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Environmental Economic Analysis of Inshore Fishery Resource Utilisation of Coastal Kerala

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Abstract

The study on the environmental economic analysis of inshore fishery resource utilisation of coastal Kerala mainly focuses on the recent changes in the techno-exploitation pattern of inshore fisheries and its socio-economic impact on stakeholders with specific emphasis on the assessment of economic loss incurred due to various environmental problems of the coastal ecosystem. The implicit sectoral conflict in the exploitation pattern of multi-species multi-gear marine fisheries is further affected by externalities like excessive fishing pressure, inflow of pollutants, shallow water mining and lifting coastal sands and various other environmental threats challenging the very sustainability of fishing resources and livelihood security of vast majority of fisher folk. The fishing villages were categorised into highly degraded, moderately degraded and comparatively undisturbed centres based on the type and level of fishing intensity and other biodiversity parameters. The data on cost and earnings of different types of fishing units collected from the representative centres of all the three categories of villages were supplemented with the data on socio-economic parameters and opinion surveys for the present analysis. Secondary time series data from 1962 to 2000, relating the species wise catch obtained from the National Marine Living Resource Data Centre of CMFRI were also used to study the extent of variation in catch composition, production trend and the impact of technological changes on marine resource.

The excessive fishing pressure exerted by the mechanised trawlers, pollution caused by the industrial effluents and sea erosion due to sand mining are the prominent features of the highly degraded centre, while the indiscriminate operation of large number of minitrawl and ring seine units leading to the depletion of fishes of commercial importance forms the major problem in moderately degraded centres. The analysis of species wise annual landings of Kerala during the last four decades indicates that the effect of technological changes in fishing methods had affected some of the marine resources leading to their depletion. The economic loss due to the extinction of resources in the annual marine landings of Kerala due to over-exploitation over the last four decades was worked out. The economic loss in terms of Net Present Value for 30 years discounted to the present level was Rs.160.6

crores for catfishes, Rs.458.5 crores for elasmobranches and Rs.3.9 crores for goatfishes.

The key economic indicators of various fishing units were calculated and compared. Intensive mechanisation and consequent increase in the operation of trawlers and purse seiners enabled the enhancement of fish production. The average annual catch of a trawler was 555 tonnes realising gross revenue of Rs.31.2 lakh. For a purse seiner, average annual catch was 197.6 tonnes fetching a gross revenue of Rs. 20.7 lakh as against a gross annual returns of Rs. 12.4 lakh by ring seine units and Rs. 5.2 lakh for minitrawl units in the motorised sector representing the moderately degraded centres. In the meantime, the traditional fishery units operating in the comparatively undisturbed areas, such as a plank built boat with shore seine earns Rs.4.5 lakh and a catamaran with gill net only Rs.1.1 lakh per annum. While there is a positive impact in production due to the technological advancements especially for trawlers and purse seiners, there is a negative impact of economic loss due to the catching of huge quantity of untargeted varieties and juvenile fishes. The annual economic loss generated due to juvenile fishing by a single purse seiner works out to Rs.39.6 lakh, a trawler Rs.28.3 lakh, a ring seine Rs.19.1 lakh and minitrawl Rs.6.9 lakh. As a whole the economic loss due to juvenile fishing in the study area is estimated at Rs.600 crores per annum in which the highly degraded centres alone contribute about 82%. The Cobb-Douglas production- function model for input-output relationship was applied in trawler operation in three major centres with number of days fished, quantity of fuel used and expenditure of repair and maintenance as inputs. The functional relationship indicates that there is a scope to enhance the net profit of trawlers by increasing fishing days and area of operation at Neendakara and Munambam, where as at Cochin Fisheries Harbour it is almost at the optimum level.

The economic loss due to environmental problems at the highly degraded centres such as Kochuveli and Alappad was worked out in terms of NPV of loss for the next 15 years discounted to the present level. For this, the fish production in these centres was compared with that of the nearby undisturbed and moderately degraded centres. The NPV of estimated loss to Kochuveli village was around Rs.157.4 crores and that of Alappad was Rs.647 crores. The socio-economic and opinion survey indicates that in the highly degraded centres, especially where there is externalities like acute

industrial pollution and rampant sea erosion due to sand mining, there is not only decline in fish production but also stagnation and lack of development of fishery related infrastructure. Further the fishermen are not willing to pay anything to compensate such losses but indicate that it should be exclusively borne by Governement or public agencies. Policy measures such as adequate care in seawall construction, discharge of industrial effluents after proper treatment, mesh size regulations to avoid juvenile fishing, restricting the number of minitrawl and ringseine units at the optimum level and sea ranching to maintain the sustainability of depleting resources are proposed for the environmental sustainability of coastal biodiversity

CHAPTER – 1

Introduction and Background

The coastal zone which is an interface between land and water, houses several productive systems namely, salt marshes, estuaries, mangroves, brackish water fisheries, coral reefs etc. These coastal areas are of enormous socio-economic importance because of the abundance of its natural resources like fish and enormous facilities for recreation, commercial and residential developments. The scope for development of ocean energy, wave energy, offshore mineral and oil deposits, sea farming and coastal aquaculture, all add to the value of these areas. Sea level rise and human activities make the preservation and management of coastal zone resources and its environment, of utmost importance.

The coastal belt of Kerala is extending to about 590 km with 226 marine fish landing centres with equal number of fishing villages with high density of population (2176/sq km). The natural habitat is under severe threat due to human intervention in forms of excessive fishing in the inshore waters, shallow water mining, lifting of coastal sands, destruction of mangroves, inflow of pollutants in the brackish water and sea, growing urbanization, construction of sea wall and other related activities. These activities are bound to disturb the coastal ecosystem affecting the sustainability of fishery resources and the livelihood security of vast majority of the inhabitants. Besides, the technological changes in fishing methods coupled with the increasing demand for fish as a food item and consequent price escalation lead to over-exploitation of the fishery resources. This condition affects the very sustainability of the productivity of the inshore ecosystems and increases the demand for environmental quality and conservation of resources. These are the motivating factors to take up the present project with the following specific objectives.

Objectives of the study

(a) To examine and document the extent of recent changes in the techno-exploitation pattern of inshore open access marine fisheries and socio-economic condition of stakeholders.

(b) To asses the economic impact of such changes on structure, composition and productivity of inshore marine fisheries and the livelihood security of the coastal population.

(c) To evaluate the economics of operation of different fishing units and its impact on fishery resource conservation and to suggest policy measures for sustainable development of coastal zone.

(d) To provide sufficient socio-economic indicators in the field of environmental economics to administrators and policy makers for decision-making in the regional environmental planning.

(e) To estimate the economic loss due to the environmental degradation of inshore marine ecosystem.

Methodology and Data Analysis

I. A preliminary survey was conducted in all the fishing villages covering the entire study area to identify representative sample villages of mechanised, motorised and non-mechanised fishing centres. For this the information on the natural resource inventory, type of fishing equipments, fishing and fish marketing infrastructural facilities, coastal biodiversity, ecosystem health and environmental degradation has been collected in the village schedule (Annexure I). The villages and the landing centres were selected for detailed study on the basis of use pattern of marine coastal resources by the coastal population of the Southern Kerala. The intensity of operation of different craft-gear combinations both in artisanal and mechanised sectors was also considered for the selection of landing centres.

II. On the basis of the preliminary survey, the fishing villages were classified into highly degraded, moderately degraded and comparatively undisturbed categories in relation to the intensity of environmental pollution as well as fishing. Munambam, Cochin and Neendakara centres in the mechanised sector and Kochuveli and Alappad centres in the non-mechanised sector were selected for detailed studies under the highly degraded category.

Valanjavazhi, Thangassery and Vizhinjam centres operating mostly motorised units were selected to represent moderately degraded category and Arthungal and Poovar centres mostly operating non-mechanised fishing units were selected to represent the comparatively undisturbed category (Fig. 1).

III. To evaluate economics of different fishing units, two types of schedules were used. The first one was to collect information on the fixed cost details of different craft-gear combinations and the other for collecting daily operating costs and earnings on sample days (Annexure II & III). These were collected from the fishing units operating in the selected centres by direct observation on sample days covering all fishing seasons for one year (2000-2001). The fishing units selected for the study were mechanised units (trawlers, purse seiners and gill netters), motorised units (Plank built boats with ring seines, mini trawlers, plywood boats with hooks and line or gill nets) and non-mechanised units (catamarans with gill nets, shore seines and dinghy with gill nets).

IV. A socio-economic survey was conducted in all the selected centres to assess the socio-economic status of the coastal rural sector with the help of a detailed schedule (Annexure IV). The direct and indirect effects of various Government policies for conservation and sustainable economic development like mesh size restrictions, introduction of restricted area of operation for ring seiners and ban on monsoon trawling, on the livelihood security of the fishermen were studied through the data collected in the socio-economic survey and the effect of these regulations on the effectiveness and profitability of various fishing operations from the data collected through cost and earnings survey.

V. Secondary time series data from 1961 to 2000, relating to species wise catch obtained from the National Marine Living Resource Data Centre of CMFRI were used to study the extent of variation in catch composition, production trend of inshore marine fisheries and the impact of technological advances on marine resource base. The analysis of the major technological transition and consequent changes in the overall production and catch

composition during the pre-mechanization period, mechanization period and post- mechanization period was also done.

VI. In order to evaluate the response of those who involved in fishing and allied activities, regarding the environmental and conservation problems of the natural fishery resources, an opinion survey was conducted in all the selected villages (Annexure V). The extent of damage caused by the technological advancements and thereby the destructive fishing by the mechanised as well as the motorised sectors was analysed.

Socio-economic evaluation

The costs and earnings data for all types of fishing units were collected on sample days covering all seasons in a year, were utilized for the calculation of the economic indicators such as net profit, rate of return etc. The various components of costs are classified into operating costs and fixed costs. Operating costs include all those costs, which are incurred only when the vessels are under operation and fixed costs are those incurred even if there is no operation. Along the Kerala coast, sharing of the catch is the prevailing system of payment of wages for fishing labour. For the mechanised fishing units, in the revenue per trip, after deducting the daily bata and fuel cost, labour share is one-third for gillnetters, 35% for trawlers and 40% for purse seiners. In the motorised sector, the share of labour is 50% for ringseiners and in the rest of the motorised units, two third of total revenue per trip catch, after meeting all the expenses is paid as wages. In the non-mechanised sector also, two third of the revenue per trip is paid as wages to the labourers. The other operational costs include fuel cost, auction charges, bata and cost towards repair and maintenance of the craft and gear. In Kerala, the share of workers remains unchanged for the last many years. This may be because the workers get higher wages each year due to the increase in revenue. This increase in revenue is mainly due to the continuing increase in fish prices in recent years.

The fixed cost includes the interest for initial investment, its depreciation and insurance premium. Depreciation is the permanent and continuing diminision in the value of capital asset, which in the case of mechanised fishing units comprised hull, engine, gear and other accessories. The depreciation for hull and engine was

calculated as 10 percent of its capital investment assuming a life span of 10 years and for the gear used in the mechanised trawler was calculated as 50 percent and for all the other types of nets 20% of their capital investment depending upon the economic life of these capital assets.

The data collected during the socio-economic survey were analysed to bring out the socio-economic indicators such as housing pattern, family size and demographic features, literacy level, ownership of fishing equipments and employment pattern with special emphasis on fishing income, income distribution, consumption and expenditure pattern, indebtedness and the environmental impact on socio economic parameters were given in percentage for different villages.

Economic loss due to juvenile fishing

Data on juvenile landings were collected from the landing centres along with the regular costs and earnings data collection. The length of juvenile specimens from the tip of the snout to the tip of the longest caudal ray were measured. The quantity of juveniles landed in each fishing unit was then recorded along with the corresponding price from the landing centre itself. The length-weight relationship of the form $W=aL^b$ was fitted to obtain the weight of the adult fish corresponding to the weight of the juvenile fish.

Where,

W= weight of the fish

L= Length of the fish

a= constant

b=exponent

The economic loss due to juvenile fishing by different fishing units was estimated using the following formula

$$I= [(\sum_{i=1 \text{ to } n} C_iQ_i)/n]-[(\sum_{i=1 \text{ to } n} c_iq_i)/n]$$

Where,

l=Economic loss per unit trip

C=Value of the marketable size fish/trip

Q=Quantity of the marketable size fish corresponding to the quantity of juvenile fish/trip

c= Value of the juvenile fish

q= Quantity of juvenile fish in the catch

n = number trips/boat

Economic efficiency of input utilisation

Cobb-Douglas production function was used to evaluate the economic efficiency of input utilization in trawler operation in three different regions viz. Neendakara, Cochin Fisheries Harbour and Munambam. The equation is given below

$Y=a.\ x_1^{b1}\ .x_2^{b2}\ .x_3^{b3}$

Where,

Y - dependent variable (Gross output in kgs)

x_1, x_2, x_3 – Independent variables

x_1 – No. of fishing days per in a year

x_2 – Quantity of fuel used in a year/unit

x_3 – Annual repairing & maintenance charges/unit

b_1, b_2, b_3 – Regression coefficients

Net Present Value for discounted economic loss

The Net Present Value (NPV) was calculated for discounted economic loss due to various environmental factors and economic loss due to the depletion of certain species because of overfishing using the following formula

$$NPV = b + b_1/(1 + r) + b_2/(1 + r)^2 + \ldots\ldots\ldots bn/(1+r)^n$$

Where,

b = present net benefit

$b_1, b_2 \ldots b_n$ = net benefit for the years 1 to n

r = discount rate

n = number of years

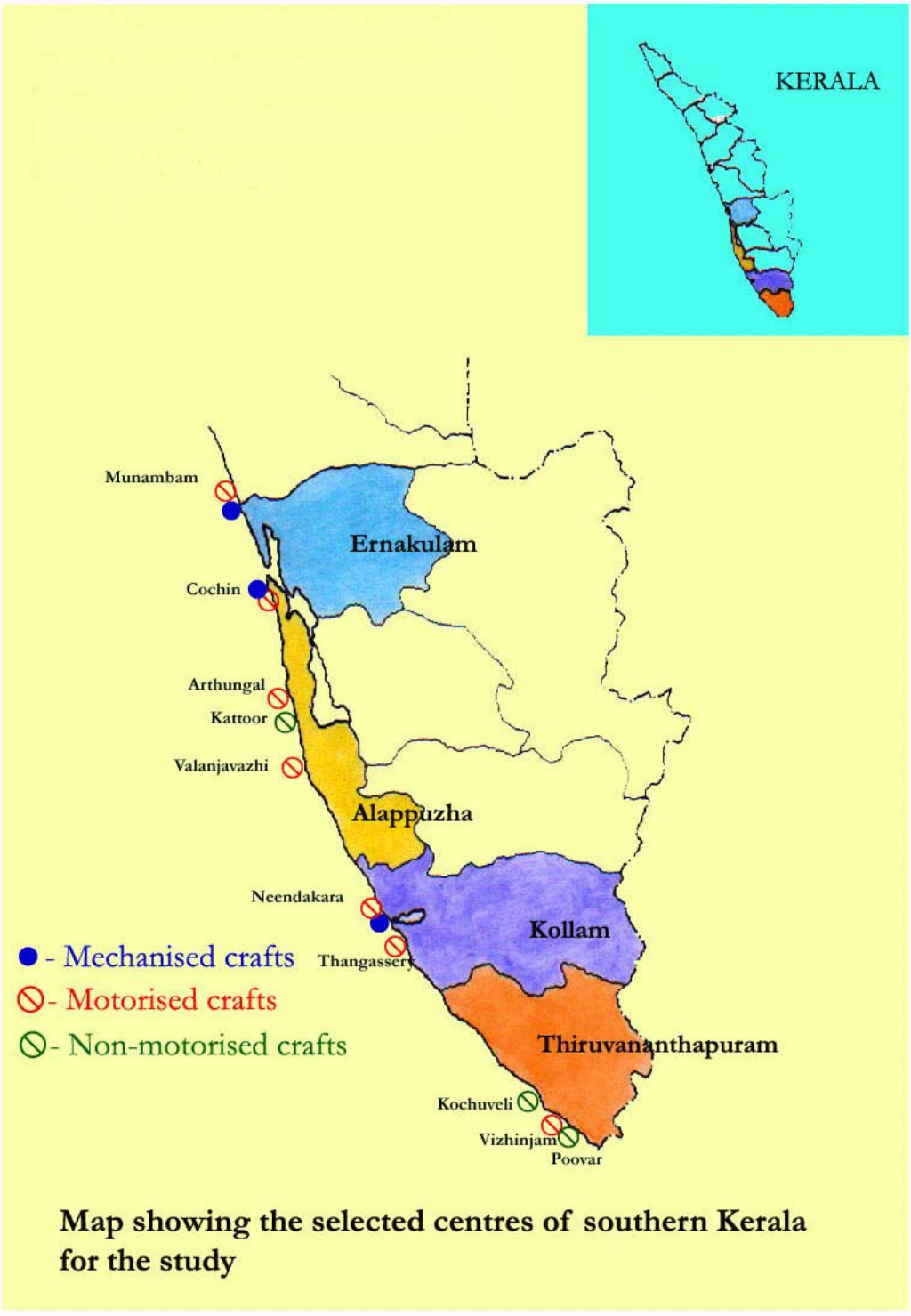


Fig 1: Map of the study area

CHAPTER – 2

Environmental features of the selected centres

The socio-economic survey reveals that more than 70% of the total population in these villages are depending directly or indirectly on the coastal resources especially the fishery resources for their livelihood. Among the selected centres, Munambam, Cochin and Neendakara are predominantly mechanised fishing centres having significant environmental and conservation problems. Many of the mechanised trawlers operating from these landing centres make multiday trips of 3-9 days duration and some units still operate single day trips. Mechanised gill-netters and purse seiners are the other types of units under operation. Many fishery related enterprises have been established in Munambam, Cochin and Neendakara, which include boat-building yards, ice plants and fish processing units. The infrastructure facilities available in each landing centre are given Table 1.

Table 1. Details of Infrastructure facilities in the selected villages (in No.s)

Village	Educational Institutions	Ice Factory	Marketing Facilities	Processing Units	Banking & Postal	Societies
Poovar	PS -2 Hr.Sec -1	9	2	-	Bank -2 PO -1	3
Vizhinjam	PS -1 Hr.Sec -1	10	-	-	Bank -3 PO -2	4
Kochuveli	PS -1	-	1	-	Bank -1 PO -1	2
Thangassery	PS -1 MS -1 Hr.Sec -1	2	3	2	Bank -2 PO -1	1
Neendakara	PS -3 MS -2 Hr.Sec -1	25	3	42	Bank -2 PO -1	1
Alappad	PS -2 MS -1	-	1	5	Bank -2 PO -1	1
Valanjavazhi	PS -1 MS -1 Hr.Sec -1	25	1	110 (Peeling Shed)	Bank -1 PO -1	12
Kattoor	PS -1 MS -1	1	2	2	Bank -1 PO -2	2
Arthungal	PS -2 MS -1	2	1	26	Bank -3 PO -1	6
Munambam	PS -3 MS -1	2	1	30	Bank -6 PO -1	3

PS -- Primary School, MS—Middle School, Hr.Sec – Higher Secondary School, PO--Post Office

Highly degraded area

The major environmental concerns of the highly degraded zone are excessive fishing pressure in the inshore region, heavy destruction of the bottom fauna, juvenile fishing, by-catches, discards and coastal pollution.

- The excessive fishing pressure exerted by the mechanised sector during monsoon season in Munambam, Cochin and Neendakara, in the inshore region up to a depth of about 50m have not only affected the sustenance of some easily vulnerable resources but also challenged the very existence of some shellfishes and finfishes.
- The mechanised bottom trawling especially, with the objective to harvest the target groups of export value, has resulted in massive destruction of juveniles/subadults of heterogeneous species of shrimps and finfishes and many bottom organisms, most of them having significant edible or economic value.
- The less valuable and undersized fish by-catches and the non-edible benthic biota are thrown overboard or dumped at the landing centres, which creates pollution and environmental hazards. By-catches were found to be more at these centres as most of the trawlers and gill-netters from these landing centres are multiday trip units.
- The post harvest loss and devastation of non-edible biota is considerably high in coastal fisheries along the study area. The most dominant items in the non-edible biota landed at these landing centres are stomatopods, gastropods, bivalves, crabs, echinoderms, benthic fishes and jellyfishes. Significant quantities of juvenile cephalopods were also landed here.
- The two major brackish water systems of Kerala join the coast of southern Kerala are the Ashtamudi Lake in Neendakara and the Vembanad Lake at Cochin. The natural habitats of Cochin coastal region are under constant and severe threat due to the increasing pressure caused by human intervention for industrial and urban activities. Along the Cochin estuary, industrial effluents together with the discharges from shipping and urban sewage have resulted in estuarine pollution. Estuary acts as a juvenile nursery ground for the commercially important marine shrimp species as well as finfish species. The

most important penaeid prawns, which enter the Cochin estuary, are *Metapenaeus dobsoni, M. monoceros* and *Penaeus indicus*.

- Contamination of seawater by the effluents discharged through the estuarine water, which include a) wastes and by products from the chemical producing industries which contain polychlorinated biphenyls (PCB), and trace metals, b) bacterial contamination associated with untreated human sewage, c) discharges of decomposable organic materials from human sewage and some industrial wastes which deplete dissolved oxygen and thereby the primary productivity of the area, d) toxic materials from industrial wastes and from land runoff, pesticides, herbicides and the waste from a variety of chemical manufacturing plants, and e) petroleum hydrocarbons discharged from shipping operations and oil spills have a variety of effects on the near shore marine fauna.
- Silting due to dredge operations has considerably reduced the quality of the estuarine and the coastal waters. Dredging of the estuary and bar mouth is being undertaken for maintenance of harbour and shipping channels. It involves massive disruption of the substratum together with disposal of soil either on the banks or out at sea. It therefore has major impacts on the ecology of the system and fishing activities.
- The abundant availability of coconut husk and the generally shallow nature of this estuary have led to the emergence of the coir industry as a massive cottage industry along this area. The coir retting in the estuarine water releases large amounts of organic matter and chemicals into the environment. These chemicals lead to the depletion of dissolved oxygen and accumulation of hydrogen sulphide, thus causing damage to the aquatic resources of the region.
- The destruction of marsh, mangrove swamps and mudflats for urban settlement and port activities have a serious concern in the coastal environment of the region. Mangroves play a role in giving shelter to the juveniles of fishes, shore stability and reduces global warming by fixing the atmospheric carbon dioxide thereby increasing the production of marine ecosystem.

