66	22848	8.34	178074	65.00
1982	325367	85190	26.18	63050	19.38	177127	54.44
1983	385817	98065	25.42	99624	25.82	188128	48.76
1984	393472	129641	32.95	133892	34.03	129939	33.02
1985	325536	120912	37.14	127952	39.31	76672	23.55
1986	382791	129785	33.90	187000	48.85	66006	17.24
1987	303286	151169	49.84	112217	37.00	39900	13.16
1988	468808	206072	43.96	231141	49.30	31595	6.74
1989	647526	213829	33.02	400131	61.79	33566	5.18
1990	662890	231572	34.93	390857	58.96	40461	6.10
1991	564161	219681	38.94	305335	54.12	39145	6.94
1992	560742	256836	45.80	273807	48.83	30099	5.37
1993	574739	308636	53.70	230883	40.17	35220	6.13
1994	568034	325282	57.26	221295	38.96	21457	3.78
1995	531646	221851	41.73	290421	54.63	19374	3.64
1996	572055	260385	45.52	290067	50.71	21603	3.78
1997	574774	283680	49.36	271611	47.26	19483	3.39
1998	542696	255399	47.06	268700	49.51	18597	3.43
1999	580773	219253	37.75	342481	58.97	19039	3.28
2000							
2001	567000						
2002	594000						

Source. 1969-1979 : PCO/SIFFS, 1991
Source. 1980-1991 : compiled from Alagaraja, K. et. al., 1994
Source. 1992-1999 : compiled from CMFRI data

The artisanal fishermen protested collectively against mechanised means of fishing and demanded total ban on such fishing methods. Their demands included banning of trawlers within 20 k.m. from the shore, total banning of trawlers during June to August, mesh size regulation, passing of marine legislation demarcating the areas of operations for the mechanized and traditional fishermen separately, the establishment of coast guards to enforce the law, and severe penalty for violation of the reserved zone. It was in response to this struggle, the Kerala Marine Fishing Regulation Act was passed by the government of Kerala in December 1980. The act prohibited the use of purse-seine, ring-seine, pelagic trawl and mid water trawl gear for fishing in the territorial waters of Kerala. Although, the act was envisaged to protect the interests of traditional fishermen and the conservation of depleting resources, and provided the authorities ample powers to enforce registration and licensing and penalty for breach of provisions, government hardly took any step for the actual implementations of the provisions of the act. Instead of banning of bottom trawling, government delineated depth zones for different sectors of fishing.

The artisanal fishermen repeatedly voiced that the extensive fishing carried out by the bottom trawlers in the inshore areas and the indiscriminate destruction of eggs, juveniles and young ones of fishes and prawns by them were the prime causes for deprivation of their normal catches and the depletion of fishery resources. They pointed out that in addition to the eggs and young ones, even the breeders of fishes and prawns were caught and hauled in huge quantities by the trawlers, thereby virtually depleting the resources during their operation. They identified the monsoon period as the most vulnerable season subjected to multifarious destruction to the breeding grounds of fish and other organisms by the bottom trawlers (Balakrshnan Nair et. al., 1991).

It was in this context the Director of Fisheries, on 23rd May 1981 issued a notification affecting a ban on mechanized fishing throughout the Kerala coast during the months of June, July and August 1981 under the purview of KMFR Act, 1980. Later on 6th June by another notification Neendakara was exempted from the ban. The owners of mechanized trawlers took up the matter with the Hon'ble High Court of Kerala questioning it's legal validity and the High Court of Kerala struck down the notification issued by the Director of Fisheries disclosing it as not an order and directed the government to appoint an expert committee to study the issue in detail. It was in this response the Government appointed Babu Paul Committee in 1981. However, with regard to the specific need for adopting a closed season for trawl boats as a management measure the opinion of the committee was divided (Babu Paul et. al., 1982). Considering the persistent unrest in the artisanal fisheries sector the government of Kerala appointed another Expert committee in 1984 consisting of one experienced fishery administrator and two leading fishery scientists from outside the State. The committee reported that abundance of shrimps in the inshore trawling grounds reaches the maximum during the monsoon months of June, July and August and reduces by about 10 times in September even in the absence of any commercial trawling in the monsoon. This is partly because of a higher natural mortality due to the prevalence of the oxygen minimum layer in the inshore waters and partly because of randomisation of the resources over a vast area. Moreover the committee was of the opinion that breeding season of prawn is protracted. The committee therefore concluded that no conservation purpose would be served by banning trawling in the monsoon. Instead, the committee strongly recommended to limit the number of trawling boats in the State to1145 with a strict regulation of the mesh size of the cod end of trawl nets to be not less than 35mm, to restrict monsoon trawling to be in day time and beyond 20m depth and to limit the number of motorized canoes in the traditional fishing grounds to be between 2200-2700 (Kalawar, A.G. et. al., 1985). But the government did not take any effective measures to implement the regulatory measures put forward by the committee.

Due to the persistent demands from the traditional fishermen for a ban on trawling during the monsoon season and the frequent clashes between the fishermen belonging to different sectors, leading to serious law and order situation, the government of Kerala in the year 1988 vide G.O. (P) 20/88/F&PD dated 29.6.88 banned trawling throughout the territorial waters of Kerala during the monsoon period. However, the area between Paravoor South Pozhi and Cheriyazheekkal (Neendakara area) was exempted on account of the belief that there was heavy concentration of Karikkadi along the inshore area during these three months, which if not exploited was likely to be lost to the fishery. Since then trawl ban has become an annual management measure of Kerala in the south west monsoons perhaps at varying intensities as given in table 4.2.

Table-4.2 Duration of Trawling Bans in Different Years.

Year	Starting date	Ending date	Total number of days
1988	June- 29th	August- 31st	64
1989	July- 20th	August- 31st	43
1990	June- 28th	July- 21st	24
1991	July- 15th	August- 16th	33
1992	June- 21st	August- 3rd	44
1993	June- 15th	July- 15th	31
1994	June- 15th	July- 29th	45
1995	June- 10th	July- 20th	41
1996	June- 15th	July- 25th	41
1997	June- 15th	July- 29th	45
1998	June- 15th	July- 29th	45
1999	June- 15th	July- 29th	45
2000	June- 15th	July- 29th	45
2001	June- 15th	July- 29th	45
2002	June- 15th	July- 29th	45

Source: Rajasenan (2001)
Indian Express (2002)

Monsoon's Bearing on the Productivity of Arabian Sea.

The influence of weather on fish populations and their behavior in general and that of the south west monsoon on the Indian marine fisheries in particular, have been recognised long back. Studies on this aspect were being carried out at CMFRI almost from its inception and the close link among the physical properties of the sea, atmospheric conditions and the monsoon is well established. The monsoons play a significant role in the ecological cycle and productivity of the sea. Solar radiation, which forms the primary source of energy and is essential for photosynthesis, is dependent on the intensity and the length of the day light and atmospheric conditions. The biomass production in the sea is thus dependent on this energy and the nutrient supply generated through the complex physical, chemical and biological process taking place in the dynamic marine environment and subsequently transmitted to aquatic organisms at different trophic levels. Similarly the upwelling phenomenon which occurs seasonally is due to the strong monsoon winds. This process is important for refertilaising the impoverished surface layers and has a great bearing on fish production, its distribution and abundance pattern. Besides, the turbulence, eddy diffusion and thermal strafication caused by the interaction among the sea and atmospheric conditions and wind speed, play a major role in the supply of nutrients which determined the productivity of the sea (James, 1992).

Studies on oceanographic features conducted by a team of CMFRI scientists show maximum changes in their characteristics during southwest monsoon season mostly in the Arabian Sea than in the Bay of Bengal. During upwelling, which starts with the onset of Southwest monsoon a general increase in phosphate and silicate contents of the waters has been observed in the region from Kanyakumari to Cochin. An increasing trend in the nutrient content of the waters is observed from South to North in this region and uniformly higher reactive phosphate values have been noticed at the bottom over the shelf region. Again southwest monsoon is the period when mud banks are formed in the southwest coast – the unique feature observed only in this region which has not been reported so far from any other place in the world. The mud banks are maintained by the southwest monsoon with its westerly winds having more northerly components which cause the monsoon swells in the inshore region which along with the waves produce a constant thrust thereby preventing the mud from spreading into the sea (Rao, et. al., 1992). The temperature and salinity in the mud bank region are lowest compared to other seasons. The dissolved oxygen is lower during the monsoon season, the reactive phosphate, silicate, nitrate and nitrite contents of the waters are highest in the region during the monsoon. These cooler waters being rich in nutrient content and low in salinity seem to favor primary production (Rao, et. al, 1984).

In the southwest monsoon when the salinity of water falls from 35 percent or more to 30-31 percent, the temperature decreases from 31-32 ^{0} C to 23-25 ^{0} C in the upper layers and the nutrients such as phosphate, nitrate and silicate become abundant due to upwelling and river discharges. Due to these optimum conditions, the production of phytoplankton is maximum in the monsoon months after which it declines (Subramanyan, R.1967).

Southwest Monsoon plays a critical role in the production of phytoplankton and zooplankton by triggering off environmental features such as sea water temperature, salinity, dissolved oxygen content and nutrient generation which in turn has a great bearing on fish yield.

The peak of the zooplankton biomass is observed during the peak southwest monsoon and post monsoon periods i.e. during and after the upwelling while the abundance of fish eggs and larvae are maximum during the pre-monsoon months (David Raj and Ramamritham, 1981), that means juveniles are maximum in the monsoon.

Several commercially important marine fishes and shellfishes, including the major groups such as Oil Sardine, Indian Mackeral and Peneaid Prawns are known to breed or to have one of their peak spawning seasons during the southwest monsoon months (June-September) on the west coast (Qasim, 1973).

Impact of Trawl Ban on Fish Resources.

Since, a considerably long time span has been taken into account in this study, any improvement in the depletion status can be considered as a result of rejuvenation of the fishery due to the ideal changes happened more in the fishery dependent factors like type of gear used, control in fishing efforts, closed seasons etc than in fishery independent factors like climatic changes. The positive changes happened in the depletion status of important species in period 3 (1988-99 i.e., post-ban period), compared to period 2 (1976-87 i.e. pre-ban period) can be understood as the positive impact of trawl ban on these species. On the basis of data derived in table-3.6 (chapter-3), the shift in the depletion status of the depleting species in period-2, after the imposition of monsoon ban on bottom trawling is presented in table-4.3. The species listed in table-4.3 have definitely been benefited form the control on effort extended on them in the Southwest monsoon in the form of trawl ban. According to Balakrishnan Nair, et. al. (1989),

> *" Since variations in the factors identified under fishery independent factors normally do not undergo violent changes for a considerable time any changes in pattern of landings, size variations, species composition of the resources may, to a very large extent, be attributed to fishery dependent factors ".*

Table-4.3 Positive Impact of Trawl Ban on Depletion Status

Name of the species depleted in period-2 (pre-ban period)	Status of Depletion in period-2 (pre-ban period)	Status of Depletion in period-3 (post-ban period)
Mackerel	Heavy Depletion	No Depletion
Other Sardine	Mild Depletion	No Depletion
Carangids	Mild Depletion	No Depletion
Croakers	Moderate Depletion	No Depletion
Lizard Fish	Mild Depletion	No Depletion
Flat Fish	Moderate Depletion	No Depletion
Goat Fish	Heavy Depletion	Mild Depletion
Penaeid Prawn	Heavy Depletion	Moderate Depletion

Source. Compiled form Table-3.6, Chapter-3.

Boxplots of Quarterly Landings Data

Apart from this, box plots of landings in different time periods are drawn to show the impact of trawl ban (figure 4.1 and 4.2). In the Box plot technique instead of the initial peak period (1971-75) which is taken as the base in the depletion status analysis, the period from 1960-75 is taken as the initial period to get a wider coverage of years. Instead of the annual landings data the quarterly landings data could be made use of in the box plots. Box plots could present a clearer picture of the status of landings of each specie in each time period including their quartiles, confidence intervals and outliers along with their means.

Result of Principle Component Analysis

Principle component analysis has been done for the pelagic and demersal species to study the impact of trawl ban on catch by reducing the dimension of data without much loss in information. The catch data of all the 8 important pelagic species have been reduced into one dimension, and the catch data of all the 11 important demersal species have been reduced into one dimension so that the overall impact of trawl ban on these traditionally harvested species together can be examined. The quarterly catch data from 1960 to 1999 are studied here and presented in figure 4.3 and figure 4.4.

Principal component analysis for all Pelagic Fishes

Component Loadings

	Dimension	
	1	2
OILSAD	-.146	.769
MACKERAL	.678	.245
WHITE_BA	.771	-.197
OTHER_SA	.128	.327
CARANDIE	.846	-.129
TUNNIES	.789	.058
SEERFISH	.722	.465
RIBBOM_F	.403	-.537

Variable Principal normalization.

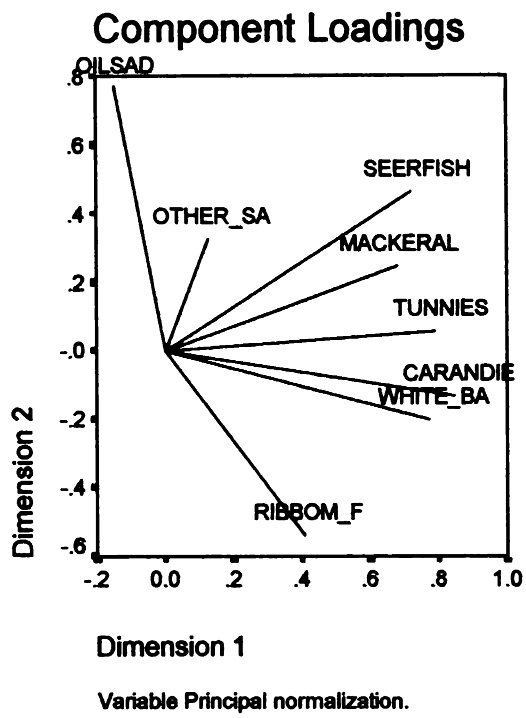
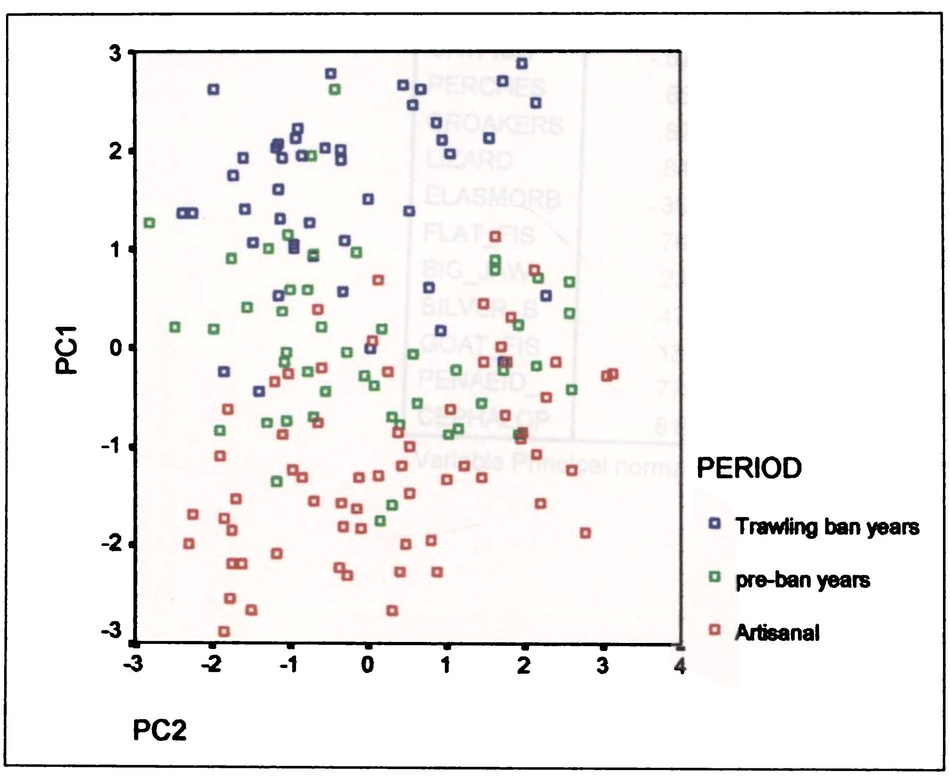


Figure 4.3. Scatter Plot of Principle Component Analysis of Pelagic Fishes



As seen in the figure 4.3 that all the points in pre-ban years ie., 1976-87 (points in green) and artisanal or the initial years ie., 1960-75 (points in red) lie below points in post ban years ie., 1988-99 (points in blue) the overall impact of trawl ban on the catch of these 8 pelgic fishes considered together is positive. In other words when we consider all the 8 important pelagic species together, we can definitely conclude that trawl ban has positive impact on them.

