TECHNOLOGICAL CHANGE AND MODERNISATION IN THE FISHING SECTOR: THE QUESTION OF SUSTAINABILITY

Thesis submitted to the Cochin University of Science and Technology
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By

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CERTIFICATE

I certify that the work entitled **"TECHNOLOGICAL CHANGE AND MODERNISATION IN THE FISHING SECTOR: THE QUESTION OF SUSTAINABILITY"** is a bonafide research done by **Bindu George** for the award of the degree of Doctor of Philosophy in the Department of Applied Economics under my guidance and supervision.

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27/02/2011

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DECLARATION

I hereby declare that the thesis entitled "**TECHNOLOGICAL CHANGE AND MODERNISATION IN THE FISHING SECTOR: THE QUESTION OF SUSTAINABILITY"** is the record of bonafide research carried out by me under the supervision of **Prof(Dr).D.Rajasenan**, Professor, Department of Applied Economics, Cochin University of Science And Technology. I further declare that this thesis has not previously formed the basis for the award of any degree or diploma of any other university. The works of authors, wherever they have been made use of in this study has been duly acknowledged.

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CHAPTER 1

INTRODUCTION

Fishery sector occupies an important place in the socio-economic development of the country. The continued changes and up-gradation of existing fishing technologies and modernization helped to increase the efficiency of craft and gears. At the same time it has also marginalized the fisher folk who are not able to cope up with the changes. In recent years there has been considerable increase in activity in the motorized sector, especially the ring seine and mini-trawl fishery, causing concern for certain exploited species. There have also been dimensional changes in the gear and the time spent for fishing in the mechanized sector by undertaking voyage fishing and use of sophisticated electronic devices for fish finding has resulted in increased fishing pressure and fishing efficiency. This raises an important issue, called sustainability.

1.1 Indian situation

Fishing has been the main occupation of the people of the coastal belt from time immemorial. The fishing sector is a unique source of animal protein to the population, employment and income for the rural poor and a source of valuable foreign exchange for the country.

Fisheries are an important sector in India providing employment to millions of people and contribute to food security of the country. With a coastline of over 8000km, an Exclusive Economic Zone (EEZ) of over 2 million sq km, fisheries play a vital role. Marine fisheries contribute to food security and provide direct employment to over 1.5million fisher people besides others indirectly depending on the sector. The total marine fisher folk population of 3.57 million is spread across the coastal states and union territories (including islands) in 3,305

marine fishing villages .Of these 0.90 million are active fisher people and another 0.76 million fisher people are involved in other fisheries-related activities.

Indian Fisheries sector has been witnessing a steady growth since First Five Year Plan. The annual fish production rose to over 6.9 million tonnes during 2006-07 from around 0.75 million tonnes in 1950-51. Fisheries became a focal theme of Indian Five year plans of the Government and this resulted in the promotion and popularization of mechanized fishing vessels and modern gear materials during First two Five year plans (1951-1960); increase in the use of synthetic gear materials during the Third Five year plan (1974-1978); introduction of purse seining during 1974-1978; motorization of artisanal craft in 1979; rapid popularization of ring seine gear operations by motorized artisanal fleet during (1985-1996). A Working Group on Fisheries for the Eleventh Five Year Plan constituted by the government of India, the Planning Commission suggested strategies for sustaining and augmenting marine fish production comprising change over from an open access to a regulated regime, employing a fishery management regime supported by a multi-dimensional information platform, upgrading technologies and capabilities in the artisanal and small mechanized sector for diversification reducing the excess capacity of fishing fleet, freezing the entry of new coastal mechanized fishing crafts, establishing an oceanic tuna and squid fishery, promoting mariculture for fin fishes, edible bivalves, sea plants and other important species and sustain fish production through the effective enforcement of Marine Fisheries Regulation Acts.

The government started its attempt of modernization of fishery sector as early as 1953 when the Indo–Norwegian Project came into being. After their unsuccessful attempts to introduce motors for artisanal craft, the project shifted its emphasis to new designs for mechanized boats to be operated from harbours. A few hundred gillnet boats were introduced during early 1960s. These boats had very limited impact on production and were largely complementary to the artisanal fleet. The high market price for penaied prawns in the world market led to the introduction of small coastal trawlers. Governments interest in promoting exports gave an impetus to trawling. Finding trawling profitable, a mad rush to

own trawlers were seen in the 1970s. Many new entrants invested, to reap the profits. The government took efforts to supply trawlers to the actual working fishermen, through co-operatives. But it ended up going into the hands of middlemen and outsiders who were absentee owners who had no long term stake in fishing than only profits.

It is agreed that open access regulations and the consequent excess capacity could result in over fishing, habitat damage, livelihood threat and wide spread poverty among the fisher folk. Despite increased productivity gains in the sector, technological advancements in the sector have also led to biological and economic over fishing in as much as to the tragedy of the commons, thereby aggravating the livelihood issues of the fisher folk. Because of the nature of labor stickiness and lack of alternate employment opportunities, the fishers go on venturing to the sea with the expectation of an unexpected bounty.

1.2 Kerala situation

Kerala with a mere 10 percent of India's coast line occupied a prestigious position in fish production since many years, still crowns the glory with its tradition of sea farming, marine fishing and maritime trade. Fish in the past was considered a poor man's food but today for the people of Kerala, cutting across religious affiliations, are avid fish eaters. Fish and fisheries therefore have a very significant place in the socio-cultural fabric of life in Kerala. Kerala is endowed with natural resources for building a strong and vibrant fisheries economy in tune with the national strategy. Kerala, besides her coastal belt extending over 590 km has an extensive inland water spread of around 4 lakh hectares. The exclusive economic zone (sea spread up to 200 meters) lying adjacent to Kerala coast is spread over 36000 square kilometers which is almost equivalent to the land area of the state. (Economic Review, 2006). At present, the estimated fisher folk population of Kerala during 2008-2009 is about 11.33 lakhs. The number of fishers dwelling in the coastal area is estimated at 8.72 lakhs. (Economic Review, 2010).

The artisanal fishermen of Kerala have an uninterrupted history of a few thousand years and their technology has developed over the centuries in tune with local conditions. Till the 1960s there were only few mechanized boats in the state and almost entire marine fish production was from the country craft propelled by wind and manpower. During the 1950s and 1960s, the output from the artisanal sector grew steadily as a result of a change from cotton nets to nylon nets as well as the greater incentive to fish due to better marketing infrastructure and enhanced local demand for fish. By 1970, output of the artisanal fishermen was close to the maximum sustainable yield in the inshore waters (0-50 m depth) estimated at 3,77,000 tones (SIFFS, 1991.)

The differential endowment of technological and other resources between the traditional fisher folk and the mechanized groups put the traditional fisher folk at disadvantage. The public good nature of fishery resources sets a clear stage for over exploitation leaving the management of negative externalities to 'others' in the absence of proper institutional mechanisms, and this could brew to a fishermen class struggle. The economic and social ramifications of such class struggles could result in suboptimal functioning of formal and informal institutions in the sector and may hinder the process of sustainable fishery resource management.

The strained environment warranted the intervention of state as policy institution to curb the resource depletion and unsustainable fishing practices to safeguard the livelihood threat of the traditional fishing community by issuing various legal policy measures, such as Marine Fishing Regulations and closed seasons.

Kerala, blessed with a long coast line of 590 kms, situated on the South-Western corner of Peninsular. The coast line is about one tenth of India's coast line and has a continental shelf of 40 thousand square km. Kerala occupies foremost position in marine fish production of India forming nearly 25 per cent (5.88 lakh tonnes) of the total annual production. Marine capture fisheries have always dominated the total fish production, compared to inland fisheries in

Kerala. The phenomenal growth in marine fisheries during the last decades was due to the introduction of innovative fishing practices, well developed harvest and post harvest infrastructure and increased demand for marine fish products both in domestic and export markets. Marine production has increased to 5.86 lakh tonnes in 2007-08 from 5.61 lakh tonnes in 2006-2007 as given in table 1.1.

Table 1.1 Fish production in Kerala 2001-2010 (lakh tones)

Year	Marine	Inland	Total
2001-2002	5.94	0.78	6.72
2002-2003	6.03	0.75	6.78
2003-2004	6.08	0.76	6.84
2004-2005	6.02	0.76	6.78
2005-2006	5.29	0.78	6.07
2006-2007	5.61	0.79	6.4
2007-2008	5.86	0.81	6.67
2008-2009	5.83	0.83	6.66

Source: Economic Review, (2010)

Kerala, one of the leading maritime states in India, has been selected for relevant case study in the context of the tremendous increase in fishing efforts and dwindling fishery resources in the region The harvesting technology is also turning out to be very expensive on account of the rising fuel prices. An economically viable fishery is one which has productive fish stocks and system of incentives which allows fish to be harvested at least cost. The government is also assigning top priority to the fisheries sector of Kerala because

1. This sector is a major employment contributor and income earner engaging 63000 people in fishery allied activities.

2. It satisfies the protein requirements of a considerable chunk of the population, specially the poor people

3 The marine products export from the state during 2008-2009 was 100780 tonnes, valuing to Rs 157218 crores.

4. Fisheries sector contributing to 3 percent of the economy of the state domestic product

The present marine fisheries scenario of the state is a free and open access system and consequently there is intense competition for the resources among the various sectors (traditional and mechanized vessels). Much unhealthy fishing practices and gears were being introduced resulting in stagnation in the marine fish production. Kerala at present is experiencing ecological, economic, social, institutional and technological threats. Resource sustainability issues as a result of modernization and mechanization has much relevance by considering the livelihood of the outliers of the society who have no other option.