- Indiscriminate use of different gears such as stake nets and Chinese dip nets destroy the juvenile shrimps and fish stocks, which enter into their nursery grounds. In the Cochin estuary, thousands of such gears are under operation, which filter the small sized juvenile shrimps, and fishes, which in turn affect the near shore coastal production of this area. Among the various categories of gear used in the estuary, 73 percent of the total landings are from these stationary gears, the stake nets contributing 53 percent (Menon *et al*.2000)

Another highly degraded area covered under the study is the Kochuveli village in Thiruvananthapuram District. The craft-gear combinations operated here are non-mechanised Catamarans with gill nets, shore seines and few motorised plywood boat units with gill nets (Table 2). About 70 percent of the population in Vettukadu and Kochuveli are engaged in fishing and fishery related activities. Even though the Kochuveli coast is dominated by non-mechanised country crafts, the environmental degradation in this area is high. This is due to the impact of marine pollution caused by a large industrial unit producing titanium products situated along the Kochuveli/Vettukadu, coast of Thiruvananthapuram. Large quantities of acid wastes from this industry are flowing to the sea, which causes many health hazards to the fishermen such as nausea, eye problems and bronchial diseases. According to the fishermen of Kochuveli, the nearshore fishing is a hazardous work in this area as the near shore water is polluted with this acid waste and eventually causes many skin problems.

Some of the areas under study are considered degraded due to sea erosion and sand mining. Alappad village in Kollam district was the one of the typically most affected and degraded villages due to the invasion of the furious sea, especially during the monsoon season. Here, many houses were collapsed along with the coconut plantations, in spite of a layer of thick wall constructed along the coast. According to the villagers, nearshore sand mining causes severe threat to the ecology and shore stability of this coastal area, which resulted in huge losses to the villagers.

Moderately degraded area

In the moderately degraded areas, the proliferation of motorised gears, operating within the nearshore areas creates heavy threat to the habitat. The indiscriminate operation of large number of minitrawl and ring seine units operated from the landing centre at Valanjavazhi (Table 2) and Pallana led to the depletion of some of the fishes of commercial importance.

Although the Kerala Marine Fishing Regulation Act of 1980 has restricted the ring seine operation, it has not yet been effectively implemented. Because of the better economic performance of ring seine units, especially in mid eighties, the size of craft, length of nets, HP of engines have been gradually increased leading to higher investment and rise in operating cost which in due course made this operation uneconomic.

Plate 1. Inflow of pollutants in Kochuveli region

Plate 2. Change of colour of seawater due to the inflow of pollutants in Kochuveli

Plate 3. Sea erosion - Washing away of shoreline in Alappad

Plate 4. Mangrove destruction – Serious threat to the ecosystem

The predominant use of gears with reduced mesh size leads to juvenile fishing and thereby growth overfishing of many important species of fishes such as sardine and mackerel. Large proportion of the catch in minitrawl is composed of juveniles/sub-adults of the flatfish *Cynoglossus macrostomus* and prawn *Parapenaeopsis stylifera,* causing damage to recruitment.

Table 2. Details of Craft -gear combinations in the different landing centres

Village/ Landing centre	Mechanised			Motorised			Non-mechanised		
	Trawler	Gillnet	Purse Seine	Plywood +gill net /HL	Ring Seine	Mini Trawl	Catamaran + gill net /HL	Shore seine	Dinghy + gill net
Poovar	-	-	-	150	-	-	600	11	-
Vizhinjam	2	-	-	800	-	-	75	10	-
Kochuveli	-	-	-	9	-	-	150	8	-
Thangassery	-	-	-	1200	25	-	-	-	-
Neendakara	800	30	11	40	45	-	-	-	-
Alappad	-	-	-	58	-	-	15	8	50
Valanjavazhi	-	-	-	25	6	500	-	-	-
Kattoor	-	-	-	-	15	40	-	-	60
Arthungal	-	-	-	-	45	300	-	-	-
CFH	500	200	70	30	-	-	-	-	-
Munambam	350	-	-	-	20	**25**	-	-	-

HL- Hooks and Line

Vizhinjam and Thangassery centres were also included under the moderately degraded area as these centres are dominated by outboard plywood boats, which are operating in the near shore areas. There are about 800 plywood boats at Vizhinjam with outboard Yamaha engine operating either with gillnet or hooks and line and this number exceeds 2000 during the monsoon period (peak season). The number of such units at Thangassery is 1200. The main occupation of more than 90 percent of the population in the Vizhinjam village is fishing or fishery related activity. The women participation in fish marketing is a noticeable feature of Vizhinjam and

Thangassery landing centres. The other major gears operating at Vizhinjam are shore seine and non-mechanised Catamaran with gill nets or hooks and line. Oil spills from outboard engines in the bay-landing centre creates pollution in the nearshore waters of

Plate 5. Juvenile fishing by the mechanised trawler

Plate 6. Shoreseine – An eco- friendly gear

Thangassery. Some mechanised trawlers also are operating from this landing centre creating further damages on the near shore areas. The major feature of this landing centre is the engagement of migrant fishermen, mostly from Kanyakumari District of Tamil Nadu, in fishing activities.

Comparatively undisturbed area

Kattoor, Arthungal coasts of Alappuzha and Poovar in Thiruvananthapuram district are the comparatively undisturbed areas along the Southern Karala coast in relation to coastal fisheries. Poovar is the southernmost landing centre selected for the study. Most of the gears under operation here are non-mechanised units such as Catamarans (Plank built canoe), shore seine units and motorised plywood boat with gill net/ hooks and line. Kattoor is a natural landing centre with traditional motorised and non-mechanised units under operation.

A preliminary analysis on the craft and gear combinations operating along the coast of Southern Kerala indicates that Ernakulam and Kollam districts share the total mechanized fishing units (Table 2). The majority of the motorised units are operating

in Alappuzha and Thiruvananthapuram districts. Catamarans operating with or without engines are only in Thiruvananthapuram district.

Recently artificial fish habitats were established off the coasts of Kochuveli, Kannanthura and Vizhinjam by Non Governmental Organizations. According to the fishermen of Kochuveli, it has resulted in an increase of fish catch in that area. But many fishermen, especially gill net operators, had complained that their gears getting damaged by entangling in such artificial structures and the real benefit is only for the hooks and line operators, who can use their gears in the artificial reef areas

CHAPTER - 3

Fishing methods and production trend

The South West Coast of India pioneered many technological innovations in fishing equipment and methods during the last five decades such as the introduction of mechanized trawling in mid sixties and large-scale purse seining in late seventies. Attracted by better catch and returns, more and more trawlers entered the fishing sector with modified technology resulting in disproportionately large-scale removal and destruction of young and juveniles of fishes and crustaceans along with a large spectrum of biotic communities. Even though intensive mechanization came into effect, during early eighties, Kerala marine fishery was dominated by traditional fishing methods till mid eighties. A fishing unit constitutes a gear, which is used for actual fishing operation and a craft for operating the gear. The traditional sector before the introduction of motorization, used the gears such as boat seines (an encircling net known as *thanguvala* in Central Kerala and *kollivala* in Northern Kerala), drift/set gill net, hooks and line and shore seines. These nets were operated by plank built boat, dugout canoes and catamarans. During early eighties, some of these traditional craft were fitted with outboard engines and these were known as motorised craft. Here, human labour was substituted by mechanical power only for propulsion. Fishing continued to be done by human labour. The traditional sector, which vehemently opposed the onslaught of mechanization, readily accepted the motorization of country craft with outboard engines mainly because it was not a labour saving device and does not create unemployment problem. The investment requirement was also within their financial limitations. Subsequently, traditional sector started operating those gears (trawl nets and purse seines) with motorised country craft so far used by only mechanised sector. This has resulted in better returns from fishing, which tempted the traditional sector almost entirely shifted to the operation of ring seine (mini purse seine) and mini trawl nets. Nineties witnessed the development of motorised plywood boats with gill nets or hooks and line in large numbers along the southern districts of Kerala coast, which further intensified the artisanal fishery.

Impact of Techno-Economic changes on inshore fishery

The species-wise annual marine fish landings of Kerala for the period from 1961-2000 is given in Table 3. The analysis of species-wise catch composition during the last four decades clearly indicate that the effect of these technological changes had affected some of the marine resources leading to their depletion. The catfish fishery along the Kerala coast is the best example for the indiscriminate fishing by the mechanised sector (Fig. 2).

Table 3: Species-wise annual average marine landings of Kerala (in tonnes)

Year	ELASMOBRACHS	Eels	Catfishes	CLUPEIDS	OilSardine	Anchovies	LIZARDFISH	H$F_BEAKS
1961	8515	2	3114	5967	166005	6742	5	128
1962	3342	3	1703	5373	91203	6367	339	16
1963	10509	6	2007	11930	58950	13180	78	141
1964	7218	0	2248	16109	190401	11216	62	20
1965	5969	3	3565	21235	219170	3567	199	35
1966	8080	0	5793	11286	202800	11560	173	190
1967	7330	271	7536	12060	235410	14391	192	101
1968	4175	2	4173	9217	247048	6945	581	114
1969	5759	9	6245	11382	139983	11652	546	83
1970	7490	1	16380	8595	191683	12558	1066	30
1971	4889	31	15189	13550	194977	13191	1395	97
1972	6986	5	12636	8555	104426	12673	1426	88
1973	8852	3	17438	64162	122783	10603	1136	185
1974	10338	49	33526	33551	102135	20784	8839	331
1975	10292	12	32603	35265	97183	13070	11294	278
1976	7308	10	12743	36298	123937	12719	99	141
1977	5796	6	7947	21863	117356	11753	5169	281
1978	9302	38	9125	14235	119937	23101	6246	281
1979	6954	10	11328	17755	116834	8341	5326	257
1980	6803	6	13936	12628	69667	10013	7080	361
1981	4871	3	9562	9569	146986	4927	5691	565
1982	6343	19	9532	11582	143215	14566	5480	1005
1983	8521	31	15344	13299	154880	56214	5456	483
1984	7637	19	11582	13151	146893	42932	6281	311
1985	6013	3	5184	7420	79237	38045	5695	664
1986	6056	1	8589	16630	40595	30254	6351	558
1987	4473	13	4660	18197	44717	19935	5212	748
1988	6761	15	9960	21573	60508	51786	13415	1269
1989	4680	1	4097	26150	184879	47944	7940	636
1990	6968	31	2739	22204	179276	29219	11469	631
1991	3441	14	1744	40186	106263	48902	11398	810
1992	3323	12	1029	44004	54118	55893	14126	407
1993	4432	47	597	37860	49675	54667	13833	398

1994	5887	131	499	31164	1554	38767	12065	456
1995	4109	244	308	56985	13328	41406	12581	3574
1996	4422	327	390	28764	30607	35701	10825	469
1997	3915	294	192	26511	93636	32220	7552	705
1998	4110	298	213	31967	77795	40013	8598	639
1999	3677	178	248	37553	143152	28810	6412	704
2000	2832	92	103	10075	241411	25643	7779	610

Table 3: continued

PERCHES	GOATFISH	THREADFINS	CROAKERS	RIBBON FISH	CARANG	SILVERBEL	B.J.JUMBER	POMFRETS
1316	226	22	2501	4047	5311	6060	1426	659
913	526	37	1228	637	1501	5285	1409	9551
831	557	240	1674	1279	4891	4548	2169	1251
791	189	113	3647	169	15313	9100	990	1077
1057	305	73	3267	13826	4083	9893	1332	435
1286	2782	152	4921	21102	8039	12970	2393	562
1717	164	49	4310	6841	10358	11987	4824	1661
1649	495	80	3630	992	4969	7099	1771	973
2340	1548	142	3195	7446	3659	14019	1301	1177
4336	279	22	5792	4922	2797	16167	1443	693
3663	1573	569	4145	17380	5310	8630	2991	2416
3939	2960	24	6137	10459	15871	5057	3034	1932
8663	1537	570	11723	23897	14572	18392	6663	1809
20970	3881	3	9220	30192	5534	17523	2904	1500
14741	23	105	16811	15175	7539	5211	983	1181
3069	2577	122	6955	7687	10911	2727	468	799
14121	240	69	11965	7440	16484	7708	823	3712
24989	171	35	13045	24207	7621	3040	1533	1614
20239	127	29	5237	25718	12635	3597	253	1737
17814	1	8	6164	12937	4760	4148	861	907
8549	33	47	3145	7066	5050	2826	879	1373
11177	244	118	3581	11034	12691	8730	1609	4245
9877	152	176	6112	1109	16526	9511	1099	1996
26873	75	453	9686	6464	13672	3911	1645	1613
30710	100	156	8630	25146	12899	3419	1041	892
45990	232	90	12701	11880	71570	6029	1435	1856
30133	684	37	8161	15295	22772	6027	618	2123
32304	9836	101	8470	8952	47069	6493	821	1605
48986	6017	426	11402	7179	50219	5354	1320	1739
67356	6919	2	10868	9751	69068	6195	2340	2598
41122	18824	658	8816	2167	78726	5643	623	1243
49759	7583	32	15603	6162	85122	4480	675	2601

74813	2489	109	14657	7290	72289	6458	907	2654
60180	382	90	16734	15435	59580	4238	1135	3391
47620	174	14	9979	4641	102762	4005	561	1675
71157	83	0	17720	21884	61970	4536	2208	3644
46763	111	9	9952	18976	50271	4732	1791	2649
42370	358	321	13431	16579	64869	5118	3016	2858
40989	122	153	7607	16542	45297	6154	1645	1964
50819	63	37	9276	19264	29368	4519	1460	774

Table 3: continued

MACKEREL	SEER_FISH	TUNNIES	BARRACUDA	MULLETS	FLAT_FISH	PenPrawn	N.P.Prawns	Lobsters
20044	2885	4503	234	25	5882	20627	43	105
11938	1533	723	54	50	16189	29688	0	22
48917	1587	2286	204	136	7485	22228	76	90
9657	1906	1342	580	463	4324	35220	0	72
18048	1513	1831	902	67	7312	14327	84	130
10747	1263	1197	267	112	4736	28120	259	557
4500	1353	1445	1129	285	3201	27164	88	58
3599	3785	1852	494	186	9495	25356	35	177
29981	1010	978	339	64	10039	34334	34	435
54659	1731	1226	79	154	10212	36940	14	0
95164	2800	3043	174	549	8807	31294	1519	523
34516	1386	3626	1125	91	6119	35866	711	0
19780	1690	2699	2333	103	8551	84770	981	1781
10335	4909	5927	3865	955	12771	59815	1014	2886
14930	4065	5845	396	74	6932	77207	755	31
19978	5936	12880	494	26	3567	34478	55	50
19968	3250	6705	353	38	5778	40150	174	40
25917	3354	6548	721	1	7276	45034	394	38
18585	6275	15391	477	39	4487	29522	75	26
18474	3763	10611	330	151	4394	52633	1742	18
16200	3330	5638	812	120	5034	22268	160	50
10717	5617	7534	656	33	11603	26708	65	94
12683	6999	5845	1140	116	13323	29754	105	68
11676	6244	6488	1109	69	17806	35529	738	53
18115	8459	10009	921	716	11332	26685	202	93
21881	4859	15030	1317	367	9435	37098	194	50
10063	5181	10763	929	841	10197	52866	259	139
43938	10162	13086	1886	19	12965	67498	163	112
85272	8029	22459	2144	78	20247	53317	18	74
78335	5372	32860	3842	39	15427	45483	2	123
53978	4600	13223	4211	103	14496	60318	276	195
37909	8734	16459	4046	66	28445	51068	63	206
59171	6447	13501	3018	195	20618	47988	131	40

111879	5837	14540	2836	663	20999	71871	103	443
78515	5910	11088	4677	701	12385	43224	182	97
128411	4828	18200	4134	306	15768	46143	136	112
82429	4216	16736	3496	75	20375	56131	431	265
61499	5669	11958	9781	116	16747	58523	52	64
82469	2945	18165	2822	49	25433	42133	2573	513
33854	4998	16763	2996	338	16769	56462	9635	535

Table 3: continued

Crabs	Stomatopods	MOLLUCS	Cephalopod	M.TURTLES	M.MAMMALS	MISCELL.	Total
0	0	0	28	0	0	2202	268624
0	0	0	17	0	0	2823	192470
0	0	0	180	0	0	5811	203242
0	0	0	340	0	0	5406	317973
0	0	0	174	0	0	6771	339173
0	0	0	714	0	0	4683	346744
0	0	0	374	0	0	5328	364129
0	0	0	1122	0	0	5283	345301
0	0	0	164	0	0	6923	294787
556	0	0	86	0	0	12966	392880
0	0	0	473	0	0	11002	445347
158	0	0	350	0	0	15419	295618
0	0	0	339	0	0	12208	448269
0	0	0	2175	0	0	14305	420257
1797	0	0	3342	0	0	43696	420836
1316	0	0	872	0	0	22824	331047
4621	0	0	4973	0	0	26254	345037
2176	0	0	6516	0	0	16823	373339
7643	0	0	2976	0	0	8635	330509
7286	0	0	4244	0	0	7803	279543
168	2830	0	2376	0	0	4251	274395
347	4023	0	3536	0	0	9690	325795
474	6341	0	1727	0	0	6404	385765
505	7055	0	5422	0	0	7576	393471
974	7817	0	8308	0	0	7112	325997
1373	9102	0	15017	0	0	6367	382907
2560	11223	0	7535	0	0	6922	303286
2151	11549	0	15155	0	0	9183	468808
2664	13312	210	23488	0	0	7245	647526
4704	17028	155	24206	0	4	7644	662890
4317	10071	134	19468	0	7	8110	564161
4864	12730	799	30625	0	4	17997	560342

5612	19145	434	28471	0	11	26771	574739
4778	20031	1334	36936	0	6	24079	568034
2030	11573	470	43472	0	3	13349	531646
3581	9115	2112	32445	29	1	12011	572055
10438	24082	731	37058	0	0	18023	574774
6985	9115	956	32311	0	0	16357	542696
4836	13020	660	31221	0	0	12723	580773
5894	11835	445	30627	0	0	8831	604113

The average annual catch of catfishes in 1961 was 3114 t, which rose upto 33526 t in 1974 owing to the large-scale exploitation by the mechanised trawlers and purse seiners during the intensive mechanization period. The annual catch recorded in 2000 was only 103 t. The major reason for the decline of this particular species was the overfishing of brooders. The harvest of catfishes was at its peak mostly during September-October period when the species congregated the coastal waters for breeding. During the period 1979-86, more than 50% of the catch consisted of gestating males, each fish carrying about 50 eggs/embryos (Bensam and Menon, 1994). This large-scale destruction took place over a period of two months, September and October.

The pelagic fishes such as the carangids, tunnies and seerfishes were exploited in their maximum during 1985 to 1990 mostly by the motorised country crafts especially using ring seines, gill nets and hooks and line. Then onwards the catch showed a declining trend in spite of the increase in the number of motorised units in the area. The highest annual catch during the last four decades recorded for carangids were 36,177 t in 1986, which declined to 16,992 t in 2000. The all time high catch for tuna and allied species was recorded in 1990 with a catch of 32,615 t, which showed a declining trend thereafter, and in 2000, it was only 15,920 t. Another endangered species is the polynemids collectively called, threadfins. In 1961, its catch was only 22 t due to the less exploitation of the species. In 1971, it rose to 570 t and the peak observed in 1991 with 658 t, which was the intensive period of mechanization and motorization. Finally the catch declined to mere 37 t owing to the overexploitation of the stock. The major cause of the depletion was destruction of their nursery grounds by the mechanised trawlers. The annual production of elasmobranches had also

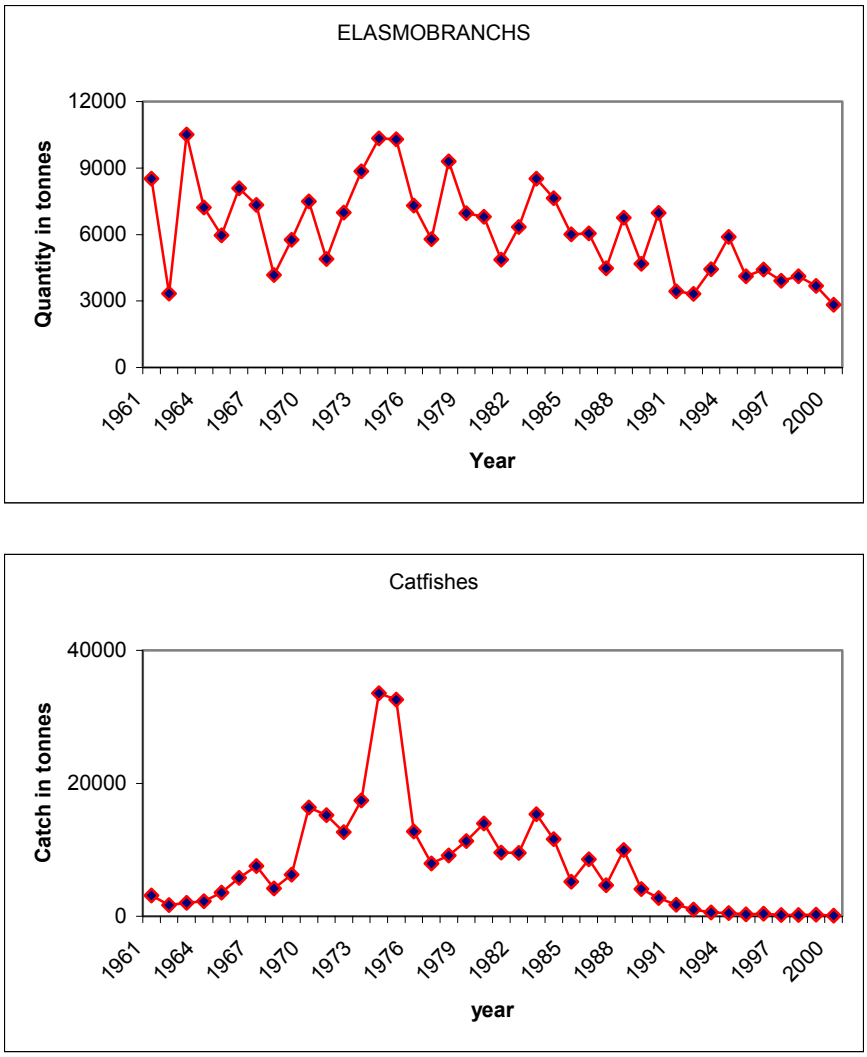
shown to be declining ever since their peak landings of 10,338 t in 1974 and in 2000 it was only 2,832 t.