The same is true in the case of demersal fishes also, which is shown in figure 4.4.

Principal Components Analysis for Demersal Fishes.

Component Loadings

	Dimension	
	1	2
CATFISH	-.521	.455
PERCHES	.883	-.253
CROAKERS	.824	.124
LIZARD	.846	-.214
ELASMORB	-.356	.215
FLAT_FIS	.764	.200
BIG_JAW	.236	.682
SILVER_B	.473	.696
GOAT_FIS	.180	.376
PENAEID_	.779	.367
CEPHALOP	.816	-.465

Variable Principal normalization.

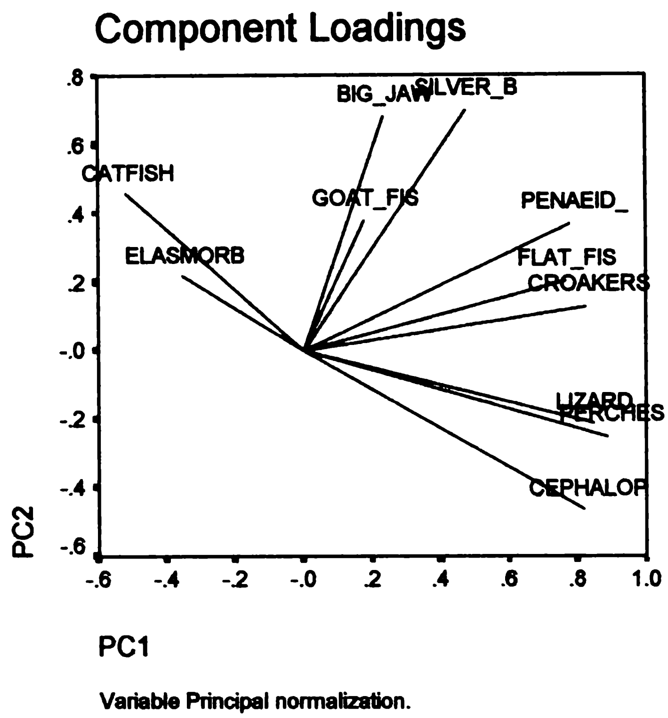
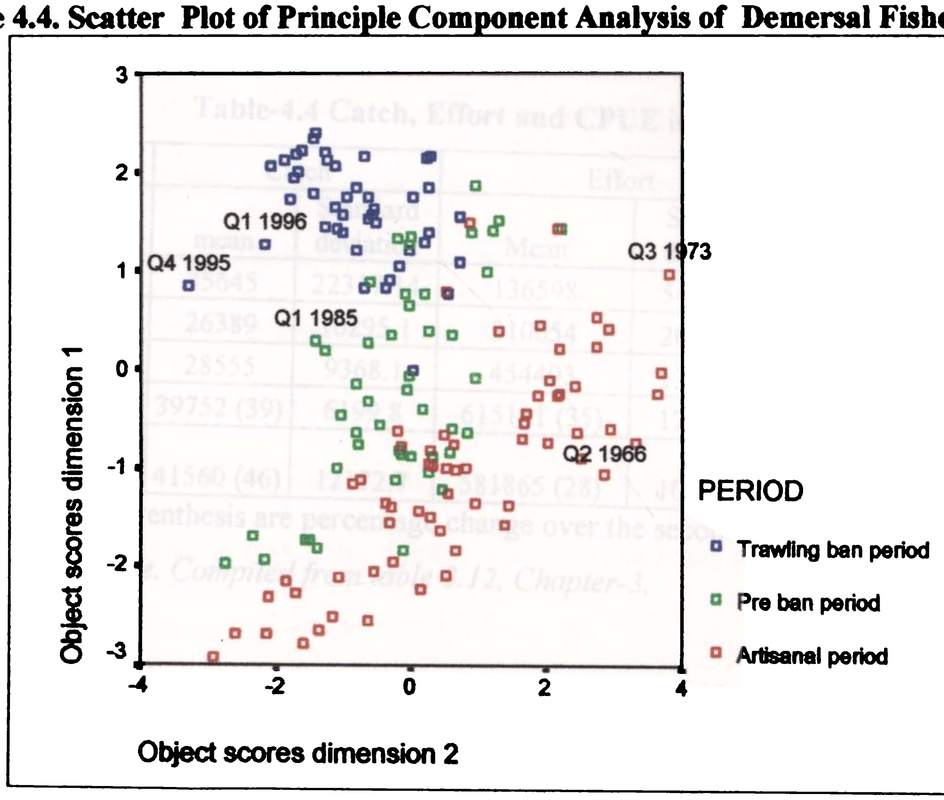


Figure 4.4. Scatter Plot of Principle Component Analysis of Demersal Fishes



Impact of Trawl-Ban with Special Reference to Penaeid Prawn

Though the trawl catch of penaeid prawns in the first and second post ban periods are higher than that in all the other three periods including the initial peak period the CPUE remains the highest in the initial peak period itself (table 4.4). This is due to a disproportionately higher effort exerted in the other two periods. It should be remembered here that trawling was only seasonal in the earlier days extending from November to May. The monsoon trawling was started only by the seventies, when penaeid prawns found a boost up demand in the world markets. Till then the rough whether in the monsoon prevented them from venturing into the sea. So there was a sort of self-regulation in the monsoons in the earlier years.

Table-4.4 Catch, Effort and CPUE in Different Time Periods

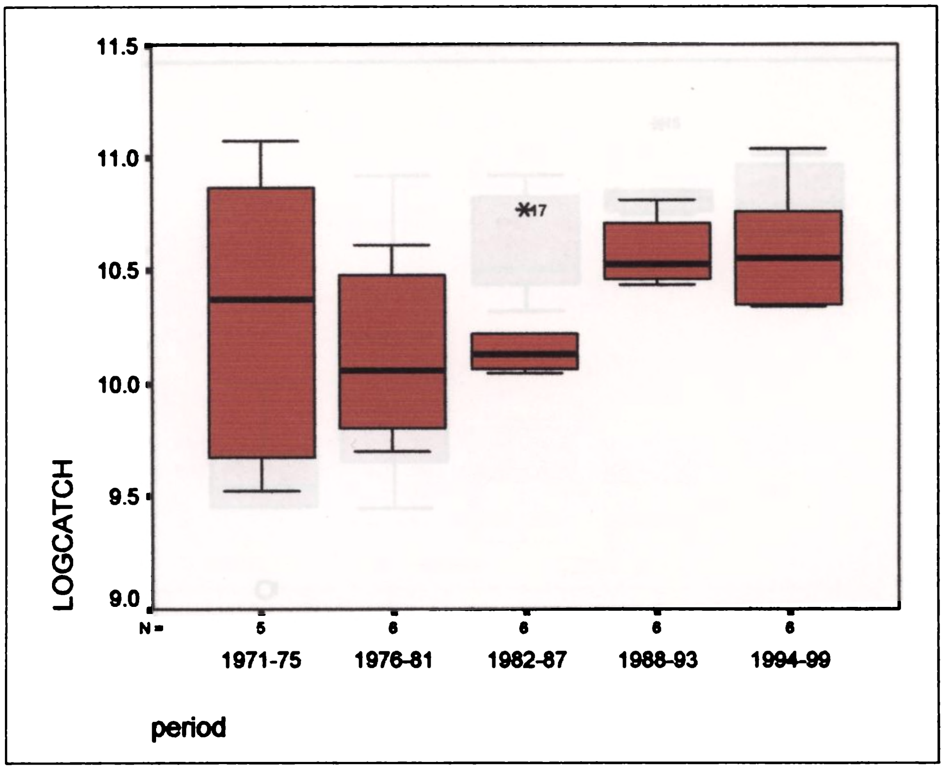
	Catch		Effort		CPUE	
	mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1971-75	35645	22317.14	136598	54071.48	255	128.4
1976-81	26389	10295.1	310054	200738.9	104	44
1982-87	28555	9368.1	454493	134401.8	64	14
1988-93	39752 (39)	6199.8	615161 (35)	124913.5	65 (2)	9.3
1994-99	41560 (46)	12172.7	581865 (28)	108210.4	71 (10)	9.6

Figures in parenthesis are percentage change over the second pre-ban period (1982-87)

Source. Compiled from table 3.12, Chapter-3.

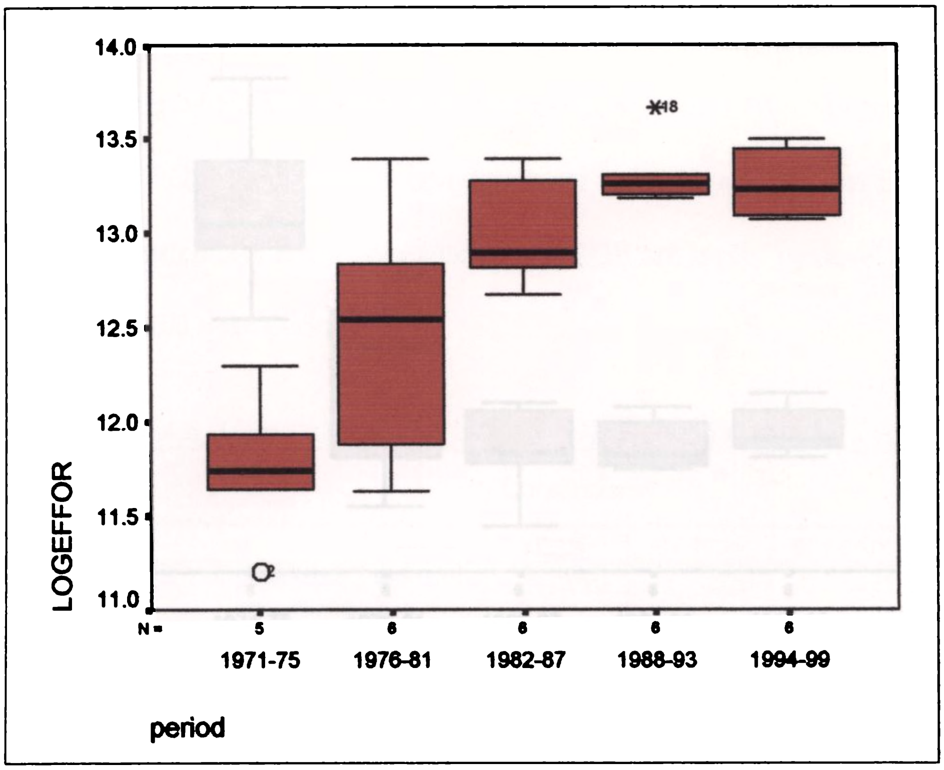
The impact of monsoon ban is explained here with the aid of box plots drawn on catch, effort and CPUE of mechanised prawn landings of different time periods (figure 4.5, 4.6 and 4.7).

Figure-4.5 Box plot of Mechanised Prawn Catch in Different Periods



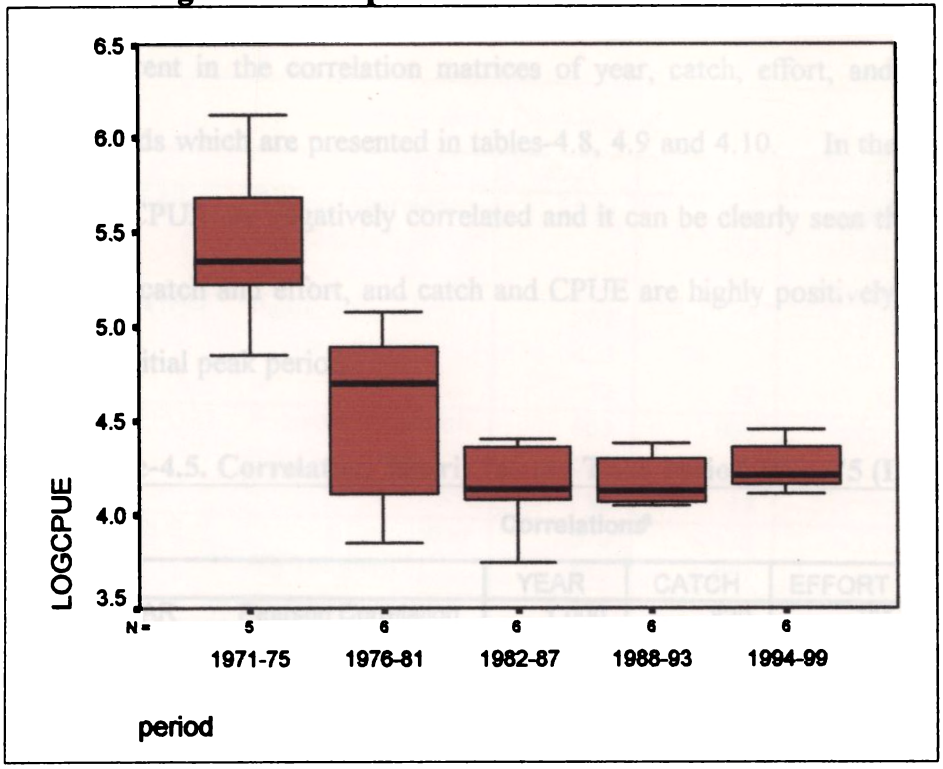
The highest catch of prawns by the mechanised trawlers is noticed in the initial peak period due to the sudden increase in the effort put into the virgin biomass in this period in general and the just started monsoon fishery in particular. With still more additions to the fleet and with no control on their efforts in the monsoon the catch declines continuously over the years in the pre-ban periods (figure 4.5). With control on fishing effort and of course with additions to the fleet with larger vessels of 46 to 52 footers, which are capable of operating up to 100-120m depth ranges, the catch has started rising up again in the post-ban periods as is seen in the figure 4.5.

Figure-4.6 Box plot of Mechanized Trawl Effort in Different Periods



In figure 4.6 it can be seen that effort increases continuously over the different periods until there is a slight fall in it in the second post ban period. The annual CPUE data of mechanised prawn landings of different time periods given as boxplots in figure 4.7 reflects the impact of control on effort. As the negative impact of depletion is more evident in the second pre-ban period the positive impact of ban is more evident in the second post-ban period. Though there is no significant increase in the CPUE after the imposition of trawl ban it could definitely arrest the decreasing trend in CPUE remarkable in the pre ban periods. However, in spite of the increased effort in the first and second post-ban periods the CPUE in these periods are higher than that in the second pre-ban period, which is the most affected period by depletion. This can be an indication of recovery of the resource due to control on efforts in the most vulnerable season.

Figure- 4.7 Box plot of CPUE of Mechanised Prawn Landings



There is a 10 percent increase in the CPUE in the second post-ban period and a meager 2 percent increase in it in the first post-ban period, after its continuous fall in all the other time periods (table-3.12, Chapter-3). The CPUE remains the highest in the initial peak period. The high CPUE in the initial peak period is not due to a catch level, which is higher than that in the post-ban periods but due to a comparatively lower level of effort in the former period. Even in the first post-ban period the prawn catch was higher than that in the initial peak period, though it could not reflect it in its CPUE only because of a disproportionately higher effort prevailed in this period. That means trawl ban could not have a direct control on total effort exerted in the first post-ban period though it might have control on the monsoon efforts.

The positive impact of trawl ban on the productivity of the resource has also been made apparent in the correlation matrices of year, catch, effort, and CPUE of different time periods which are presented in tables-4.8, 4.9 and 4.10. In the pre-ban period the catch and CPUE are negatively correlated and it can be clearly seen that in the post-ban period both catch and effort, and catch and CPUE are highly positively correlated as they are in the initial peak period.

Table-4.5. Correlation Matrix for the Time Period 1971-75 (Initial Peak Period)

Correlations[a]

		YEAR	CATCH	EFFORT	CPUE
YEAR	Pearson Correlation	1.000	.820	.781	.443
	Sig. (2-tailed)	.	.089	.119	.455
	N	5	5	5	5
CATCH	Pearson Correlation	.820	1.000	.739	.759
	Sig. (2-tailed)	.089	.	.154	.137
	N	5	5	5	5
EFFORT	Pearson Correlation	.781	.739	1.000	.137
	Sig. (2-tailed)	.119	.154	.	.827
	N	5	5	5	5
CPUE	Pearson Correlation	.443	.759	.137	1.000
	Sig. (2-tailed)	.455	.137	.827	.
	N	5	5	5	5

a. NEWYEAR = 1971-75

Source. Compiled from raw data of prawn landings of mechanized trawlers.

The high correlation existing between year and catch (0.820), catch and CPUE (0.759) in spite of the high correlation between effort and catch (0.739) indicate productivity of the period (table-4.8). The high correlation between catch and CPUE means increase in CPUE is more induced by increase in catch due to the abundance of resource than by the increase in catch due to increase in effort.