1.3 Survey of Literature

An attempt is made to blot some studies on global over fishing, fisheries management, sustainable fisheries development, community participation, regulations etc. Many fruitful and scholarly studies have come up on the process of technological change and mechanization which is taking place in the marine fishery sector of the state. A few expert committees which have been appointed by the government of Kerala regarding conservation of resources in the marine coast of Kerala are also reviewed.

1.3.1 Over fishing-A major Issue

Prior to the 19th century, scholars viewed the oceans as a vast frontier with in-exhaustible resources, creating the philosophy of the freedom of humanity to exploit the seas. (Friedheim ,1999; Smith ,2000).

The concept of over fishing was nonexistent, as the dominant world view was one of unlimited resources and a massive ocean frontier with limited local capacity of fish, marine productivity was far in excess of catching capacity. (Haggan, 1998; Smith, 2000).

The 19th century, saw the expansion of the global feet and the development of distant water capacity (Smith, 2000). Advancements in Industrial revolution increased the capability of vessels to access distant fishing grounds and to catch fish through developments in gear. The development of the steam engine, refrigeration, the auction system, and road and rail transport facilitated the rapid development of the fishing industry, new markets, and increased production. (Smith, 2000; Garcia, 2001, Kaye, 2001).

In the late 19th century, the idea emerged that intense harvesting of marine resources could detrimentally affect populations (Friedheim, 1999; Kaye, 2001). At the turn of the century, conservation issues and related speculations led to the development of the International Council for the Exploration of the Sea (ICES) aimed at "promoting and encouraging research and investigations for the study of the sea, in particular those living resources thereof" (CIESIN, 1998).

In 1950 less than 20 million tones had been extracted from capture fisheries and by 1970 the amount had trebled to 60 million tones (FAO, 2000). Signs of stress starting showing in several large-scale fisheries during the 1960s and 1970s (Hannesson, 1995). In 1971-72 the Peruvian anchovy fishery off the coasts of Peru and Chile collapsed with global repercussions and over fishing was a significant factor in the collapse (Pauly et al, 2002). Besides North-Atlantic demersal fisheries such as haddock, halibut and cod were showing signs of depletion (Fairlie, 1995; Bots ford, 1997; Haggon ,1998) .The Cod stocks off New

England and Eastern Canada collapsed in the early 1990 with dire regional socio-economic consequences (Buckworth, 1998; Charles, 1998; Pauly et al, 2002)

Fisheries in the 20th century have shifted from local activities to global market- influenced industries, employing millions and generating export income for many nations. Despite this growth, local communities still depend on fisheries resources as a source of protein and livelihood. Small scale community fisheries employ 50 of the world's 51 million fishers mostly from developing countries (Berkes et al, 2001).

Coastal marine and fresh water resources are under stress, with many showing signs of resource degradation and collapse as a result of increasing fisheries exploitation and habitat degradation (Buckworth, 1998). The demand for fisheries products is increasing along with the geographical spread and intensification of fisheries around the world by growing population and market economy and overcapitalization in world fisheries.

Globally, the estimates for 2006-07 based on reporting by some major fishing countries indicate that total world fishery production reached almost 149 million tonnes, representing an increase of over one million tonnes compared with 2005-06 and a record high production. Global capture production in 2005-06 reached 102.0 million tonnes, an increase of 4.5 percent in comparison with 2004-05, when total catch had declined to 92.5 million tones. Around 105.6 million tonnes of this (75 per cent) is used for direct human consumption; the rest is used for non-food products, in particular the manufacture of fishmeal and oil. Globally, the per capita fish consumption has increased from about 9 kg per annum in the early 1960s to about 16 kg in 2000. The per capita availability of fish and fishery product has therefore nearly doubled in 40 years, outpacing population growth, which also nearly doubled in the same period. However, the trend after 2000 shows a stagnant position in terms of per capita fish consumption.

The world fisheries face a grim forecast. The increased fishing pressure for the past 45 years has resulted in bearing many major fish stocks depleted or to

decline (World Resources, 1998) The World Watch Institute has catalogued the disastrous consequences of over exploitation of marine fisheries around the world (Weber, 1994). Globally, the marine catch has stagnated and we appear to be reaching, or have already exceeded, the limits of the sustainable harvest of the oceans (Symes, 1996). The North East Atlantic which is one of the most prolific fisheries and the first world region to exhibit signs of over fishing in the modern era, has recorded the longest period of sustained decline. Estimates show that 70 percent of the worlds' fish stocks are now over fished (FAO, 1995).

Bailey (1987) highlights some of the social consequences of excess fishing effort. In the context of Southeast Asian Fisheries, which are characterized by a dualistic structure with distinct small scale and large scale sub sectors. The consequences of excessive fishing is reflected in dissipation of resources rent, gear conflicts leading to broader social conflicts, increased use of destructive fishing techniques, changes in the food supply and distribution channels and concentration of economic power within the fisheries sector.

The economic factors, which have caused and causing economic and biological over fishing in Southeast Asian countries has been analysed (Willman, 1987). A list of scientific and policy issues to be addressed by scientists and policy makers while working together towards a system of governance of coastal areas is provided and argued that a population bomb has already been destroying the worlds coast lines (Hinrichsen ,1995) .

Veiel (1999) explains how over fishing leads to the collapse of Morocco's sardine port Safi, where 35,000 inhabitants are struggling for a living. Open access regulations and the resulting excess capacity results in over fishing, habitat damage, critical levels of by-catch of non-target species, some of which are close to extinction is the root cause of over fishing, habitat damage, and critical levels of by-catch of non-target species, some of which are close to extinction. Excess capacity has been shown to be a major cause of illegal, unregulated and unreported (IUU) fishing. Most importantly, excess capacity leads to poor economic conditions in the fishery and related sectors such as processing and

marketing and this is true in both developed and developing countries. Even with a healthy target stock overcapitalization will lead to profit dissipation as too many fishers chase too few fish (Lent and Rebecca, 2006). In the global context, Ridgeway and Lori (2006) highlight serious threat to world fisheries due to overcapacity. Overcapacity undermines conservation and effects ecosystem due to over-fishing, illegal, unregulated and unreported fishing (IUU), which results in economic conditions and return on investment.

1.3.2 FAO studies

FAO was instrumental in undertaking and promoting many valuable studies. Since its inception it was pinpointing to promotional fisheries development of the less developed countries of the world. In Great Britain, FAO outlined the resources rendered by the government for the benefit of the industry. Studies on the fishing industry of Sweden also give an account of the working of fishermen's organizations and regulation of fish prices.

Changes in science and policy issues from an environmental perspective are of utmost need for an effective management of population and consumption pressure on marine fisheries (Speer, 1995). Strategies have been adopted by FAO and the World Bank to facilitate the implementation of the International code of conduct for responsible fisheries by fishing and coastal nations (Garcia et al, 1997). Mean while, over capacity - too many boats chasing too few fish has come to be a critical issue, with the world's fishing capacity greatly exceeding what is needed to catch the sustainable yield (Buck worth, 1998). IUCN (1998) official records state that the capacity of the world's fishing fleet has been increasing by 4.6 percent per year between 1970 and 1990, twice as rapidly as catches.

FAO statistics highlights that approximately 70 per cent of stocks are fully exploited, recovering or depleted and hence the capacity of stocks to provide for increased and continual demand is limited (FAO,2000). Overcapacity or excessive fishing inputs are said to be the major contributors to the deterioration of these fish stocks. The state of global stocks of marine fish highlights that 52 per cent of

stocks are fully exploited showing that they are at or near their maximum sustainable production levels. Remaining 20 per cent are moderately exploited, 17 per cent are overexploited, 7 per cent are depleted and 3 per cent are under exploited. And only one per cent is recovering from depletion (FAO, 2007).

An outline of the current state of affairs in the fisheries sector on a global level and the need for sustainable management of the fisheries sector describing the options for interventions in the context of Dutch policy, examines the choice of channels for support to the fisheries sector and provides guidelines, which can be used in the appraisal of activities in the sub-sectors of artisanal fishery and small scale aquaculture has been provided by the Ministry of Foreign Affairs, Netherlands (1995). The world fishing fleet which consisted of about 4 million units; of which 1.3 million were decked vessels of various types, tonnage and power, and 2.7 million were undecked (open) boats. Virtually all decked vessels were mechanized, only about one-third of the undecked fishing boats were powered with outboard engines. The remaining two-thirds were traditional crafts of various types, operated by sail and oars. About 86 percent of the decked vessels were concentrated in Asia, followed by Europe (7.8 per cent), North and Central America (3.8 per cent), Africa (1.3 per cent), South America (0.6 per cent) and Oceania (0.4 per cent) (FAO, 2006).

1.3.3 Mechanization and Its Consequences

The productivity of the Kerala coastal belt is considered the richest in the Indian Ocean and the state is in the forefront in the matter of exploitation of the fishery resources. The state is also a pioneer for embarking upon many innovative measures in harvest and post harvest technologies. Recently landings have witnessed wide fluctuations and stagnation. This is because of the severe over fishing throughout the coastal belt of Kerala. The technological advancements have considerably influenced the fishing activities in the country. Many studies which have emanated during the past years, concerns to all these issues both at the global level and in the state level

1.3.3.1 Impact on Nature and Resources

The depletion of shrimp resources along the coast of Neendakara was investigated by George et al (1980). George (1980) also analyzed the concentration of mechanized boats in certain centres, the changes in species composition and the size of prawn being attributed as the major cause of sickness in the mechanized fishing sector of Kerala.