Certain less valuable fishes, which form the by catches in the mechanised trawlers, recorded an increasing trend in their catch (Fig. 3). These were the threadfin breams, lizardfishes, ribbonfishes etc. Ever since the landings data taken from 1981, the threadfin breams showed an increasing trend from 6,442 t to the peak catch of 55,708 t in 1993. The major reason for this increase was the increase in the effort of mechanised trawling for the targeted species such as cuttle fish and penaeid prawns. The production of lizardfishes also increased for the last three decades especially by the mechanised trawlers. Stomatopods were the other bycatch species landed by the trawlers and mostly regarded as discards, recorded an increase from 556 t in 1970 to 10,438 t in 1997. It was estimated that, in the total trawl landings, more than 45% was composed of bycatches, which include besides above mentioned species, the juveniles and sub-adults of a wide variety of commercially important fishes of pelagic and demersal habitats and prawns which are discarded.

The significant change in the marine fish production along the coast for the last two decades was the increase in the landings of the cephalopods, which forms a major share of the Indian export earnings. Cuttle fish, squids and octopus formed the major items among the cephalopods. In 1961, only 28 t of cephalopods were landed which increased to 30,627 t in 2000 with the highest value of 43,475 t recorded in 1995. The penaeid prawn catch of the State also substantially increased due to the influence of mechanization and motorization. The peak landings of penaeid prawns were observed in 1973 with 84,770 t, which then declined and stabilized around 56,400 t in 2000. The recent exploitation of deep-sea prawns by the mechanised trawlers operating from Neendakara, Cochin and Munambam also contributed substantially to the penaeid prawn catches. Irregular trend was observed in the catch of the two important pelagic fishes; oil sardine (Fig. 4) and Indian mackerel. However, it is evident from the available data that the total annual marine fish landing of the state has substantially increased between 1961 and 2000 with the highest landings of 6,62,890 t in 1990. The annual average marine landing in 2000 was recorded as 6,04,113 t. The growth rate recorded over the last four decades was 2.09%. The growth of motorised sector was higher compared to the mechanised sector during the

last 20-year period with 17.15 and 3.32% respectively. Negative growth was recorded by non-mechanised sector (-9.09%) during the above period.

Figure 2: Extinction of some of the resources due to environmental and technological changes



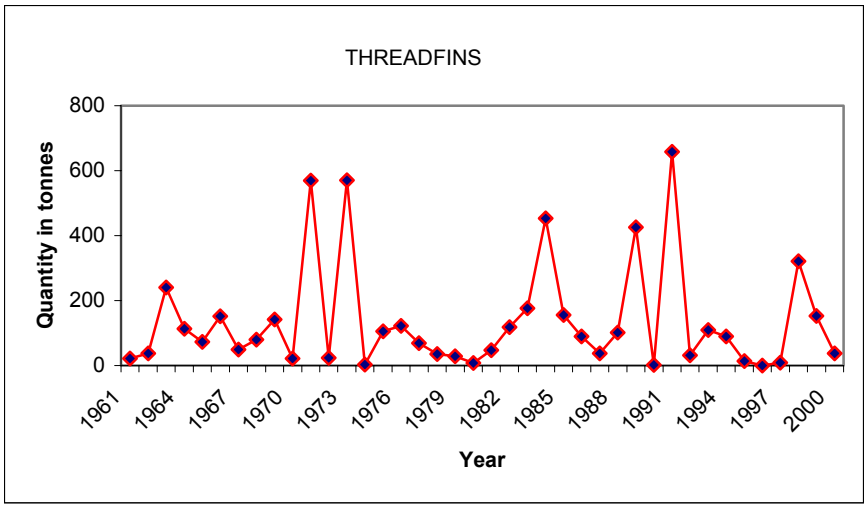
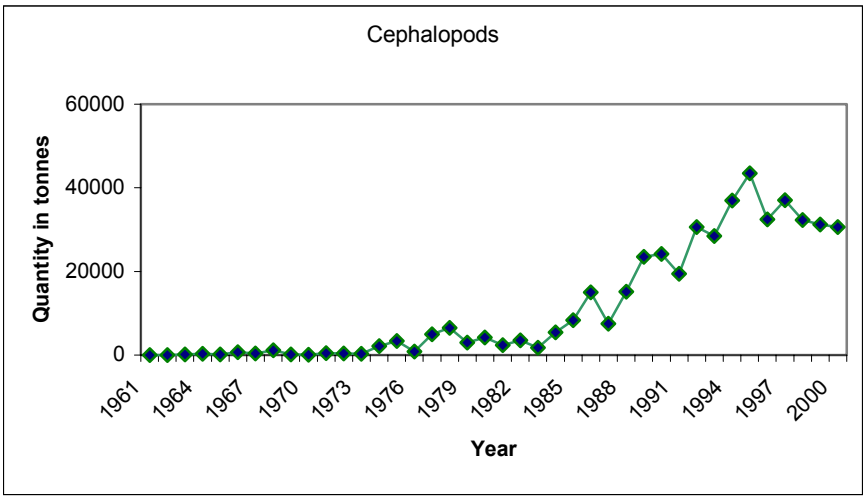
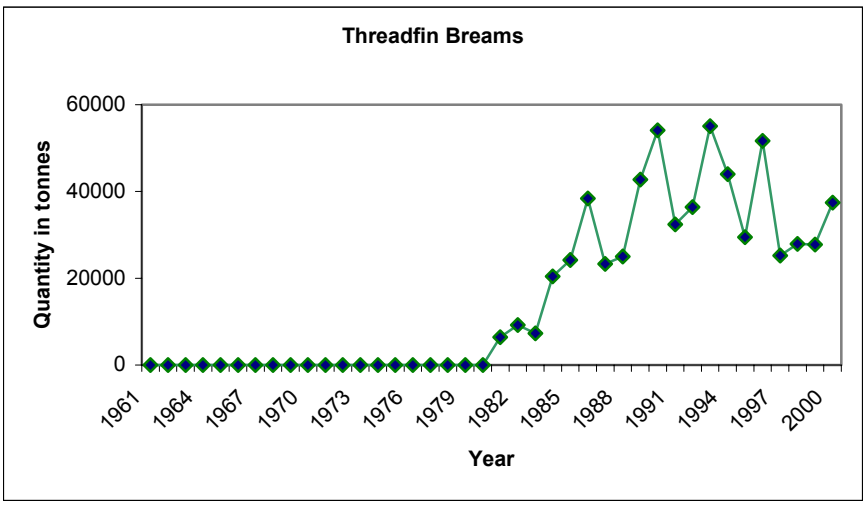


Figure 3: Increasing annual landings of some of the resources due to technological impact





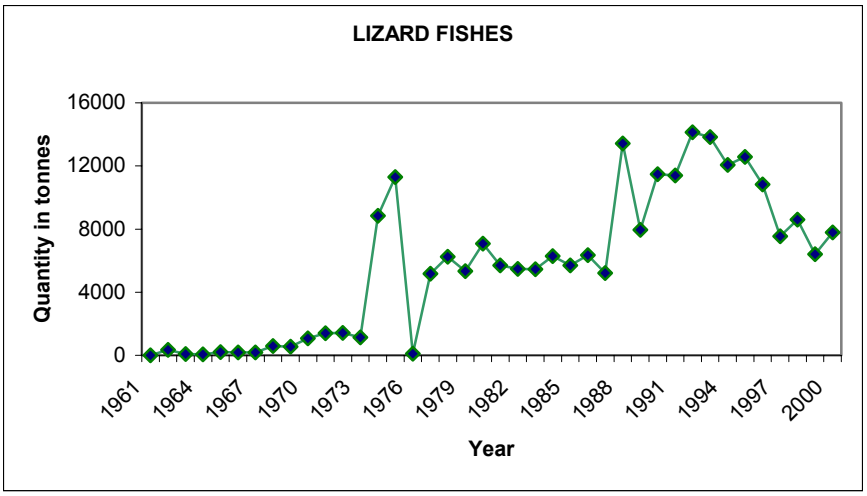
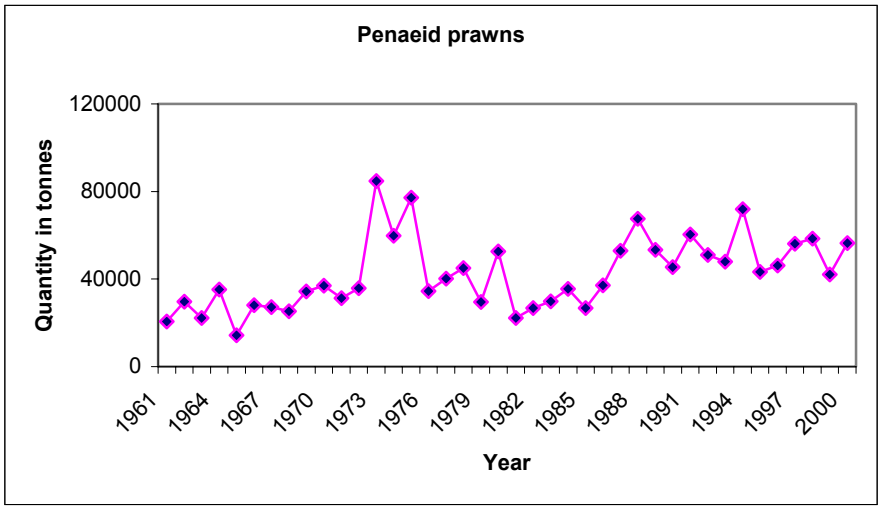
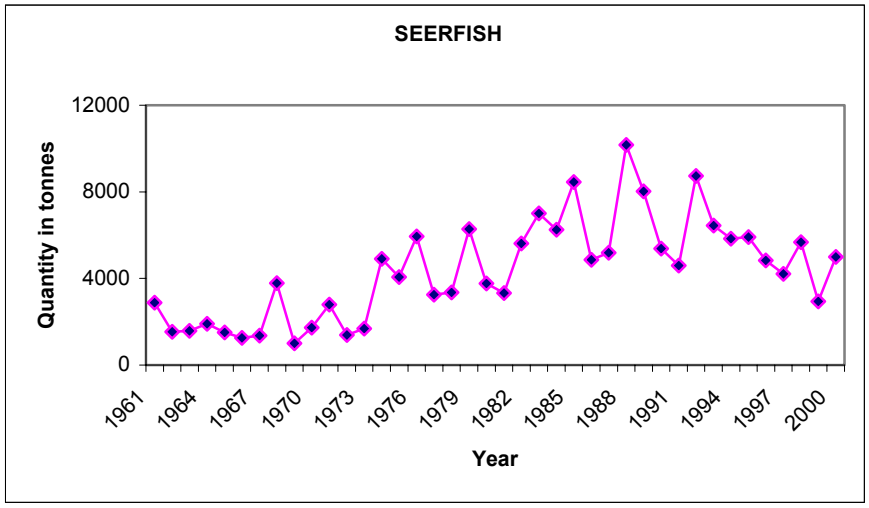
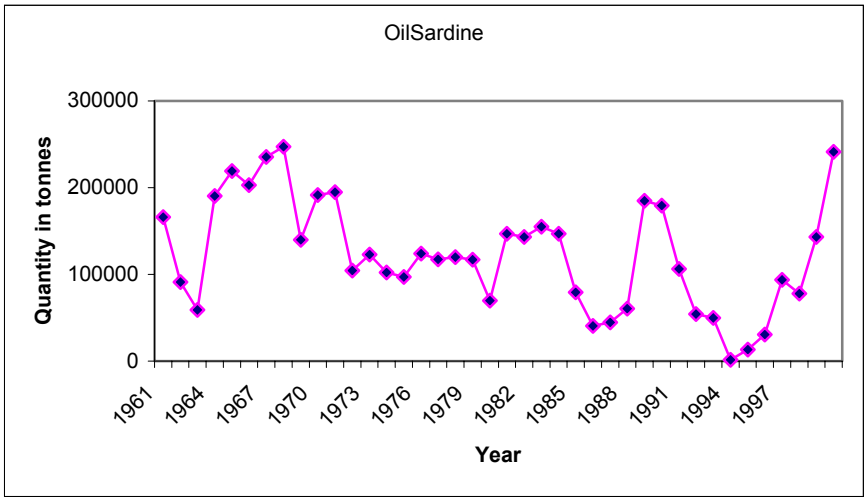


Figure 4: Trends in the annual landings of some cyclically fluctuating resources






OilSardine
300000
200000
100000
0
Quantity in tonnes
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
Year

CHAPTER - 4

Socio-economic evaluation

The selected villages along the coastal stretch of Kerala between Munambam in the north and Poovar in the south were surveyed to assess the socio-economic status of fishermen and the other people who depend on the coastal resources for their livelihood. The surveyed villages are shown in the map (Fig 1). In each village, the coastal wards, where fishermen are predominantly inhabited were covered under the survey. The indicators such as housing pattern, family size and demographic features, literacy level, ownership of fishing equipments and employment pattern with special emphasis on fishing people, income distribution, consumption and expenditure pattern and indebtedness have been worked out. The total number of households, sample size for the survey and details of fishing units in each village are given in Table 4.

Table 4 : Total households and fishing units in the surveyed villages

Village	Total households	Sample size	Fishing units		
			Mech units	Motor units	Non-mech
Poovar	800	100	0	150	611
Vizhinjam	3700	160	2	800	85
Kochuveli	500	100	0	9	158
Thangassery	6000	200	0	1225	0
Neendakara	7500	200	841	85	0
Alappad	1100	100	0	58	73
Valanjavazhi	2850	150	0	531	0
Kattoor	700	100	0	55	60
Arthungal	2700	150	0	345	0
Munambam	4300	200	350	45	0

Housing pattern

Housing pattern is one of the important yardsticks to measure the economic well being of any society or households. The total number of households ranged from

about 1000 in Kochuveli to 12000 in Thangassery. The houses were classified into thatched- those with thatched roof, tiled- those with tiled roof and brick walls and concrete- those with concrete roof and brick walls. The concrete houses were more in Munambam (39%) as well as in Kochuveli (32%) and least in Alappad village with 7% followed by Kattoor (9%) (Table 5). Tiled houses dominated in Kattoor (78%) and in Valanjavazhi (72%), which is an indication of the improvement of the living standards due to intensive motorization of traditional crafts, which helped the fishermen to increase their earnings. The tiled houses in Neendakara village were only 29%; most of them were wage earners in the mechanised trawlers. The number of thatched houses was highest in Alappad (66%), where sea erosion is predominant and least in Munambam and Kattoor villages. About 96 percent of the houses in Thangassery, Vizhinjam, Kochuveli and Munambam also had electric connections.

Table 5: Percentage distribution of housing pattern

Village	Thatched	Tiled	Concrete	Electrified	
				Yes	No
Poovar	17	69	14	83	17
Vizhinjam	44	44	12	90	10
Kochuveli	28	40	32	90	10
Thangassery	19	66	15	96	4
Neendakara	59	29	12	68	32
Alappad	66	27	7	52	48
Valanjavazhi	15	72	13	68	32
Kattoor	13	78	9	49	51
Arthungal	15	68	17	70	30
Munambam	13	48	39	88	12

Family size and demographic details

The average family size ranged from 4 in Poovar, Vizhinjam, Kattoor and Arthungal to 6 in Valanjavazhi. All other villages had a family size of 5. Except in Thangassery and Munambam, all other villages show a dominance of male population ranging from 50-56%, highest being in Kochuveli (56%). More than 70% of the population in Kochuveli, Valanjavazhi and Kattoor were adults. Adults were least in Poovar (59%), where 30% were children of less than the age of 14. In Thangassery and Munambam also the children population were high with 30% each. 2% in Neendakara and 1% each in Poovar and Kattoor in the age group of 15-18 were workers. The details of family size and demographic features are given in Table 6.

Literacy level

In Munambam and Arthungal, more than 95% of the people (excluding children of 7 years) were literates and more than 60% had completed primary education (64% and 62% respectively). Illiterates were more in Vizhinjam (27%) and Thangassery (21%). Maximum number of people with secondary level of education was observed in Alappad (50%) followed by Valanjavazhi (40%) and Kattoor (36%). Except Vizhinjam and Valanjavazhi, in all the villages 4-6% of the people have gone for college level education. Percentage distribution of literacy level in the selected villages is given in Table 7.

Table 6: Average family size and percentage demographic details of the selected villages

Villages	Family size	Male (%)	Female (%)	Adults (%)	15-18 age group		Children (Age <14) (%)
					Working (%)	Non-working (%)	
Poovar	4	56	44	59	1	10	30
Vizhinjam	4	50	50	62	0	10	28
Kochuveli	5	56	44	70	0	8	22
Thangassery	5	48	52	64	0.5	5.5	30

Neendakara	5	55	45	68	2	7	23
Alappad	5	51	49	67	1	10	22
Valanjavazhi	6	54	46	72	0	4	24
Kattoor	4	55	45	73	1	8	18
Arthungal	4	51	49	68	0	8	24
Munambam	5	48	52	61	0	9	30

Table 7: Literacy level – percentage distribution of people in the surveyed villages

Village	Illiterate	Primary	Secondary	Above secondary upto graduation		PG
				Technical	Non technical	
Poovar	18	52	24	0.5	5	0.5
Vizhinjam	27	45	26	0.5	1	0
Kochuveli	15	45	35	3	2	0
Thangassery	21	47	28	2.5	1.5	0
Neendakara	5	49	40	0	6	0
Alappad	5	38	50	0	7	0
Valanjavazhi	17	42	40	0	1	0
Kattoor	15	44	36	0	5	0
Arthungal	2	62	32	3	1	0
Munambam	0.5	64	30	4	1	0.5

Ownership of fishing implements

The non-mechanised fishing vessel owners were more in Kochuveli and Poovar where 18 and 20% of the families respectively are having non-mechanised catamaran with gill nets. The percentage of families having non-mechanised shore seine were 7% in Poovar and 4% in Kochuveli. About 5% of the families in Alappad

and Kattoor were the owners of non-mechanised dinghy with gill nets. In Kochuveli, the livelihood of fishing community was seriously affected by pollution, which indicated by the non-existence of any improved technology in this area. Fishermen are mostly using country craft and catamaran without any sort of mechanised device. In Poovar, more families use non-motorised catamaran and country crafts mainly because it is an economically backward village with having no facility for institutional credit. In Vizhinjam, 23% of the families were owner operators of plywood boat units with gillnet/hooks and line. Motorised minitrawl units were found more in Valanjavazhi with 24% of the families owning such units. In Arthungal 12% of the families have minitrawl units. About 4% of the families in Alappad was having motorised ring seine units. The proportion of households that owned mechanised trawlers were 5, 4 and 4% in Alappad, Neendakara and Munambam respectively. The details of fishing implements owned by families are shown in Table 8.

Table 8: Ownership pattern of fishing implements – percentage distribution of families

Village	**Non-mechanised**			**Motorised**			**Mechanised**
	Shore seine	Catamaran & gillnet	Dinghy & gillnet	Plywood boat & gillnet	Ring seine unit	Mini trawl unit	Trawler
Poovar	7	18	-	8	-	-	-
Vizhinjam	-	3	-	23	-	-	-
Kochuveli	4	20		2	-	-	-
Thangassery	-	-	-	7		2	-
Neendakara	-	-	-	4	-	-	4
Alappad	-	-	5	6	4	-	5
Valanjavazhi	-	-	-	-	-	24	-
Kattoor	-	-	5	-	3	4	-
Arthungal	-	-	2	-	1	12	-
Munambam	-	-	-	-	-	3	4

Employment pattern

Out of the total population, 69% of the adult people in Arthungal were employed followed by Poovar (67%) and Valanjavazhi (61%) (Table 9). The lowest employment status was obtained in Kochuveli (47%), followed by Thangassery (51%), where most of the women members are housewives. More than 50% of the employed people in Vizhinjam, Valanajvazhi and Kattoor were wage earners in the motorised fishing units, which offer better living standard and income to the fishermen. About 47% in Neendakara and 48% in Munambam were employed as wage earners in the mechanised fishing units. In Poovar and Vizhinjam, where non-mechanised units are predominant, the percentage of people working as wage earners in non-mechanised units was 30 and 48% respectively. Motorised fishing unit operating owners were higher in Vizhinjam (15%) and Valanjavazhi (13%) and non-mechanised units operating owners were encountered more in Poovar (12%) followed by Kochuveli (10%). About 21% of the people in Kochuveli and 19% in Poovar were engaged in marketing mostly representing the women headload vendors, generating additional income to support their family. In Kochuveli, because of the discharge of effluents from Titanium factory to the sea, the intensity of fishing has come down as the pollutants from the factory is having a detrimental effect on the fishery. There has been a considerable shift in occupation from fishery to non-fishery activities. Many have migrated to abroad for employment.