Table-4.6. Correlation Matrix for the Time Period 1976-87 (Pre-ban Period)

Correlations[a]

		YEAR	CATCH	EFFORT	CPUE
YEAR	Pearson Correlation	1.000	.252	.503	-.670*
	Sig. (2-tailed)	.	.430	.096	.017
	N	12	12	12	12
CATCH	Pearson Correlation	.252	1.000	.669*	-.152
	Sig. (2-tailed)	.430	.	.017	.637
	N	12	12	12	12
EFFORT	Pearson Correlation	.503	.669*	1.000	-.755**
	Sig. (2-tailed)	.096	.017		.005
	N	12	12	12	12
CPUE	Pearson Correlation	-.670*	-.152	-.755**	1.000
	Sig. (2-tailed)	.017	.637	.005	
	N	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. NEWYEAR = 76-87

Source. Compiled from raw data of prawn landings of mechanized trawlers.

The negative correlation between CPUE and year (-0.670) signals the declined productivity of the pre-ban period (table 4.9). Though the negative correlation between catch and CPUE is negative and negligible (-0.152), the negative correlation between effort and CPUE is high (-0.755) and highly significant. The indication is that with every increase in effort, CPUE is declining since there is no corresponding increase in catch as there is no abundance of the resource.

Table-4.7. Correlation Matrix for the Time Period 1988-99 (Post-ban Period)

Correlations[a]

		YEAR	CATCH	EFFORT	CPUE
YEAR	Pearson Correlation	1.000	-.089	-.369	.293
	Sig. (2-tailed)		.784	.238	.355
	N	12	12	12	12
CATCH	Pearson Correlation	-.089	1.000	.744**	.621*
	Sig. (2-tailed)	.784		.005	.031
	N	12	12	12	12
EFFORT	Pearson Correlation	-.369	.744**	1.000	-.054
	Sig. (2-tailed)	.238	.005		.868
	N	12	12	12	12
CPUE	Pearson Correlation	.293	.621*	-.054	1.000
	Sig. (2-tailed)	.355	.031	.868	
	N	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. NEWYEAR = 88-99

Source. Compiled from raw data of prawn landings of mechanized trawlers.

The high positive correlation between catch and CPUE (.621) indicates the improved productivity of the period due to trawl ban (table 4.10). Unlike in the pre-ban period, here there is no negative correlation between year and CPUE and the high and highly significant negative correlation between effort and CPUE, which existed in the pre-ban period, has also disappeared. All these are the positive impacts of trawl ban.

The positive impact of trawl ban on landings has been made clear in the present chapter. Now in the context of 12 years of this single seasonal management tool, then it is necessary to check the sustainability of the system at its current level of exploitation. A humble attempt towards this has been done in the next chapter.

CHAPTER-5

SUSTAINABILITY ASSESSMENT OF THE STATE'S COASTAL FISHERY SECTOR

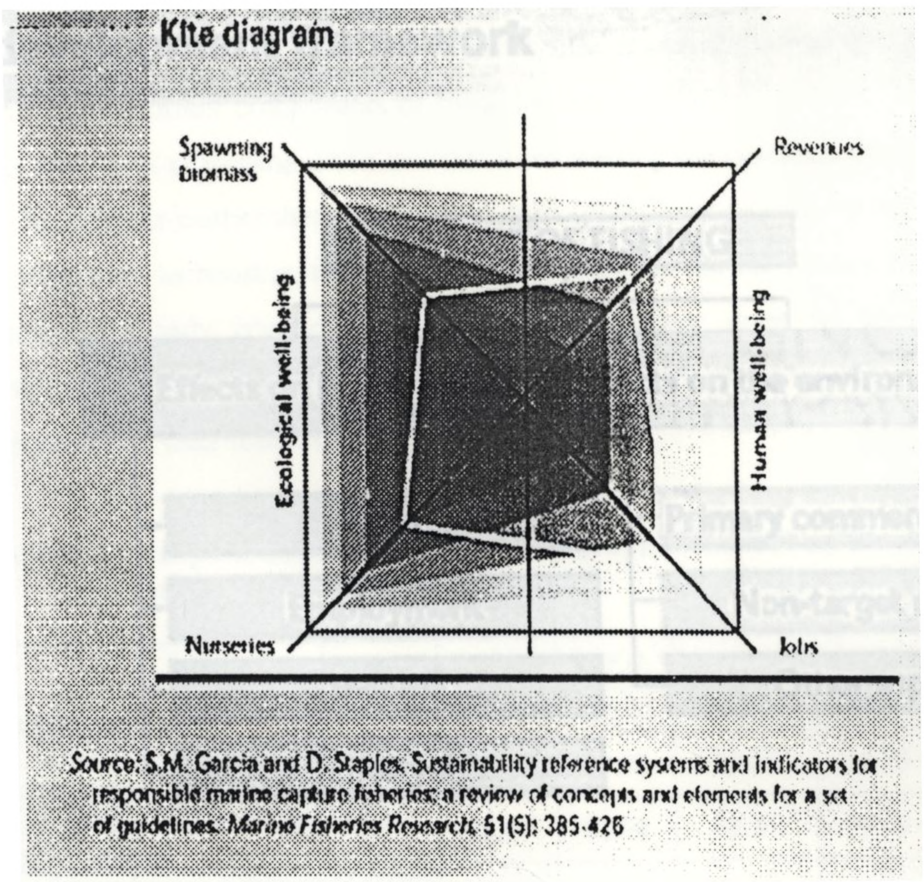
In the previous chapters in the background of several socio-economic issues or constraints faced in the sustainable management of the State's coastal fishery sector, an historical analysis of the status of depletion of the resources is done and the effectiveness of the single management tool- seasonal trawl ban – practiced in the State's coastal waters as a conservational measure is examined. Now in the context of the ongoing socio-economic problems and the resultant overfishing and resource depletion on the one hand, and the absence of other management or regulatory practices except the seasonal trawlban in the context of the open access nature of the resource on the other, an attempt towards understanding the present status of the sustainability of the system in its varying dimensions is done in this chapter.

There are many ways of representing the interdependent components of a fishery or of a fishery sector in a sustainable development reference system. The minimum critical components are the ecosystem, the economy, society and governance. The ecosystem comprises the fishery resources that support the fishery as well as other aspects of the ecosystem that control the productivity of the resource, including dependent and associated species. The economy reflects the results - expressed in terms of benefits and costs - that are derived from the use of the ecosystem. The benefits and costs are experienced by consumers, producers and society at large. Short- and long-term equity is included. The society component of the system consists of non-monetary costs and benefits, which are important elements of human welfare. Governance includes the institutions as well as the rules governing the system. Indicators should reflect the performance of the system in each of these components.

Simple representations of a fishery system in relation to the dimensions of sustainable development are proposed in the relevant FAO guidelines and by Garcia and Staples.29 The kite diagram (FAO, 1997) is one such representation in which each dimension (e.g. spawning biomass and revenues) is represented by one of the axes. Each axis is appropriately scaled and there are established societal evaluation criteria to qualify the various levels on each scale (e.g. bad, mediocre, acceptable, good). The position of the fishery is shown by a white polygon. The degree of shading represents value judgements, from bad (black) to good (clear). Thus, the fishery illustrated in Figure-5.1 is satisfactory in so far as it creates a high number of jobs and adequate revenues, although it's spawning biomass is inadequate in size and its nursery areas are threatened. A complete system of sustainable development indicators should include mechanisms for effective communication among fisheries stakeholders, those responsible for governance and the general public. A number of visual reporting methods would greatly enhance communication in this regard. The system of indicators should be reviewed regularly in order to provide the necessary incentives to maintain and improve it.

In general, indicators should reflect the state of the system and its outcomes in relation to societal goals and objectives, the long-term sustainability of the fishery, the ecosystem supporting it and the generation of net benefits to fishers and society. The indicators of sustainability should reflect the well-being of (or the problems related to) the resource and human components of the system, as well as the progress (or lack of it) towards the objective of sustainable development (figure-5.2)..

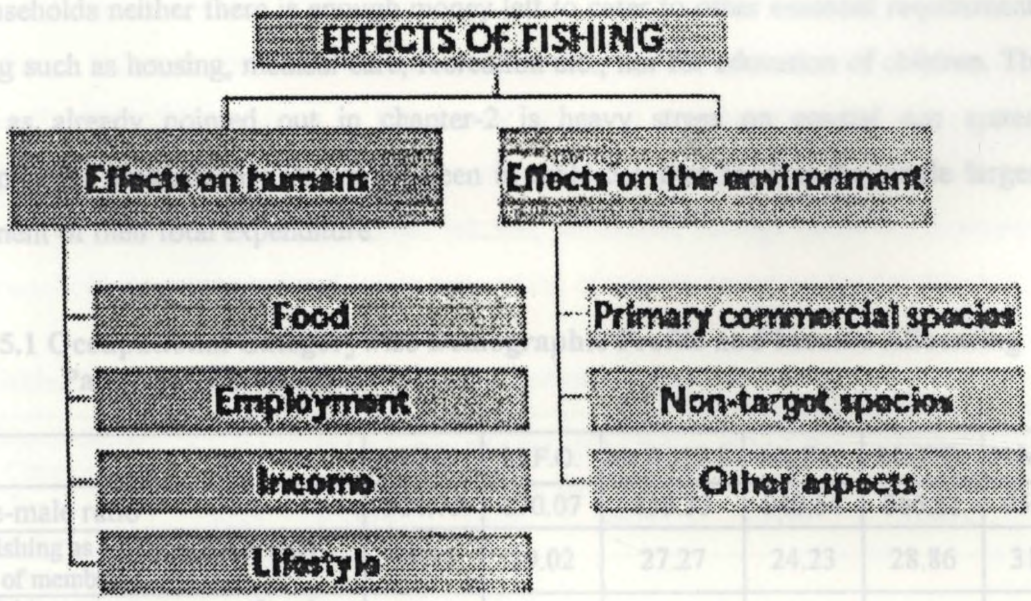
Figure-5.1 Kite Diagram



Source: S.M. Garcia and D. Staples. Sustainability reference systems and indicators for responsible marine capture fisheries: a review of concepts and elements for a set of guidelines. *Marine Fisheries Research*. 51(5): 385-426

Figure-5.2 Hierarchical Subdivision of a Sustainable Development Framework.

Hierarchical subdivision of a sustainable development framework



urce: J. Chesson and H. Clayton. 1997. *A framework for assessing fisheries with respect to ecologically sustainable development.* Bureau of Resource Sciences, Fisheries Resources Branch, Australia

Some Demographic and Economic Aspects of Fishermen Households in the Context of Sustainability

Occupational category wise demograhic and economic profile of fishermen households studied is presented in table-5.1, along with their pattern of allocation of income among the three important components of food, interest burden and savings. The study reveals that their level of income is too low that after meeting the minimum food requirements of the households neither there is enough money left to cater to other essential requirements of living such as housing, medical care, recreation etc., nor for education of children. The result, as already pointed out in chapter-2 is heavy stress on coastal eco system threatening its sustainability. It can be seen in table 5.1 that food is the single largest component of their total expenditure.

Table-5.1 Occupational Categorywise Demographic Profile and Income Allocating Pattern of Households.

	M.F.L.	M.F.O.	Me.&M.F.L.	Me.F.L.	Me.F.O.	N.M.F.L.	N.M.F.O.
Female-male ratio	914.73	870.07	833.33	940.54	866.31	956.52	803.92
No. in fishing as a percentage of total number of members	25.71	29.02	27.27	24.23	28.86	31.11	34.78
No. in fishing as a percentage of total number occupied	78.88	81.98	92.31	79.09	85.59	77.78	86.49
No. of dependents as a percentage of total number of members	67.41	64.60	70.45	69.36	66.29	60.00	59.78
No. occupied as a percentage of total number of members	32.59	35.40	29.55	30.64	33.71	40.00	40.22
Exp. on food as a percentage of total expenditure	84.67	80.82	86.99	85.39	82.10	89.29	84.34
Interest burden as a percentage of income	3.33	6.04	3.43	3.52	5.24	2.62	2.24
Interest burden as a percentage of total expenditure	6.02	13.43	6.35	5.83	15.11	5.72	5.86
Saving as a percentage of income	9.57	32.25	15.99	11.15	49.83	3.30	34.16

Source: survey data

As far as saving is concerned, unlike in the past, at least the fishing operator categories save a good proportion of their income ranging from 32 percent to 49 percent. Their main motivation behind saving is either acquiring ownership of fishing assets or reinvesting in the already acquired fishing craft or gear in the form of modification or capacity enhancement. Studies on distribution of income and distribution of savings prove wide disparity in them (figure-5.3 and figure-5.4). The disparity in income distribution may be due to the entry of non fishermen capitalist class into the fishery through acquiring mechanized boats and other more capital demanding gears and equipments used in the fishery. However, to some extent motorisation has helped in attaining equity in the distribution of income, as in the survey results it can be seen that motorised fishing operator households stood next to mechanised fishing operators in terms of per capita income (table-5.2), total household income, household savings (table-5.3), proportion of household income saved and lower proportion of income spend on food (table-5.1).

Table-5.2 Occupational Category wise Per capita Income

Occupational Categories	Me.F.L.	M.F.L.	Me.&M.F.L.	N.M.F.L.	N.M.F.O.	M.F.O.	Me.F.O.
Per capita income (Rs.)	7485	7819	8262	9471	10519	10918	15206

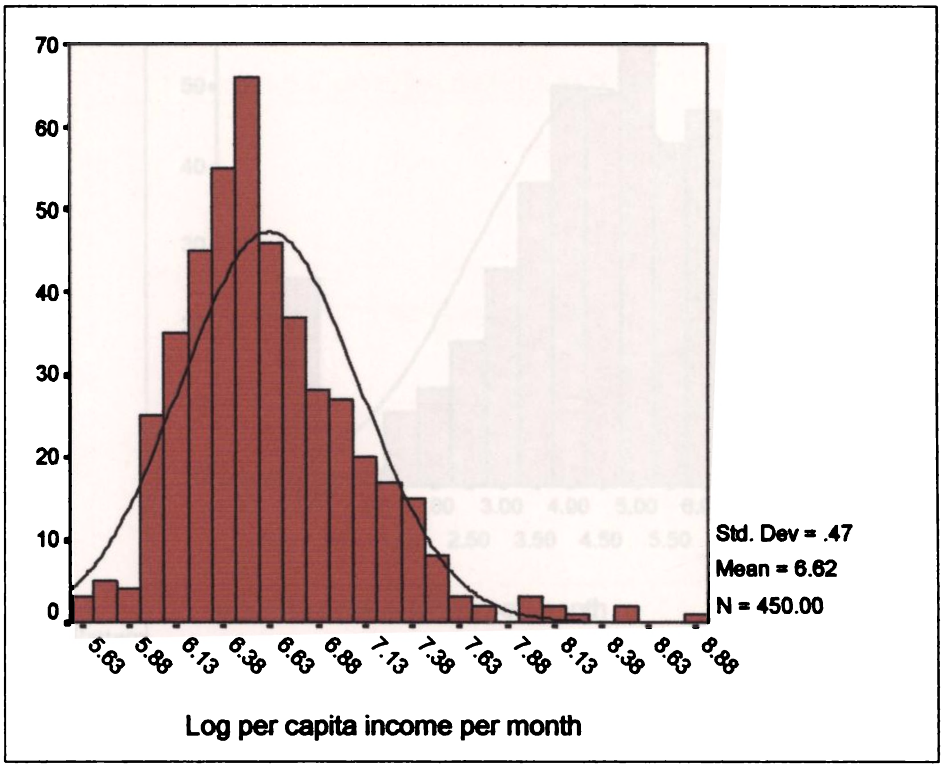
Source: Survey data

Table-5.3 Economic Variables and Occupation Categories of Households in the Surveyed Districts

	Ernakulam			Kozhikode			Kollam		
Occupational categories	Total Income/year	Debt	Savings/month	Total income / year	Debt	Savings /month	Total income / year	Debt	Savings / month
MFL	42356	12453	96	49519	19095	910	37529	10629	211
MFO	58764	21547	2747	58152	20551	1214	57989	42802	602
NMFL	44878	8111	123	.	.	.	.	.	.
MEFL	38245	13929	65	48966	9909	820	37796	12333	204
NMFO	56463	8500	1607	.	.	.	.	.	.
MEFO	76033	13333	3848	68210	38710	2799	97983	21957	3934
ME MFL	.	.	.	41600	15714	582	63000	0	644

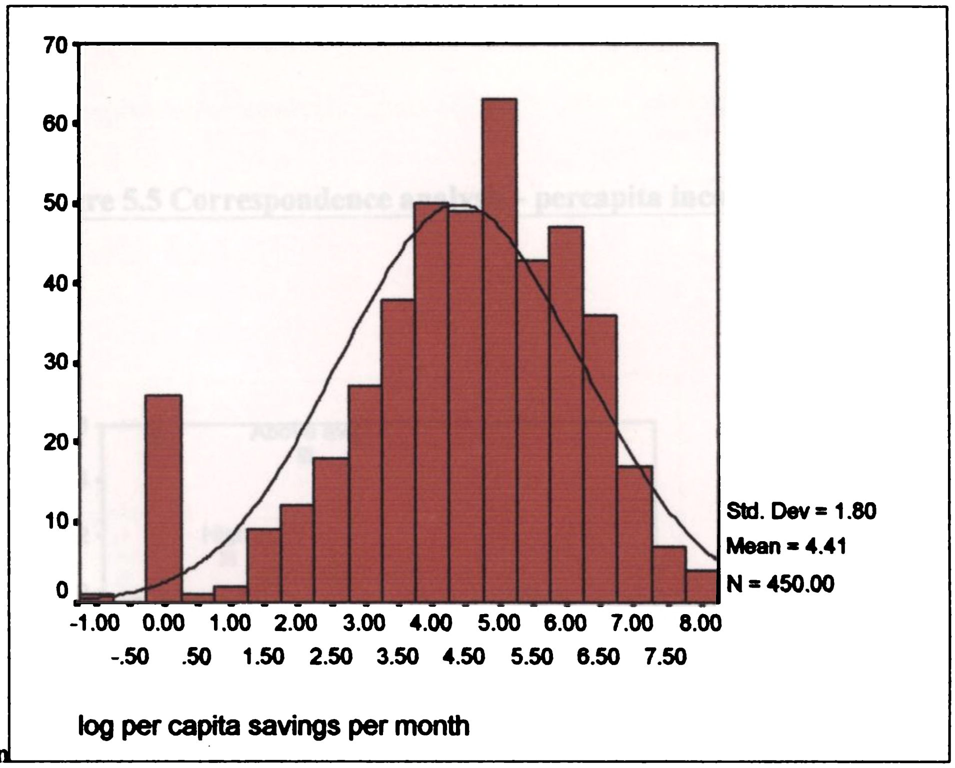
Source: survey data

Figure-5 . 3 Distribution of Log of Per capita Income



In figure 5.3 it is clearly seen that distribution of per capita income is positively skewed.