The conflict brewing in the purse-seine fishing industry of Kerala became the subject of analysis of Korakandi (1984). Taking the period 1951-1985 he analyzed the process of development in the primary marine fishing industry of Kerala and identified the factors which have contributed to its growth in the initial stages of development as well as the factors that led to its decline in the later stages. The ecological and economic impacts of the new technology introduced into Kerala's fishing industry over the past three decades of fisheries development planning was analyzed by Kurien (1987)

Achari (1987) examines the reasons for the imbalanced fishery as a result of mechanization and suggests remedial measures for overcoming the crisis. Kurian and Achari (1988) analyses the fisheries development policies and fishermen struggles in Kerala and highlight the explicit and implicit policy orientations adopted by the Government and examine its effect on the fish economy, the fish workers and the fishery resources and reveal how all these led to the upheaval of the workers in the state. Achari (1989) identifies little improvement in the catch; shrink in real income from fishing, relegation of fishermen's natural skills, disruption of harmony in the traditional community, increased level of investments in fishing units, high level of indebtedness among fishermen owners and co-operativisation of ownership and management as the major results of motorization process.

Kurian and Achari (1989) examines the common property resource nature,the coastal ecosystem and the fish therein which in turn has a combination of economic, technological and social factors interacting in specific context,

results in the over use of the commons, leading to its near ruin and points that ensuring economic consequences are by no means equitably distributed.

Chandrasekharan and Natarajan (1992) stress the need for protecting swamps, since it acts as a nursery for the Juveniles. Studies conducted from 2001 to 2004 for the state government and also for the Central Government on the "Impact of Trawling On the Sea Bottom and its Living Communities" reveal that trawling destroys 2500 tonnes of juvenile squid and cuttle fishes, 5000 tonnes of shrimp juveniles, 80,000 tonnes of juveniles of low quality fishes and 700 tonnes of eggs (Kurup, 2006).

Iyer, Rajendran and Choudhury (1968) studies the relative performance of three different size group trawlers(viz 30ft, 32ft and 36ft) operating along the Kerala coast (cochin base) and found that the 36ft vessels were much better than the other two categories in efficiency. The Kerala State Planning Board (1969) also evaluated the comparative efficiency of the different fishing vessels in operation in the Kerala coast.

Joseph (1973) worked out the economics of operating the 17.5m indigenous steel trawlers along the Kerala coast. Shrimp exports gained much prominence during the mechanization period. Ramakrishnan (1976) makes a critical study of employment, organization and productivity in the fishing industry of Kerala following this in the same year Valsala (1976) attempted a study on the structure of marine products export industry and the backward linkages operating in it.

Ramakrishnan (1977) studies the process of capitalist development in the Kerala fishing industry and in 1979 he analyses the structure and pattern of employment in Kerala as a result of mechanisation. Kurien (1978) through a macro analysis of the fisheries development on the basis of secondary data, analyses the trends in production and distribution of fish output during the post-mechanization period 1963-1976. Kurien (1978) and Hakim (1980), examines the economic issues of fishing in relation to mechanization.

Bhushan (1979) makes an evaluation of the technological changes in the fishing industry of Kerala and finds that changes has taken place involving greater division of labour, higher skills, ownership pattern and changes in the mode of sharing output. Gopalan (1980) dealt with the dwindling catches, restrictions imposed by the government on mechanised fishing boats from operating within 5 km, from the shore, mounting operational costs due to increased taxes on oil, diesel and spares, high investment and diesel scarcity as the major reasons for the sickness in the mechanized sector. Kurien and Jayakumar (1980) make a preliminary assessment of the motorization of traditional canoes in Purakkad village in Alleppey district. Pillai (1981) argues that if monsoon trawling is banned, mechanized section will suffer great loss. Klausen (1968) explains the process of mechanization required in the traditional fishery and sets up the maximum sustainable yield (MSY) from the virgin bio mass.

Positively, Krishana kumar (1981) probes into the reasons which led to the failure of the mechanized fishing and as a remedial measure, he suggests measures to solve the problems faced by the sector. Kurien and Willmann (1981) made a comparative study of the cost and earning of artisanal and mechanized fishing boats operating in Kerala and found that profitability ratios were high in the artisanal fishing and mechanised vessels were found to be incurring losses. Kurien and Willman (1982), analyses the economics of artisanal and mechanized fishing units, highlight the fact that fishing economy is on the vortex of a crisis. They found that ,in terms of productivity, profitability, employment and fuel efficiency the mechanized sector did not possess the merits generally attributed to it. SIFFS (1998) as a continuation of the previous SIFFS census of 1991 analyses the classification of artisanal fishing fleet used in 1991 census, updates and assesses the number of artisanal fishing craft in use, estimates the number of gear used in the section according to type, estimates the craft and gear combination and also the number of out board motors in each H.P category. The cost and earning profile of the selected craft and gear combinations in Kerala has been worked out to identify the investment option (CMFRI 2007-08).

1.3.3.2 The effect of mechanization on fisher folk

The fishing community of the state has been largely left out of the general development experience. A major reason for this is the community's rapid marginalization in the coastal waters and in the market, following government-initiated measures in the state in the early 1960s to promote modern fishing methods. The wealth of opportunities offered by these "development" programmes led to the unregulated entry of rich "outsiders" into what was a caste-bound sector. These new entrants took on the roles of boat owners, employers, moneylenders and middlemen-traders, and ordinary fisher folk were unable to free themselves from their stranglehold.

Along with this development came the competitive use of fish harvesting techniques, encouraged in both the mechanized and traditional sectors by an initial spurt in output and profits. This caused an alarming depletion of resources in the fisheries sector and led to the degradation of the marine ecosystem. Traditional fishers who had no other employment option suffered and as a community they continued to lag behind others in the rest of the State in all areas of development.

Technology has also had the potential to give rise to negative consequences for those unable to access it, by: (i) creating polarization among fishermen; (ii) making traditional knowledge, processes and skills redundant leading to deskilling; (iii) increasing capital investments and concentrating ownership and thus, decision-making processes into fewer hands; (iv) increasing indebtedness; (v) leading to excessive energy intensity and increasing the dependence on fossil fuel; (vi) making the livelihood of fisherwomen precarious; and (vii) increasing exploitation levels to unsustainable levels.

Kerala’s long tradition of marine fishing, the plentitude of fishery resources and the life of fishing communities and prevalent fishing techniques are referred to in ancient Malayalam Treatise, Valavisu Puranam. The folk songs of Sangam age and the writings of Pliny give us an insight into the extent of fishery and the importance of fishing community. Friar Odoronic, who sailed down the

west coast of India in 1320 observes "There are fishes in those seas, that come swimming in such abundance that, for a great distance nothing can be seen but the back of fishes, which casting themselves on the shore, do suffer men for the space of three daies (days) to come and take as many as them as they please" (GOK, 1983). Later the advent of colonial powers resulted in the systematic classification of the fish wealth for scientific value. Day (1865) highlights the development of fishing industry in Malabar compiling information from the pre-historic to the second half of the 19th century

Pillai (1959) gives a vivid picture of the deplorable socio-economic conditions of the traditional fishermen of Kerala on the eve of mechanization. Achari and Menon (1963) on the contrary observe that, the introduction of mechanised fishing had perceptibly improved the levels of living of fishermen of the area under study. Planning commission (1971) conducted a survey of three fishing villages in Kerala and concluded with the opinion that, mechanised fishing resulted in tangible benefits, value of output per boat and income per worker were higher than in the traditional sector.

Klausen, (1968) opines that, when mechanization was introduced, all the communities in the area did not readily take to it; the reactions of each community were influenced by a host of factors like social structure, kinship and work ethics. Prakasam (1972) studies the socio-economic transformation taking place in the araya fishing community of Vypeen in Ernakulam district he further reviews the impact of mechanisation on the fishermen of Vypeen Island by analysing the improvements in living conditions. The positive effects emerging from mechanised fishing was noted by Mathur (1977) by investigating in the Tanur fishing village of northern Kerala. He pointed out the emergence of absentee fishermen - a section from outside the fishing sector-the studies focused mainly on the social and anthropological aspects of the phenomenon.

Vattamattom (1978) finds that in Poonthura, a traditional fishing village of southern Kerala, fishermen faced many problems. He suggests that for a speedy upliftment of the impoverished masses of traditional fishermen, ownership of

fishing equipments should be vested with real producers and bring about essential institutional reforms, rather than introducing modern technology for which there are no facilities. Platteau et al (1979) remarking on the growth of capitalist relations in the sector, focuses the enquiry on credit system. They surveyed three fishing villages of Kerala which were at three different levels of mechanisation and found that

1) The volume of credit was positively correlated with the degree of mechanisation.

2) The major part of borrowing in the mechanised areas was for investment, while it was for consumption in the non-mechanised sector, and

3) Institutional borrowing was positively related to the degree of mechanisation.

Annie Felice (1980) also made an enquiry of fishing in the Vypeen Island and brought to notice, certain structural and organizational changes taking place in the fishing sector consequent on mechanization. Hakim (1980) studied a few fishery cooperatives in Kollam district and found that the lion share of benefits of mechanised fishing in the state was garnered by persons or groups who are not actually engaged in fish production sector such as officials, traders and industrialists, who set up fictitious fishery cooperatives. Krishna Kumar (1980) through his study provides new strategy and action programme for fisheries development and fishermen's welfare in the state. .A case study by Sathiadas and Venkataraman (1983) of indebtedness and credit utilisation in the two villages of Sakthikulangara and Neendakara was undertaken. Sathiadas and Venkataraman (1981) make an extensive study on the impact of mechanised fishing on the socio-economic condition of the fishermen of Sakthikulangara-Neendakara area.