Table 9: Percentage distribution of people in different occupations

Village	Fishery									Fishery allied			Non-fishery
	Mechanised			Motorised			Non-mechanised			Marketing	Processing	Other	
	WE	OO	NO	WE	OO	NO	WE	OO	NO				
Poovar	1	-	-	22	5	-	30	12	-	19	-	-	11
Vizhinjam	0.5	-	-	55	15	0.5	6	2	-	6	-	2	13
Kochuveli	-	-	-	3.5	0.5	-	48	10	-	21	-	1	16
Thangassery	19	-	-	46	7	-	-	-	-	6	-	8	14

Neendakara	47	-	4	16	3	-	-	-	-	18	8	1	3
Alappad	25	-	5	20	10	-	25	5	-	1	2	-	7
Valanjavazhi	0.5	-	-	55	13	0.5	-	-	-	1.5	28	1	0.5
Kattoor	2	-	-	59	7	-	5	4	-	2	3	-	18
Arthungal	1	-	-	41	8	-	-	1	-	-	9	40	-
Munambam	48	-	3	7	1	-	7	2	-	17	2	13	-

WE: Wage earner, OO: Operating owner, NO: Non-operating owner

About 28% in Valanjavazhi were engaged in processing work, with most were ladies working in prawn peeling sheds. The other fishery-allied activities included those working in ice plants, net making and repairing etc. About 15% in Kattoor were engaged in such activities and the people working in activities other than fisheries such as agriculture, coir making, business, Government employment etc. were came about 18%. The average fishing days in a year ranges from 217 at Kattoor to 266 in Vizhinjam centre (Table 10)

Table 10: Seasonwise fishing days in a year

Village	Seasons				Total
	June-August	September-November	December-February	March-May	
Poovar	48	60	64	69	241
Vizhinjam	58	67	69	72	266
Kochuveli	47	68	67	68	250
Thangassery	60	65	60	62	247
Neendakara	42	63	61	57	223
Valanjavazhi	50	65	65	60	240
Kattoor	50	64	45	58	217
Arthungal	48	62	64	64	238
Munambam	47	59	62	62	230

Consumption and expenditure pattern

On the whole, in all the villages, the consumption pattern indicated that about 80% of the household expenditure was for household consumption. Among all the surveyed villages, about half of the households in Thangassery owned television, where as 29% of the total loan amount was utilized for the purpose of purchasing consumer durables and the lowest percentage (14%) was recorded in Kattoor. At Thangassery, 10% of the families were having Refrigerator in their houses and 10% telephone connection (Table 11). About 29% of the families in Valanjavazhi were having Audio sets. In Munambam, 41% of the families having television, 17% having audio sets and 12% are having telephone connection.

The average annual expenditure of households was worked out, representing all the categories in the mechanised, motorised and non-mechanised fishing sector and fishery allied and other categories. It ranged from Rs.19,600 for the families of peeling shed workers in Kattoor to Rs. 65,412 for the mechanised boat owning families in Munambam. The expenses were categorized into household expenses, which include expense for food, clothing fuel and other expenses, educational expenses and medical expenses. The category wise expenses of people in different sectors in percentage are shown in Table 12. It is clear that, more than 80% of the total annual expense was for household purposes. The major reasons for the higher medical expenses in Poovar could be attributed to poor living conditions and at Neendakara to environmental pollution in the coastal area and availability of better medical facilities. However, it was observed that medical expenses of families in different villages had not positive correlation with the intensity or incidence of diseases. Highest expenses were recorded from the two mechanised landing centres such as Munambam and Neendakara, which are more affluent and from the non-mechanised centre, Poovar, a backward village. In Kochuveli, which is considered as a highly degraded area, the medical expenses incurred were only 8% of the total expenditure of the family. The lowest percentage of 6.5 was observed in Kattoor, Thangassery and Vizhinjam centres.

Table 11: Family-wise ownership of consumer durables- percentage distribution

Village	TV	Audio	Cycle	M.cycle	Fridge	Telephone	Auto	Others
Poovar	27	15	6	-	-	-	-	-
Vizhinjam	37	8	-	-	2	-	-	-
Kochuveli	47	17	4	-	7	2	-	-
Thangassery	49	8	-	-	10	-	-	-
Neendakara	20	16	3	1	4	2	-	-
Valanjavazhi	24	29	1	-	-	-	-	-
Kattoor	14	24	-	-	-	-	-	-
Arthungal	27	20	8	-	-	2	-	1
Munambam	41	17	2	8	12	7	3	4

Income distribution

The average annual income of households belonging to each category is worked out and shown in Table 13. Among the people engaged in fishery and allied activities, the highest annual income recorded was for the mechanised boat owners with maximum in Neendakara and minimum in Munambam. The lowest income was recorded for the families of head load women vendors in Kochuveli and Vizhinjam villages and peeling shed workers in Neendakara and Alappad villages.

Table 12: Percentage distribution of expenses for different purposes

VILLAGE	FISHERY									FISHERY ALLIED			NON-FISHERY		
	Mechanized			Motorized			Non-mechanized								
	House hold	Education	Medicin	House hold	Education	Medicin	House hold	Education	Medicin	House hold	Education	Medicin	House hold	Education	Medicin
Poovar	84	6	10	86	6	8	89	3	8	80	3	18	78	16	6
Vizhinjam	83	12	5	83	9	8	92	2	6	92	1	7	-	-	-
Kochuveli	-	-	-	86	13	1	85	7	8	82	4	14	81	9	9
Thangassery	87	4	9	87	7	6	-	-	-	84	9	7	88	8	4
Neendakara	88	4	8	82	8	10	-	-	-	87	5	8	87	-	13
Alappad	82	9	9	82	10	8	88	2	10	83	11	6	89	6	5
Valanjavazhi	85	6	10	84	7	9	-	-	-	86	6	9	-	-	-
Kattoor	88	8	4	84	11	5	84	7	9	83	9	8	87	6	7
Arthungal	90	1	9	88	5	7	90	2	8	85	3	11	91	4	5
Munambam	80	9	11	80	11	9	-	-	-	79	12	9	79	10	11

Table 13: Estimated average annual income of families of different categories

VILLAGE	FISHERY									FISHERY ALLIED			NON-FISHERY
	Mechanised			Motorised			Non-mechanised			Marketing	Processing	Other	
	WE	OO	NO	WE	OO	NO	WE	OO	NO				
Poovar	110000	-	-	89100	166200	-	27800	95300	65900	12500	-	18000	45600
Vizhinjam	110000	-	-	89100	166200	77100	27800	95300	65900	15960	-	17000	55800
Kochuveli	-	-	-	89100	166200	-	35000	94200	60200	12000	-	21000	85940
Thangassery	125000	-	-	102800	213500	-	-	-	-	14000	-	25000	29230
Neendakara	125000	-	545900	102800	213500	-	-	-	-	15000	17500	21300	28500
Alappad	125000	-	545900	64500	94200	-	38600	74500	-	18000	18000	-	35400
Valanjavazhi	125000	-	-	46200	236300	194330	-	-	-	23500	19000	19700	48600
Kattoor	72200	-	-	39600	158500	117300	29500	30400	-	26000	22000	-	25700
Arthungal	72200	-	-	39600	158500	117300	-	30400	-	-	19800	24500	-
Munambam	58600	-	242200	39600	158500	117300	29500	30400	-	25700	19000	35900	-

WE: Wage earner, OO: Operating owner, NO: Non-operating owner

Indebtedness

The number of households in debt in the surveyed area and the average outstanding debt per household is given in Table 14. Indebtedness is one of the clear indications of economic activities of any region. Less number of families availing loans indicates that the production activities in the region is in lower ebb due to the lesser availability of credit. The percentage of families in debt ranged from 12% in Vizhinjam to 59% in Thangassery. The average outstanding debt per indebted household worked out at Rs. 12000 in Poovar to Rs. 57,047 in Munambam.

Table 14: Extent of indebtedness and credit pattern

Village	Percentage of families indebt	Purpose (%)			Average debt per family (Rs)	Average out-standing debt (Rs)
		Productive	Housing	Others		
Poovar	24	54	46	-	20291	12000
Vizhinjam	12	50	33	17	49333	30083
Kochuveli	14	57	29	14	31107	17464
Thangassery	59	27	24	49	32813	15781
Neendakara	18	36	34	30	80000	52000
Alappad	26	31	35	34	83988	33269
Valanjavazhi	24	46	30	14	36875	14104
Kattoor	16	31	44	25	68125	40538
Arthungal	38	45	37	18	22684	13214
Munambam	53	30	36	34	72990	57047

The loans taken for the purchase of fishing implements, agricultural activities and other income generative activities are considered for Productive purposes. The amount taken for the construction or maintenance of the house are considered Housing purposes and the loan taken for the household expenditure during the lean season, expenditure on marriage, social and religious purposes, medical treatment and purchasing consumable durables are considered Others category. The utilization

pattern of credit for different purposes clearly indicate that in most of the villages maximum loan was availed for the productive purposes. In Thangassery, where the percentage of families in debt was the highest, the major share of the loan was utilized for the other purposes mainly for purchasing consumer durables such as TV or audio. The amount of loan taken in the villages having more mechanised vessels was higher compared to the other villages. In Vizhinjam and Kochuveli in Trivandrum district, the percentage of families in debt were lesser mainly due to the lack of institutional credit facilities especially in Kochuveli, where fishing is still in the primitive stage without any technological advances due to pollution. The people, in many cases, find it difficult to obtain credit form the formal capital market, as they are unable to fulfil the conditions imposed by it before extending credit facilities

CHAPTER - 5

Economic evaluation of fishing units

Craft-gear combinations and investment pattern

The average initial investment for a trawler unit of above 50ft accounts to Rs.25 lakhs including all the accessories such as GPS, Echo sounder etc. A mechanised trawler with a length of 42-48ft costs Rs.13 lakhs without GPS and Echo sounder and for a unit of 38-42ft at Rs.6 lakhs. The average investment of a purse seine unit with a length range of 45-48 is Rs. 11 lakhs, which included craft, gear and engine. The initial investment of a gill net unit with length range of 32-38ft is Rs. 11.5 lakhs.

A plywood boat of 22-25ft with gill net and outboard engine on an average requires an investment of Rs.1.9 lakh and a minitrawl unit Rs.0.97 lakh. For a motorised ring seine unit of 50-55 ft length with an engine of 40HP, the investment comes about Rs.6.5 lakh of which more than 40% is for the gear having a length of 500 to 700 metres. A 40ft long motorised ring seine unit costs around Rs.5.1 lakhs. with all its accessories.

Among the non-mechanised units, a Catamaran unit with gill net of 100m length costs Rs.24000. The investment for a shore seine net of 40 metres length with the craft of 38ft costs Rs.1.02 lakh with a craft of 12 metres.

Catch composition of different craft-gear combinations

The major species composition in the annual catch of the mechanised trawler varied from centre to centre. In Neendakara, the deep-sea prawns dominated with 64% followed by cuttlefish (11%), whereas in Munambam, the major species landed was the less valuable threadfin breams (31%) followed by highly priced cuttlefish (24%). Some quantity of ribbonfishes (12%) also was landed here. Prawns contributed only 5% to the total catch. Ribbonfishes were the major contributor in the mechanised trawler at Cochin Fisheries Harbour (60%) followed by cuttlefish (17%). Threadfin breams (29%) and tunnies (28%) were the dominating species in the annual landings of the mechanised gill net unit operating from Cochin Fisheries Harbour. The pelagic

species such as mackerels (76%) and oil sardine (13%) were contributed to the bulk of the catch of mechanised purse seine unit (Fig. 5).

In the motorised sector, oil sardine (60%) and anchovies (21%) formed the major species in the landings of the minitrawl unit at Valanjavazhi. About 13% of penaeid prawns

Figure 5. Catch Composition of mechanised units at Selected Landing Centres

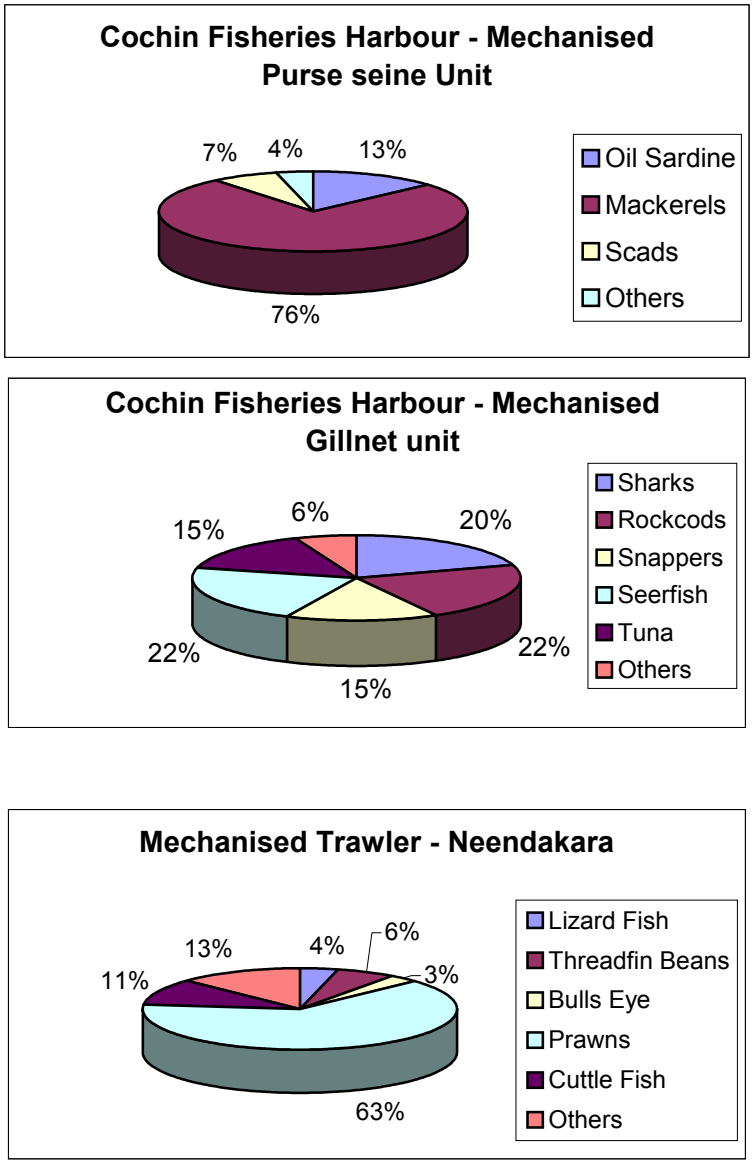
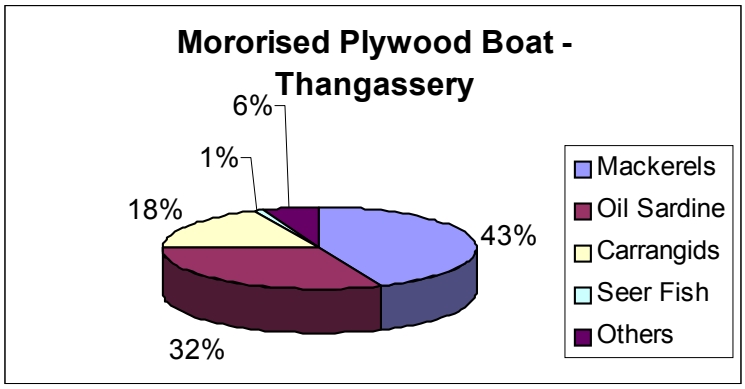
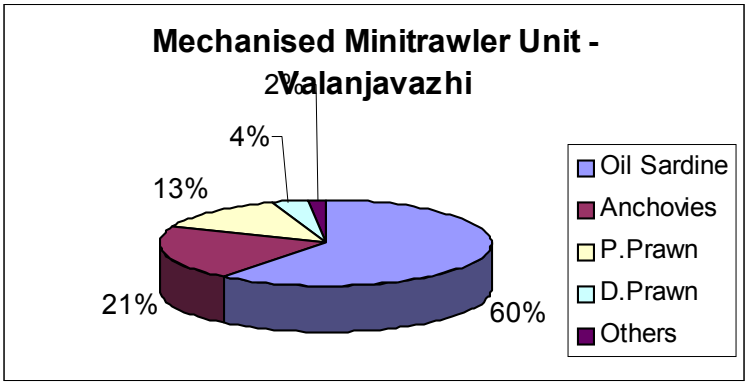


Figure 6. Catch Composition of motorised units at Selected Landing Centres





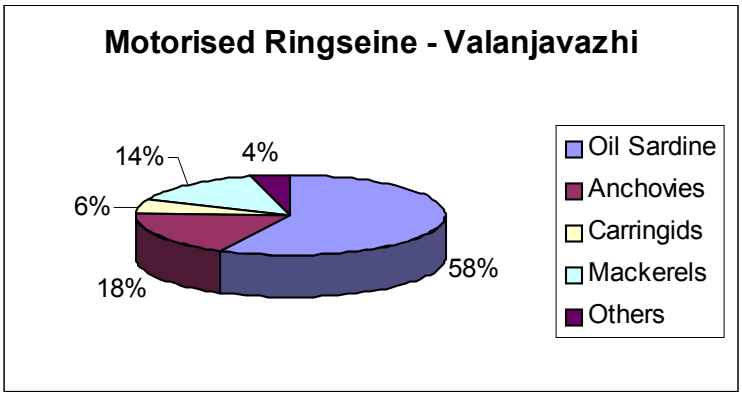
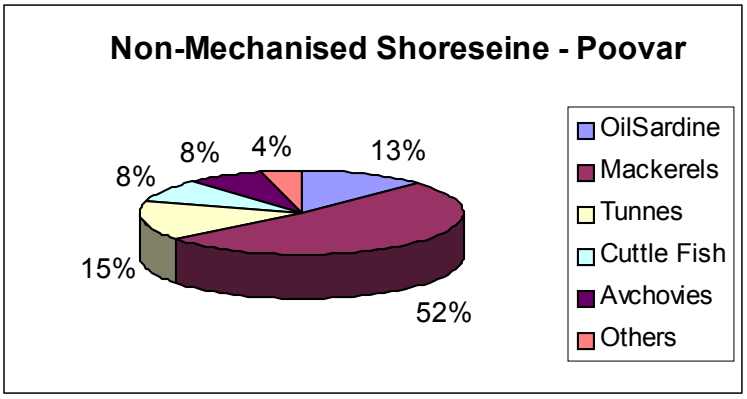
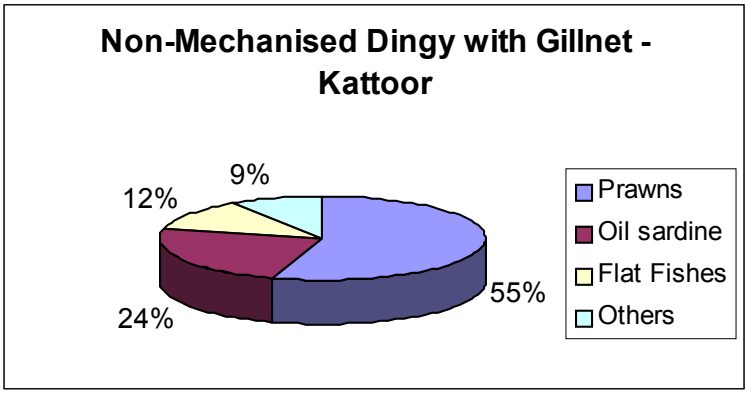
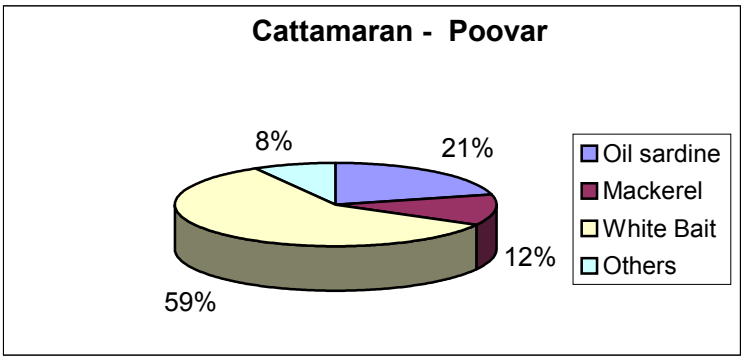


Figure 7. Catch Composition of non-mechanised units at Selected Landing Centres







and 4% of deep-sea prawns also were landed here, whereas in Arthungal, penaeid prawns dominated in the minitrawl catch (72%) followed by oil sardine (23%). About 44% of the catch of the plywood boat with gill net at Thangassery was composed of mackerels and 32% by oil sardine (Fig. 6). Carrangids formed 18%. In Vizhinjam, the catch of plywood boat with gill net unit was dominated by ribbon fishes (50%), followed by scads (21%) and tunnies (13%).

In the non-mechanised sector, oil sardine (53%) dominated in the catch of catamaran with gill net unit at Kochuveli, followed by anchovies (29%). The scads formed 5% of the total catch. In Poovar (Fig. 7), Catamaran unit with gill net was dominated with white baits (59%) and oil sardine (21%).

Economic evaluation

The annual average costs and earnings of various fishing units operating from the selected landing centres have been worked out. The technical parameters of operation of three different categories of craft-gear combinations are presented in Tables 15 to 17. In the mechanised sector, the annual net profit from the trawlers having Overall Length (OAL) of 36-42ft, 45-48ft and >50ft operating from Cochin Fisheries Harbour worked out at Rs.3.7 lakh, Rs.7 lakh and Rs.4.2 lakh respectively (Table 18). About 40% of the total expenditure was for the fuel followed by 25% for wages. The gross revenue worked out at Rs.28 lakh for the trawler with >50ft was highest because these crafts were equipped with fish finding devices which help them to locate the more valuable species such as cuttlefish and squids and these crafts have high storage capacity. However, the net profit was more for the 45-48 ft trawler because of the higher cost of 50ft trawler. At Munambam, the highest rate of return was recorded for the trawler with 36-42ft OAL mainly because of the lower investment (Table 19).

Regarding the purse seine units operating from Cochin Fisheries Harbour, the annual net profit worked out at Rs.14.3 lakh was maximum for above 50ft craft with the highest rate of return of 87% (Table 20). However, the rate of return of a purse seine unit with 36-42ft OAL was only 36%. About 60% of the total expenditure has gone for the cost of labour. Fuel accounted only 18% of the total operating costs. The mechanised gill net units operating from Cochin Fisheries Harbour with a length of 36-42ft are mostly multiday trip vessels. The average revenue obtained during the period 2001-2002 was Rs. 20.9 lakh with a net profit of Rs.4.7 lakh (Table 21). The rate of return worked out was 55%. The major operating expenditure worked out was for fuel (40%) and labour (39%). In Neendakara, which is one of the biggest mechanised landing centres in the country, most of the mechanised trawlers are in a length range of 32-48 ft. Normally, 2-3 days are involved in a single fishing trip.