Figure-5.4 Distribution of Saving



Pattern

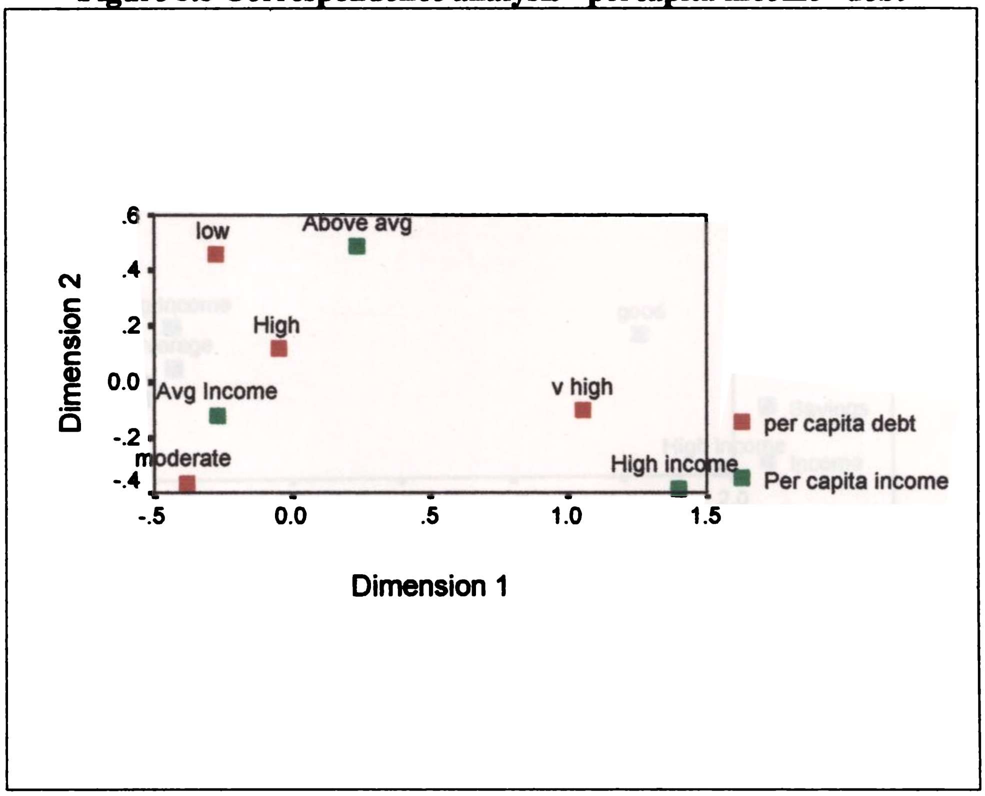
Table-5.4 Per Capita Income- Savings and Debt

		Per Capita Savings / month				Per Capita Debt			
		Low	Average	Above avg.	Good	Low	Moderate	High	Very High
Per capita income / month	Low	17 (3.8)	5 (1.1)			3 (0.7)	4 (0.9)	9 (2.0)	
	Avg Income	62 (13.8)	106 (23.6)	107 (23.8)	9 (2.0)	35 (7.8)	71 (15.8)	84 (18.7)	26 (5.8)
	Above avg	4 (0.9)	13 (2.9)	42 (9.3)	45 (10)	14 (3.1)	16 (3.6)	31 (6.9)	15 (3.3)
	High Income		2 (0.4)	3 (0.7)	35 (7.8)	2 (0.4)	5 (1.1)	10 (2.2)	12 (2.7)

Source. Survey data

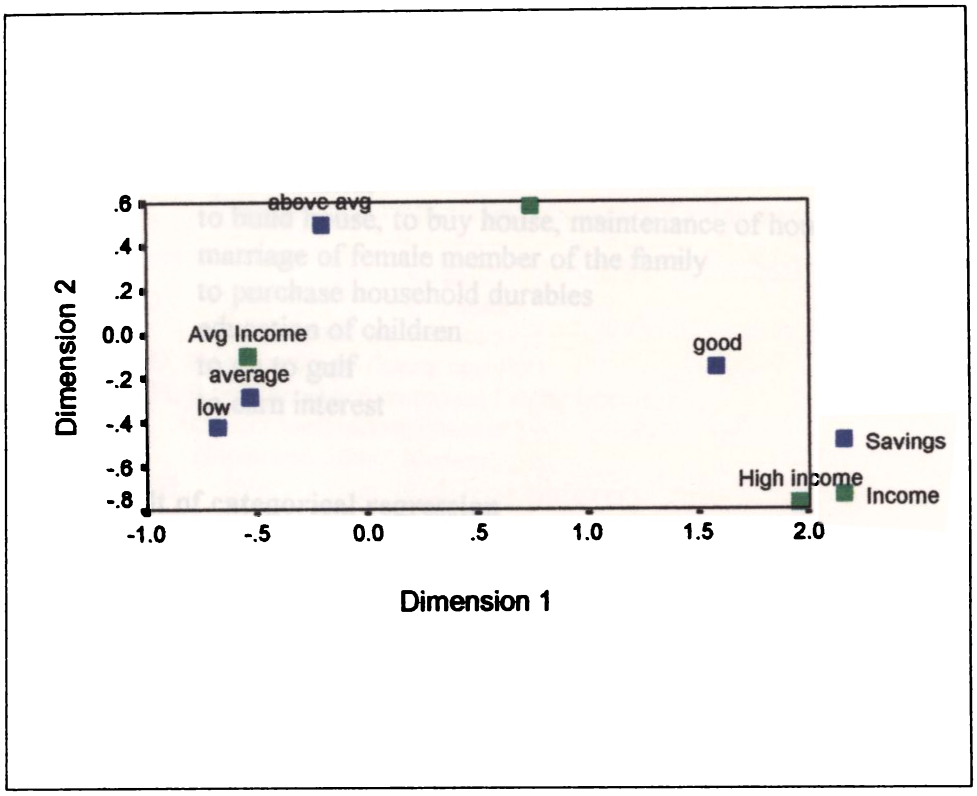
The correspondence analysis done on savings and debt and savings and income reveals a paradoxical situation - those who have high income have good savings, but those who have high income have high debt also. So debt is playing as a negative agent on saving (figure5.5 and 5.6).

Figure 5.5 Correspondence analysis - percapita income –debt



Note: In the figure 5.5, it can be seen that the points of very high (v high) percapita debt and very high percapita income lie close ie., those who have high income group have high debt also.

Figure 5.6 Correspondence analysis - percapita income – savings



From the field survey it has been made clear that the major objective of saving is marriage of female member of the family followed by either acquisition of fishing assets or maintenance or modification of the already acquired craft and gear. The fact that atleast 9 percent of them are saving for the future education of their children is a promising matter towards the changing lifestyle of a hitherto isolated community (table-5.5). Considering the importance of ownership of fishing assets in income generation and the overall well being of fishermen households in turn, and the role of savings in it, a study of dynamics of savings will be helpful for the policy makers. Savings and its varied determining forces among fishermen communities are studied with the help of categorical regression.

Table-5.5 Distribution of Savings According to Purpose

Purpose of saving	A	B	C	D	E	F	G	H	Do not save
Percentage	27.6	3.8	9	38.4	1.1	9.1	4.9	0.9	5.1
Number	124	17	41	173	5	41	22	4	23

Source: survey data

A to buy craft, net, motors etc
B to do business
C to build house, to buy house, maintenance of house, etc
D marriage of female member of the family
E to purchase household durables
F education of children
G to go to gulf
H to earn interest

Result of categorical regression

$$Y = -.254X_1 + .716X_2 + -.203X_3 + .399X_4 + 0.05474X_5 + -0.04898X_6 + 228X_7$$

(Footnote. Here standardized coefficients are taken since they are independent of unit of measurement. Hence the constant or mean is zero).

With one unit increase in per capita income savings increases by 71 percent of the original savings. Similarly a one level increase in occupational category can increase savings by nearly 40 percent. Similar explanations can be given for other coefficients also.

Model Summary

Multiple R	R Square	Adjusted R Square
.912	.831	.828

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	373.901	7	53.414	310.242	.000
Residual	76.099	442	.172		
Total	450.000	449			

Regression Coefficients

X_1 = Per Capita Expenditure on Food
X_2 = Per Capita Income
X_3 = Per Capita Debt Per Month
X_4 = Occupational Category
X_5 = Cast
X_6 = Education
X_7 = District

Codes assigned to the categories of coefficients according to their quantification on the basis of savings are given in tables 5.6, 5.7, 5.8 and 5.9.

Table-5.6 Occupational Category Codes and Their Quantification

Code	Quantification	Frequency
7 = MeFO (Mechanised fishing operator)	1.377	60
6 = MFO (Motorised fishing operator)	0.544	206
5 = NMFO (Non motorized fishing operator)	0.206	16
4 = MeMFL (Mechanised and motorized fishing labourer)	-.818	8
3 = MeFL (Mechanised fishing labourer)	-.860	63
2 = MFL (Motorised fishing labourer)	-1.240	88
1 = NMFL (Non motorized fishing labourer)	-3.116	9

Table-5.7 Caste Codes and Their Quantification

Code	Quantification	Frequency
5 = Others	1.871	20
4 = Latin	1.104	142
3 = Muslim	0.165	74
2 = Araya	-0.917	198
1 = Ezhava	-1.547	16

Table-5.8 District Codes and Their Quantification

Code	Quantification	Frequency
3 = Kollam	1.399	150
2 = Ernakulam	-.520	150
1 = Kozhikkode	-.879	150

Table-5.9 Educational Levels and Their Quantification

Code	quantification	Frequency
1	2.253	31
2	0.763	24
3	-0.173	51
4	-0.114	41
5	-0.849	50
6	-0.152	55
7	0.755	44
8	-0.774	65
9	-1.374	34
10	0.224	47
11	3.685	8

Per capita income has the highest amount of influence on per capita savings. With a unit increase in per capita income the per capita saving increases by 71.6 percent.

It can be seen that per capita expenditure on food and per capita debt have negative impact on savings. With a one level increase in per capita expenditure on food and per capita debt, the savings decreases by 25.4 and 20.3 percent.

In terms of per capita savings occupational categories are ranked in the descending order of MEFO, MFO, NMFO, MEMEFL, MEFL, MFL and NMFL in the last i.e. as in the case of income MEFO is the occupational category with the highest savings, MFO is the next like that (table-5.6). In the model with a one level increase in the occupational category, for instance with a shift from NMFL to MFL the saving increases by 40 percent.

In terms of per capita savings, the different cast groups can be arranged from Ezhava at the bottam with the lowest level of savings to Araya, Muslim, Latin, and 'Others' at the top with the highest level of per capita savings (table-5.7).

Though education has a negative impact on savings, it is promising that those who have education above matriculation have the highest per capita savings (table-5.9).

Among the three sample districts, Quilon is having the highest per capita savings, followed by Ernakulam and Calicut (table-5.8). (The statistical print out of result of categorical regression is given as such in the Appendix (Appendix- 10).

The Present Status of Sustainability of Kerala Fishery

The welfare aspects, which have already been discussed in chapter-2, prove that fishermen are living a very poor quality of living. Besides, high dependency on fishing as a primary occupation and primary source of income of fishermen households has been revealed in the field survey (table-2.6). The marine fishery sector of Kerala is supporting, a total fishermen population of 8.3lakhs. (Economic Review, 2002), in the 222 marine fishing villages, through the185000 active fishermen population by acting as their primary source of income. Approximately, an equal number is engaged in allied activities of processing and marketing. Along with this, the fact that livelihood alternatives though existing are scarce and also meager to support households even at subsistence levels (table-2.7), calls forth the importance of defending sustainability of the system, for at least the subsistence - if not the well being - of a livelihood threatened community. An attempt towards assessing sustainability status of the coastal fishery sector is done in table-5.10. The various dimensions of sustainability of the system discussed here are those adapted from the works of Charles (1995) and FAO (2000) and analysed in the Kerala situation. Some important aspects of sustainability like long term food security and inter generational equity are omitted in the present study due to absence of required information.

Table-5.10 A Preliminary Assessment of The Sustainability of Kerala Fishery Sector.

I) Economic sustainability indicators				**Ratio**	**Range**	**Comment on the indicator**
1. Fishery Sector Product (FSP) *		1980-81	1994-95			
		Rs.7743 lakhs	Rs.10010 lakhs	1.29	1 to ∞	Promising
2 .Contribution of fishery to SDP (FSP/SDP) *		1980-81	1994-95			
		2.02	1.55	0.767	1 to ∞	Very low (below the critical minimum)
3. Contribution of fishery to Primary Sector Product (FSP/PSP) *		5.16	4.79	0.928	1 to ∞	Very low (below the critical minimum)
4. Employment (including secondary and tertiary activities ≠		1980	1999-2000			
		262202	370000	1.4	1 to ∞	Promising
5.Sustainable fleet capacity (over investment)	**Recommended ♦**	**Actual ≠**	**Surplus**	**Ratio**	**Optimum**	**Comment on the indicator**
Trawlers	1145	3806	2661	0.699	0	Far exceeded the limit
Purse-seiners	0	40	40	1	0	Far exceeded the limit
Motorized crafts	2690	28829	26139	0.907	0	Far exceeded the limit
Non motorized crafts	20000	21751	1751	0.081	0	Near optimum

II. Community or Social Sustainability Indicators						
Livelihood alternative and community independence ♣						
				Ratio	The critical minimum	Comment on the indicator
Total	Fishing occupation		Non fishing occupation			
862	705		157	0.182	0.5	Very low, far below the critical minimum
Total	Fishing Skills		Non Fishing Skills			
450	403		47	0.104	0.5	Very low, far below the critical minimum
Total	Education below SSLC		Education above SSLC			
450	441		9	0.02	1	Very low, far below the critical minimum
Total	Fishing income		Non fishing income			
Rs. 24841320	Rs.22128920		Rs. 2712400	0.109	0.5	Very low, far below the critical minimum
	Per capital fishing income		Per capital non fishing income			
	Rs. 31388.5		Rs. 17276.4	0.55	1 to ∞	Very low, far below the critical minimum
Gender Equity ♠						
Sex ratio	Kerala		Fishermen community	Ratio	The critical minimum	
	1058		886.57	0.838	1	Very low, far below the critical minimum
Gender equity in decision making	Total	Women do not having equal decision making	Women have equal decision making power			

	330	260	70	0.212	1	Very low, far below the critical minimum
III. Ecological sustainability indicators						
Change in area and ability of critical habitat ♦	Area of backwaters in the year 1958 (ha)		Area of backwaters in the year 1988 (ha)			
	550000		35000	0.636	1	Far below the critical minimum
Level of eco-system Understanding ♣	Total	Respondents having ecosystem understanding	Respondents do not having ecosystem understanding			
	450	424	26	0.942	1	Near optimum
Human carrying capacity (livelihood) of the resource ♥						
Area in ha. Per active fishermen inshore (0-50 m) depth	Area in ha. Per active fishermen in inshore (0-50m) depth in 1973-77		Area in ha. Per active fishermen in inshore (o-50m) depth in 1990			
	16		6	0.375	1	Very low, far below the critical minimum
Area in ha. Per active fishermen inshore (50-200m) depth	Area in ha. Per active fishermen in offshore (50-200m) depth in 1973-77		Area in ha. Per active fishermen in offshore (50-200m) depth in 1990			
	33		13	0.394	1	Very low, far below the critical minimum

Source

∗ Government of Kerala (1997)

≠ Economic Review (Various Issues)

♣ Survey data

♠ Choudhary, A. R. (2001)

♦ Balakrishnan Nair, et. al.(1989)

♥ Sathiadas, R. et. al.(1995)

As far as economic sustainability is concerned only 2 out of 5 indicators are showing promising trends. Fishery Sector Products in constant prices in 1980-81 and 1994-95 are compared and found increasing. However the contribution of Fishery Sector Product to the State Domestic Product and Primary Sector Product are declining. Employment generation is another economic sustainability criterion considered in the present study. Total employment is calculated by doubling the number of active fishermen, on the ground that every year approximately a number equal to the number of active fishermen are employed in allied activities of processing marketing etc. Employment generation, in spite of problems in the capture fishery is showing a positive trend. Thus as far as employment and income generation is concerned the situation of fishery is acceptable. Fleet capacity as an economic indicator warrants immediate action. All the indicators under fleet capacity, except the number of non motorised crafts have far exceeded the sustainability limits. Necessary actions should be taken to divert the excess fleet to reap the so far untapped resources and thereby attaining sustainability by neither endangering the employment nor the resource base. Since only two out of five indicators under economic sustainability are showing positive trends the situation of the fishery can be judged as 'mediocre'.