Panikkar and Alagaraja (1981) also analyzed the socio economic conditions of the fishermen at the Puthiappa-Puthiangadi region in Kozhikode district. They also found clear improvements in the socio-economic condition of the fishermen. But, the prevalence of indebtedness was on the rise, to loans taken

for financing the fishing units. Later (1983) they conducted a case study of the indebtedness and credit utilization in the two fishing villages of Sakthikulangara and Neendakara according to which approximately 61 percent of households in Neendakara and 65 percent of households in Sakthikulangara were in debt.

Gulati (1984) makes a specific impact study on the fisherwomen of the state, as a result of technological changes, analysing the socio-economic improvements which they gained. The inter-linkages of technology, credit and indebtedness in the marine fishing villages was deeply analyzed by Platteau and others (1985). Ibrahim (1986) focuses on the capitalist intrusion in the primary fishing activity and analyses its implications on employment and income. He shows that mechanisation process has adversely affected the income and employment prospects of the traditional fishermen. Rajasenan (1987) has made an in depth and comprehensive analysis on the fishing industry in Kerala probing into the major problems faced by the sector and upholding the potentialities of the fishing sector.

State Planning Board (1993) made an impact analysis of motorisation on the income and employment levels of traditional fishermen, pinpointing to the fact that though motorization has made the fishing industry more capital intensive it has not resulted in a commensurate increase in total landings. Nayak (1993) probes into the changes triggered by the motorisation in the socio-economic conditions of the artisanal fishing communities on the South West coast of India, and reveals that fishery sector is in a transition which is influenced by the socio economic forces operating at the macro level. Suresh Kumar (1999) unfolds the capitalist development process of the fishery sector of Kerala state and also explains the changes in labour process and the gradual marginalisation of the traditional fishermen in the development process of the fishery sector.

1.3.4 Sustainable Development

Sustainable development has emerged as a guiding principle and process for all forms of resource development, environmental management and protection,

economic development and social justice. It is a value-laden construct, integrating issues of the environment with issues of development, and exploring the dynamic and reciprocal relationship between the natural world and human society. It has infiltrated all levels of government, sectors of economic and financial activity, non-government organizations (NGO's) and Civil Society (Potts, 2003)

The concept emerged in the late 1980's with ground breaking international report, "Our common future" and in early 1990's with the negotiation of the UN declaration on Environment and its product Agenda 21. Sustainability implies that all socio-economic (human based) systems and ecological (natural based) systems should remain in a healthy and viable state, so that benefits can flow to current and future generations. According to the Brundtland Report, "Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987)

Sustainable development is implied as

1) Help for the very poor because they are left with no option other than to destroy their environment.
2) Idea of self reliant development, within natural resource constraint.
3) The idea of cost effective development, using differing economic criteria to the traditional approach.
4) The great issues of health control, appropriate technologies, food, self reliance, clean water and shelter for all.
5) The notion that, people centered initiatives is needed: human beings are the resources in the concept.

Tietenberg (2004) stresses that sustainability principle involves the use of all resources in a manner which respects the needs of future generations. The inter-generational aspect is made more explicit when sustainable development is that which leaves our total patrimony, including natural environmental assets, intact over a particular period. We should bequeath to future generations the same capital, embodying opportunities for potential welfare that we currently enjoy.

Although the evolution of sustainable development as the new development paradigm is the result of public pressure, this concept is not new.

In early 1849, this concept has been used by all those working in forest management. Especially this is of much relevance in fishery economics literature and in agriculture. In Hicksian (1968) writings_sustainability is implied when he defines a person's income as the maximum amount he can spend during the week and still expect to be better off at the end of the week. He emphasized sustainable consumption. This is a practical guide to the survival of humanity in general. It aims at bringing together man, nature and development for a better future. Tietenberg (2004) explains the sustainability criterion by stating that at a minimum, future generations should be left no worse off than current generations. Allocations that impoverish future generations in order to enrich current generations are according to this criterion, patently unfair.

1.3.5 Empirical Analysis on Sustainability

The over fishing has not freed the Indian coasts. Kurien (1991) makes a brief analysis of fishing development process in Kerala and documents the ruin of the coastal commons as a result of intensive fishing techniques encouraged by official development plans. Yohannan and Sivadas (1993) analyses the impact of the introduction of ring nets in 1988 on the mackerel fishery at Calicut and warns that the small mesh size of ring net and their better efficiency in the gear can cause over fishing. Deep-sea trawls catch a large quantity of undersized fish. To prevent this, windows made of square mesh panels should be introduced in the upper panel of the cod ends or to increase the area of open meshes, thereby giving the juveniles a greater chance to escape Robertson (1993). Ramakrishnan (1994) notes that Adam Smith in his Wealth of Nations has dealt with several of the problems of the fishing industry such as low earnings of fishermen, low productivity, high uncertainty effects of technical improvements, question of subsidy etc. Even though Smith was not directly concerned with the problems of the fishing industry, his observations are still relevant to the conditions of the fishing industry in most parts of the world.

Korakandi (1999) focuses on the major threats to sustainability identified in the fisheries scenario and also makes an analytical study on the remedial measures suggested by specialists and organizations. The impact of modernization programmes introduced in Kerala fisheries in the 1950s and the concentration of mechanized vessels in certain areas resulting in over fishing, profitability is calculated in terms of cost and yield (Rajasenan, 2000). There are many socio-economic issues hindering the sustainable development of the state's coastal fishery sector and the extent of depletion of marine resources were estimated, assessing the overall sustainability status of the coastal fishery sector (Suja ,2003).

According to Rajasenan (2005) increased fishing effort may be inferred as the major unsustainable practice which led to stock collapse eventually leading to economic and biological over fishing. This is further accentuated with ever increasing number of active fishermen and mechanized boats leading to a reduction in area available per fishermen and also reduction in area to a boat.

Changes in the last decade had resulted in the new phenomenon of over capitalization of a major segment of the artisanal fishery leading to energy intensification of fishing operations making them economically unsustainable both for the large number of artisanal fishermen as well as the new entrants into the fishery. The ecological sustainability of these operations is also an issue. The total number of motorized crafts specifically plywood and plank canoes increased while the catch stagnated, the major part of which is contributed by the ring seine and trawler. The per unit investment and cost of operation specifically the fuel cost has increased significantly making fishing units vulnerable for losses. The non-mechanized sector has 81 percent overcapacity, the motorized sector has 60 percent overcapacity and the mechanized sector has 55 percent overcapacity. The problem of discarding by-catch were studied and estimated that about 55 percent of currently 'wasted' marine fish could be saved and better utilised by appropriate interventions (Modayil, 2006).

The severity of pollution problem and its impact on fisheries was analyzed pointing that inland water bodies of Kerala are subjected to various

types of pollution hazards mainly from industrial effluents, pesticides, chemical fertilizers and sewage (Korakandy, 2008). A problem usually highlighted in the sustainability debate is the issue of discarding by-catch. annual discards from the world‘s fisheries were estimated to range from 17.9 million tones to 39.5 million tones. In an unregulated fishery, fisheries have an incentive to discard if the expected net price, i.e., the real price less landing costs is negative and if the resultant costs incurred in landing are greater and also due to limited holding capacity (Korakandy, 2008).

Fisheries policies in India have been developed with few linkages between the sectors, based on dated and fragmented legislation at the National and State level, and has generally focused on increased production with little emphasis on conservation, sustainability or responsible fisheries management. The present marine fisheries scenario of the state is a free and open access system and consequently there is intense competition for the resources among the various sectors (traditional and mechanized vessels), a lot of unhealthy fishing practices and gears being introduced and generally stagnation in the marine fisheries production. Stake nets are traditional fish bag nets operated widely in the backwaters of Kerala mainly for catching penaeid prawns. There are 17,724 stake nets in the state. Studies conducted by the Central Institute of Fisheries Technology showed that the three species caught in the stake nets ie metapenaeus dobsoni, metapenaeus monoceros and penaeus indicus is having a modal length less than the size at first maturity. The percentage of immature prawns landed by stake nets is 88.3 per cent, 94.7 per cent and 82.7 per cent for these three species.

The traditional motorized crafts continue to engage in seining operations using extremely small meshed nets during this period which destroys both spawners and young fish. Voluntary adoption of mesh size regulation for trawl and purse seine nets will be helpful for conservation of resources and avoiding harvesting juvenile fish. It is imperative that destructive fishing practices using small meshed seines are effectively controlled by enforcing mesh size regulation (minimum 18 mm), closed season and restricted fishing (June-September) besides

strict licensing and optimum deployment of fishing units especially ring seines and purse seines. The recommended minimum stretched cod-ended mesh size of trawl net is 35 mm to ensure sustainable exploitation of the fish and shrimp stocks. Technological solutions involve the introduction of low energy passive fishing techniques, minimizing the cost and the damage occurring to the resource.

1.3.6 Studies on Management of Fisheries

International debate is focusing on systematic capacity reduction through fishing and gear bans, escalating regional conflicts etc. Scott (1953) attempted to offer an economic theory of commercial fishing the represented an economic model of fishing in which fish catch in related to fishing efforts, corresponding to a given stock of fish. Gordon (1954) explains the economic wastes involved in exploiting the common property natural resource like the fishery and points out the likelihood of its exploitation at less than optimum.