Table 15:Technical and Economic parameters of craft-gear combinations of the study area – mechanised units

Fishing unit	Length (ft)	Avg. Investment (Rs)	No days/ trip	No of days/ year	Average fuel/ day	No of crew	Avg. ann. net profit (Rs.lakh)	Species composition
Mechan. Trawler	36-42 45-48 >50	6.0 13.0 25.0	4 5 7	200 200 200	96 120 154	4 6 8	3.7 6.9 7.2	T.Breams, Bulls eye, D.prawn, cuttle fish
Mechan. Purse seiner	34-42 45-48 >50	6.7 11.0 20.0	1 1 1	180 180 180	133 141 150	20 25 30	1.2 4.3 14.3	Oil sardine, mackerel, carangids
Mechan. Gill net	36-42	11.8	6	230	119	6	4.6	Sharks, Tuna, Snappers, Groupers

Table 16:Technical and Economic parameters of craft-gear combinations of the study area – motorised units

Fishing unit	Length (ft)	Avg. Investment (Rs)	No days/ trip	No of days/ year	Average fuel/ day	No of crew	Avg. ann. net profit (Rs.lakh)	Species composition
Motorised Ring seine	<32 32-48 >50	2.4 5.2 6.5	1 1 1	220 220 220	56 137 160	14 19 30	1.6 1.64 3.7	Oil sardine, Mackerel, Anchovies
Motorised Mini trawl	32-40	0.97	1	200	31	4	1.48	P. Prawn, Flat fish, Anchovies, Oil sardine
Motorised Plywood +Gill net /HL	32-40	1.5	1	215	20	4	1.1	Ribbon fish, Scads, Tunnies, Mackerel

The annual net profit worked out at Rs.5.45 lakh with a rate of return of 56%. The major expenditure incurred was for fuel (42%) and labour (30%). The other expenditure includes auction charges (7.5%), Bata and food (9.5%) and cost of ice (11%) including its transportation to the landing centre (Table 23).

Table 17:Technical and Economic parameters of craft-gear combinations of the study area – non-mechanised units

Fishing unit	Length (ft)	Avg. Investment (lakh)	No days/ trip	No of days/ year	Average fuel/ day	No of crew	Avg. ann. net profit (Rs.lakh)	Species composition
Dinghi + gill net	25	0.28	1	217	-	2	0.010	Prawns, Oil sardine, flat fishes
Shore seine	36	1.02	1	230	-	18	0.90	Oil sardine, anchovies, mackerel
Catamaran + gill net	32	0.23	1	230	-	2	0.2	Anchovies, oil sardine, mackerel, scads

The annual profit for the operation of the ring seine unit with a craft of >50ft at Valanjavazhi was Rs. 3.74 lakh (Table 24). The major expenditure was labour charges (40%) as 20-30 crew, depending on the size of the craft, are engaged in a single day trip. 37-40% of the total cost was for fuel. The rate of return from the ring seine unit at Arthungal was worked out at 60% (Table 24). The annual net profit obtained from a motorised minitrawl unit during the above period was Rs.1.48 lakh at Valanjavazhi and Rs.0.93 lakh at Arthungal with the highest rate of return of 168% were worked out for the former landing centre (Table 25). Labour and fuel costs were the major expenses in the operation of minitrawl unit. The average annual revenue from a plywood boat with gill net, operating from Vizhinjam centre was Rs.5.73 lakh with a net profit of Rs.0.77 lakh. The net profit from the same type of unit operating

from Thangassery centre was calculated at Rs.1.10 lakh. The rate of return was 62% and 86% respectively for Vizhinjam and Thangassery landing centres (Table 26). The annual profit from plywood boat unit at Kochuveli was only Rs.0.33 lakh with a rate of return of 36%. Rate of return from plywood boat unit at Alappad was only 35% (Table 27). Major portion of the expenditure of the plywood boat unit operation was the labour cost (79%) followed by fuel cost (13%).

Comparatively higher rates of return were obtained from the non-mechanised units such as Catamaran and shore seine units mainly because of lower investments. The only exception was the non-mechanised dinghy with gill net, which obtains a rate of return of only 19%, with an annual profit of Rs.955 (Table 28). However, in the dinghy unit, mostly the owner is the operator so that he can earn an annual income of Rs.0.16 lakh. The net profit from a shore seine unit worked out at Rs.1.14 lakh at Poovar and Rs.0.91 lakh at Kochuveli with a rate of return of 126% and 103% respectively. About 95% of the expenses were towards the labour cost. The rate of return from the shore seine unit operating form Alappad village was higher than that from Kochuveli with 116% (Table 29). Among the non-mechanised catamaran units, the annual profit was higher in Kochuveli with Rs.0.30 lakh compared to that of Poovar with Rs.0.20 lakh. At Kochuveli, due to pollution from industrial effluents to near shore waters, even though the average catch per unit of catamaran was much less than that of Poovar. The average revenue was high because fishing was extended to interior ground, thereby they could get quality fishes fetching higher prices. The rate of return was 145% and 101% respectively for Kochuveli and Poovar (Table 30). In both the cases, 95% of the expenditure was for the cost of labour.

Table – 18: Annual Average Costs & Earnings of Mechanised Trawler – Cochin Fisheries Harbour

A. Initial Investment (Rs.)	36-42	45-48	>50ft
Craft & Engine	560000	1245000	2428000
Gear	40000	55000	72000
Total	600000	1300000	2500000
B. Catch (Kgs.)			
Quantity	81555	87333	91333
No. of days fished	200	200	200
C. Revenue (Rs.)			
Total	1392222	2361666	2806666
D. Operating Cost (Rs.)			
Fuel	366666	356666	586666
Wages	333278	647150	712483
Auction	51111	141700	168400
Ice	40000	46000	51000
Food	33333	46666	51000
Repairing & Maintenance	30000	65000	125000
Total	854388	1303182	1713549
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	56000	124500	242800
Net (50%)	20000	27500	36000
Interest (@15%)	90000	195000	375000
Insurance (Rs.)	6000	13000	25000
Total Fixed Cost	172000	360000	678800
F. Total Cost (D + E) (Rs.)	1026388	1663182	2392349
G. Gross Returns (C – D)(Rs.)	537834	1058484	1093117
H. Net Returns (G – E) (Rs.)	365834	698484	414317
Rate of return (%)	62	68	31.5

Table – 19. Annual Average Costs & Earnings of Mechanised Trawler – Munambam

A. Initial Investment (Rs.)	36-42	45-48	>50ft
Craft & Engine	580000	1245000	2428000
Gear	20000	55000	72000
Total	600000	1300000	2500000
B. Catch (Kgs.)			
Quantity	104000	97488	109504
No. of days fished	200	200	200
C. Revenue (Rs.)			
Total	1145920	1856960	2907360
D. Operating Cost (Rs.)			
Fuel	417760	724320	868640
Wages	194936	323064	626752
Auction	84960	109440	136640
Ice	56000	62400	84800
Food	35200	43200	51200
Repairing & Maintenance	30000	65000	125000
Total	818856	1327424	1893032
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	58000	124500	242800
Net (50%)	10000	27500	3600
Interest (@15%)	90000	165000	375000
Insurance (Rs.)	6000	13000	25000
Total Fixed Cost	158000	330000	656400
F. Total Cost (D + E) (Rs.)	976856	1657424	2549432
G. Gross Returns (C – D)(Rs.)	327064	529536	1014328
H. Net Returns (G – E) (Rs.)	169064	199536	357928
Rate of return (%)	43	29	30

Table - 20
Annual Average Costs & Earnings of Mechanised Purse seiner – Cochin Fisheries Harbour

A. Initial Investment (Rs.)	36-42	45-48	>50ft
Craft & Engine	650000	900000	1700000
Gear	18500	200000	300000
Total	668500	1100000	2000000
B. Catch (Kgs.)			
Quantity	165600	197640	324862
No. of days fished	180	180	180
C. Revenue (Rs.)			
Total	1677600	2066400	4970400
D. Operating Cost (Rs.)			
Fuel	455400	485280	496920
Wages	671040	589248	1761792
Auction	49896	89100	439056
Ice	Nil	Nil	Nil
Food	Nil	Nil	Nil
Bata	114840	108000	189000
Repairing & Maintenance	40000	55000	100000
Total	1331176	1326628	2986768
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	65000	90000	170000
Net (20%)	30000	40000	60000
Interest (@15%)	120000	165000	300000
Insurance (Rs.)	8000	11000	20000
Total Fixed Cost	223000	306000	550000
F. Total Cost (D + E)	1554176	1632628	3536768
G. Gross Returns (C – D)	346424	739772	1983632
H. Net Returns (G – E) (Rs.)	123424	433772	1433632
Rate of return (%)	36.4	54.4	86.6

Table - 21
Annual Average Costs & Earnings of Mechanised Gillnet unit – Cochin Fisheries Harbour

A. Initial Investment (Rs.)	
Craft & Engine	1000000
Gear	150000
Total	1150000
B. Catch (Kgs.)	
Quantity	41170
No. of days fished	230
C. Revenue (Rs.)	
Total	2087480
D. Operating Cost (Rs.)	
Fuel	520950
Wages	514970
Auction	125350
Ice	49680
Food	24380
Bata	12000
Repairing & Maintenance	57500
Total	1304830
E. Fixed Cost (Rs.)	
Depreciation	
Craft (10%)	100000
Net (20%)	30000
Interest (@15%)	172500
Insurance (Rs.)	11500
Total Fixed Cost	314000
F. Total Cost (D + E) (Rs.)	1618830
G. Gross Returns (C – D) (Rs.)	782650
H. Net Returns (G – E) (Rs.)	468650
Rate of return (%)	55

Table - 22
Annual Average Costs & Earnings of Mechanised Trawler - Neendakara

A. Initial Investment (Rs.)	
Craft & Engine	1245000
Gear	55000
Total	1300000
B. Catch (Kgs.)	
Quantity	554994
No. of days fished	200
C. Revenue (Rs.)	
Total	3120000
D. Operating Cost (Rs.)	
Fuel	924000
Wages	658280
Auction	168200
Ice	253200
Food	62000
Repairing & Maintenance	65000
Bata	148400
Total	2214080
E. Fixed Cost (Rs.)	
Depreciation	
Craft (10%)	124500
Net (50%)	27500
Interest (@15%)	195000
Insurance (Rs.)	13000
Total Fixed Cost	360000
F. Total Cost (D + E) (Rs.)	2574080
G. Gross Returns (C – D) (Rs.)	905920
H. Net Returns (G – E) (Rs.)	545920
Rate of return (%)	56

Table - 23
Annual Average Costs & Earnings of Ringseine unit – Valanjavazhi

A. Initial Investment (Rs.)	<32	32-48	>50ft
Craft & Engine	220250	377000	407129
Gear	18500	138250	252000
Total	238750	515250	659129
B. Catch (Kgs.)			
Quantity	47529	84626	57273
No. of days fished	220	220	220
C. Revenue (Rs.)			
Total	722443	1235549	1890020
D. Operating Cost (Rs.)			
Fuel	184140	451880	531080
Wages	264568	386335	673053
Auction	29700	50600	71500
Ice	Nil	Nil	Nil
Food	Nil	Nil	Nil
Bata	9167	11000	12833
Repairing & Maintenance	10942	23615	30209
Total	498517	923430	1318675
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	22025	37700	40712
Net (20%)	3700	27650	50400
Interest (@15%)	35812	77287	98869
Insurance (Rs.)	2387	5152	6591
Total Fixed Cost	63924	147789	196572
F. Total Cost (D + E) (Rs.)	562441	1071219	1515247
G. Gross Returns (C – D) (Rs.)	223926	312119	571345
H. Net Returns (G – E) (Rs.)	160002	164330	374773
Rate of return (%)	82	46.89	71.8

Table - 24
Annual Average Costs & Earnings of Ringseine – Arthungal

A. Initial Investment (Rs.)	
Craft & Engine	225250
Gear	90000
Total	315250
B. Catch (Kgs.)	
Quantity	50444
No. of days fished	215
C. Revenue (Rs.)	
Total	756660
D. Operating Cost (Rs.)	
Fuel	189000
Wages	277330
Auction	28088
Ice	Nil
Food	Nil
Bata	13000
Repairing & Maintenance	15762
Total	523180
E. Fixed Cost (Rs.)	
Depreciation	
Craft (10%)	22525
Net (20%)	18000
Interest (@15%)	47287
Insurance (Rs.)	3152
Total Fixed Cost	90964
F. Total Cost (D + E) (Rs.)	614144
G. Gross Returns (C – D)(Rs.)	233480
H. Net Returns (G – E) (Rs.)	142516
Rate of return (%)	60.2

Table - 25
Annual Average Costs & Earnings of Minitrawl Unit

	Valanjavazhi	Arthungal
A. Initial Investment (Rs.)		
Craft & Engine	94000	94000
Gear	2500	2500
Total	96500	96500
B. Catch (Kgs.)		
Quantity	14158	9657
No. of days fished	200	200
C. Revenue (Rs.)		
Total	517534	377119
D. Operating Cost (Rs.)		
Fuel	121507	94524
Wages	193073	137726
Auction	15237	14809
Ice	4298	2190
Food	Nil	Nil
Bata	5582	4952
Repairing & Maintenance	4488	4476
Total	344185	258677
E. Fixed Cost (Rs.)		
Depreciation		
Craft (10%)	9400	9400
Net (20%)	500	500
Interest (@15%)	14475	14775
Insurance (Rs.)	965	965
Total Fixed Cost	25340	25340
F. Total Cost (D + E) (Rs.)	369525	284017
G. Gross Returns (C – D)(Rs.)	173349	118442
H. Net Returns (G – E) (Rs.)	148009	93102
Rate of return (%)	168	111

Table - 26
Annual Average Costs & Earnings of Motorised Plywood boat with Gillnet unit

	Vizhinjam	Thangassery	Kochuveli
A. Initial Investment (Rs.)			
Craft & Engine	145500	134455	140000
Gear	18500	21591	20000
Total	164000	156046	160000
B. Catch (Kgs.)			
Quantity	27343	54705	13640
No. of days fished	220	215	220
C. Revenue (Rs.)			
Total	572822	668710	477400
D. Operating Cost (Rs.)			
Fuel	57986	60200	64100
Wages	356510	411057	300620
Auction	10578	15265	10140
Ice	Nil	Nil	Nil
Bata	Nil	21285	18580
Food	18857	Nil	Nil
Repairing & Maintenance	7517	7455	7500
Total	451448	515262	400940
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	14550	13446	14000
Net (20%)	3700	4318	4000
Interest (@15%)	24600	23407	24000
Insurance (Rs.)	1460	1560	1400
Total Fixed Cost	44310	42731	43400
F. Total Cost (D + E) (Rs.)	495758	557993	444340
G. Gross Returns (C – D)(Rs.)	121374	153448	76460
H. Net Returns (G – E) (Rs.)	77064	110717	33060
Rate of return (%)	61.9	85.9	35.7

Table – 27
Annual Average Costs & Earnings of Motorised Plywood with Gillnet – Alappad

A. Initial Investment (Rs.)	
Craft & Engine	134455
Gear	21591
Total	156046
B. Catch (Kgs.)	
Quantity	10478
No. of days fished	214
C. Revenue (Rs.)	
Total	188884
D. Operating Cost (Rs.)	
Fuel	34240
Wages	66710
Auction	3210
Ice	Nil
Food	Nil
Bata	7000
Repairing & Maintenance	4000
Total	115160
E. Fixed Cost (Rs.)	
Depreciation	
Craft (10%)	13446
Net (20%)	4318
Interest (@15%)	23407
Insurance (Rs.)	1560
Total Fixed Cost	42731
F. Total Cost (D + E) (Rs.)	157891
G. Gross Returns (C – D)(Rs.)	73724
H. Net Returns (G – E) (Rs.)	30993
Rate of return (%)	35

Table - 28
Annual Average Costs & Earnings of Non –Mechanised Dingy with Gillnet - Kattoor

A. Initial Investment (Rs.)	
Craft	25000
Gear	3500
Total	28500
B. Catch (Kgs.)	
Quantity	1460
No. of days fished	217
C. Revenue (Rs.)	
Total	42133
D. Operating Cost (Rs.)	
Fuel	Nil
Wages	29493
Auction	2500
Ice	Nil
Food	Nil
Repairing & Maintenance	1425
Total	33418
E. Fixed Cost (Rs.)	
Depreciation	
Craft (10%)	2500
Net (20%)	400
Interest (@15%)	4275
Insurance (Rs.)	285
Total Fixed Cost	7760
F. Total Cost (D + E) (Rs.)	41178
G. Gross Returns (C – D) (Rs.)	8715
H. Net Returns (G – E) (Rs.)	955
Rate of return (%)	18.4

Table – 29: Annual Average Costs & Earnings of Shoreseine unit

	Poovar	Kochuveli	Alappad
A. Initial Investment (Rs.)			
Craft	35000	35000	35000
Gear	67000	67000	67000
Total	102000	102000	102000
B. Catch (Kgs.)			
Quantity	35880	14621	22244
No. of days fished	230	230	210
C. Revenue (Rs.)			
Total	447810	437000	407703
D. Operating Cost (Rs.)			
Fuel	Nil	Nil	Nil
Wages	286902	299805	258205
Auction	8957	8707	7500
Ice	Nil	Nil	Nil
Food	Nil	Nil	Nil
Repairing & Maintenance	4867	5060	5020
Total	300726	313572	270725
E. Fixed Cost (Rs.)			
Depreciation			
Craft (10%)	3500	3500	3500
Net (20%)	13400	13400	13400
Interest (@15%)	15300	15300	15300
Insurance (Rs.)	1020	1020	1020
Total Fixed Cost	33220	33220	33220
F. Total Cost (D + E) (Rs.)	333946	346792	303945
G. Gross Returns (C – D)(Rs.)	147084	123428	136978
H. Net Returns (G – E) (Rs.)	113864	90208	103758
Rate of return (%)	126	103	116

Table – 30: Annual Average Cost & Earnings of Non-mechanised Catamaran unit with Gillnet

	Poovar	Kochuveli
A. Initial Investment (Rs.)		
Craft	10000	9620
Gear	13500	13559
Total	23500	23179
B. Catch (Kgs.)		
Quantity	8663	5238
No. of days fished	230	230
C. Revenue (Rs.)		
Total	107908	142472
D. Operating Cost (Rs.)		
Fuel	Nil	Nil
Wages	75535	99730
Auction	3450	3976
Ice	Nil	Nil
Food	Nil	Nil
Repairing & Maintenance	1175	1158
Total	80160	104864
E. Fixed Cost (Rs.)		
Depreciation		
Craft (10%)	1000	962
Net (20%)	2700	2711
Interest (@15%)	3525	3476
Insurance (Rs.)	235	232
Total Fixed Cost	7460	7381
F. Total Cost (D + E) (Rs.)	87620	112245
G. Gross Returns (C – D) (Rs.)	27748	37608
H. Net Returns (G – E) (Rs.)	20288	30227
Rate of return (%)	101	145

Table 31: Key Economic Indicators on the operation of different mechanised craft-gear combinations

Key Economic Indicators (Mechanised units)				
		Gill net	**Trawler**	**Purse seine**
1.	Average catch per day of operation (Kg)	179	2775	1098
2.	Average revenue per day (Rs)	9076	15600	11480
3.	Average No. of days fished in a year	230	200	180
4.	Average value realized per Kg of fish Rs)	50.70	11.02	10.45
5.	Quantity of fish produced per man day (Kg)	35.8	462.5	36.6
6.	Quantity of fish produced per litter of fuel (Kg)	1.58	12.02	8.14
7.	Value of production per man day (Rs)	1815.2	2600	382.66
8.	Average fuel cost per day of day of operation (Rs)	2265	4620	2696
9.	Avg. Operational cost per day of operation (Rs)	5673	11070	7370
10.	Avg. total cost per day of operation (Rs)	7038	12870	9070
11.	Fuel cost per Kg of fish (Rs)	12.65	1.7	2.4
12.	Operational cost per Kg of fish (Rs)	31.69	4	6.7
13.	Total cost per Kg of fish (Rs)	39.32	4.7	8.26
14.	Man days required to produce1 tonne of fish	27.93	2.16	27.32
15.	Fuel required to produce 1 tonne of fish (ltr)	869.56	83.33	122.86
16.	Returns to Labour (Rs)	855.3	1003.5	189.4
17.	Gross returns per day of operation (Rs)	3403	4529	4109
18.	Annual gross profit (Rs)	782650	905920	739772
19.	Annual net profit (Rs)	468650	545920	433772
20.	Rate of return (%)	55	56	55

The key economic indicators of different mechanised craft-gear combinations are given in Table 31. Among the three different types of mechanised gears, the average catch per day of operation is highest in trawler (2775 kg) and lowest in gill net with only 179 kg. However, in terms of average value realisation per kg of fish , it is very much higher in gill net (Rs.50.70) compared to that of trawler and purse seiner. This is mainly because as the gill net is a selective gear, the species landed in it are large sized valuable fishes such as seerfish, groupers and tuna. The low value per kg realisation in trawler is an indication of increased bycatch landings. Quantity of fish produced per man day is very much high in trawler with 462.5kg which shows that the

trawling is not labour intensive. Highest quantity of fish per litre of fuel was obtained from trawler. Fuel consumption for producing one kg of fish is highest for gill net with Rs. 12.65. There is no substantial variation in rate of return for the three types of mechanised units.

Table 32: Key Economic Indicators on the operation of different motorised craft-gear combinations

Key Economic Indicators (Motorised units)				
		Plywood Boat	**Ring seine**	**Minitrawl**
1.	Average catch per day of operation (Kg)	254.4	384.7	71
2.	Average revenue per day (Rs)	3110.3	5616	2587.6
3.	Average No. of days fished in a year	215	220	200
4.	Average value realized per Kg of fish Rs)	12.23	14.6	36.45
5.	Quantity of fish produced per man day (Kg)	63.6	32.06	23.67
6.	Quantity of fish produced per litter of fuel (Kg)	18.17	3.75	2.33
7.	Value of production per man day (Rs)	777.56	468	862.53
8.	Average fuel cost per day of day of operation (Rs)	280	2054	607.5
9.	Avg. Operational cost per day of operation (Rs)	2396.5	4197	1721
10.	Avg. total cost per day of operation (Rs)	2595.3	4869	1847.6
11.	Fuel cost per Kg of fish (Rs)	1.1	5.4	8.58
12.	Operational cost per Kg offish (Rs)	9.4	11	24.31
13.	Total cost per Kg of fish (Rs)	10.2	12.65	26
14.	Man days required to produce1 tonne of fish	15.72	31.19	42.25
15.	Fuel required to produce 1 tonne of fish (ltr)	55.03	266.67	429.18
16.	Returns to Labour (Rs)	606.7	208.6	568.47
17.	Gross returns per day of operation (Rs)	713.7	1418.6	866.7
18.	Annual gross profit (Rs)	153448	312119	173349
19.	Annual net profit (Rs)	110717	164330	148009
20.	Rate of return (%)	85.9	47	168

The key economic indicators on the operation of various motorised units along the study area show that the catch and revenue of per day of operation is highest for the ring seine units (Table 32). The average value realisation is high in minitrawl with Rs.36.45/kg. This is mainly due to the landings of penaeid prawns in the minitrawl operating at Valanjavazji and Arthungal. Value of production per man day is also higher in minitrawl with Rs. 862.50. The rate of return is very high in minitrawl unit operation compared to the other two motorised gears.