Livelihood alternatives or community independence indicators show lack of livelihood alternatives among fishermen communities and their high dependence on an overexploited resource base. Any sudden fall of the fishery even due to a climatic failure will undoubtedly affect the very existence of coastal community coming up to 8.3 lakhs (1999-2000).

The well being of a community will invariably be reflected in its gender status. In the context of our coastal fishery sector, Gender equity indicator of coastal fishery sector is also very low both in terms of sex ratio and equity in decision making, pointing to its lack of communal or social well being. The sex ratio unfavorable to women has two dimensions of importance in sustainability assessment of the system. One is, a lower health status of both elder women and female children of which the former is induced by poverty and lack of sanitation facilities and unhygienic conditions, and the latter is due to again the poverty induced negligence of female child, considering the future importance of male children in fish harvesting and income earnings, (Kurien, 1995). The second is a dimension of over dependence on the fishery by the male members, as unlike the members of other communities, there is no considerable migration of males to Gulf or other States or they are not even willing or prepared to leave their native village for a livelihood. The implication is heavy stress on coastal ecosystem. In short as far as social or community sustainability is concerned all the indicators are distressing, so the situation of the fishery can be judged as 'bad'.

Ecological sustainability relating to catch structure is studied in detail in the coming part of this session. Ecological sustainability in general is considered here. The level of ecosystem understanding is the only area, which shows a promising trend here. It has been revealed in the field survey that coastal fishermen are well aware of their ecosystem, the changes happening to it from varying sources like backwater reclamation for development purposes, pollution of backwaters due to large scale discharge of industrial waste, kerosene pollution from motorised boats, destruction of the sea bottom by the trawlers, depletion in both the number and size of some species etc. As far as nursery areas are concerned, though widespread destruction of mangrove swamps has happened since independence, there is no reliable data on it. Estimates on backwater reclamation states that only two third of it are remaining, signals a very low level of ecological sustainability. Considering the carrying capacity of the resource, both the inshore and offshore area per active fishermen has now been confined to one fourth of its original area. In spite of a well understanding of the ecosystem, the unsustainable practices are continued by both the stakeholders of the resource and others. The implication is that situation of the fishery is 'bad' (and demands immediate action) when looked at from the dimension of ecological sustainability, as there is considerable damage in the area and quality of critical habitat like mangrove swamps and backwaters.

Ecological Sustainability and the Catch Structure

Sustainability of the catch structure is studied by computing the ratio of, difference between MSY and catch to MSY for each specie for each year from 1988-1999 and presented in table-5.11. Mean and upper and lower confidence intervals of these ratios of a specie from the year 1988 to 1999 are taken to state whether the harvest level of the specie is sustainable or not. A positive mean and confidence intervals indicate exploitation level of the specie is sustainable.

Table-5.11. Sustainability of the Catch Structure.

Fish	Mean and C. Interval			Remark
Oil Sardine	-.092	.255	.602	Not sustainable
Mackeral	-.893	-.548	-.203	Not sustainable
Other Sardine	-1.075	-.561	-0.048	Not sustainable
White Bait	-.697	-.463	-.228	Not sustainable
Carangids	-.379	-.182	0.015	Not sustainable
Tunnies	-0.065	.133	.331	Not sustainable
Seer Fish	.261	.391	.521	Sustainable
Ribbon Fish	-7.239	-5.080	-2.921	Not sustainable
Catfish	.588	.792	.996	Sustainable
Perches	-.185	-0.018	.148	Not sustainable
Croakers	-.064	.098	.260	Not sustainable
Lizardfish	-.176	-.019	.137	Not sustainable
Elasmorbranchs	.284	.387	.491	Sustainable
Flatfish	-11.465	-9.617	-7.770	Not sustainable

Big Jawed Jumper		
Silverbelly	-6.131 -6.899 -5.364	Not sustainable
Goatfish		
Penaeid Prawn	.168 0.074 .262	Sustainable
Cephalapod	-.569 -.837 -.300	Not sustainable
Total	.001 -.054 .056	Not sustainable

Source. Analysed from the annual landings data of CMFRI

As in the analysis the exploitation rate of all the commercially important species except Seerfish, Catfish, Elasmobranches and Penaeid Prawns are found to be unsustainable, it should be understood that the sustainability of the very catch structure itself is under threat. If the same trend is continued, it will surely affect the people not only for whom fishing is the main source of livelihood but also for whom fish is the main source of animal protein intake.

As both socio-economic sustainability, and ecological sustainability are under threat it is clear that seasonal trawl ban alone cannot protect the fishery sector of Kerala, by assuring livelihood security to the 1.85 lack active fishermen population (and their dependents) who are directly depending on it and an equal number engaged in support and ancillary activities. Along with other conservation measures, efforts should be taken to promote various aspects of social well-being such as community independence, gender equity etc so that an assured socio-economic sustainability could ensure ecological sustainability more easily.

CHAPTER-6

FINDINGS OF THE STUDY AND RECOMMENDATIONS

Labour stickiness, overcapacity and excess capital are the major issues to be tackled in the move towards attaining sustainable development of the marine fishery sector of Kerala. The major reasons identified for labour stickiness in the Kerala fisheries are:- ownership of fishing assets and resultant indebtedness, lack of alternative employment opportunities, occupational attachment, lack of control over first sale and marketing, poor quality of living etc.

There are several reasons identified as the reasons for over capacities and excess capital in the fisheries sector, the most important among them are government subsidies and credit schemes, lopsided development efforts of government and the resultant sectoral inbalance.

While analysing the nature of indebtedness with the result of primary survey, it is found that 63 percent of fishermen have ownership of fishing assets. Among them 85 percent of the motorised fishing operators, 65 percent of the mechanized fishing operators and 63 percent of the non motorised fishing operators.

The survey result shows that 85 percent of the respondent fishermen do not know any job other than fishing and out of the total occupied (fishing as well as non fishing), 82 percent are occupied in fishing.

Though, 80 percent of the respondents expressed the view that in future, their occupation in fishing will be worse, and 12 percent had the view that any improvement in the current status of their occupation in fishing is impossible, only 24 percent showed willingness to quit fishing, provided they get alternative occupations. Those who are not willing to quit under any circumstance (66 percent) have the view that fishing is their traditional occupation in which they have more freedom, leisure and adventure than in any other job on shore.

Lack of control over first sale and marketing not only put them to poor living but exerts pressure on fishermen to use more and more efforts. For some species the fishermen's share of consumer rupee is as low as 20 percent.

Poor quality of living is one reason for their over dependence on fishery. Over crowding, lack of basic amenities, low level of educational attainment etc are the reasons for the poor quality of living which in turn is acting as a major player in their down word spiral of poverty.

While analysing each data we have identified that though there has been considerable increase in the fishing activity, there is only a miniscule increase in catch per fishermen. During the period 1961-2000 the number of active fishermen increased by 2.6 times and the increase in mechanised boats is 25 times. The interesting change happened in Kerala fisheries during the period was conversion of traditional crafts to motorised crafts. At the same time, there has not been any proportionate increase in output. Not only that many species, showed the tendency of overfishing both economic and biological. The catch data of 19 important species in the pre-ban (1976-1987) and post-ban (1988-1999) periods are compared with the catch data in the period 1971-1975 – the period of initial fishery upsurge consequence to modernisation to the virgin biomass and this is explained as the initial peak period.

Declining quantities of the traditionally harvested species support the tendency of biological overfishing.

- Ribbonfish , Catfish, Other sardine, Elasmobranches, Bigjawed jumper, Silverbelly are species showing heavy depletion in both pre-ban and post ban and periods.
- Oil sardine showed heavy depletion in the post ban period, whereas Mackerel showed heavy depletion in pre-ban period
- Only Tunnies, Seerfish, Perches and Cephalopods have not shown any depletion
- Peneaid prawn, which shows heavy depletion in the pre-ban period, started showing improvement in catch.

To get a detailed outlook of depletion the pre-ban period and the post-ban period are again split up into two equal parts containing 6 years each. The average landings in these periods are compared with that of the initial peak period (1971-75). The percentage fall in the landings of each specie in each period compared to the initial peak period gives the following results.

- Reduction in Oil sardine has been 6, 18, 14, and 51 percent in the four periods
- Reduction in Other sardine is 42,78,41 and 23 percent
- Reduction in ribbonfish has been 27, 39, 64 and 19 respectively
- Mackerel declined by 43 and 59 percent in the pre ban periods
- Overall drops in pelagic totals have been 16 and 13 percent in the pre ban periods
- Depletion in Elasmobranches has been 18, 22, 41, 48
- Depletion in cat fish is in the order of 52, 59, 85, 99
- Depletion in croakers has been 19 and 15 in the pre-ban periods
- Depletion in big jawed jumper has been in the order of 76, 63, 66, 48
- Depletion in silver belly has been 64, 43, 48, 56
- Depletion in goat fish has been 74, 88, 90 in the first and second pre-ban period and second post ban period
- Depletion in penaeid prawn has been 36, 41, 8, 10

This shows that there has been 29 and 13 percent reduction in the demersal total in the first and second pre-ban periods.

As far as the impact of trawl gear is concerned, it has been found that among the 14 species where more than 20 percent landings are contributed by trawl, 11 are either moderately or heavily depleted. In other words for all the thirteen heavily or moderately depleting species identified in the current analysis except Oil sardine and Mackerel, trawl is the major gear used in catching them. Considerable fall in the CPUE of mechanised prawn landings substantiates the depletion of prawn fishery which in turn indicate, biological and economic overfishing in the Kerala fishery.

Impact of trawl ban on catch level has been analysed (in the fourth chapter), found that there is improvement in the depletion status of eight out of the fifteen depleting species (mackerel, whitebait, carangids, croakers, lizardfish, flatfish, goat fish and penaeid prawn). However, the trawl ban has not been able to restore the catch level of oil sardine, ribbonfish, catfish, other sardine, elasmobranches, bigjawed jumper, and silverbelly. The Principle component analysis done period wise on the quarterwise landings of the 19 important species, also shows the positive impact of ban when all the traditionally harvested species are considered together.

It also showed that, increase in Catch Per Unit Effort (CPUE) of penaeid prawn shows the tendency of recovery in the post-ban period in comparison to the pre-ban period. The correlation coefficients of year, catch, effort, and CPUE of mechanised trawl landings of penaeid prawn in the pre-ban and post-ban periods also support effectiveness of trawl ban as a conservation measure.

Economic and demographic aspects of fishermen households studied (in the fifth chapter) leads to the following findings:

The major objective of saving (38 percent) is meant for marriage of female member of the family followed by either acquisition of fishing assets or maintenance or modification of the already acquired craft and gear (28 percent).

The result of Correspondence analysis on savings and income as well as savings and debt show a paradoxical situation - high income groups have both high savings as well as high debts.

Categorical regression is used to analyse the effect of per capita expenditure on food per month, per capita income per month, per capita debt per month, occupational category, caste, education and district on per capita savings per month shows that

$$(Y = -0.254X_1 + 0.716X_2 + -0.203X_3 + 0.399X_4 + 0.05474X_5 + -0.04898X_6 + 0.228X_7)$$

with one unit increase in per capita income savings increases by 71 percent of the original savings. Similarly a one level increase in occupational category can increase savings by nearly 40 percent. Similar explanations can be given for other coefficients also.

Regression Coefficients

X_1 = Per Capita Expenditure on Food

X_2 = Per Capita Income

X_3 = Per Capita Debt Per Month

X_4 = Occupational Category

X_5 = Cast

X_6 = Education

X_7 = District

The fact that livelihood alternatives though existing are scarce and also meager to support households even at subsistence levels, calls forth the importance of defending sustainability of the system, by preventing their over dependence on an over exploited resource base.

Sustainability assessment pertaining to the coastal fishery with the aid of statistical analysis highlight the fact that:

> *Though, the fishery sector product is increasing, the contribution of fishery sector product to the state domestic product and primary sector product are declining. Employment generation is also showing a positive trend. Fleet capacity is an economic indicator, which warrants immediate action of curtailment and redeployment. Livelihood alternatives or community independence indicators show lack of livelihood alternatives among fishermen communities and their high dependence on an overexploited resource base.*

Gender equity indicator of coastal fishery sector is also very low both in terms of sex ratio and equity in decision making, pointing to its lack of communal or social well being.

Considering the carrying capacity of the resource both the inshore and offshore area an active fishermen has now been confined to one fourth of its original area. It is found that the exploitation rate of all the 19 commercially important species except seerfish, catfish, elasmobranches and penaeid prawns are found to be unsustainable, and among these four, seerfish is the only specie, which has not been depleted.

As both socio-economic sustainability, and ecological sustainability are under threat it is clear that seasonal trawl ban alone cannot protect the fishery sector of Kerala, for ensuring livelihood security to the fishermen and their dependents that are directly depending on it and an equal number engaged in support and ancillary activities and their dependence. Along with other conservation measures, efforts should be taken to promote various aspects of social well being, such as, community independence, gender equity etc so that an assured socio-economic sustainability could ensure ecological sustainability more easily, without an element of compulsion in it.

Need for Alternative Management Measures

The sustainability threatened human component and catch structure of Kerala coast indicate the inadequacy of seasonal trawl ban as a conservation measure. Various other management interventions are needed. The type of intervention required in the inshore area should be the one that discourages further exploitation and which can sustain the resource base through a package of measures including conservation, regulation and co preservation.

Fisheries management is a dynamic resource allocation process where the ecological, economic and institutional resources of a fishery's exploitation system are distributed with value to the society as the overall goal. Fish is the largest living resource that is exploited from the nature. One of the most important characteristics of capture fisheries is that the resource is a common property, the access to which is free and open. The limited but renewable nature of the resources and ownership conflicts have no parallel in other sectors. Irrespective of the type of exploiters – artisanal fishers mechanised or large fleet owners, their operation will not be limited until zero profitability thresholds is reached.

The objectives of fisheries management are to provide wholesome food, gainful employment and economic benefits. In managing fisheries, these benefits should be maximized in the short term, and the long term benefits of sustained catches, stable employment, stable economic gains should be ensured, as well as ensuring preservation of resources for future options.

Strict Enforcement of Mesh Regulation

Regulation of mesh size of gears is often emphasized to protect the young fish and to regulate the size of fish caught. If fishing on immature fish is intense, the abundance of the species may be so reduced before it approaches maturity that there would be insufficient adult fish surviving even if there is no fishing on them. Another purpose of controlling mesh size is to permit the escape of juveniles hoping that their growth will increase the exploitable biomass, which might be available to the fishery later. The catch on a later day, is expected not only to compensate the loss but also to become more valuable. This is achieved through an increase in total weight and a higher market price per unit realized because of the larger size of each fish caught. It is even possible that an increase in unit value can make up for a decrease if any in the catch.