Scott (1955) puts forth the sole ownership theory for an effective management of otherwise over exploited fishery. Schaefer wrote three articles (1954, 1957 and 1959) integrating the economic theory of production to a natural resource industry, the fishery. Crutchfield and Zellner (1962) provided an explicit dynamic model of competitive fishing. Later Turvey (1964) presented the criteria for optimization in marine fisheries regulations.

Anderson (1977) assumed that, fishery resources are biologically and technologically not independent but interdependent hence their size depends much on fishing effort, which is an economic variable controlled by man. Hector (1979) presented an economic analysis of the over fishing problem , and suggested solution for overcoming unsustainable practices in fishing. Meany (1987) analyses the relationship between resources rent, common property and fisheries management. He argues that, fisheries will sufficiently contribute to economic growth, if a proper management of fisheries is done so as to capture the rents. If resource rent continues dissipating more and more resources will be sucked into

the over fishing contests where managers strive to protect declining resources from ever rising fishing pressure.

Kurien and Rao (1988) in a study on the economic and social implications of the shift from the traditional mode to the mechanical mode of production in Visakhapatanam fisheries shows the need to introduce various management regulatory systems in order to protect the interest of both the communities without endangering the resource base and to productivity. The Chinese are considered to be pioneers in the field of fish culture and its management, its history extending back to 1766 B.C (Agarwal, 1990).

Charles (1992) presented a Bayesian updating algorithm which can be incorporated into fishery management simulation models to examine the effect of imperfect knowledge, parameter uncertainty and the role of learning process in fishery systems. Crowley and Palsson (1992) examine the application of operation research models which have been applied to enforcement issues in Canada's offshore fishery. Lane (1992) surveys literature of applied management science models and methods on issues and problems for control and management of fishery systems into areas pertaining to fisheries applications. In Newfoundland and Japan, some communities hold annual lotteries for the best fishing areas. Among the Cree people of St. James Bay, Canada, and in Donegal, Ireland, fishermen competing for particularly good spots agree to fish in turns. The Boston-based Conservation Law Foundation is currently working with fishermen in developing economic structures for them to take on greater responsibility as ecosystem managers (The Ecologists, 1995). Sathiadas (1996) makes an analysis of the different types of fishing units operating along the Indian Coasts, and highlights the trends in exploitation of major marine fishery resources, in relation to its potential yield and suggests policy measures for optimum exploitation of resources, conservation and management.

1.3.7 Expert committee studies

An environment of conflict existed in the states fishery sector among different stake holders and the views of these competing groups and scientific committees came forth for conserving and regulating resources in the industry. Babu Paul Committee Report (1982) on marine fishery resources recommended checking of poisoning of fish and for establishing a Resource Management cell. Regarding issues of depletion of marine fishery resources and the need for regulation of trawling, the committee did not express a unified opinion with regard to the specific need for adopting a close season as a management measure for trawling boat.

Kalawar Committee (1985) recommended that shrimp trawling during monsoon season should be permitted, but restricted to day time and beyond a depth of 20m, limiting the number of trawlers to 1145 fishing boats, both mechanized and non-mechanized should be registered and licensed, curb the growth of purse seiners and limit them to areas beyond the traditional sea to protect the Indian mackerel and Indian oil sardine fisheries and introduction of trammel nets in the artisanal sector. They too did not agree to a ban on monsoon trawling.

The state government was forced to appoint an expert committee to study the impact of monsoon trawling on marine wealth, and the committee headed by Balakrishnan Nair (1989) recommended a 90-day ban during the monsoon for three consecutive years, followed by a re-evaluation of the situation. No mechanized vessel above 25 HP capacities should be allowed to fish during the ban period, even though in Kerala traditional fish workers using valloms (with inboard engines of much higher capacity) are not restricted. With the controversy regarding the traditional canoes using higher horse power engines, the Government enacted the Kerala Monsoon Fishery (Pelagic) Protection Bill in 2007 to protect the traditional fish workers from the ban. Over a lakh traditional fishermen stand to gain from the Act as it enables them to catch pelagic fish, such as oil sardine and mackerel in the State‘s territorial waters that stretch to 12

nautical miles. The ecological issues threatening the sustainability such as the use of destructive fishing methods in the form of trawling, dynamitising, poisoning leading to biological over-fishing, habitat loss, environmental pollution, biodiversity loss etc. The possibility of biological over-fishing in the inshore waters of Kerala has also been reported by the committee.

Balakrishnan Nair Committee (1991) which studied monsoon trawling in Kerala failed to arrive at specific conclusion regarding fishing resources conservation all along the Kerala coast, as a result of the imposition of ban on trawling.

Silas committee (1992) stipulated total ban for mini trawls in the Exclusive Artificial Fishing Zone (EAFZ) and the operation of ring seines also not to be permitted in the EAFZ. They recommended a restricted fishing zone outside the line of territorial waters, which should be closed for trawling during the months June, July and August and concerns with the recommendation of earlier committees on mesh size regulations. Another Expert Committee (2000) for Fisheries Management Studies highlighted the severity of pollution problem and its impact on fisheries. It pointed out that inland water bodies of Kerala are subjected to various types of pollution hazards mainly from industrial effluents, pesticides, chemical fertilizers and sewage (Korakandy, 2008).

1.4 Research problem

The issue of overcapacity in fishing fleets and their reduction to the levels that should be in balance with long-term sustainable exploitation of resources has received global attention during the past two decades. Many countries have adopted policies for limiting the growth of national fishing capacity in order to protect the aquatic resources and to make fishing economically viable for the harvesting enterprises. In Southeast Asia, overcapacity is seen as the largest fisheries management problem threatening sustainability. Similarly in motorized sector technological up-gradation in the form of size of the net and the boat has increased over the years. Declining fish availability, coupled with over-capacity

and the dependence of the small-scale sector on coastal fisheries for income generation has led to the adoption of destructive fishing. All these have ultimately worsened the situation of fishermen. This study intends to focus on the sustainable fisheries development of Kerala, and brings to notice the government policies and the trends of over fishing, the market forces swaying the fishery sector and all the more to analyze the capitalist development engulfing the coastal fishermen of Kerala, who were thrown out of scene, marginalized and deprived of, even a precarious existence. The socio economic life of this peripheral group and their survival strategies are intimately related to each other.

1.5 Objectives of the study

1. To unfold the technological change and modernization which have taken place in the state's fishing sector.

2. To assess how far technological changes and modernization affected the socio-economic condition of the fisher folk.

3 To analyze how far technological changes and modernization affected the fishing sector and the sustainability of fishery resources

4. To see the efficacy of conservation measures in supporting the sustainability of fishery resources.

5. To make recommendation for the improvement of fishery sector and fisher folk.

1.6 Methodology

The area wise collection of primary sample data pertains to the coastal villages of Kerala from the three zones. Primary data were collected from three selected coastal districts representing North zone, South zone, and Central zone. Districts representing three zones with Thiruvananthapuram and Kollam

representing South zone, Ernakulam and Alappuzha representing Central zone and Malappuram and Kozhikode represented North zone. Total of 450 active fishermen are interviewed. The selection was done on the basis of active fishermen population, their involvement in the fisheries sector and the number of fishing crafts and gears used

A questionnaire is used to elicit information from the fishermen. Information on the non-respondent members of the households have also been collected.

Both published and unpublished secondary data were collected from institutes of research and organizations such as Central Marine Fishery Research Institute (CMFRI), Central Institute of Fisheries Technology (CIFT), Fishery Survey of India. Data collected from State Planning Board, Directorate of Fisheries and publications of Non Governmental Organizations like South Indian Federation of Fishermen Society (SIFFS) and Programme for Community Organization (PCO). Information from magazines, journals, published articles, newspapers, published thesis, internet sources etc marine landings

The data were analyzed using various statistical tools like percentage analysis, rank correlation and correlation analysis for depicting the socio-economic and psychological features of the social actors. Trend analysis for major fish species and were made use of.

1.7 Significance of the Study

The study is significant for understanding the impact of technological change and modernization on fishermen folk and fishing resources. It also helps to understand the sustainability aspect so that policy interventions are framed.

1.8 Limitations

The study mainly faced the problems, related to collection of primary data, since fishermen are not in the habit of keeping accounts of the income and catch data. But effort has been taken to cross check the information with different groups of fishermen.

1.9 Chapter Scheme

The study is organized in six chapters. **Chapter I** deals with introduction, statement of the problem, an overview of the topic, review of literature, objectives of the study and methodology and global relevance of the fishing sector. **Chapter 2** analyses the fisheries sector in Kerala. **Chapter 3** analyses the technological changes and modernisation which have taken place in the fishing sector over the years, both in the harvesting and post harvesting sectors. **Chapter 4** deals with the unsustainable exploitation of resources in the wake of modernisation **Chapter 5** analyses the socio economic condition of fishermen and the need for management conservation measures **Chapter 6** is a conclusion of the study with recommendations.

CHAPTER 2

FISHERIES SECTOR IN KERALA

Kerala, rich in a variety of tropical marine fauna, is intensively exploited. Kerala is also a leading supplier of prawn and other demersal species. The fishery sector is very vital for Kerala since it contributes much to employment, income, foreign exchange earnings and protein intake of the people. Both mechanized and traditional fishing is prevalent in Kerala. But both are concentrated near the coast where the sea is upto 50 meters deep. The off-shore fishery is not yet developed in this region. Kerala coast is the first in India where mechanization was introduced on a large scale in the 1950s with the launching of the Indo-Norwegian Project. Mechanisation and modernization changes has resulted in changes in the craft and gears used, which resulted in overcapitalization and resultant fishery resource problems.