Table 33: Key Economic Indicators on the operation of different non-mechanised craft-gear combinations

Key Economic Indicators (Non-mechanised units)				
		Dinghi+ gillnet	**Catamaram**	**Shore seine**
1.	Average catch per day of operation (Kg)	6.7	37.7	156
2.	Average revenue per day (Rs)	194	469.2	1947
3.	Average No. of days fished in a year	217	230	230
4.	Average value realized per Kg of fish Rs)	28.96	12.45	12.48
5.	Quantity of fish produced per man day (Kg)	3.35	18.85	8.67
6.	Quantity of fish produced per litter of fuel (Kg)	NA	NA	NA
7.	Value of production per man day (Rs)	97	234.6	108.17
8.	Average fuel cost per day of day of operation (Rs)	NA	NA	NA
9.	Avg. Operational cost per day of operation (Rs)	154	348.5	1307.5
10.	Avg. total cost per day of operation (Rs)	189.7	380.9	1452
11.	Fuel cost per Kg of fish (Rs)	NA	NA	NA
12.	Operational cost per Kg of fish (Rs)	22.9	9.25	8.38
13.	Total cost per Kg of fish (Rs)	28.2	10.11	9.3
14.	Man-days required to produce1 tonne of fish	298.51	53.05	115.38
15.	Fuel required to produce 1 tonne of fish (ltr)	NA	NA	NA
16.	Returns to Labour (Rs)	70.2	208.3	96.8
17.	Gross returns per day of operation (Rs)	40.2	120.64	639.5
18.	Annual gross profit (Rs)	8715	27748	147084
19.	Annual net profit (Rs)	955	20288	113864
20.	Rate of return (%)	18.5	101	126

Among the non-mechanised units, the average catch per day of operation is highest in the shore seine (156 kg) and lowest in dinghy with gillnet (6.7 kg). The average value realisation is highest in dinghy with 28.96 kg (Table 33). Even though the average catch per day is highest in shore seine unit, the quantity of fish produced per man-day is only 8.6 kg, indicating high labour involvement in its operation. The average operational cost is highest in shore seine unit with Rs.1307/day. Catamaran with gill net unit provides the highest return to labour with Rs.208.3 and lowest value obtained for dinghy with gill net.

Production function analysis of trawler operation

More then 50%of the total fish landings of the State is contributed by trawlers. An attempt was made to study the input-output relationship in trawler operations at three different regions, using the model Cobb- Douglas production function.

The data used in the study was collected from about 50 trawlers operating in Neendakara, Cochin Fisheries Harbour (CFH) and Munambam landing centres for a period of 5 years from 1996 to 2000 by CMFRI.

The estimated production equation is given below

Neendakara

$Y=0.68901.X_1^{0.78**}.X_2^{0.312**}.X_3^{-0.112NS}$

$R^2=87.2\%$

Cochin Fisheries Harbour

$Y=0.68901.X_1^{0.69**}.X_2^{0.71**}.X_3^{0.026NS}$

$R^2=88\%$

Munambam

$Y=0.68901.X_1^{0.72**}.X_2^{0.61**}.X_3^{0.05NS}$

$R^2=75\%$

** = Significant at 5% level

N.S =Non Significant

Y- Dependent variable (Average annual catch/unit in kgs)

X_1-No. of fishing days per unit in a year

X_2-Quantity of fuel used in a year/ unit

X_3-Annual repairing & maintenance charges/ unit

- The above equation shows that the coefficient of days fished is 0.78 for Neendakara, which is significant at 5% level. This indicates that if the number of days fished is increased by 1%, the output will increase by 0.78%. The coefficient of fuel consumption was 0.312, which was also significant at 5% level indicating an increase in oil expenditure by 1% would increase the gross output by 0.31% and the coefficient of repairing and maintenance expenditure was non-significant and negative. The value of R^2 is 0.872, which indicates that 87.2% of the variation in Y is explained by the estimated function.

- For Cochin Fisheries harbour the coefficient of days fished is 0.69 and fuel consumption 0.72 both significant at 5% level. The coefficient of repairing and maintenance at 0.026 is not significant. R^2 is 88%.

- In the case of Munambam coefficient of fishing days is 0.72, fuel consumption 0.61 and repair and maintenance 0.05. Here the value of R^2 is 0.75, so 75% of the variation in Y is explained by the estimated function.

Profit is maximum when MR = MC, where MR is marginal revenue and MC is marginal cost. For X_i

$MR = b_i (Y/Xi)*PY$ and

MC is the acquisition cost for one unit of X_i ie. PXi.. Hence

$b_i * (Y/Xi) * PY = PX_i$

Optimum level of $X_i = b_i * Y *(PY/PX_i)$

Where, b_i is production coefficient of X_i

Y is average annual output

X_i is the average annual input used

PY is the price of output

PX_I is the price or acquisition cost of input X_i

Table 34: Regression coefficients, MVP, Geometric means & ratios of MVPs to their factor costs of trawler operations.

Variables	Regression coefft.	MVP of out puts (Rs)	Geometric mean of $Y_1X_1X_2\&X_3$	Acquisition cost (Rs)	RatioMVPs to their acquisition
Neendakara					
Y	-	-	307256 Kg	-	-
X1	0.78	14901	193 days	14070	1.06
X2	0.312	28.89	39814 Ltr.	20	1.445
X3	-0.112	-0.546	63000 Rs.	1.15	-0.364
CFH					
Y	-	-	63168 Kg	-	-
X1	0.69	4307	192 days	4271	1.008
X2	0.72	26.21	32064 Ltr.	20	1.31
X3	0.026	2.5	12480 Rs	1.15	2.17
Munambam					
Y	-	-	87800 Kg		
X1	0.63	4632	203 days	4094	1.13
X2	0.61	22.87	39800 Ltr.	20	1.14
X3	0.05	3.62	20600 Rs	1.15	3.14

It is obvious from the Table 34 that those inputs for which ratio of MVP to acquisition is more than one can be increased from the average level. At Neendakara landing centre, fishing days in a year can be increased from the average level of 193 to 204 to get the maximum profit. So also the annual oil consumption can be increased to

the optimum level of 54,672 litres from the average level of 39814 litres. Maintenance & repairing expenditure had a negative MVP indicating that gross returns can be increased by reducing the maintenance and repairing charges.

For Cochin fisheries harbour fishing days in a year can be increased from the average level of 192 to 194 to get the maximum profit. So also the annual oil consumption can be increased to the optimum level of 32,064 litres from the average level of 43,139 litres and Maintenance & repairing expenditure from Rs.12,480 to Rs 27,091. At this centre, trawl units are operating almost at the optimum level, so that there is no scope for further increase in number of fishing units or number of fishing days for the existing units.

At Munambam, the fishing days in a year can be increased from the average level of 203 to 229 to get the maximum profit. The annual oil consumption can be increased to the optimum level of 39800 litres from the average level of 45,524 litres and maintenance & repairing expenditure from Rs.20600 to Rs 64,895.

From the above analysis for the optimum level of operation, fishing days at all the 3 centres can be increased from the present level whereas at CFH it is only marginal. So also an increase in the fuel utilisation would enhance the profit of trawlers at all the centres. However the repairing and maintenance expenses at Neendakara is beyond the optimum level, and should be reduced for the benefit of operators. At Cochin fisheries harbour and Munambam adequate repairing and maintenance was not done by the boat owners and they have to take proper steps for the timely maintenance of fishing units to increase their net benefit.

Even though the number of days fished in a year is not upto the optimum in all the major centres selected for the study, it was observed that there was excessive fishing pressure due to over crowding of fishing units during monsoon season, resulting in over-fishing of certain species of fish, which is all the more true in the case of Neendakara, the biggest landing centre for trawlers in the State.

CHAPTER - 6

Economic loss due to juvenile fishing

In the mechanised trawler the major species with juvenile fishing observed in annual catch were cuttlefish, threadfin breams, prawns and lizardfishes. Substantial quantity of juvenile sardines and anchovies were landed in ring seine units at valanjavazhi (Table 35-36) and juveniles of flatfishes and prawns could be observed in minitrawl units. Juvenile fishing was comparatively lesser in the mechanised and motorised gillnet units.

The economic loss due to juvenile fishing by different fishing units was estimated using the formula developed. The length-weight relationship of the form $W=aL^b$ was fitted to obtain the weight of the adult fish corresponding to the weight of the juvenile fish. The model was developed considering the quantity of juveniles landed by different gears, landing centre level prices of juveniles and adult fish of each species and the approximate period in years by which the juveniles attain adult or marketable size. The model used for the estimation of economic loss due to juvenile fishing is given below.

The formula is

$L = (\sum_{i=1 \text{ to } n} C_iQ_i)/n-(\sum_{i=1 \text{ to } n} c_iq_i)/n$

Where,

l=Economic loss per unit trip

C=Value of the marketable size fish

Q=Quantity of the marketable size fish corresponding to the quantity of juvenile fish

c= Value of the juvenile fish

q= Quantity of juvenile fish in the catch

n = number trips/boat

There is higher variation in the landing centre level price of juveniles and adults of the commercially important species of fish (Table 37). Some fishes which are too small and less economic important like flat fishes are some times thrown away without finding any market. The species which are getting reasonable price for the juvenile fishes are cuttlefish and prawns because these species are exported even in other forms/ products.

Table 35: Juvenile and adult length of fishes of some of the commercially important species landed in the study area

Name of the fish	Adult size (cm)	Medium size (cm)	Juveniles (cm)
Oil sardine	22	14-15	< 10
Lesser sardines	18-20	12-15	< 8
Mackerel	20-25	18-19	<15
Seer Fish	75	50-55	<25
Scads	20	8-15	<8
Silver Belly	20	6-10	<5.5
Flat Fishes	20	10-13	<7
Barracuda	25	15-16	<10
Lizard Fish	30	20-22	<15
Threadfin Breams	30	10-14	<7.5
Cuttle Fish	22	14-16	<12
Deepsea prawns	10	7-8	<6
Penaeid prawns	12	8-10	<6

Table 36 : Percentage share of juveniles in the catch composition of some selected gears

Species	Mini trawl (%)	Ring Seine (%)	Mech. Trawl (%)	Purse seine (%)	Shore seine (%)
Anchovies	30	40			40
Mackerels		15		20	15
Carangids		15		15	
Oil Sardine		30		25	20
Cuttle Fish			20		
T. Beams			25		

Lizard Fish			20		
Bulls Eye			10		
Flat Fish	50				
P. Prawns	30				
D Prawns	20		30		

Table 37. Average price/kg of the juvenile and adult of the selected species

Species	Juveniles (Rs/kg)	Adults (Rs/kg)
Anchovies	4	20
Mackerels	8	25
Carangids	8	28
Oil Sardine	6	15
Cuttle Fish	25	75
T. Beams	6	28
Lizard Fish	5	14
Bulls Eye	9	22
Flat Fish	2	14
P. Prawns	20	60
D Prawns	18	45

Table 38. Estimated Economic loss due to juvenile fishing by various gears along the study area during 2001-2002 (Rs)

Species	Mini Trawl (Rs)	Ring seine (Rs)	Mech.Trawl (Rs)	Purse seine (Rs)	Shore seine (Rs)
Anchovies	67872	584832			110208
Mackerels		207909		3514797	327366
Carangids		100452			
Oil Sardine	19527	1015956		443187	64377
Cuttle Fish			1462300		
T. Beams			1012370		

Lizard Fish			49187		
Bulls Eye					
Flat Fish	96220				
P. Prawns	475720				
D Prawns	29187		302634		
Total	**6,88,526**	**19,09,149**	**28,26,791**	**39,57,984**	**5,01,951**

The highest economic loss was observed in mechanised purse seine followed by mechanised trawler and ring siene unit (Table 38). Even though the annual revenue generated by a purse seiner is Rs. 20.7 lakh, the annual economic loss due to juvenile fishing by the same unit works out to Rs.39.6 lakh. In the mechanised trawler, the economic loss due to juvenile fishing was Rs.28.3 lakh as against annual revenue of Rs. 31.2 lakh. In the motorised sector, a ring seine contributes a loss of Rs.19.1 lakh, which is higher than that of the annual revenue generated by the same unit (Rs.12.4 lakh) and for the minitrawl the annual economic loss was estimated as Rs.6.9 lakh. Among different centres, the highest economic loss was at Neendakara mechanised landing centre with Rs. 200 crores/year followed by Cochin Fisheries Harbour (Rs.169.1 crores) and Munambam (Rs. 120 crores). The total economic loss due to juvenile fishing along the entire study area without considering the natural mortality is about Rs.600 crores (Table 39)

Table 39. Estimated annual economic loss due to juvenile fishing at different landing centres in the study area

Landing Centre	Annual Economic Loss (Rs. in crores)	Annual Economic Loss (%)
Highly degraded centres		
Kochuveli	0.40	0.61
Neendakara	200.00	33.33
Alappad	0.40	0.61
Cochin FH	169.10	28.18
Munambam	120.00	19.9
Sub Total	**489.9**	**81.64**
Degraded Centres		
Valanjavazhi	35.60	5.93
Arthungal	29.30	4.88
Thangassery	39.10	6.52
Sub Total	**104.00**	**17.33**
Comparatively Undisturbed Centres		
Kattoor	5.62	0.94
Poovar	0.55	0.92
Sub Total	**6.17**	**1.03**
Total	**600.10**	**100**

It is obvious from Table- 39 that the juvenile fishing is comparatively very high in highly degraded centres. Maximum loss due to juvenile fishing is recorded in mechanised centres where trawl fishing is prominent. Altogether about 82% of the total economic loss due to juvenile fishing is in these centres. With regard to motorised fishing units in degraded centres, ring seines and mini trawls add more and come around 17% of the total economic loss. In comparatively undisturbed areas, non-mechanised fishing units are dominant and the total economic loss is negligible (1.03%) compared to highly degraded areas

CHAPTER -7

Environmental problems at Kochuveli and Alappad and its effects on fisheries

Environmental Scenario

The titanium dioxide factory situated at Kochuveli, Trivandrum, Kerala, the only one of its kind in South Asia, manufactures Titanium dioxide pigment using the locally available mineral sand; ilmenite and concentrated sulphuric acid. The factory discharges its effluent into the Arabian Sea through a tunnel formed across the beach. The rate of discharge is estimated as about 4000 m^3/day. The temperature of the effluent varies from 45 ^oC to 50 ^oC, its pH from 0.8 to 1.0 and it has a pungent odour. The discharge consists of a mixture of sulphuric acid (20%), Ferrous sulphate (7%), Titanium oxysulphate and some trace elements like Aluminium, Magnesium, Vanadium, Zinc, Chromium and Zirconium in the form of sulphates (Vijayamohanan *et al*., 1984). On mixing with seawater, the ferrous sulphate gets oxidised to ferric form causing oxygen depletion and imparting a reddish brown colour in the seawater. Constant exposure to the suspended matter from the effluent present in the seawater results in the depletion/death of the fauna owing to prolonged sub-lethal effects such as slow choking of the respiratory and feeding organs of the animals (Qasim and Rao, 1980). **S**tudies on the effect of titanium effluents on the respiratory movements of some aquatic organisms have shown that drastic reduction in the movements was observed when exposed to the media containing more than 1% of the effluent (Vijayamohanan *et al*., 1984). A heavy deposit of the precipitate over the body surface was noted in higher concentrations. In an experiment with the barnacle *Balanus tintinnabulum* have shown that at an effluent concentration of 0.3%, none of the animals could survive for a period of more than 12hrs. This was due to the sharp decline in the pH of the medium and asphyxiation owing to oxygen depletion. Vijayamohanan and Achuthan Nair (2000) found that the fishes *Oreochromis mossambicus* and *Etroplus maculatus* were sensitive to the titanium dioxide industrial effluent. The low pH and the lesser oxygen content of the effluent mixed water along with the presence of trace elements in the medium cause changes in the biochemical composition of these fishes. The growth rates and food conversion were both shown

to be affected in the cichlid fish *Sarothorodon mossambicus* exposed to the titanium effluents of 0.1%. The fish was unable to withstand at a concentration of above 0.1% (Nair *et al*., 1985). From the above experiments, it is evident that the discharge of untreated effluent from the titanium dioxide industry to the coastal waters of Kochuveli will adversely affect the fishery of that area. Moreover, the waste is liable to be harmful to human health and the environment. According to the fishermen of Kochuveli, what was happening was that the plankton and the benthos in this area were being killed off, bottom sediments drastically polluted and in consequence area were no longer capable of maintaining its former production. There are many health problems such as itching, breathing problems and eye diseases. Qasim and Rao (1980) found that the pH of the well water near Kochuveli beach varied between 2.02 and 3.4 indicating the seepage of the industrial effluent in the neighboring wells. To avoid this it is suggested that the effluent should be discharged by a closed and buried pipeline right from the factory outlet and across the beach. The regular costs and earnings data of different crafts-gear combinations were observed for a period of one year to analyze the magnitude of this pollution on the fishery of the area.

Economic loss to the fishery

At Kochuveli, because of pollution problem people are reluctant to adopt improved technologies of fishing. The average annual catch of a catamaran-gill net unit at Kochuveli is only 5.24 tonnes, but at Poovar, in the same district, the catch is 8.66 tonnes and because of the proximity to Thiruvananthapuram city and the scarce availability of fish at Kochuveli, the annual average revenue from a catamaran unit is higher than that of Poovar (Table 40). So also for the shore seine unit, the annual average landings (35.88 tonnes) at Poovar is almost double that of Kochuveli (14.62 tonnes). This low level of landings for these two types of fishing units in Kochuveli can mainly be attributed to discharges of the industrial pollutants to the sea from the local Titanium Industry. Due to this the fishing intensity also has come down. Presently at Kochuveli, the existing fishing fleet consists of 9 plywood boats, 150 catamaran and 6 shore seine units with a total annual landings of 996.18 tonnes valued at Rs. 3.5 crore, whereas at Vizhinjam and Poovar centres, selected for the study in Trivandrum district the total production were 22,544.41 tonnes and 9,693.93

tonnes respectively (Table 41). At vizhinjam there are 800 plywood boat units with gill net, 10 shore seine units and 100 catamaran units with gillnet are under operation. In Poovar also the number of units are high with 600 catamaran with gill net/hooks and line, 11 shore seine and 150 plywood boats with gillnet/hooks and line. The low level of fishing units as well as fish landings and earnings at Kochuveli could be mainly attributed to the pollution of inshore area due to the discharges from the industrial effluents of Titanium factory. Taking into account, the major factors influencing the level of effort and the catch and value, the estimated loss to the village due to pollution comes around Rs. 23.7 crore. To arrive at this value, it is assumed that there is no problem of pollution at present in Kochuveli area. In that case, what will be the annual fish landings by the fishermen households inhabited in the area. The number of different types of fishing equipments, their fishing efficiency, level of fishing effort, level of adoption of improved technology, labour efficiency, credit facility, proximity to urban markets, transportation and marketing facilitates demand function, water quality, primary productivity and landing centre facility are the major factors which determine the level of fish landings. Vizhinjam and Poovar in Thiruvananthapuram district are two other villages selected for the study where there is no major problem of pollution affecting the fishing. Comparing the influence of above-mentioned factors in these two villages, the present level of fish production in the absence of pollution is estimated in Kochuveli. Hence the net benefit is calculated by estimating the excess benefits in the absence of pollution. Since there can be a flow of future benefits in coming years, a cost benefit analysis is done and the NPV is calculated for 15 years with discount rate of 12%. Since this benefit comes from fishing income, net benefit is the excess over fishing cost. However, all the components of the fishing cost except fuel cost (which constitutes only less than 10% of the total costs) are value added incomes as these are distributed as income to different stakeholders. Hence, in the calculation of NPV regarding the operating costs of fishing units only the fuel cost is added to the fixed costs for discounting purpose. NPV calculated for Kochuveli is Rs.157.4 crores (Table 42).

Table 40. Average annual catch/unit at Kochuveli and Poovar during 2001-2002

Unit	Kochuveli (Tonnes)	Poovar (Tonnes)
Catamaran + Gill net/ HL	5.24	8.66
Shore seine	14.62	35.880

Table 41. Comparative annual fish production among highly degraded and less degraded centres

	Kochuveli	Vizhinjam	Poovar
Quantity (Tonnes)	996	22,545	9,694

Table 42. Net present value of the economic loss at Kochuveli for the next 15 years

Years	NPV (Rs. In crores)
1	38.14
2	54.21
3	68.2
…….	
13	149.6
14	153.7
15	157.4

This loss affects at least thousand fishing families in this region and it has affected the entire economy of the village. Also it has a recurring effect for the coming years also. Now the fishing is extended to distant fishing grounds due to the effect of pollution in the nearshore area. This makes the fishing more expensive in this area. Moreover, there is a drastic reduction in the pelagic fish landings, which are more affected by pollution.

In Alappad, sea erosion is an after effect of sand mining from nearshore areas. This necessitates the construction of sea wall, which in turn obstructs the landings facilities of motorised as well as non-mechanised fishing units operating from this area.

Tabe 43. Net present value of the economic loss at Alappad for the next 15 years

Years	NPV (Rs. In crores)
1	156.7
2	222.7
3	281.6
…….	
13	614.5
14	631.5
15	646.6

The fishing units from this area are compelled to land at the nearby landing centres such as Neendakara, Thangassery, Pallana etc. This significantly reduced the fish catch from this area. There are about 58 plywood boats with gill nets, 8 shore seine units and 50 non-mechanised dinghy with gill net exist in this area which bring forth a total annual production of 9,536.72 tonnes. The total annual landings estimated from the nearby Thangassery landing centre was about Rs. 6.6 crores from

1200 plywood boats. The low level of annual landings from Alappad landing centre is mainly due to the sand mining and sea erosion and thereby the construction of sea wall, which obstructs the landing centre facilities. The economic loss due to these factors is amounted to Rs.97.4 crores. The Net Present Value calculated for 15 years is Rs. 647 crores (Table 43).