The Kerala Marine Fisheries Regulation (KMFR) Act, insist that the mesh size in the code end of trawls should not be below 30 mm (stretched from knot to knot). In spite of this, the code end of the trawls prevalent in the State is only 10 mm. The 10 mm codends fetch not only larger amounts of by-catch of economically unimportant groups but also juveniles of economically important groups which are either thrown overboard or sold at a very low price. This will not only cause recruitment overfishing and consequent future loss to the fishery but also current loss to the fishery because of their very low market price. For the compulsory practice of minimum mesh size of cod end stipulated, not only that enforcement mechanisms be strengthened, awareness creation among different user groups is more important. The media, extension literature in local languages and video shows in fishing villages should be used effectively to bring about the required changes in the attitude of the fisher folk. Harvesting, discarding and sale of undersized fish should cause indignity and embarrassment among the fisher folk.

Generation of Alternative Employment Opportunities

In view of the close relationship between poverty, overfishing and degradation of aquatic ecosystems, the creation of alternative and complementary sources of income and employment is essential for the sustainable development of the State's fisheries sector.

The State's fisheries policy should pursue not only the sustainable use and equitable sharing of fishery resources but also alleviation of poverty of the fishing communities by improving their socio-economic conditions and strengthening the productive basis of their existence. Special attention should be paid to the interests of the poorest and the most vulnerable members of the fishing communities and other members in artisanal fisheries. However the policies should be long term and sufficiently flexible to respond to new experiences and changing needs of beneficiaries. When alternative income generating employment opportunities are created outside the fisheries the surplus labour will leave the fisheries, which is a pre requisite for the sustainability and profitability of the State's fisheries sector. In the context of the very high occupational attachment of the fisherfolk to fishing, the point to be considered here is that, only highly remunerative alternative opportunities can attract them from fishing. The possibilities of ornamental fishing, particularly for women can be made one such opportunity from the side of government.

Diverting Efforts To Beyond 50m Depth

No new permits should be given to mechanized vessels of 32 to 36 footers as inshore waters are already overcrowded with various types of fishing units. Only the larger vessels of 46 to 52 footers, which are capable of long endurance in the sea and operating up to 100-120m depth ranges, should be encouraged. Instead of foreign fleet, this domestic fleet, which is made superfluous in the inshore area beyond 20m depths, by the artisanal fleet through their enhanced capacity should be allowed to tap the deep sea resources. The benefits expected from this kind of diversion of efforts are increased fish production domestically, increased export earnings, increased availability of fish for local consumption, employment generation and more than everything self resolution of the allocation conflicts in the inshore area by the fishermen themselves. Not only that the electronic fish finding devices such as Echo- sounder, Sonar etc. should be popularised through subsidies or loans.

In the context of over exploitation of traditional grounds and ever growing number of active fishermen, even the motorised crafts should be encouraged for capacity addition and modernisation to reach the deep seas. Such vessels should be equipped with sophisticated fish detecting devices and sufficient storage facility. All the centrally or state sponsored schemes or subsidies should be diverted towards this. That is subsidies should be there but in the right direction. Utilizing the funds released by the cutting down of subsidies for the implementation of management measures and for the creation of alternative employment would, in the long run, benefit both the socio-economic and ecological sustainability of the sector.

Protection of Backwaters

Estuaries or backwaters have important ecological roles. They play as nutrient and organic material transport through tidal circulation. They form nursery grounds for a variety of commercially important penaeid prawns, clams, edible oyster, crabs, mullets, pearlspot, catfishes, perches and others. They provide breeding grounds for the fresh water caridian prawns. The berried population of the fresh water prawn (Macrobrachium rosenbergii) migrates downstream to the backwaters during September to December for hatching and the completion of larval metamorphosis. Indigenous gears catching juveniles from backwaters should be strictly controlled. Fishing activities in the backwaters support the livelihood of about 0.2 million fishermen and provide employment for about 50,000 active fishermen. So it is important to protect backwaters from reclamation and industrial and agricultural pollution.

Construction of Artificial Reefs

The biota of lower trophic levels will flourish well on the artificial reefs, which will provide food for the fishable stocks as well as an attractive environment for breeding and nursery phase for fishes.

Minimising By-catch and Post Harvest Losses

A considerable amount of fish catch is lost through decay caused by poor conservation. Losses also occur as a result of deficiencies in marketing and distribution system. There again another large proportion of the catch is lost because it is regarded as undesirable by-catch or waste and not landed. Industrial harvesting methods are particularly unselective and lead to unnecessarily large quantities of by-catch. Attempts to reduce wastage call for research into more selective fishing methods as well as improved regulations regarding the application of known methods. Complementary measures, such as participatory enforcement systems and training and consciousness-raising for fishers regarding the effects of inefficient harvesting methods on the catch require more attention. These are important in the endeavor to reduce over exploitation of fishery resources.

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i) Name of the Village :

ii) Name & Number of the Household :

iii) Name of the head :

iv) Serial Number :

v) Caste and Community :

vi) Number of members :

2. HEAD AND OTHER MEMBERS OF THE HOUSEHOLD

Sl. No.	Name	Gender	Age	Relation to the Head	Marital status	Education and Skills	Main Occupation*			
							A	B	B1	C

* A-Fishing Operator B-Fishing Labourer C-Non-Fishing Occupation
B1-Fishing Labourer in the Processing Sector.

3. HOUSING AND LAND

1. Is the house you presently living in	2. Is your crop land
( ) Your own House ( ) Your parent's House ( ) Your relation's house ( ) Rented house	( ) Free public land ( ) Rented land ( ) Your own land ( ) Free Relation land ( ) Other

4. LOCAL PUBLIC UTILITIES

i) What is the main source of drinking water in the household?

( ) Canal/River ( ) Public Well
( ) Public pond ( ) Own Well
( ) Public Taps ( ) House connections
( ) Other

ii) Source of light in the household

( ) Electricity ( ) Oil lamps
( ) Kerosene ( ) Other

iii) What is the main source of outside general information?

( ) Newspaper ( ) Magazines
( ) Radio ( ) T.V.
( ) Govt. Officials ( ) Neighbours
( ) Public leaders ( ) Others

5. EARNING PATTERNS

i) How many of the family members earn an income per month?

. . .. |

Total amount Rs. . . . .

ii) Do you have any income generating occupation apart from fishing?

/__/ Yes /__/ No

If Yes, for how many months do you engage yourself in the occupation ____________________

and how much earn out of it? ____________________

iii)

5. EARNING PATTERNS

FOR FISHING LABOURER (On boat, with stationery gear or in the processing sector)

FOR FISHING OPERATOR (Both mobile and stationary gears) in Season I

No.	Name	Fishing ground		Time Spent for Fishing					Income		Type of Fishing Gear	Catch
		Distance from Shore Km Hr	Distance from home Km Hr	Hrs/ Day	Day/ Month	Month/ Year	Hrs/ Trip	Trip/ Month	Gross	Net		

SEASON II

Income of Household from other sources:

Type of Occupation	Cash Earnings		Non-Cash Earnings per month	Labour		Season
	Gross Imcome per month	Net Income Per month		Family Labour	hired Labour	

6. ASSETS

1. FISHING ASSETS

Type	Present Value	Economic Life	*Ownership Pattern				Remarks
			A	B	C	D	

*A- Owner operated, B- Cooperative ownership
C- Absentee Owner, D- Company Owner

Items	Present Value	Economic Life
i) LAND		
ii) FARM AND MACHINERY TRANSPORTATION		
iii) LIVESTOCK AND POULTRY		
iv) OTHERS		

V. HOUSEHOLD EXPENDITURE

Items	Annual Pay	Monthly Pay	Daily Pay	Home Production
Food				
Clothes				
Household Durables				
Medical Care				
Education				
House Repairing				
Festivals/Rituals				
Others				

12. SAVING PATTERNS

1. Do you/your family save?

   ( ) No. Why not?

   ( ) Yes

2. How often do you save? ( )Daily ( )Weekly ( ) Monthly
3. For what purpose do you save?
   a) For purchasing. What?
   b) Education for children
   c) Marriage of daughter
   d) To earn interest
   e) To do business
   f) Others
4. Where do you Save?

   ( ) Bank ( ) Post Office ( )Chit Fund ( ) Co-ops

   ( ) At home ( ) Others

1. Have borrowed money in the last year?

( ) Yes ( ) No

2. If yes,

How much?

For what purpose?

3. From whom have you borrowed?

4. How much interest? percent per month

Mode of payment

Repayment period

10. PROBLEMS AND AREAS WHERE HELP IS NEEDED

Problems	Priority Numbering		Remarks/opinions/Remedies
Health facilities			
Water			
Safe drinking water			
Sewage disposal			
Crowedd conditions			
Firewood/Kerosene			
Harbour			
Schools			
Technicial Education			
Fishing			
Land for cultivation			
Other specify			

15. Suggestions to improve occupational and sociological conditions.

11. EXPERIENCE IN OCCUPATION

Sl. No.	Name	Current Occupation	Experience	Other Training	Previous Main Occupation	Ever before attempted to change occupation? Why?	Are you Willing to change?	If Yes What Job and Why?	If No Why?

12. JOB OPPORTUNITIES AND MOBILITY

Sl No.	Name	Did you go away from the village last year?	If No Why?	If Yes, How often?	Where to	Purpose

12.2. What kind of job do you think you can take in addition to fishing?

Sl. No.	Name	Job	Place		*Income		If A, are you willing to change?	If No, Why?	Do you know the wag rate in town	
			inside the Village	Outside the Village	A	B			Yes, How much?	No

* A- greater than fishing, B - Less than fishing

12.3. If your current occupation is not fishing do you plan to take it up in the future?

Sl.No.	Name	Yes	Why?	No	Why?

13. FUTURE OUTLOOK FOR OCCUPATION

.1. In future do you think your occupation in fishing will be

Sl. No.	Name	Better	Why?	Worse	Why?	No change	Why?

13.2. Do you think your children should take up fishing as this occupation?

( ) Yes. Why?

( ) No. Why?

13.3. Do you think that in future your children would be forced to take up fishing as their main occupation?

( ) Yes. Why?

( ) No. Why?

14. RESOURCE DEPLITION AND CONSERVATION

1. Over the last 50 years have you noticed depletion of any fish species?

( ) Yes ( ) No

1.1. If yes, is it in any particular season/month or in the whole year?

( ) Seasonal ( ) Year

Which season:

1.2 If yes, is it applicable to any particular type of fish or to the fishery resource as a whole?

1.2.3. If it is found in particular types of spices only, which are these species?

Name of the species	Reasons

1.3. Is depletion more prominant in the territorial waters, inshore area or any another areas?

( ) inshore area ( ) territorial waters ( ) any other

Reasons : Reasons : Reasons :

1.4. In your opinion what are the reasons for the general resource depletion, and what are the remedies you can put forward?

Reasons	Remedies

1.5. Do you think that the seasonal trawl ban has been effective in conservation of depleting species?

( ) Yes fully why?	Partially why?	( ) No. Why?

1.6. Do you think that the seasonal trawl ban is a necessary measure?

Yes. Why?	No. Why?

1.7. Do you think that any other regulations are needed for the conservation of depleting resources?

( ) Yes ( ) No Why?

Why?

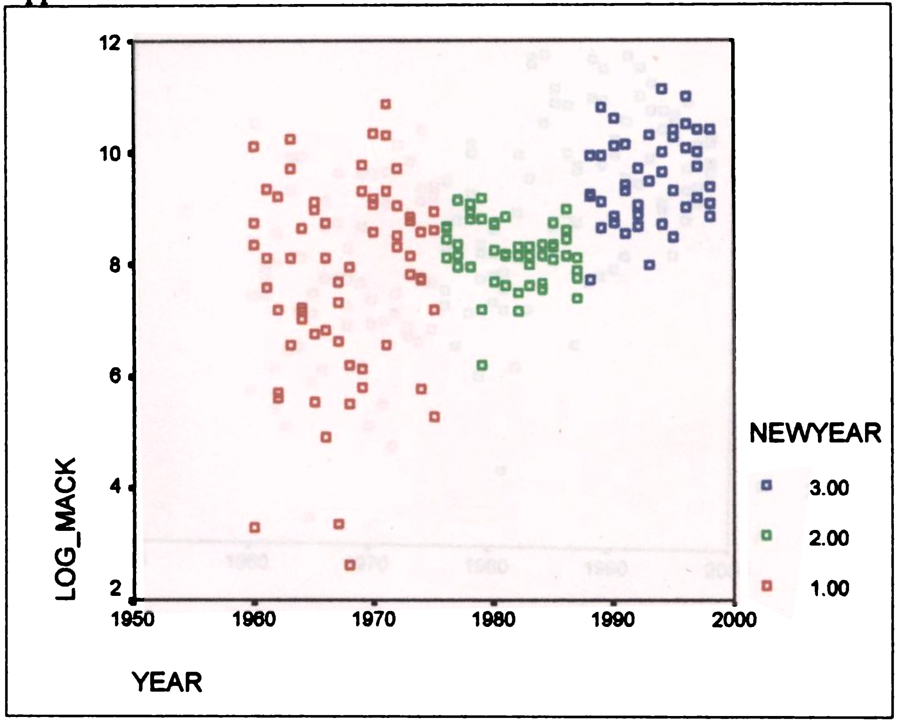
List: Purpose

1.8 Do you think that resourse depletion is affecting the day to day life in the village?

( ) Yes ( ) No.

If yes, in what way?

Appendix-1



LOG_MACK
12
10
8
6
4
2
1950
1960
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1980
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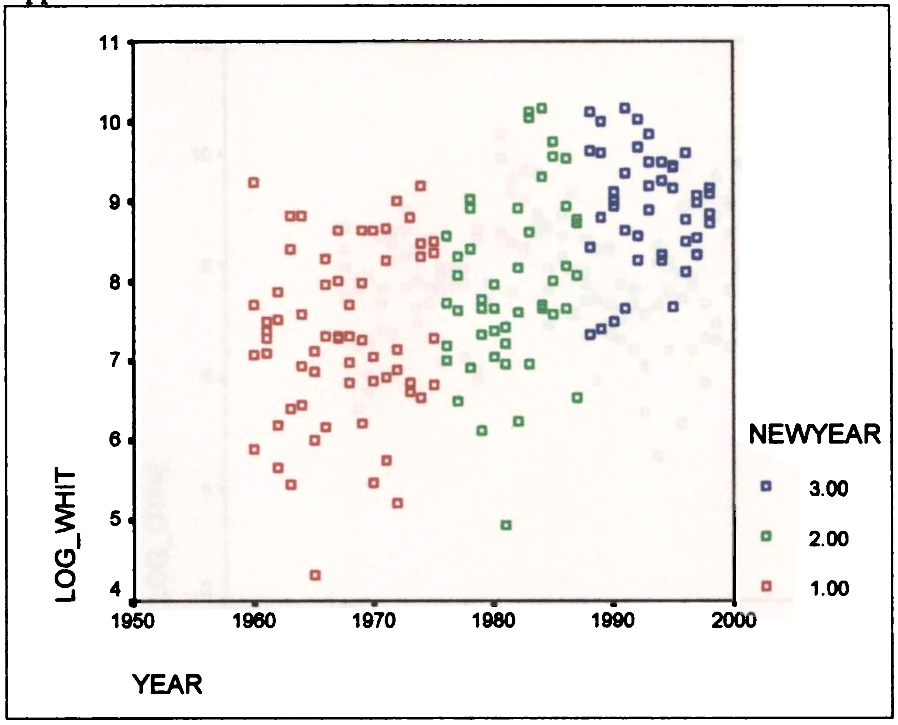
2000
YEAR
NEWYEAR
3.00
2.00
1.00

Appendix-2



11
10
9
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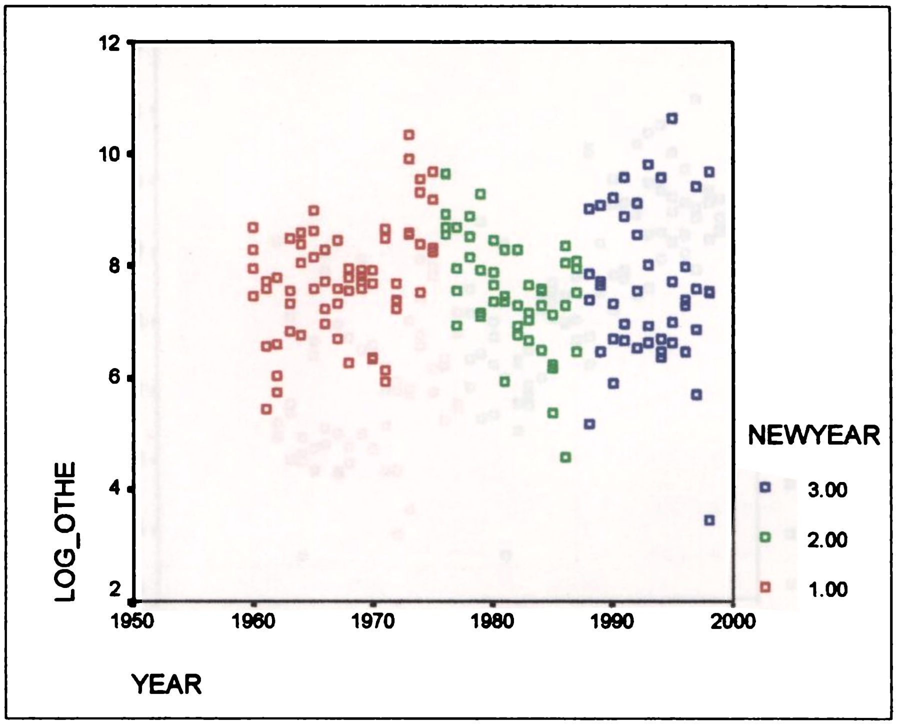
7
6
5
4
LOG_WHIT
1950
1960
1970
1980
1990
2000
YEAR
NEWYEAR
3.00
2.00
1.00