Through the process of modernization , labour process also underwent tremendous changes. The implications of modernization process in the marine fisheries of Kerala resulted in a development scenario that led to the deprivation and marginalization of the real fishermen. High productivity and lucrative price for fisheries because of overseas demand in the initial stages made this sector highly attractive leading to over-capitalization and over-fishing thereby leading Kerala into problems of ecological damage and depletion of fish stocks

2.1 Fish Production

Kerala is occupying the foremost position in marine fish production, accounting for about 21 per cent of the total landings. The fish production in Kerala during 2008-09 was 6.66 lakh tones. The phenomenal growth seen in the marine fishing sector was due to the introduction of innovative fishing techniques,

infrastructure developments which have occurred both in the harvest and post-harvest activities and above all the increased demand for marine fish products both in domestic and export markets.

The Long-Term Potential Yield (LTPY) and Average Long Term Yield (ALTY) of marine fish landings of Kerala were 6.63 lakh tones while the current yield was 6.19 lakh tones which indicates that there is scope for increase in landings. The estimation of potential yield and landings of different resource groups is given in table 2.1

Table 2.1 Potential yield estimates and landings of various resource groups in kerala

Resource	LTPY (t)	ALTY(t)	YIELD 2007
Oil sardine	264372	236182	250469
Mackerel	128411	106250	68062
Penaeid prawns	71871	57894	41002
Seer fishes	10162	7862	9750
Cephalopods	43472	37658	23391
Tunas	32615	22671	25009
Silverbellies	6887	6176	6186
Elasmobranches	6968	6136	2755
Lizardfishes	14126	13341	7741
Rockcords	9386	6822	3752
Snappers	2482	2066	1141
Threadfin breams	55078	45163	27943
Other perches	16488	13640	4716
Sciaenids	17720	15665	10363
Soles	27301	22802	19146
Total	662890	624859	619255

Source: CMFRI, (2007)

A mid-term appraisal of the tenth plan recommended an integrated approach for the sustainable development of fisheries sub-sector with the objective of optimizing production and productivity, augmenting the export of marine products, generating additional employment opportunities and improving the socio-economic conditions of the fisher community. Major recommendations were improvements in infrastructure facilities, policy intervention for the effective management of inshore fisheries and rational exploitation of deep sea, offshore and oceanic fishery resources (Planning Commission ,2005).

Thrust areas for the Eleventh Five Year Plan include conservation and management of fisheries resources, modernization of landing centers including infrastructure development, development of coastal infrastructure for the development of sub sector, promotion of social and livelihood security, promotion of income security of fisher folk through micro enterprises, exploitation of deep sea, offshore and oceanic fishery resources and improvements in quality of products through up gradation of facilities in processing and marketing.

2.2 Fisheries trade

The Gross State Domestic Product has increased to 96 percent during the period 1999-2000 to 2008-09 and the share of the fisheries sector in the State Domestic Product declined from 2.21 per cent to 1.15 per cent during the same period. The average per capita production of fishermen at the consumer price of fish is around Rs 215611. The contribution of fisheries sector GSDP is given in table 2.2

Table 2.2.Contribution of fisheries sector to GSDP

Category	2004-05	2005-06	2006-07	2007-08 (Provisional)	2008-09 (Quick)
Gross State Domestic Product (Rs.crore)	94421	103081	115103	126377	135202
Fishing(Rs.crore)	1536	1469	1549	1545	1552
Share Of Fisheries Sector in GSDP	1.63	1.43	1.35	1.22	1.15
Share of Primary Sector in GSDP	18.23	17.27	14.9	13.18	12.4

Source Economic Review, (2009)

The marine fish landings in India during 2008-09 touched 3.21 million tonnes, where Kerala is the highest contributor (21 per cent) of marine fish. During the same period marine fish production decreased from 5.86 lakh tonnes to 5.83 lakh tonnes.

The maximum sustainable yield estimated was 6.99 lakh tonnes. The first catches from Kerala coast comprise of more than 300 different species but commercially important ones are only forty in number. Prominent among the high value species are seer fish, prawn, ribbon fish and mackerel. High value fishes like coastal tuna and oceanic tuna registered a growth of 23 per cent and 39 per cent respectively. Oil sardine comprised a major share of landings (71 per cent). Heavy landing of juvenile oil sardine in ring seine was recorded.

2.3 Export trend of marine products

Marine exports from Kerala during 2008-2009 stood at 100780 tones valued at Rs 157218 lakh as against 100318 tonnes, valued Rs 143094 lakh during 2007-2008. India's marine export from 2008-2009, Kerala's share stoodat 16.72 per cent in volume and 18.26 per cent in terms of value.

Table 2.3. Export trend of marine products – India & Kerala

Year	India		Kerala		Share of Kerala %
	Quantity	Value	Quantity	Value	
1999-2000	343031	511667	92148	1147	27
2000-2001	440473	644389	88852	1046	20
2001-2002	424470	595705	72756	951	17
2002-2003	467297	688131	81393	1046	17
2003-2004	412017	609195	76627	109913	18.6
2004-2005	461329	664669	87337	115742	18.93
2005-2006	512164	724530	97311	125765	19
2006-2007	612642	836353	108616	152412	17.74
2007-2008	541701	762092	100318	143091	18.52
2008-2009	602835	860794	100780	157218	16.72

Source:Economic Review (2009)

The state's share in all India exports has been declining in recent years. the share declined heavily from 27 per cent in quantity in 1999 to 2000 to 16.72 per cent in 2008-2009. Export of marine products during 2008-09 stood at 6.03 lakh tonnes valued at Rs 8607.94 crores as against the former year's export of 5.42 lakh tonnes valued Rs 7620.92 crores in 2007-08. In dollar terms India stands at US $1908.63 million in 2008-2009 showing a growth rate of 0.5 per cent. In terms of quantity India registered an increase of 11.29 percent in 2008-09. The export trend of marine products from India from 2003-2004 to 2008-09 is given in table 2.4

Table 2.4 Export trend of marine products from India.

Details	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	Growth in 2008-09 from 2007-08
Quantity (Tons)	412017	431629	512164	612641	541761	602835	61134 (11.29%)
Rupees (Crores)	6091.95	6646.64	7245.30	8363.53	7620.92	8607.94	987.02 (12.95%)
U S$ (Million)	1330.76	1478.48	1644.21	1852.93	1899.09	1908.63	9.54 (0.50%)

Source: Compiled from MPEDA (various years)

European Union is the largest group market for marine products from India accounting for a share of 33.16 per cent in value and 25.74 in quantity followed by China 15.6 percent in value and 24.44 percent in quantity. The major marine products exported are frozen shrimp, frozen fish, frozen cuttlefish, frozen squid, dried items, live items and chilled items. Item wise export of marine products from India for the last five years are given in table 2.5

Table 2.5 Item-wise Export of Marine Products from India, 2004-05 to 2008-09

(Quantity in MT, Value in Rs.Crore)

Sl. No	Item	2004-05		2005-06		2006-07		2007-08		2008-09	
			Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	2	3	4	5	6	7	8	9	10	11	12
1	Frozen shrimp	138055	4221	145180	4271	137397	4506.08	136223	3941.62	126010	3779.26
2	Frozen fish	159689	759	182344	999	270751	1452.88	220200	1303.41	238544	1722.34
3	Frozen cuttle fish	44239	474	49651	549	55701	797.37	45955	744.13	50750	761.05
4	Frozen squid	48124	477	52352	575	47250	568.32	34172	408.42	57125	632.35
5	Dried items	9692	121	14167	133	24293	183.16	22414	258.88	31688	420.75
6	Live items	2262	51	2568	62	2478	64.06	2498	69.07	3434	99
7	Chilled items	3988	68	5060	82	7200	117.3	6541	118.11	21453	217.34
8	Others	55250	476	60842	574	67571	574.35	73698	777.29	73831	975.87
	Total	461329	6647	512164	7245	612641	8363.52	541701	7620.93	602835	8607.96

Source: MPEDA, (2009)

In dollar terms the export of marine products were 350.26$ compared to the previous year a decline of 1.7 per cent is seen in 2008-09. Item wise export of marine products from Kerala during 2007-08 and 2008-09 is given in table 2.6

Table2.6 Item-wise exports of marine products from Kerala during 2007-08 and 2008-09

Sl.No	Item	2007-2008			2008-2009		
		Qty (Tons)	Val.Rs (Crores)	US$ (Million)	Qty. (Tons)	Val.Rs. (Crores)	US$ (Million)
1	2	3	4	5	6	7	8
1	Frozen shrimp	26566	547.50	136.15	25381	588.60	129.69
2	Frozen fish	30946	196.49	48.91	25667	208.19	46.56
3	Frozen cuttle fish	20484	376.36	93.71	18075	330.04	74.01
4	Frozen squid	11486	159.34	39.8	19760	247.91	56.01
5	Dried items	73	3.14	0.79	138	11.40	2.59
6	Live items	185	15.93	3.99	304	20.62	4.61
7	Chilled items	1682	31.70	7.92	2280	67.63	14.79
8	Others	8897	100.29	24.99	9175	97.78	22.00
	Total	100318	1430.94	356.26	100780	1572.18	350.26

Source: MPEDA, (2009)

2.4 Ownership of factors of production

Based on the accessibility to the owners of the factors of production, in fisheries there are absentee fishermen, rich fishermen, middle fishermen and proletariats (Klausen, 1968). The motivation behind organization of production in the traditional sector is subsistence. The limited accumulation of resource which they make do not create much difference in the economic lives of fishermen. In fishing sector more of a collective ownership of the modes of production is observed. The tendency is generally to own craft and gear on a share basis of 15-20 persons sharing in the purchase of a craft and becoming owners and workers at the same time. This pattern is dominant in the traditional sector, more due to the fact that investment requirements are very high, which leads to choice of collective ownership. Canoe units and ring seine units are requiring high investments as compared with catamaran units. Some fishermen act as rentiers of crafts and gears. Since the yield from fishing is uncertain, high returns leads to higher accumulation and higher investments whereas when returns are less, they may not be able to maintain ownership

of the existing units and will be forced to dispose off. Thus the status of the owner and owner-worker is very narrow and vulnerable

Table 2. 7 Per capita investment on fishing equipments per active fishermen in India 1997-2004.