CHAPTER - 8

Problem of conservation and sustainability

With the advent of motorization of country craft during the early eighties, the traditional sector almost entirely shifted to the operation of ring seine (mini purse seine) and mini trawl nets, the gears so far used only by the mechanised sector. These gears as compared to the traditional nets are highly efficient. A more efficient gear is more destructive to the fish stock and this is the first time that the problem of conservation and sustainability of fish catch has come up in the traditional sector.

The sharp decline in oil sardine catch, which is the major component of ring seine catch during 1989 onwards considerably eroded the fishing revenue of ring seine units. By 1993-94 onwards the operation of bigger units became uneconomic and the craze for bigger units and urge for higher speed in the hope of getting more fish and more income started disappearing. That is how the minitrawl operation had been initiated by the traditional fishermen. It has got the advantage of lower investment requirement (about Rs. One lakh) and lesser operating cost. Even though the introduction of these gears appears to be economically beneficial to the traditional sector a number of issues have come up which demand immediate attention to maintain the sustainable development of the marine fishery. Most of the developments either in traditional sector or mechanised sector has been based on short term results rather than long-term strategies.

Based on the opinion survey conducted so far it is clear that the fishermen are aware of the importance of keeping the fish stock within some acceptable range to maintain the sustainability of the catch. However, the individual decisions on their economic activities motivated mainly by short-term gains often ignore the benefits of maintaining the long-term sustainability.

In the mechanised sector also sustainability is under constant threat. The process of mechanization in the marine fishery of Kerala was initiated in early fifties and subsequently in the first three five year plans high priority was given to the development of marine fishery sector. The enhanced fishing efficiency, which

resulted in better returns, induced a lot of fishermen to shift from traditional to mechanised sector. Along Kerala coast mechanization led to intensive and diversified fishing, which paved the way for an organized seafood industry. During the mid seventies the unprecedented increase in export demand led to a price escalation of prawns and shrimp trawling became highly profitable. The continuous increase in shrimp prices induced the investors to increase the effort that has been ended up in excessive number of trawl units operating beyond maximum sustainable yield warranting regulatory measures for obtaining sustainable income in the long run.

Contrary to the expectations with increased tempo of mechanization, total fish landing in Kerala showed a declining trend during seventies. The traditional fishermen attributed the destructive type of mechanised fishing methods especially bottom trawling to the continuous falling in fish landings. The traditional fishermen started agitation against mechanised fishing and demanded a total ban on such fishing methods. According to them it is the only way to conserve the existing fish stocks. Since no regulation was enacted, during recent years the traditional sector collectively voiced for a complete ban on mechanised fishing during monsoon period (June-August) in the territorial waters of Kerala. Consequently, there has been a ban on mechanised fishing during the monsoon. However, no tangible effect of this ban has so far been noticed. In the mean time the traditional sector has also started operating these gears so far used only by mechanised sector. Hence, at present the problem of conservation and sustainability has been facing more serious threats from both traditional and mechanised sectors, than at any time before.

Estimated economic loss due to overfishing

Economic loss due to the extinction of three species of fish (Table 44) due to over-exploitation was worked out. Catfish is almost disappeared as the entire stock was caught during the period 1970-1990. The net loss due to overfishig was estimated in terms of NPV of MSY, the quantity of fish that can be caught continuously for 30 years if there is no overfishing, discounted to the level of the year 2000. The net loss due to overfishing of catfish in terms of Net Present Value (NPV) was estimated as 160.6 crores at a discount rate of 10% assuming a price increase of 5% every year

and time horizon of 30 years. So also under the same assumptions, the net loss of elasmobranches is Rs. 458.5 crores and for goat fish Rs.3.9 crores. This loss of Rs.623 crores not only affects the producers but also the consumers of fish. An additional loss of 30% of this amount comes in the form of consumers' surplus. This is the case of just 3 species of fish. Some other fishes are also now under the threat of extinction, which will further increase the loss to the society.

Table 44 : Some of the depleting species in the annual landings of Kerala during 1961-2000

Year	Elasmobrachs	Catfishes	Goatfish
1961	8515	3114	226
1962	3342	1703	526
1963	10509	2007	557
1964	7218	2248	189
1965	5969	3565	305
1966	8080	5793	2782
1967	7330	7536	164
1968	4175	4173	495
1969	5759	6245	1548
1970	7490	16380	279
1971	4889	15189	1573
1972	6986	12636	2960
1973	8852	17438	1537
1974	10338	33526	3881
1975	10292	32603	23
1976	7308	12743	2577
1977	5796	7947	240
1978	9302	9125	171
1979	6954	11328	127
1980	6803	13936	1
1981	4871	9562	33
1982	6343	9532	244
1983	8521	15344	152
1984	7637	11582	75
1985	6013	5184	100
1986	6056	8589	232
1987	4473	4660	684
1988	6761	9960	9836
1989	4680	4097	6017
1990	6968	2739	6919

1991	3441	1744	18824
1992	3323	1029	7583
1993	4432	597	2489
1994	5887	499	382
1995	4109	308	174
1996	4422	390	83
1997	3915	192	111
1998	4110	213	358
1999	3677	248	122
2000	2832	103	63

Quantity in tonnes

Opinion of Stakeholders

An opinion survey was conducted covering 100 people in each of selected villages. The respondents are a sample of people who in one way or other are involved in fishery activities either as fishing workers, fish traders or boat owners. Though they share a common bond, a strong attachment to fisheries, their interests are diverse with different perspectives. Each person interviewed answered a series of questions related to environmental and conservation management problems specifically on discharge of industrial and other types of pollutants to the sea, mangrove destruction, pollution by siltation from boat engines, economic and biological over-fishing, destroying juveniles and eggs by using destructive type of nets, unhygienic condition of landing centres etc.

Attitude of the people towards the ecosystem in general and conservation of natural resources is a major factor for the proper environmental management. The survey reveals that more than 80% of the respondents are aware of the importance of environmental management for the conservation of natural resources, especially fishery. The entire people interviewed in Kochuveli village, which is included in the category of 'highly degraded', consider the industrial effluents from the Titanium factory situated near seashore, is a major contributor of pollution of inshore waters, very seriously affected the fishery resources. Many of them believe that due to pollution, some of the economically important varieties of fish like 'parava', 'mulluvaala', threadfin breams and 'kora' have disappeared from the fishery. More than 50% of them are of opinion that as compared to many other landing centres in

Thiruvananthapuram district, Kochuveli village is still predominantly an artisanal fishing area without having any technological advancements in craft and gear combinations, mainly because of the adverse effect of industrial pollutants.

In the Alappad village, all are of opinion that fishery and thereby fishing community is seriously affected by sand mining by Indian Rare Earth Ltd. And sea erosion. About 60% of them demand the construction of sea wall to protect the shore and 100% to stop sand mining. Five percent of them do not want sea wall as it will disturb the natural ecosystem and obstruct the landing centre facilities in the village.

Out of the interviewed people, 20% are either mechanised trawler owners, workers in trawlers or processing units. Among them, boat owners agreed that as a conservation measure there should be ban for all types of mechanised fishing including motorised country crafts during peak monsoon period. But, majority of workers in trawlers and processing units do not want any such ban. Some believe that the technological advancement in synthetic fibres for nets and large-scale motorization of country crafts contribute to increase in fishing effort making fishing more safe and effective which is ultimately end up in biological overfishing.

All the respondents except those were involved in the operation of minitrawl consider this net as highly destructive and detrimental to the growth of fishery in the long run.

The entire people interviewed support the idea of restricting the present use of fishery resources for a flow of future benefits. However, very careful in making any response to the restrictive measures which would affect their present benefits. Majority are in favour of a fishing holiday, but there is no unanimity in the type of unit or duration.

Even though, the Balakrishnan Nair (Expert committee to look into trawl ban) committee recommends the gradual ban of ring seine operation and the Kerala Government have issued orders restricting its operation, majority of the respondents are against such actions

Costal Regulation Zone (CRZ) notification and environmental management

Coastal zone management plan (CZMP) of each maritime state has been prepared and approved as per the Coastal Regulation Zone (CRZ) notification 1991 as amended in 1994 and also incorporating the directions given by the Supreme Court Judgement dated 18-04-96. The CRZ forms only part of the coastal agro-climatic zone of India in the geographical classification. As per the CRZ "the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in the landward side) upto 500 meters from the High Tide Line (HTL) and the land between the Low Tide Line (LTL) and the HTL as a Coastal Regulation Zone". In the notification 13 categories of activities are included which are prohibited within the zone. In Kerala, as the coastal belt is densely populated and high fishing pressure exists in the nearshore region, the CRZ could not be strictly implemented. The following activities prohibited in the CRZ are not yet strictly followed.

1. Setting up and expansion of fish processing units including warehousing (excluding hatchery and natural fish drying in permitted areas)

As per the recommendations by the European Economic Union for improving the quality of seafood exported from India for acceptance, many of the processing units around Cochin and Neendakara have expanded their facilities, which are coming under the CRZ area.

2. Discharge of untreated wastes and effluents from industries, cities or towns and other human settlements. Schemes shall be implemented by the concerned authorities for phasing out the existing practices, if any, within a reasonable time period not exceeding three years from the date of this notification.

Even though the discharge of untreated industrial waste is prohibited in the CRZ area, the Titanium dioxide industrial wastes are still discharged to the sea without treatment at Kochuveli coast of Trivandrum district.

These are the instances found along the study area violating the CRZ notification. Strict adherence and compliance of CRZ notification will ensure the protection of the degrading environment, depleting bio-diversity and increased production

CHAPTER – 9

Policy Recommendations

Serious environmental problems are observed at Kochuveli and Alappad villages among the selected centres. In Kochuveli, the major problem is the discharge of industrial acid waste to the sea from the local Titanium Dioxide Factory. The change in the colour of the seawater is visible along the coastline of the disposal site. The development of the fishery sector in this area is stagnating over the years. There is absolutely no development of fishery infrastructure and technological upgradation of fishing techniques. There is a considerable shift in occupation from fishery to non-fishery activities and many have even migrated for employment. The cumulative economic loss calculated for fishery alone in this area is Rs.152.4 crores over a period of 15 years. Hence the acid waste from the Titanium Industry in Kochuveli should be treated to reduce the temperature and acidity before discharging into the sea. It is recommended that the effluent should be discharged, after treatment, through a closed and buried pipeline right from the factory outlet and across the beach.

In Alappad, the sea erosion mainly due to the near shore mining by the Indian Rare Earths factory causes washing away of the shoreline and consequent collapse of houses. To prevent sea erosion sea walls are constructed in this region. The construction of seawall also mostly serves as an obstruction for fishing activities, fish landing facility and also it causes ecological disturbances. There is no technological improvement of fishing units over the years in this region. The fishing units of this region have migrated to Neendakara and other nearby centres for their operations. The cumulative loss for fishery in this area is calculated as Rs.647 crores for 15 years. This will further adversely affect the long-term development of the fishery in this area. Hence sea erosion should be prevented through more eco-friendly methods such as the plantation of certain types of trees, mangroves etc without affecting the landing facilities.

The study indicates that in the mechanised fishing centres, there is no tangible effect on environmental degradation, but the effect is mainly on the sustainability of fishery

because of the indiscriminate trawling thereby the destruction of eggs and bottom organisms in addition to juvenile catches. For preventing the indiscriminate exploitation of the fishery resources there should be mesh size regulations and fishing holidays for all types of mechanised fishing units and its socio-economic impact should be assessed.

Since the economic loss due to the extinction of three species (elasmobranches, catfish and goatfish), because of overfishing is very high, other endangered species such as carangids, seerfish, threadfins etc. have to be protected by restricting the indiscriminate fishing by mechanised as well as motorised fishing units.

As the ring seines contributed substantially to the economic loss due to juvenile fishing, their number should be restricted together with the size of the gear, mesh size and horse power of the engine. The *chooda vala* commonly used for anchovies usually catch juveniles of oil sardine and mackerel inflicting heavy economic loss to the fishery. Hence this net should be allowed to operate only when the anchovy shoals are located.

Since minitrawl is comparatively highly profitable (Rate of return 168%) and less capital intensive (Rs.96500), there is every chance for its expansion. It also contributes substantial loss to the fishery not only by juvenile fishing but also by destroying the nearshore bottom habitat of the sea. It is detrimental to the sustainable development of the fishery. Hence further proliferation of this unit should be restricted.

The standardized mesh size regulations should be introduced and implemented with proper monitoring for all types of gears in order to avoid juvenile fishing. The ecofriendly fishing devices/methods like gill nets, hooks and lines and shore seine should be encouraged.

The growth and development of the marine fishery is interlinked with estuarine and brackishwater ecosystems as the commercially important species of prawns such as *Penaeus indicus, P.monodon, P.monoceros* and *Metapenaeus dobsoni* and many other finfishes during the early stages of their life cycle enter into the estuary and be there for certain period. Hence the estuarine pollution also affects their survival.

There should be a comprehensive effort for controlling the pollution both in the marine and brackishwater environments. There is enormous increase in the pollution of estuarine areas by sewage disposal, plastic dumping, oil spills, industrial and agricultural waste disposal, reclamation and dredging in recent years. Ultimately, all these pollutants ends up into the sea and adversely affect the overall fish production in the inshore waters.

An *Aquatic Life Conservation Department* should be established at the national level and *sea ranching* should be accorded top priority for the replenishment of depleting stocks. Fisheries being a common property resource and high uncertainty is associated with the earnings of different fishing units, the fishermen are more prone to migration rather than willing to continue their fishing operations at the degraded centres. The socio-economic survey indicates that almost all of them are not willing to pay anything for environmental enrichment and conservation of resources. Rather they indicate that Government should initiate adequate measures for their rehabilitation. The public agencies and corporate sector of fisheries should contribute for the installation of artificial reefs in the inshore regions and other stock replenishment measures.

All types of constructions along the seashore even for developmental purposes should be regulated and the CRZ Act should be strictly enforced for the environmental protection of the coastal area. Integration of coastal mariculture with the small-scale inshore fisheries is a viable alternative to enhance the earnings and livelihood security of coastal fisherfolk without endangering the environment.

Executive Summary

The coastal zone, which is an interface between land and water, has enormous socio-economic importance as these areas are characterised by the abundance of its natural resources. The coastal belt of Kerala with a length of about 590 km and having 226 marine fish landing centres and equal number of fishing villages with high population density. The coastal habitat of Kerala is under severe threat due to human intervention in forms of excessive fishing in the inshore waters, shallow water mining, lifting of coastal sands, destruction of mangroves, inflow of pollutants, growing urbanization, construction of sea wall and other related activities. These activities are bound to disturb the coastal ecosystem affecting the sustainability of fishery resources and the livelihood security of the vast majority of the inhabitants. Besides, the technological advancements in fishing methods coupled with the increasing export demand for fish lead to over-crowding of fishing units especially during peak seasons. This condition affects the sustainability of the ecosystem and increases the demand for environmental quality and conservation of resources.

The specific objectives of the present study are 1) to examine and document the extent of recent changes in the techno-exploitation pattern of inshore open access marine fisheries and socio-economics of stakeholders 2) to asses the economic impact of such changes on structure, composition and productivity of inshore marine fisheries and the livelihood security of the coastal population 3) to evaluate the economics of operation of different fishing units and its impact on fishery resource conservation and to suggest policy measures for sustainable development of coastal zone 4) to provide sufficient socio-economic indicators in the field of environmental economics to administrators and policy makers for decision-making in the regional environmental planning and 5) to estimate the economic loss due to the environmental degradation of inshore marine ecosystem.

A preliminary survey was conducted in all the fishing villages covering the entire study area from Poovar in the south to Munambam in the north along southern Kerala coast to identify representative sample villages of mechanised, motorised and non-mechanised fishing centres. The villages and the landing centres were selected for

detailed study on the basis of use pattern of marine coastal resources and intensity of operation of different craft-gear combinations both in artisanal and mechanised sectors by the coastal population of the Southern Kerala. The villages were then classified into highly degraded, moderately degraded and comparatively undisturbed categories in relation to the intensity of environmental pollution as well as fishing. The costs and earnings data for all types of fishing units were collected on sample days from each landing centres and the economics of different fishing units were evaluated, covering all seasons in a year (2001-2002). A socio-economic survey was conducted in all the selected centres to analyse the socio-economic framework of the coastal rural sector. Secondary time series data from 1962 to 2000, relating to species wise catch obtained from the National Marine Living Resource Data Centre of CMFRI were used to study the extent of variation in catch composition, production trend of inshore marine fisheries and the impact of technological advances on marine resource base. In order to evaluate the response of those who involved in fishing and allied activities, regarding the environmental and conservation problems of the natural fishery resources, an opinion survey was conducted in all the selected villages. The extent of damage caused by the technological advancements and thereby the destructive fishing by the mechanised as well as the motorised sectors was analysed.

The economic loss due to juvenile fishing by different fishing units was estimated using suitable models developed during the study. Cobb-Douglas production function was used to evaluate the economic efficiency of input utilization in trawler operation in three different regions. The Net Present Value (NPV) was calculated for discounted economic loss due to various environmental factors.

The socio-economic survey reveals that more than 70% of the total population in these villages are depending directly or indirectly on the coastal resources especially the fishery resources for their livelihood. Among the selected centres, Munambam, Cochin and Neendakara are predominantly mechanised fishing centres having significant environmental and conservation problems. The major environmental concerns of the highly degraded zone are excessive fishing pressure in the inshore

region, heavy destruction of the bottom fauna, juvenile fishing, by-catches, discards and coastal pollution.

The excessive fishing pressures exerted by the mechanised sector in Munambam, Cochin and Neendakara, in the inshore region upto a depth of about 50m have affected the sustenance of some easily vulnerable resources. The post harvest loss and devastation of non-edible biota is considerably high in coastal fisheries along the degraded area. The less valuable and undersized fish by-catches and the non-edible benthic biota are thrown overboard or dumped at the landing centres, which creates pollution and environmental hazards. Moreover, contamination of seawater by the effluents discharged through the estuarine water is higher in this region. The destruction of marsh, mangrove swamps and mudflats for urban settlement and port activities have a serious concern in the coastal environment of the region.

Another highly degraded area covered under the study is the Kochuveli village in Thiruvananthapuram District. Even though the Kochuveli coast is dominated by non-mechanised country crafts, the environmental degradation in this area is high. This is due to the impact of marine pollution caused by a large industrial unit producing titanium products situated along the Kochuveli/Vettukadu, coast of Thiruvananthapuram. Large quantities of acid wastes from this industry are flowing to the sea, which causes many health hazards to the fishermen such as nausea, eye problems and bronchial diseases. Some of the areas under study are considered degraded due to sea erosion and sand mining. Alappad village in Kollam district was the one of the typically most affected and degraded villages due to the invasion of the furious sea, especially during the monsoon season.

In the moderately degraded areas, the proliferation of motorised gears, operating within the nearshore areas creates heavy threat to the habitat. The indiscriminate operation of large number of minitrawl and ring seine units operated from the landing centre at Valanjavazhi and Pallana led to the depletion of some of the fishes of commercial importance. The predominant use of gears with reduced mesh size leads to juvenile fishing and thereby growth overfishing of many important species of fishes such as sardine and mackerel. Large proportion of the catch in minitrawl is composed of juveniles/sub-adults of the flatfish *Cynoglossus macrostomus* and

prawn *Parapenaeopsis stylifera,* causing damage to recruitment. The other centres selected in this category are Vizhinjam, Thangassery and Arthungal landing centres. Oil spills from outboard engines in the bay-landing centre creates pollution in the nearshore waters of Thangassery and Vizhinjam.

Kattoor coast of Alappuzha and Poovar in Thiruvananthapuram district are the comparatively undisturbed areas along the Southern Karala coast in relation to coastal fisheries and environmental problems. Most of the gears under operation in Poovar are non-mechanised units such as Catamarans (Plank built canoe), shore seine units and motorised plywood boat with gill net/ hooks and line. Kattoor is a natural landing centre with traditional motorised and non-mechanised units under operation.

The analysis of species-wise annual landings of Kerala during the last four decades clearly indicates that the effect of the technological changes in fishing methods such as introduction of mechanisation and motorisation of country crafts had affected some of the marine resources leading to their depletion. The catfish fishery along the Kerala coast is the best example for the depletion of a resource due to indiscriminate fishing by the mechanised sector The average annual catch of catfishes in 1961 was 3114 t, which rose upto 33526 t in 1974 owing to the large-scale exploitation by the mechanised trawlers and purse seiners during the intensive mechanization period came down to only 103 tonnes in 2000. The major reason for the decline of this particular species was the overfishing of brooders by the mechanised purse seiners and trawlers.

The pelagic fishes such as the carangids, tunnies and seerfishes were exploited in their maximum during 1985 to 1990 mostly by the motorised country crafts especially using ring seines, gill nets and hooks and line. Then onwards the catch showed a declining trend in spite of the increase in the number of motorised units in the area. Another endangered species is the polynemids collectively called, threadfins. The major cause of the depletion was destruction of their nursery grounds by the mechanised trawlers. The annual production of elasmobranches had also shown to be declining ever since their peak landings of 10338 t in 1974 and in 2000 it was only

2832 t. The heavy exploitation of sharks by the mechanised vessels along the coast reduced its catch from 7747 t in 1983 to 1706 t in 2000.

Certain less valuable fishes such as threadfin breams, lizardfishes, ribbonfishes which form the by catches in the mechanised trawlers, recorded an increasing trend in their catch. It was estimated that, in the total trawl landings, more than 45% was composed of bycatches, which include other than the above mentioned species, the juveniles and sub-adults of a wide variety of commercially important fishes. The increase in the landings of the cephalopods, which forms a major share of the Indian export earnings was also noticeable in recent years.

The selected villages along the coastal stretch of Kerala between Munambam and Poovar were surveyed to assess the socio-economic status of the fishermen and the other people who depend on the coastal resources for their livelihood. The total number of households ranged from about 1000 in Kochuveli to 12000 in Thangassery. In each village, the coastal wards, where fishermen are predominantly inhabited were covered under the survey and the information on socio-economic indicators such as housing pattern, family size and demographic features, literacy level, ownership of fishing equipments and employment pattern with special emphasis on fishing people, income distribution, consumption and expenditure pattern and indebtedness.