Appendix-3



LOG_OTHE
12
10
8
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4
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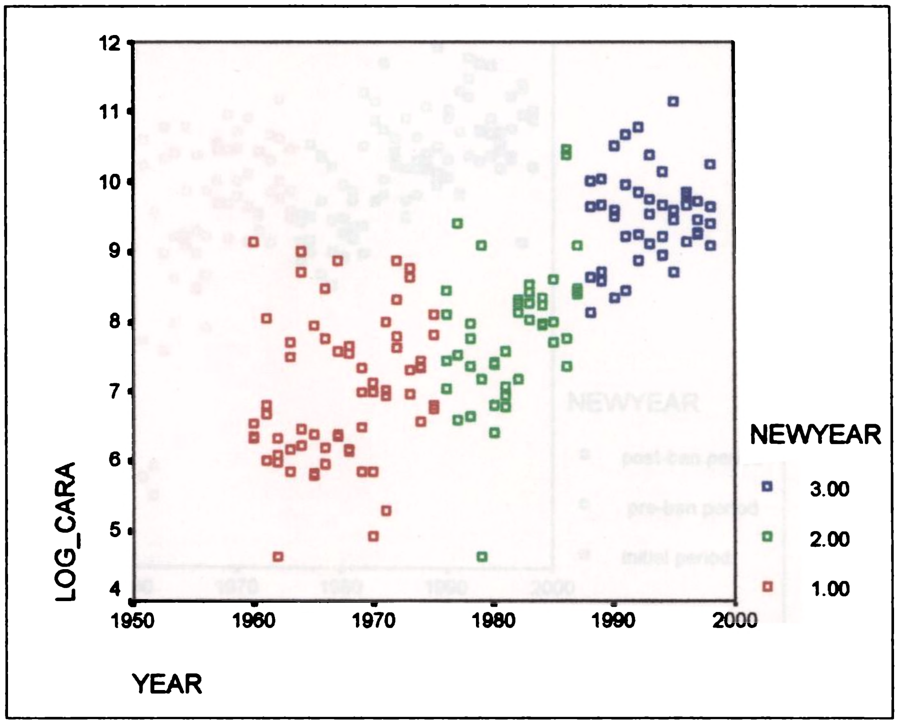
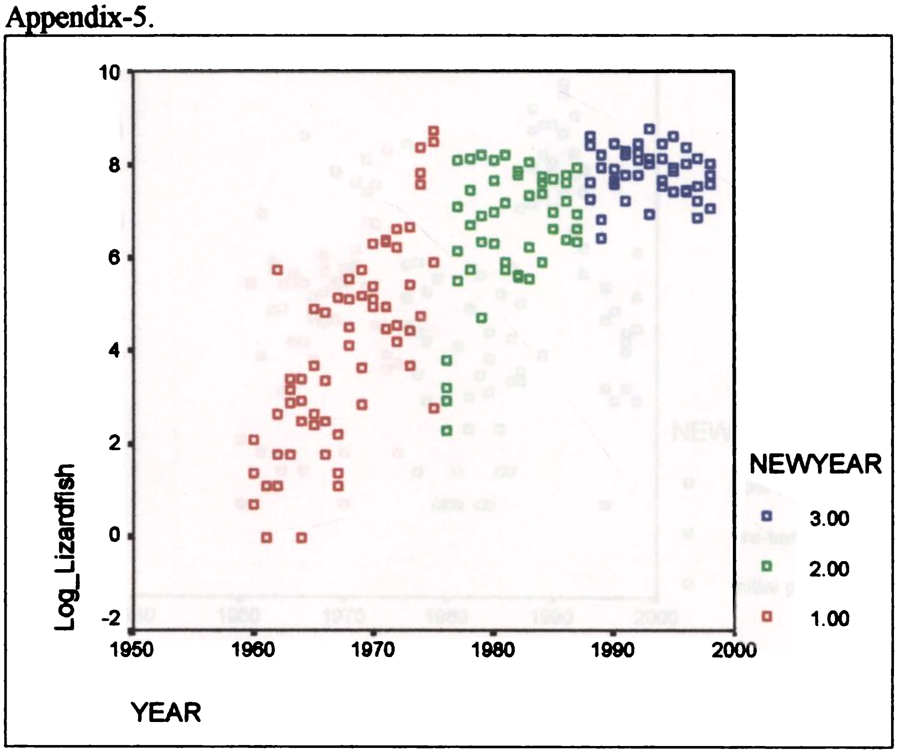
1950
1960
1970
1980
1990
2000
YEAR
NEWYEAR
3.00
2.00
1.00

Appendix-4.

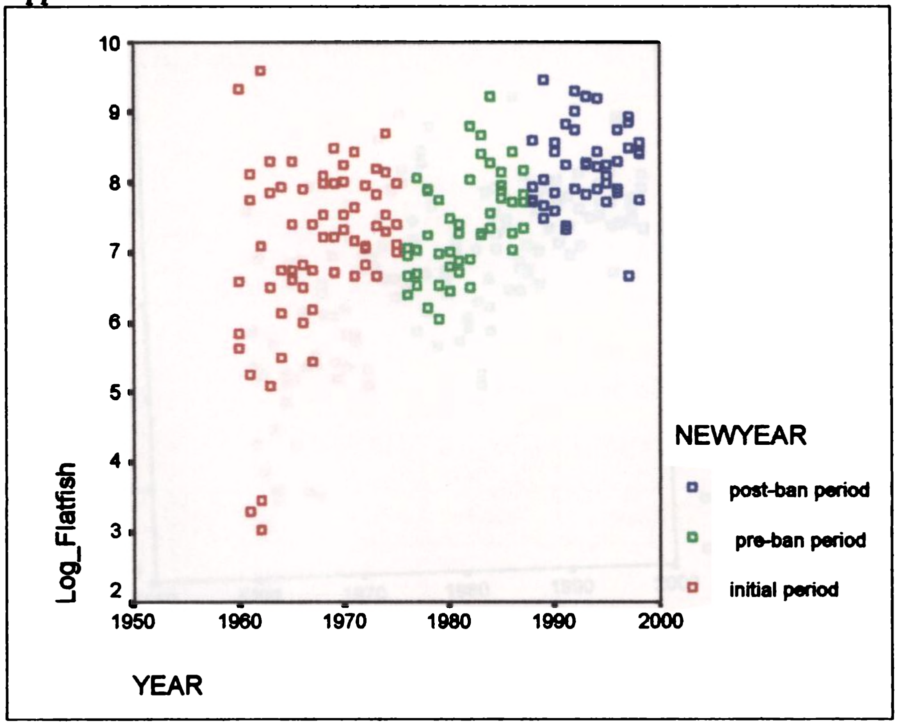


Appendix-5.

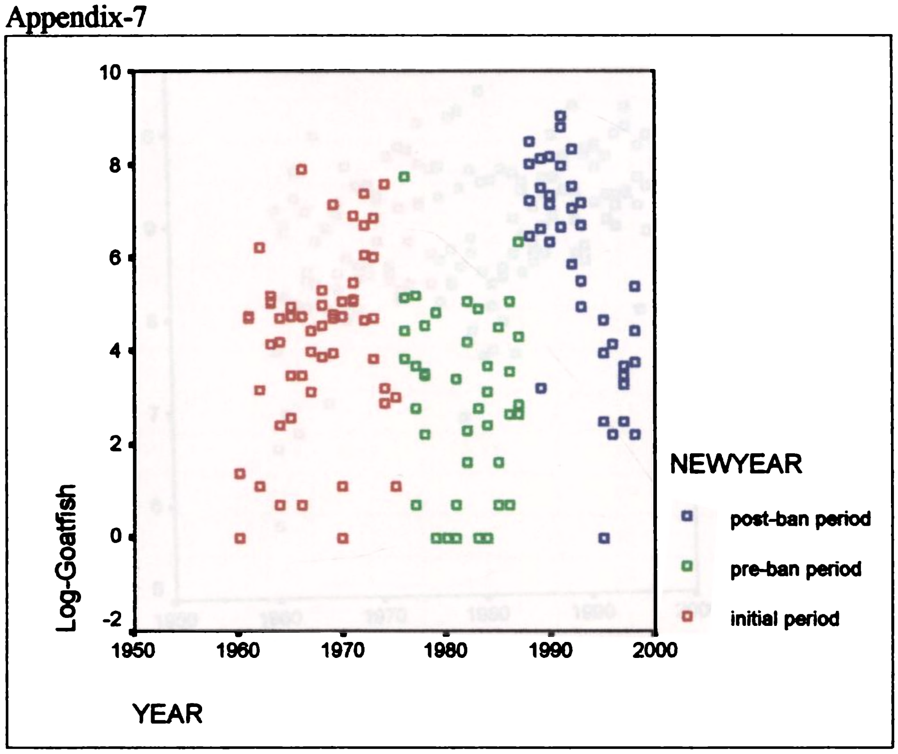


Appendix-6

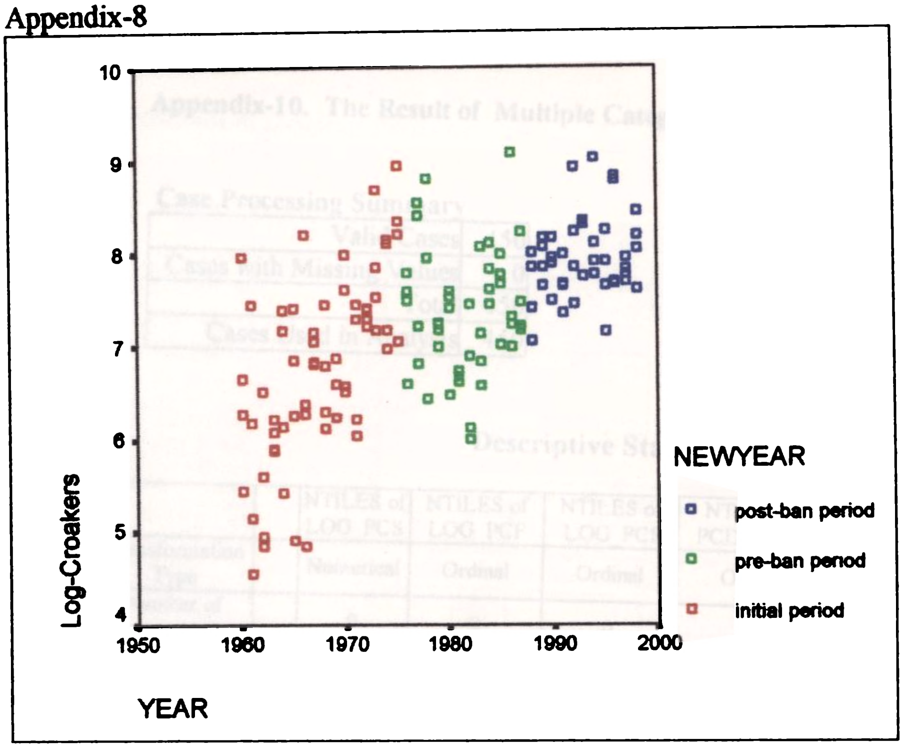
Appendix-6



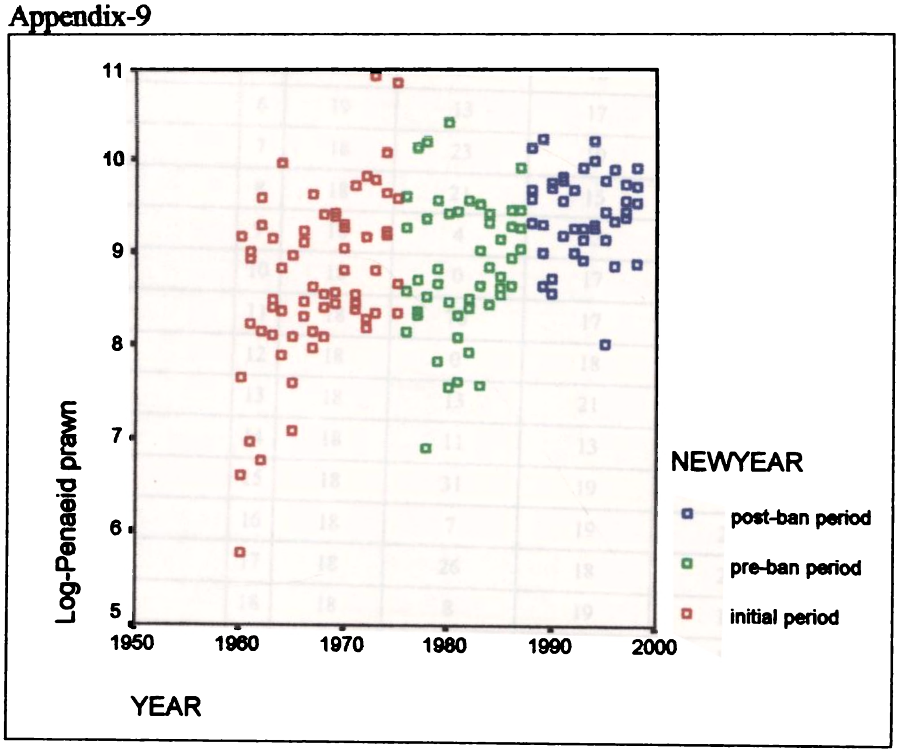
Appendix-7



Appendix-8



Appendix-9



Appendix-10. The Result of Multiple Categorical Regression

Case Processing Summary

Valid Cases	450
Cases with Missing Values	0
Total	450
Cases Used in Analysis	450

Descriptive Statistics

		NTILES of LOG PCS	NTILES of LOG PCF	NTILES of LOG PCI	NTILES of PCDEBT M	OCC CAT	NEW CASTE	EDU LEVE	District
Transformation Type		Numerical	Ordinal	Ordinal	Ordinal	Nominal	Nominal	Nominal	Nominal
Number of Missing Values		0	0	0	0	0	0	0	0
Mode		1	11	9	4	2	1	8	1
Categories	1	24	21	18	0	88	198	31	150
	2	11	14	18	0	206	20	24	150
	3	18	19	21	0	9	142	51	150
	4	19	21	15	113	63	74	41	
	5	17	15	18	0	16	16	50	
	6	19	13	17	0	60		55	
	7	18	23	19	13	8		44	
	8	18	21	15	24			65	
	9	18	4	23	14			34	
	10	18	0	17	19			47	
	11	18	76	17	8			8	
	12	18	0	18	26				
	13	18	13	21	11				
	14	18	11	13	24				
	15	18	31	19	11				
	16	18	7	19	26				
	17	18	26	18	24				
	18	18	8	19	12				
	19	18	12	14	14				
	20	18	47	21	25				
	21	18	0	18	14				
	22	18	17	18	19				
	23	18	15	17	19				
	24	18	18	19	14				
	25	18	18	18	20				

a Dependent variable
b Multiple modes exist. The smallest value is shown.