Sector	1997-1998	2003-2004
Non-motorized	13979	17024
Motorized	26835	19454
Mechanized	125689	219319
Overall	40363	86290

Source: Sathiadas, (2005)

Many changes that took place in the last decade led to over capitalization of a major segment of the artisanal sector. The high price offered for marine products and increased demand resulted in accelerated investments in the harvest operations. Higher investments has an other side which speaks of high debts incurred and increased efforts to earn more returns to pay off the investments. This leads to increased fishing pressure on coastal resources.

2.5 Depletion of resources

Fish species like Sardinella , Hilsa ,Rastrelliger, Scomberomorus, Euthynnus, Caranx, Harpadon, Nemipterus are fully exploited or overexploited in most of the regions. The high exploitation rate(E=0.59) is indicative of degradation and biological over fishing of fish stock. Using destructive fishing methods, harvesting immature and undersized fishes, degradation of habitats, post harvest losses, discards, by-catches-all these add pressure on resources leading to depletion. The Indian mackerel Rastrelliger kangurta is able to adapt to rise in sea surface temperature by extending its distribution towards northern latitudes and by descending to depths. In recent years the

fish is increasingly caught in bottom trawl nets operated by large mechanized boats at about 50m depth. In 1985 only 2 percent of the mackerel catch was from bottom trawlers. In the last five years about 10 percent of the mackerel catch is by the bottom trawlers. This shows that the fish descends down to deeper waters to overcome warmer surface waters (CMFRI, 2007).

Conservation and management of resources is a major concern of fisheries development. It is widely accepted that both trawl and ring seine operations bring juveniles and young fishes in substantial quantities during certain periods of the year. The mesh size used in trawl and ring seines is lower than the prescribed limit in many cases and this has to be discouraged to conserve the resources.

Trawling adversely affects the flora and fauna of the bottom sea. The coastal waters of Kerala is open to heavy fishing pressure by trawlers and ring seiners. Each sector should rationally evolve strategies to optimize the number of fishing units. The cod-end mesh size of 35 mm recommended for "karikkadi" fishery should be strictly observed to ensure prevention of landing of juveniles. The mini trawls operating in the depth zone of 10m along the shore is destroying juveniles of fin fishes and karikkadi. Hence the indiscriminate use of this gear has to be restricted. Considering the importance of marine fisheries as a source of protein, employment and foreign exchange, there is an urgent need to conserve the resources and sustain production.

2.6 Fishing allied activities

The bulk landings resulting from mechanized and motorized operations have generated indirect employment opportunities in the coastal areas,but it has not benefited the fishing community. Despite stagnation in fish output, the continuous increase in fish prices brings higher income flow to the fishery sector. A part of this is appropriated as operating cost, marketing cost, cost of capital etc since nearly half of the catch is by the mechanized trawler, and the income

distribution is highly skewed .Marketing of fish, making and repairing nets, curing and processing, peeling etc are post-harvest sector activities. Many are found to work from outside this sector in these activities. The distribution of the number of fishermen involved in fishing allied activities is shown below (table 2.8) Due to wideness of market compared with other districts 9278 percents of fisher folk families from Thiruvananthapuram are engaged in marketing of fish which is very high compared to all other districts

Table 2.8 Distribution of number of fishermen involved in fishing allied activities

District	Active fishermen	Marketing of fish	Making/Repairingnet	Curing/Processing	Packing	Labourer	Others	Total	Other thanfishing	ccupied FisherfolkPopulation	Fisherfolk population
Trivandrum	38805	9278	7006	1413	181	3870	25323	25323	2066	66194	143436
Kollam	3665	1072	607	318	190	3953	6515	6515	1166	16346	43210
Alappuzha	25255	664	110	550	5169	1201	10740	10740	3158	39153	101341
Eranakulam	9713	526	523	358	1772	1040	6057	6057	1693	17463	42069
Thrissur	7054	794	160	418	423	580	2668	2668	288	10010	34078
Malappuram	16422	857	38	193	49	1409	5583	5583	1153	23158	79858
Kozhikode	20119	1083	69	465	265	1509	7787	7787	1806	29712	87600
Kannur	6470	1191	34	153	6	238	2100	2100	1070	9640	36686
Kasarcode	7719	2511	1013	13	2	558	4301	4301	910	12930	33866
TOTAL	149222	17976	9560	3881	8057	14358	71074	71074	13310	224606	602234

Source: Marine Fisheries Census,(2005)

2.7 Alternate opportunities for work

The lions share of income is apportioned by trawler groups leaves the majority of workers marginalized. Besides the daily earnings are fluctuating and uncertainty affects the livelihood security of the traditional fisher folk. Fluctuations in income which may be unpleasant for the better off can prove disastrous for the less well-off for whom adequacy and regularity of income are vitally important (ILO, 2000).

Therefore efforts to improve the income of people in fishing communities involve development of alternate economic opportunities and strengthening the ability of individuals and the community to take advantage of these communities. Almost all goods and services for household needs are purchased from outside the sector and for making the payment they have only their catch.

Efforts should be taken to produce these goods and services utilizing the surplus labor available in the fishery sector thereby helping them to tide over the income differences arising out of the seasonality nature of the occupation. Improving the transport facilities will enable the womenfolk to go out for jobs outside this sector. Since fisher folk live close to seas, where they go for fishing they will be naturally cut off from the main stream population. This leads to an isolated and marginalized existence. Hence, improved transport facilities in the coastal areas can improve their income levels by enabling them to take up other work during off season for the fisher folk as well as for the womenfolk in this sector. The difficulty in traveling often pulls them back from going out to work. Hence better transport facilities can improve the position of the marginalized community to a great extent.

2.8 Changes due to globalization

Fishing is comparatively a skilled occupation and it requires less waiting than agriculture and industry. The social fabric of society underwent changes

with the advent of government's intervention in fisheries development. Traditional technologies got replaced by modern capital-intensive technologies shifting fishing technology from eco-friendly to eco-destructive, active gear to passive gear and low cost to high cost. Globalization brought about changes causing structural shift, creating new employment and income generating opportunities. Fishing became a commercialized venture with the advent of globalization.

The incremental income generated as a result of subsequent developments got dissipated to various sectors of the fish economy and fishers benefited very little from it. Despite structural changes, due to globalization, diversification of employment has not taken place among the fishing community. Much structural changes took place in the fishing sector of Kerala with globalization. The advent of commercialization has promoted trade and industry leading to new entries into the sector. The major activities undertaken by the community themselves and the structural changes that has taken place within the fish economy after commercialization process is given in the table 2.9

Table 2.9 Fish economy before and after commercialization.

Activity	Before commercialization	Specialization	After commercialization
Pre-harvest:			
Craft-making	*Odavi* / traditional carpenters	Craft engineering	Entry of boat yard
Gear-setting	Madikettali/ hand-made nets	Textile engineering	Entry of machine-made nets
Maneuverability	Oar/ sail	Navigation	Import of OBMs
Harvest:			
Skills, knowledge and expertise	Crossing the surf Water currents Star location *Kanicham*	Navigation Oceanography Astronomy Triangulation-engineering	More of mechanical viz, wienches, trolleys, campus, GPS etc
Post-harvest:			
Disposal	Head load	Transportation	Entry of motor vehicles
Storage	Drying and salting	Processing	Entry of cold storage/ freezer
Vending	Head load/ cycle load	Marketing	Entry of large scale

			traders/ merchants

Source: Rajan, (2002)

Before commercialization almost all activities relating to fisheries had been carried out by the community themselves and had acquainted with versatile skills and knowledge viz, craft engineering, textile engineering, navigational skills, oceanography, astronomy, engineering, transportation, processing, marketing etc. the advent of commercialization has open space for the entry of large scale trade and industry into the sector (Rajan, 2002).

Globalization which has taken the centre stage in the contemporary world economy refers to the growing economic inter dependence of countries world wide through increasing volume and variety of cross border transactions in goods and services, and international capital, flows and also through a more wide spread diffusion of technology (IMF,1997). Economies over the world underwent a progressive international economic integration, i.e. internationalization of production, trade, investment and finance since 1950 and this process of globalization accentuated since 1970 globalization has brought about sea changes in the international economy. As a result of globalization Multi National corporations (MNC's) became active across boundaries and MNC's transformed international economy into a global economy.

A phenomenal expansion of international trade flow was facilitated and capital flowed among developed countries globalization should have a human face only then can this exercise could improve the daily lives of 1.3 billion people world wide who lives below poverty line earning less than 1$ a day.