Regarding the ownership of fishing implements, the non-mechanised fishing vessel owners were more in Kochuveli and Poovar where 18 and 20% of the families respectively are having non-mechanised catamaran with gill nets. The percentage of families having non-mechanised shore seine were 7% in Poovar and 4% in Kochuveli. 5% of the families in Alappad and Kattoor were the owners of non-mechanised dinghy with gill nets. In Kochuveli, the livelihood of fishing community was seriously affected by pollution, which indicated by the non-existence of any improved technology in this area. Fishermen are mostly using country craft and catamaran without any sort of mechanised device. In Poovar, more families use non-motorised catamaran and country craft mainly because it is an economically backward village having no facility for institutional credit. In Vizhinjam, 23% of the families were owner operators of plywood boat units with gillnet/hooks and line.

Motorised minitrawl units were more found in Valanjavazhi with 24% of the families. The households owned mechanised trawlers were 5, 4 and 4% in Alappad, Neendakara and Munambam respectively.

Out of the total, 69% of the adult people in Arthungal were employed followed by Poovar (67%) and Valanjavazhi (61%). The lowest level of employment was in Kochuveli (47%), followed by Thangassery (51%), where most of the women members were housewives. About 50% of the employed people in Vizhinjam, Valanajvazhi and Kattoor were wage earners in the motorised fishing units, which offer better income to the fishermen. 47% in Neendakara and 48% in Munambam were employed as wage earners in the mechanised fishing units. About 21% of the people in Kochuveli and 19% in Poovar were engaged in fish marketing mostly representing the women headload vendors, generating additional income to support their family. In Kochuveli, because of the discharge of effluents from Titanium factory to the sea, the intensity of fishing has come down as the pollutants from the factory is having a detrimental effect on the fishery. There has been a considerable shift in occupation from fishery to non-fishery activities. Many have migrated to other places for employment. About 28% in Valanjavazhi were engaged in processing work, mostly ladies working in prawn peeling sheds.

On the whole, in all the villages, the consumption pattern indicated that about 80% of the household expenditure was for household consumption. The average annual expenditure of households was worked out, representing all the categories. It ranged from Rs.19600 for the families of peeling shed workers in Kattoor to Rs. 65412 for the mechanised boat owning families in Munambam. In all the villages, more than 80% of the total annual expense was for household purposes. However, it was observed that medical expenses of families in different villages is having no significant relation with the intensity or incidence of pollution. In Kochuveli, which is considered as a highly degraded area, the medical expenses incurred were only 8% of the total expenditure of the family. The utilization pattern of credit for different purposes clearly indicate that in most of the villages maximum loan was availed for the productive purposes.

The annual average costs and earnings of various fishing units operating from the selected landing centres have been worked out. In the mechanised sector, the annual net profit from the trawlers having Overall Length (OAL) of 36-42ft, 45-48ft and >50ft operating from Cochin Fisheries Harbour worked out at Rs.3.66 lakh, Rs.6.98 lakh and Rs.4.14 lakh. About 40% of the total expenditure was for the fuel followed by 25% for wages. Regarding the purse seine units operating from Cochin Fisheries Harbour, the annual net profit worked out at Rs.14.36 lakh was maximum for above 50ft craft with the highest rate of return of 87%. The average revenue obtained for the mechanised gill net units during the period 2001-2002 was Rs. 20.87 lakh with a net profit of Rs.4.69 lakh. The annual profit for the operation of the ring seine unit with a craft of >50ft at Valanjavazhi was Rs. 3.75 lakh. The major expenditure was labour charges (40%) as 20-30 crew, depending on the size of the craft, are engaged in a single day trip. The annual net profit obtained from a motorised minitrawl unit during the above period was Rs.1.48 lakh at Valanjavazhi and Rs.0.93 lakh at Arthungal with the highest rate of return of 168% were worked out for the former landing centre. The average annual revenue from a plywood boat with gill net, operating from Vizhinjam centre was Rs.5.73 lakh with a net profit of Rs.0.77 lakh and the net profit from the same type of unit at Thangassery centre was calculated at Rs.1.11 lakh. Comparatively higher rates of return were obtained from the non-mechanised units such as Catamaran and shore seine units mainly because of lower investments. The only exception was the non-mechanised dinghy with gill net, which obtains a rate of return of only 19%, with an annual profit of Rs.955. The net profit from a shore seine unit worked out at Rs.1.14 lakh at Poovar and Rs.0.90 at Kochuveli with a rate of return of 126% and 103% respectively. 95% of the expenses were towards the labour cost. At Kochuveli, even though due to pollution from industrial effluents to near shore waters, the average catch per unit of catamaran was much less than that of Poovar, the average revenue was high because fishing was extended to interior ground, thereby they could get quality fishes fetching higher prices.

The key economic indicators of operation of the mechanised, motorised and non-mechanised fishing units were calculated and compared. Among the mechanised units, the average catch per day of operation was highest in trawler and lowest in gill

net, but in terms of average value realisation, it was very much higher in gillnet. This is because, the gillnet is selective gear which often harvest large sized valuable fishes such as seerfish and tuna. Labour productivity was more in trawler. Among motorised units, the catch and revenue per day of operation was highest in ring seine. Average value realisation was high in minitrawl due to the landings of penaeid prawns. Labour productivity and rate of return also highest in minitrawl. Shore seine obtained highest catch per day of operation in non-mechanised units. Average value realisation was highest in dinghy with gill net just as in the case of mechanised gill nets. Quantity of fish produced per man day in shore seine was very low indicating high labour involvement in its operation.

The major species composition in the annual catch of the mechanised trawler varied from centre to centre. In Neendakara, the deep-sea prawns dominated with 64% followed by cuttlefish (11%), whereas in Munambam, the major species landed was the less valuable threadfin breams (31%) followed by high priced cuttlefish (24%). Threadfin breams (29%) and tunnies (28%) were the dominating species in the annual landings of the mechanised gill net unit operating from Cochin Fisheries Harbour. The pelagic species such as mackerels (76%) and oil sardine (13%) were contributed to the bulk of the catch of mechanised purse seine unit. in Arthungal, penaeid prawns dominated in the minitrawl catch (72%) followed by oil sardine (23%). 44% of the catch of the plywood boat with gill net at Thangassery was composed of mackerels and 32% by oil sardine. Carrangids formed 18%. In the non-mechanised sector, oil sardine (53%) dominated in the catch of catamaran with gill net unit at Kochuveli, followed by anchovies (29%). Scads formed 5% of the total catch. In Poovar, Catamaran unit with gill net was dominated with white baits (59%) and oil sardine (21%).

An attempt was made to study the input output relationship in trawler operation in three regions using the model Cobb- Douglas production function. The functional relationship indicates that there is a scope to enhance the net profit of trawlers by increasing fishing days and area of operation at Neendakara and Munambam, where as at Cochin Fisheries Harbour it is almost at the optimum level. At Neendakara landing centre, fishing days in a year can be increased from the average level of 193

to 204 and in Munambam from 203 to 229 days to get the maximum profit. Even though, the number of days fished in a year is not upto the optimum in all the major centres selected for the study, it was observed that there was excessive fishing pressure due to over crowding of fishing units during monsoon season resulting in overfishing of certain species of fish especially in Neendakara landing centre

The economic loss due to juvenile fishing by different fishing units was estimated using the model which was developed on the basis of the quantity of juveniles landed by different gears, landing centre level prices of juveniles and adult fish of each species and the approximate period in years by which the juveniles attain adult or marketable size. In the mechanised trawler the major species with juvenile fishing observed in annual catch were cuttlefish, threadfin breams, prawns, lizardfishes. Substantial quantity of juvenile sardines and anchovies were landed in ring seine units at valanjavazhi, juveniles of flatfishes and prawns could be observed in minitrawl units. Juvenile fishing was comparatively lesser in the mechanised and motorised gillnet units. Even though the annual revenue generated by a purse seiner is Rs. 20.7 lakh, the annual economic loss due to juvenile fishing by the same unit works out to Rs.39.6 lakh. In the mechanised trawler, the economic loss due to juvenile fishing was Rs.28.3 lakh as against annual revenue of Rs. 31.2 lakh. In the motorised sector, a ring seine contributes a loss of Rs.19.1 lakh, which is higher than that of the annual revenue generated by the same unit (Rs.12.4 lakh) and for the minitrawl the annual economic loss was estimated as Rs.6.9 lakh. Among different centres, the highest economic loss was at Neendakara mechanised landing centre with Rs. 239.1 crores/year followed by Cochin Fisheries Harbour and Munambam. As a whole the economic loss due to juvenile fishing in the study area is estimated at Rs.600 crores per annum in which the highly degraded centres alone contribute about 82%.

Environmental problems at Kochuveli and Alappad were discussed in detail and their effects on fisheries of the area were worked out in terms of Net Present Value of loss of fish due to pollution for the next 15 years discounted to the present level. The regular costs and earnings data of different crafts-gear combinations were collected for a period of one year were to analyse the magnitude of this pollution on the fishery

of the area. At Kochuveli, because of pollution problem people are reluctant to adopt improved technologies of fishing. Due to this the fishing intensity also has come down. Taking into account, the major factors influencing the level of effort and the catch and value, the Net Present Value of estimated loss to the village due to pollution for the next 15 years comes around Rs. 2371,01,515. The fishing intensity of the nearby areas such as Poovar and Vizhinjam was taken as control centres to estimate the economic loss. Since there can be a flow of future benefits in coming years, a cost benefit analysis is done and the NPV is calculated for 15 years with discount rate of12%. NPV calculated for Kochuveli is Rs.157.4 crores. The fish production and fishing intensity of Alappad village was compared to that of nearby Thangassery landing centre to calculate the economic loss. The low level of annual landings from Alappad landing centre is mainly due to the sand mining and sea erosion and thereby the construction of sea wall, which obstructs the landing centre facilities. The annual economic loss due to these factors is amounted to Rs.97.4 crores. The economic loss in terms of Net Present Value calculated for 15 years is Rs. 647 crores.

An opinion survey was conducted on Government policies on the conservation of resources, covering 100 people in each of selected villages, who in one way or other are involved in fishery activities either as fishing workers, fish traders or boat owners. The survey reveals that more than 80% of the respondents are aware of the importance of environmental management for the conservation of natural resources, especially fishery. Many of the respondents in the degraded area believed that many economically important species of fish are disappeared or declined from that area especially from Kochuveli. About 60% of the interviewed people at Alappad demanded the construction of sea wall to protect the shore and 100% to stop sand mining. All the respondents except those were involved in the operation of minitrawl consider this net as highly destructive and detrimental to the growth of fishery in the long run. However, most of the fishermen interviewed were very cautious in making any response to the restrictive measures which would affect their present benefits. Majority are in favour of a fishing holiday, but there is no unanimity in the type of unit or duration.

Economic loss due to the extinction of some of the species of fish because of over-exploitation was worked out. The net loss due to overfishing was estimated in terms of Net Present Value of MSY for 30 years discounted to the present level. The net loss in terms of NPV for 30 years discounted to the present level was Rs.160.6 crores for catfishes, Rs.458.5 crores for elasmobranches and it was 3.9 crores for goatfishes. An additional loss of 30% of this amount comes in the form of consumer's surplus.

Policy measures have been recommended for the conservation of resources and environmental problems along the study area. In Kochuveli, where environmental problems affect the future benefit from fishery, it is suggested that the industrial effluents should be treated before discharging into the sea through a buried tunnel. For preventing the indiscriminate exploitation of the fishery resources there should be fishing holidays for all types of mechanised fishing units and its socio-economic impact should be assessed. Since minitrawl is comparatively highly profitable and less capital intensive, there is every chance for its expansion. It is detrimental to the sustainable development of the fishery. Hence further proliferation of this unit should be restricted. As the economic loss due to juvenile fishing is substantial, the standardized mesh size regulations should be introduced and implemented with proper monitoring for all types of gears in order to avoid juvenile fishing. All types of constructions along the seashore even for developmental purposes should be regulated and the CRZ Act should be strictly enforced for the environmental protection of the coastal area. Since the economic loss due to the extinction of three species (elasmobranches, catfish and goatfish), because of overfishing is very high, other endangered species such as carangids, seerfish, threadfins etc. have to be protected by restricting the indiscriminate fishing by mechanised as well as motorised fishing units. Integration of coastal mariculture with the small-scale inshore fisheries is a suggested viable alternative to enhance the earnings and livelihood security of coastal fisherfolk without endangering the environment

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Annexure I

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Environmental Economic Analysis of Inshore Fishery Resources Utilization of Coastal Kerala

Schedule I: Village Schedule

1. Name of the fishing / coastal village:
2. Location Taluk: District:
3. Name(s) of the fish landing centre(s):
4. (a) Total number of households in the village:
   (b) Total number of fishing households:
5. Total population:
6. Occupation of the people (Number or percent)
   a). Fishing
   b) Fishery related
   -Marketing
   -Processing
   c) Other non-fishing (Specify)
7. Educational Institutions
   -Primary School
   -Middle School
   -Higher secondary
8. Infrastructure inventory
   (a) Drinking water facilities
   (b) Sanitary facilities
   (c) Landing centre facilities
   (d) Marketing facilities
   (e) Ice factories
   (f) Processing units
   (g) Drying facilities for fish
   (h) Transport facilities in terms of average number of trucks, tempos, autos and cycle.
   (i) Banking facilities
   (j) Post Office
   (k) Co-operative Societies

Name	Number	Strength
Producing		
Marketing		
Fish farmers		
Any other (Specify)		

9. Inventory of fishing equipments (Number)
   a). Mechanised fishing trawlers b). Mechanised (IBE) gill nets
   c) Motorised ring seine units d). Motorised mini trawls
   e). Other motorised country crafts f). Any other (Specify)
10. Average landings and value (Season-wise)

Season	Average landing per trip	Average revenue per trip	Imp. Species of fish
Pre-monsoon			
Monsoon			
Post-monsoon			

11. Details of coastal aquaculture
(a). Potential area available for culture: _____ (ha).
(b) Area under culture as on now: _____ (ha)
(c) Percentage of utilization:
(d) Common species cultured and seasons
(e) Type of farming followed
(f) Number of farmers

12. Extent of agriculture
(a). Gross cropped area under each crop:

13. Area under social forestry/ agro forestry
14. Livestock population
    a) Cattle:
    b) Poultry:
    c) Others (Specify)

15. Establishment of artificial fish habitats and details

16. Industries
a) Nature of the industry: Small/ medium/ large
b) Ownership: Private/ government
c) Nature of product: Main: _____ By product: _____
d) Effluents (if any)
e) Discharge point
17. Assessment of Environmental Damage
i) Land
- Loss of land area due to sea erosion: _____ (ha)
- Loss of land area due to construction of sea walls: _____ (ha)
- Destruction of natural habitats: _____ (ha)

ii) Fishing
- Any reduction in fish catch
- Decrease in days of fishing
- Reduction in depth/ distance of fishing

iii) Pollution
- Reduction in catch
- Health hazard through increase in medical expenses
- Pollution of drinking water
- Pollution of ground water table
- Soil salinity

18. a. Structural change in the use of coastal resources for the past 5 years

Coastal resources	Changes	Remarks*
1. Aquaculture a). Area b). Species cultured c) Farming pattern		
2. Fishery		

a). Fleet size b) Fishermen household c) Catch per trip		
3. Natural habitats a) Area under mangroves (ha) b) Area under wetland (ha) c) Others (Specify)		

* In remarks column, the reason for such changes can be recorded

b). Structural changes in the social setup for the past 5 years;

Annexure II

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Environmental Economic Analysis of Inshore Fishery Resources Utilization of Coastal Kerala

Schedule IIIa- Economics of Fishing Unit (Fixed cost details)

1. Landing Center: Village: Dist.
2. Type of unit:

3. Craft/Gear details:

		Length	HP	Mesh Size	Year of purchase	Purchase value	Annual expenditure on repairing & maintenance	Longevity
a)Craft	Mother boat							
	Carrier boat							
b)Gear								
c)Engine								
d) Other accessories (Specify)								

4. Loan taken for the investment of the unit:

Source	Amount (Rs)	Interest (%)	Amount outstanding

5. Type of ownership: Single owner/ Shared/ Leased:
6. Type of sharing:

7. Persons engaged in fishing operations:

	Family workers	Hired labourers
a) Number of Crew		
b) Number of persons employed/ engaged in loading / unloading, transporting & marketing the catch		

8. Average number of fishing days in a year (Seasonwise)

June-August	September-November	December-February	March-May

9. Time of departure and arrival to the fishing ground:
10. Duration of fishing trip (Hrs.):
11. Distance to the fishing ground (Kms):
12. Where and whom the catch is sold :
13. Mode of disposal of catch:

14. Percentage of the catch sold (Specieswise)

Particulars	Fresh	Dried
1		
2		
3		
4		
5		

15. Any type of marketing expenditure incurred by the boat owner at this landing center:

16. License, Insurance, Jetty rent etc. :

17. Any other expenditure (Specify):

Name of Enumerator

Annexure IV

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Environmental Economic Analysis of Inshore Fishery Resources Utilization of Coastal Kerala

Schedule II: Socio-economic survey of fishermen households

Sl.No.

1. Name of the fishing / coastal village:
2. Location Taluk: District:
3. Name(s) of the fish landing centre(s):
4. (a) Name of the head of the family:

Adults	Age	Sex (M/F)	Occupation		Education
			Main	Subsidiary	
1.					
2.					
3.					
4.					
Children					
1					
2					
3					

4. Family size:

5. Occupation details: **Fishing (F)**

No of persons active in fishing				**Income**
	Mechanised	Motorised	Non motorised	
Non operating Owner				
Owner Operator				
Wage earner				

Fishing allied activities

Occupation	No of persons	Income
Fish trading (FT)		
Processing units, ice factories & peeling sheds (P)		
Transporting, loading and unloading (T)		
Net making and repairing (NR)		
Boat building and engine repairing (BR)		
Other fishery related activities (OT)		
Non-fishery activities (Specify) (NF)		

6. Ownership pattern of fishing equipments & Employment pattern:

a. Ownership pattern

Equipments	Name	No	Purchase year	Purchase value	Fuel required	Owned/sharing /leased in/out	Present Value
Craft							
Gear							
Engine							

b. No. of days of fishing in the last year:

c. No of days employed in a year (season-wise)

June-August	September-November	December-February	March-May

7. a. Type of the house: Thatched/Tiled/Concrete; Land area:
   b. Drinking water facility:
   c. Electrified: Yes / No

8. Live stock:

Cattle: Poultry:

9. Consumer durables:

Equipments	No.s	Purchase year	Purchase value

10. Income, expenses and indebtedness:

A. All type of income:

B. All expenses:

Food	Education	Medicine	Cloth	Fuel	Rent	Total

C. Indebtedness:

Loan Amount	Purpose taken	Purpose spent	Source	Year	Rate of interest	Amount repaid	Amount outstanding

11. Structural changes in the social setup for the past 10 years:

1. Housing pattern:
2. Ownership pattern:
3. Children education:
4. Income level:
5. Ownership of consumer durables:

12. Income Generation by women members

Types of major occupation

1. House Wife :
2. Fresh fish vendor :
3. Fish processor (Specify) :
4. Auctioneer :
6. Labourer(specify) :
7. Any other(specify) :

Total

13. Have you experienced in your area any environmental damage such as

	Yes	No	Remarks
a. Industrial waste deposition:			
b. Sewage dumping:			
c. Dredging:			
d. Reclamation:			
e. Siltation:			
f. Discharge of coolant waters:			
g. Offshore mining:			
h. Sea erosion:			
i. Loss due to sea wall construction:			
j. Others:			

- Note: - If the answer is yes for a few or all of these indicators, then ask the appropriate expenses incurred to rectify each of them and record them in the remarks column.

14. If so give details:

Date: Name & Signature of the Enumerator

Annexure V

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Environmental Economic Analysis of Inshore Fishery Resource Utilisation of Coastal Kerala.

Opinion Survey Schedule. Date:

Landing Centre**:** Village**:** Dist**:**

A.

1. Name of the Respondent:
2. His /Her Occupation or Position:
3. Experience in Fishery:
4. Age: Qualification:
5. Annual Income**:** Fishery: Others**:**

B.

1. Are you aware of any sort of environmental degradation that has affected the fishery in your region?

2. Have you experienced any change in Species composition of landings?

3. Is there any major change in fishing technology in their area?

4. In your opinion which is the best of all the gear combination affordable to the local traditional fishermen?

5. Can you mention the name of any fish that has permanently disappeared from the catch?

6. Do you think that any type of fishing unit where operation in your area creates any sort of ecological problems significantly which affects the fishing?

7. Are you in favour of a fishing holiday? If so, what extent. Whether only for mechanised fishing or for the entire operations or monsoon fishing?

8. How far the Mini Trawling affects the conservation of fishery?

9. Do you think that the present day mechanised trawling has an adverse impact on the sustainability of marine fishery?

10. What are the measures you suggest for the conservation and proper management of marine fishery?

11. Do you think that the landing centres in your region are environmentally polluted?

12. Do you agree that at your nearest landing centres fish is auctioned in a unhygienic situation?

13. Do you think that there is biological or economic & over fishing in your area?

Annexure III

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Environmental Economic Analysis of Inshore Fishery Resources Utilization of Coastal Kerala

Schedule IIIb - Economics of Fishing Units (operating costs and earnings)

1. Landing Center: Village: Dist. Month: 200

2. Type of unit: Date:

Unit Sl. No.																					**Total**	
Length of the craft(ft)																						
Name of the fish	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)	Qty. (Kg)	Value (Rs)
Total																						

Details of operating costs per day/ trip (Rs) Date:

HP of the engine											
Unit Sl. No. Item											Total
1.Loading, unloading & transportation charges 2.Repair & maintenance (if any) Craft Gear Engine 3.Fuel (Specify) Mother boat Qty (lit) Value (Rs) Carrier boat Qty (lit) Value (Rs) 4.Engine oil 5.Auctioning 6.Rent for carrier boat, if any 7.Bata 8.Food 9.Ice 10.Salt 11.Drying 12.Market tax 13.Others, if any											
Total											

Actual number of fishing trips (monthly)
Number of days in a trip
Remark