Correlations of Original Predictors

	NTILES of LOG_PCF	NTILES of LOG_PCI	NTILES of PCDEBT_M	OCC_CAT	NEWCASTE	EDU_LEVE	DISTRICT
NTILES of LOG_PCF	1.000	.316	.030	.055	.066	.060	.007
NTILES of LOG_PCI	.316	1.000	.096	.124	.089	-.144	-.025
NTILES of PCDEBT_M	.030	.096	1.000	-.060	-.093	.035	.054
OCC_CAT	.055	.124	-.060	1.000	.031	-.068	.061
NEWCASTE	.066	.089	-.093	.031	1.000	-.146	.111
EDU_LEVE	.060	-.144	.035	-.068	-.146	1.000	.110
DISTRICT	.007	-.025	.054	.061	.111	.110	1.000

Correlations of Transformed Predictors

	NTILES of LOG_PCF	NTILES of LOG_PCI	NTILES of PCDEBT_M	OCC_CAT	NEWCASTE	EDU_LEVE	DISTRICT
NTILES of LOG_PCF	1.000	.326	.045	.136	.100	-.059	.039
NTILES of LOG_PCI	.326	1.000	.121	.354	.018	.099	.005
NTILES of PCDEBT_M	.045	.121	1.000	.198	-.003	.004	.129
OCC_CAT	.136	.354	.198	1.000	.043	.019	-.028
NEWCASTE	.100	.018	-.003	.043	1.000	.018	.357
EDU_LEVE	-.059	.099	.004	.019	.018	1.000	.003
DISTRICT	.039	.005	.129	-.028	.357	.003	1.000

Model Summary

Multiple R	R Square	Adjusted R Square
.912	.831	.828

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	373.901	7	53.414	310.242	.000
Residual	76.099	442	.172		
Total	450.000	449			

Coefficients

Coefficients

	Standardized Coefficients		F	Correlations			Importance	Tolerance	
	Beta	Std. Error		Zero-Order	Partial	Part		After Transformation	Before Transformation
NTILES of LOG_PCF	-.254	.021	148.214	.024	-.501	-.238	-.007	.876	.886
NTILES of LOG_PCI	.716	.022	1047.489	.745	.839	.633	.642	.781	.852
NTILES of PCDEBT_M	-.203	.020	100.993	-.079	-.431	-.197	.019	.936	.970
OCC_CAT	.399	.021	350.904	.585	.665	.366	.281	.844	.971
NEWCASTE	5.474E-02	.021	6.721	-.022	.122	.051	-.001	.858	.944
EDU_LEVE	-4.898E-02	.020	6.145	.044	-.117	-.048	-.003	.980	.930
DISTRICT	-.228	.021	115.320	-.252	-.455	-.210	.069	.851	.962

The estimated values of regression can be written as

$$Y = -.254X_1 + .716X_2 + -.203X_3 + .399X_4 + 5.474E\text{-}02X_5 + -4.898E\text{-}02X6 + .228X7$$

Quantifications

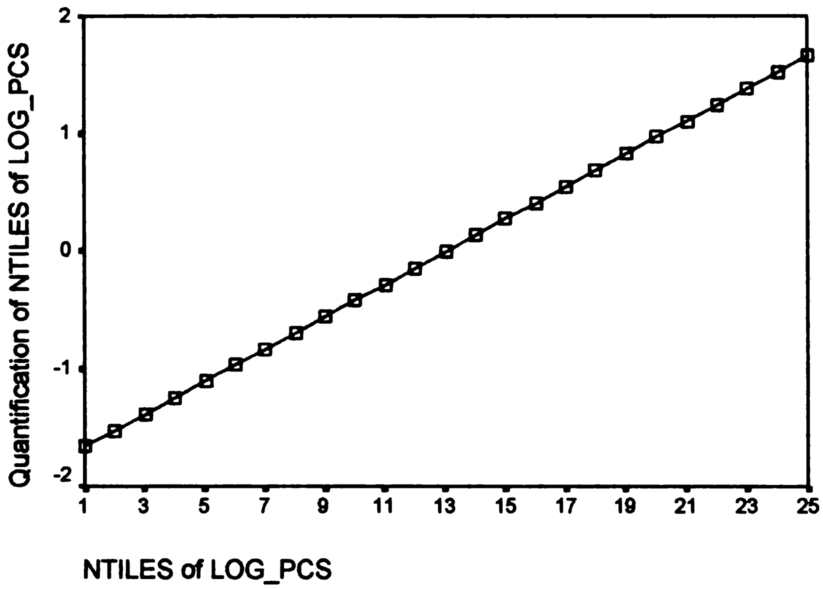
		Quantification	Frequency
NTILES of LOG_PCS (Numerical)	1	-1.660	24
	2	-1.522	11
	3	-1.383	18
	4	-1.245	19
	5	-1.107	17
	6	-.968	19
	7	-.830	18
	8	-.691	18
	9	-.553	18
	10	-.414	18
	11	-.276	18
	12	-.138	18
	13	.001	18
	14	.139	18
	15	.278	18
	16	.416	18
	17	.555	18
	18	.693	18
	19	.832	18
	20	.970	18
	21	1.108	18
	22	1.247	18
	23	1.385	18

	24	1.524	18
	25	1.662	18
NTILES of LOG_PCF (Ordinal)	1	-1.750	21
	2	-1.750	14
	3	-1.453	19
	4	-1.453	21
	5	-.773	15
	6	-.773	13
	7	-.773	23
	8	-.699	21
	9	-.050	4
	10	.	0
	11	-.050	76
	12	.	0
	13	.318	13
	14	.318	11
	15	.318	31
	16	.318	7
	17	.318	26
	18	.318	8
	19	.658	12
	20	.658	47
	21	.	0
	22	1.176	17
	23	1.176	15
	24	1.957	18
	25	1.957	18
NTILES of LOG_PCI (Ordinal)	1	-1.762	18
	2	-1.303	18
	3	-1.303	21
	4	-1.106	15
	5	-1.004	18
	6	-1.004	17
	7	-.740	19
	8	-.740	15
	9	-.454	23
	10	-.454	17
	11	-.331	17
	12	-.309	18
	13	.110	21
	14	.110	13
	15	.283	19
	16	.283	19
	17	.436	18
	18	.436	19
	19	.436	14
	20	.687	21
	21	1.128	18
	22	1.206	18
	23	1.518	17
	24	1.741	19
	25	2.041	18

NTILES of PCDEBT_M (Ordinal)	1	.	0
	2	.	0
	3	.	0
	4	-.662	113
	5	.	0
	6	.	0
	7	-.662	13
	8	-.662	24
	9	-.662	14
	10	-.662	19
	11	-.662	8
	12	-.662	26
	13	-.130	11
	14	-.130	24
	15	-.102	11
	16	-.102	26
	17	.066	24
	18	.358	12
	19	.358	14
	20	.358	25
	21	.358	14
	22	.640	19
	23	.911	19
	24	1.537	14
	25	3.801	20
OCC_CAT (Nominal)	MFL	-1.240	88
	MFO	.544	206
	NMFL	-3.116	9
	MEFL	-.860	63
	NMFO	.206	16
	MEFO	1.377	60
	ME MFL	-.818	8
NEWCASTE (Nominal)	araya	-.917	198
	Others	1.871	20
	latin	1.104	142
	muslim	.165	74
	ezhava	-1.547	16
EDU_LEVE (Nominal)	1.00	2.253	31
	2.00	.763	24
	3.00	-.173	51
	4.00	-.114	41
	5.00	-.849	50
	6.00	-.152	55
	7.00	.755	44
	8.00	-.774	65
	9.00	-1.374	34
	10.00	.224	47
	11.00	3.685	8
DISTRICT (Nominal)	ekm	-.520	150
	kkd	-.879	150
	qln	1.399	150

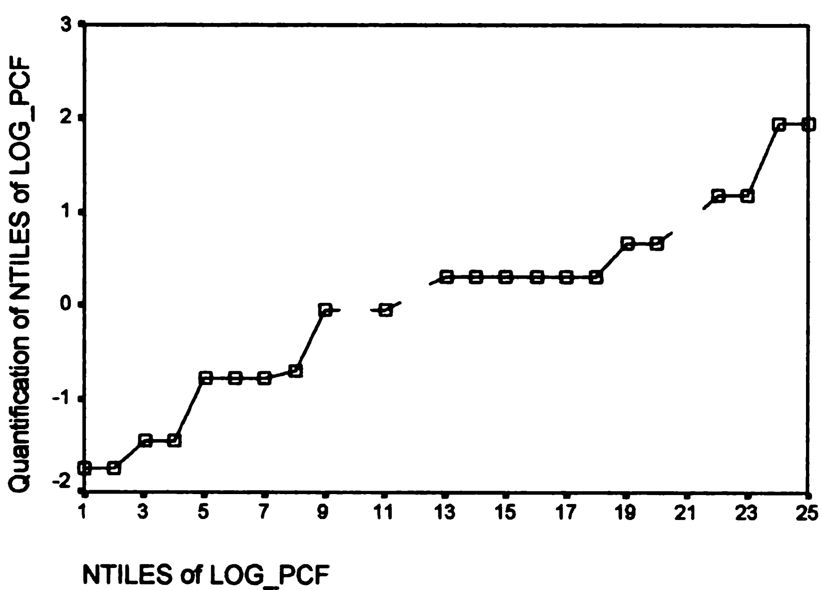
Category Quantifications for NTILES of LOG_PCS

Transformation Plot

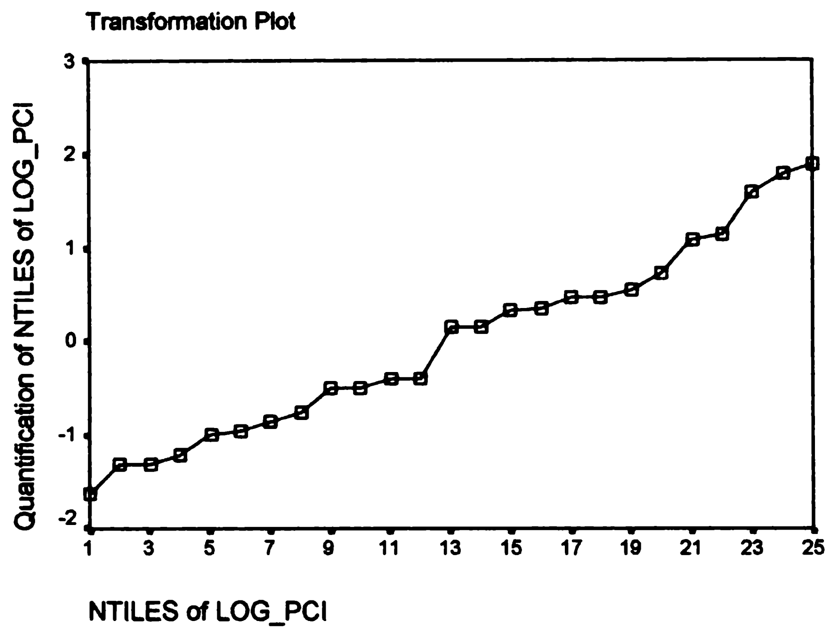


Category Quantifications for NTILES of LOG_PCF

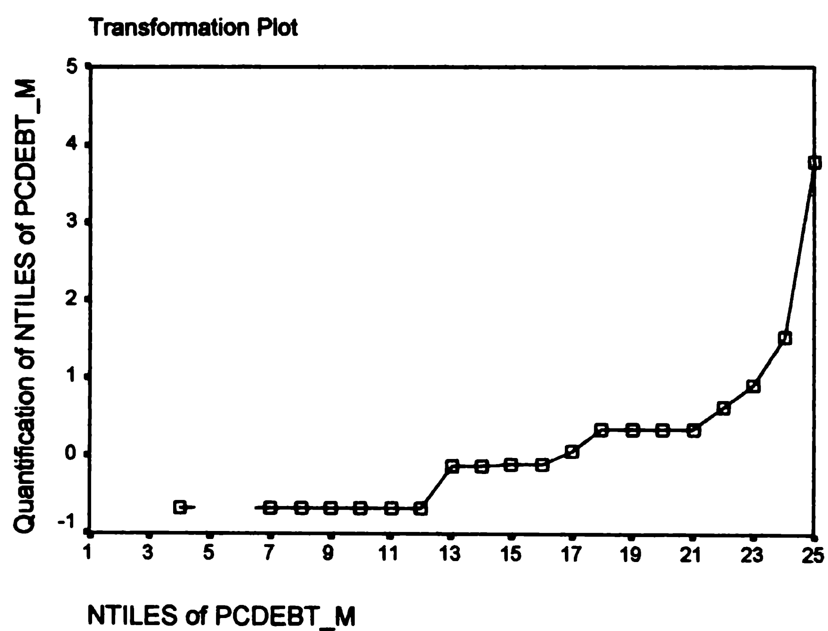
Transformation Plot



Category Quantifications for NTILES of LOG_PCI

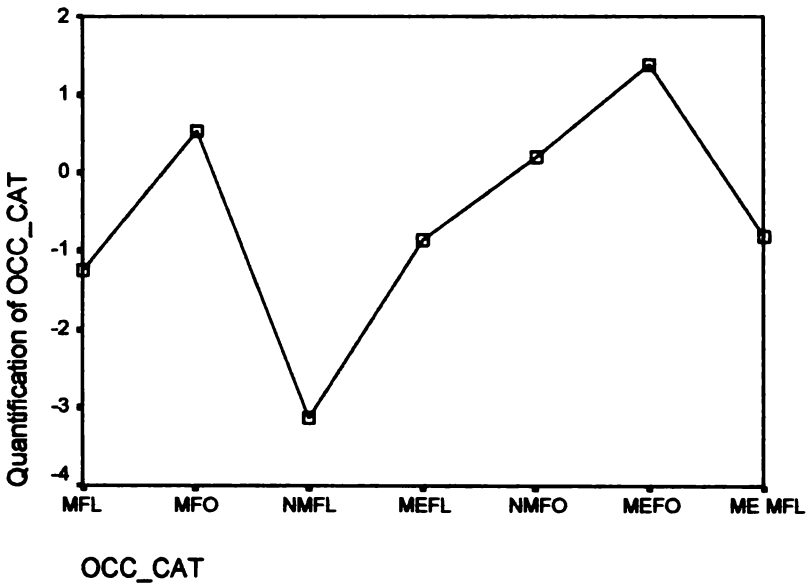


Category Quantifications for NTILES of PCDEBT_M



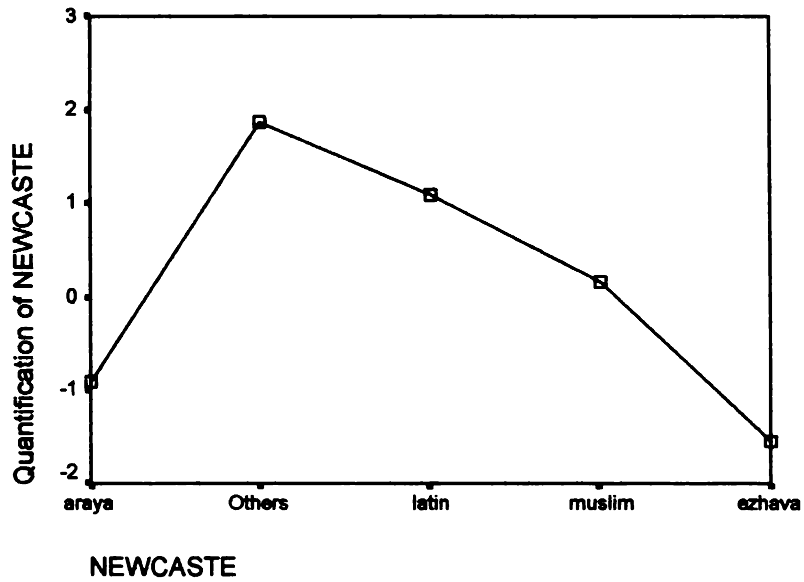
Category Quantifications for OCC_CAT

Transformation Plot



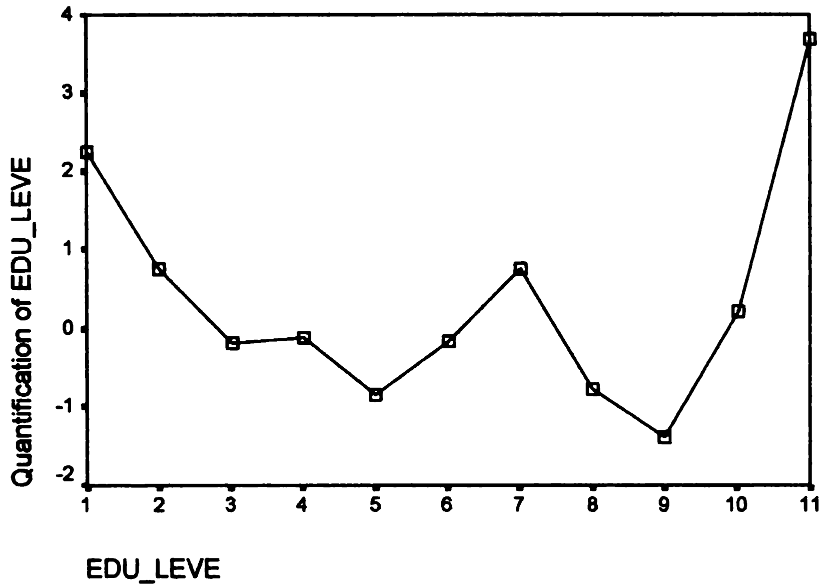
Category Quantifications for NEWCASTE

Transformation Plot



Category Quantifications for EDU_LEVE

Transformation Plot



Category Quantifications for DISTRICT

Transformation Plot

G18503