Global fish and fishery product trade has come to a phenomenal increase over the last two decades, with export value rising from U.S. $ 15 billion in 1980 to US $ 56.3 billion per year. (Boslock et al, 2004). The share of India rose from US $ 450 million to US $ 1416 million during the same period, with an average growth rate of 10 percent per annum. Fishing industry is the most highly globalised economic sector. Nearly 40 percent of the total global fish production is traded in the international market consequently all fish worker become a part of this transaction directly or indirectly. While many fishing systems relied on large

scale trade for a very long time, globalization of the economy has accelerated remarkably in recent decades forcing dynamic changes in many fisheries (Kurien, 1998).

In Kerala globalization has affected the fish price levels and has led to competition between sea food and other categories. The state's share in all India exports has been declining in recent years from 20 percent in quantity terms in 2000-01 to 17 percent in 2008-09 and the share in value increased to 18 percent from 16 percent. The percentage share of Kerala in India's marine products export is shown in table 2.10

Table 2.10 Percentage share of Kerala in india's marine products export

Year	% Share in Quantity	% Share in Value
1985-1986	35	35
1986-1987	40	36
1987-1988	37	35
1988-1989	46	37
1989-1990	43	38
1990-1991	37	35
1991-1992	-	-
1992-1993	23	23
1993-1994	26	25
1994-1995	24	23
1995-1996	26	24
1996-1997	24	22
1997-1998	23	20
1998-1999	23	18
1999-2000	27	22
2000-2001	20	16
2001-2002	17	16
2002-2003	17	15
2003-2004	19	18
2004-2005	19	17
2005-2006	19	17

2006-2007	18	18
2007-2008	19	19
2008-2009	17	18

Source: Economic Review(various years).

2.9 Challenges of globalisation

After the sanitary and phyto sanitary regulations international came into force, stringent quality controls for marine products, were made as a result and fish and fishery products are subjected to a number of food safety requirements related to hygiene and stipulated microbiological and chemical containments, because these products were treated as high-risk food major markets have undertook, over whelming change in the safety requirements, due to factors such as advances in scientific knowledge, consumer concerns and political pressures. The demand for stringent and high hygienic standards in the production and processing facilities greatly increased, after the stipulation of Hazard Analysis Critical control point (HACCP) in 1993 by United States Food and Drug Authority (USFDA) Codex Alimentarius Commission (CAC,1996) such as ISO 9000 and other European community directives and the EC ban on Indian marine Products in 1997 (Rajasenan, 2005).

Competition is increasing in the international markets and Kerala has to keep the quality standards in order to retain the market share. The Sanitary and Phyto Sanitary (SPS) agreement under the world trade agreement stipulates maximum permissible chemical residue and other standards. Poor sanitation conditions and bad handling practices, degradation of harbors and landing centers start from the day of commissioning this heavily contributes to fish spoilage and wastage leading to high value erosion. The infrastructure facilities available in Kerala are of great relevance in the present scenario. Out of 14283 fishing vessels

operating in India, 4971 is in Kerala. There are 106 freezing plants in Kerala with a capacity of 2289 tonnes per day. There are 152 cold storages in Kerala out of a total of 477 in all India. The cold storage in Kerala has capacity of handling 33566 tonnes per day. The infrastructure facilities of the seafood industry in Kerala and India is given in table 2.11

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Table 2.11 Infrastructure facilities of seafood industry in Kerala and All India

Sl. No	Facilities	All India	Capacity tons/day	Kerala	Capacity tons/day
1	Fishing vessels	14283		4971	
2	Conveyance	305		164	
3	Freezing plant	358	1332	106	2289
4	Canning plant	8	30.5	3	11.5
5	Ice plant	164	3216	61	207
6	Peeling sheds	545	6592.7	245	2926
7	Cold storages	477	169492	152	33566
8	Other storages	131	7464.5	3	27

Source:MPEDA,(2003)

State should move towards international standards of product hygiene, in order to retain the market share in future. A good number of countries have specified Hazard Analysis and Critical Control Point (HACCP) based regulations of fish and fish products.

EU legislation requires strict, restrictions on landing of fish, structure of auction and wholesale markets and processing facilities, like construction of walls and floors, lighting, refrigeration, ventilation, staff hygiene etc, processing

operations, transportation, storage, packaging, checks on finished products including visual, organoleptic, chemical and microbiological parameters, laboratories and water quality.

United States has its food safety controls on imports of fish and fishery products, based on Physical examination at the border. The examinations are intended to identify substances that would cause the consignment to be adulterated under the US law more recently, rules have been chart out requiring importers to be proactive in ensuring that the consignments comply with US regulatory requirements. Processing sector are to comply with general requirements relating to the structure of premises, equipment and product and process controls that mandate the application of good manufacturing Practice. (GMP) Japan has put forward very limited requirements specific to fish and fishery products. Importer requires a health certificate from the relevant government agent in the country of origin, specifying the species and the area of collection. Importer of fish and fishery products to Japan should comply with the Provisions of both the Food sanitation law and the Quarantine Law (Globe fish, 1998).

Globalization has brought in much enhanced food safety requirements and processors with high standard of hygiene and premium quality stands to gain. Herb Baum, President of Campbell USA points out that in the early days anything microwave able was ok. Now, Consumers are looking for more quality and even more convenience. In terms of packaging there will be a tremendous move to Microwave containers which will offer the consumers the option of using the package as both the cooking and serving vessel (Cherunilam,1993). Globalization has led the economy at crossroads requiring better sanitary facilities and hygienic conditions. In this context the technological changes that supported the economy and modernization that has taken place over the years acquires much significance, and this is being enquired into in the following chapter.

Chapter 3

TECHNOLOGICAL CHANGE AND MODERNIZATION IN THE FISHING SECTOR

Modern Age has witnessed far reaching developments in fisheries as in so many other fields. This included a great acceleration in the use of fisheries resources, along with basic changes in the technology of catching and big development in marketing and commercial organization. Since the second world war, there was an over all development of an extensive and sophisticated range of equipments and improved methods of vessel propulsion and gear hauling and included much advanced means of navigation and fish location. One of the most significant early developments was the expansion of trawling in the Eastern channel and the Southern North Sea from the late eighteenth century (Hardy, 1959). Over time, a great variety of fishing methods and techniques developed whereby gear made of locally available materials evolved to exploit a diversity of ecological situations and riches, and the rise and fall of the tide, annual river rises, spawning and feeding migrations, and many other features of the natural environment were in some degree harnessed.

In addition to the employment of particular gears, there could be the building of obstructions, including weirs in streams and barriers in coastal shallows and estuaries which helped direct, swimming fish into traps and nets. Traps are of materials like basketry or osier set in streams, are well the first methods for catching fish in quantity. The great variety of methods which have developed also range from the widespread practice of poisoning to stun fish (Gunda,1984), to the use of trained birds such as cormorants to catch fish (Kani, 1984).As time passed gear and methods were developed in the direction of attaining greater efficiency. In line fishing the advent of barbed hooks from the late Bronze Age (Clark,1952) represented a very important improvement as it was

difficult for the fish to escape once hooked. The earliest nets have been made from materials as nettle fibre and tree baste Clark,(1952) the latter, spinning of stronger fibres like linen and hemp after the advent of farming has provided stronger and more efficient lines and nets.

3.1 Development of Commercial Fisheries in the past

The development of commercial fisheries is by and large linked to the development of methods which can be employed on a bigger scale in the open sea. For bottom living fish and especially for those species with limited shoaling behavior, the use of the long line involving the use and frequently the baiting of hundreds or even thousands of hooks was an important advance which was used by the Dutch from the seventeenth century on the open sea.

To catch fish en masse the best method used has been the use of nets a variety of types of nets has been developed. The earliest nets were simply placed in the water of locations, fish were known to frequent. There are indications that from the Mesolithic period in Europe they were equipped with head floats and with sinkers along their bottom edge. To use nets on a bigger scale in the open sea, the Dutch development of drift netting played an important role. It was operated from big decked boats and involved setting net trains of as much as a kilometer or more in length, and this was one of the important methods in the days of sailing ship. The drift net is still in use, especially in the tuna fisheries of the tropical oceans. Another advance made was the use of trawl bag nets in the open sea from the early nineteenth century. Even though this method was used on a limited scale in coastal waters around the Southern North Sea it is more productive in demersal fisheries than long lining.

Another modern method the purse seine employs the encircling principle for catching mainly pelagic species. This is more energy efficient and is suited specially for catching densely shoaling species. Even though encircling principle is age old in fisheries, the invention of power block for hauling along with the making of bigger nets from strong synthetic fibres has opened up its use in the

open sea and has turned out to be the main method in pelagic fisheries. Since the Second World War efficiency of all types of gear has been enhanced by using and refining echo sounding methods of fish location modern methods of navigation and position finding at sea has also improved the catching power of modern fleets.

3.2 Fishing Technology in Kerala over the years

The total complex of fishing units, comprising a variety of composite systems of two factors – craft and gear constitutes the means of production. There existed a variety of craft and gear. The craft is an important instrument as it is used to take the fishermen to the fishing ground, gear is used to catch fish (Rajasenan, 1987).

Analysing the past production techniques helps in understanding the transition which has occurred in this sector, capital requirement needed, and the extent of modernization and mechanisation in the fishery sector. In fish harvesting the major means of production involved are (1) Crafts, (2) Gears and its accessories, (3) Methods of fishing. The place to place changes in the type of equipments and their operations depend upon factors such as nature of coastal region, climatic conditions, species of fish available capital at the command of fisher folk and local conditions (Kurien, 1978). Any change in technology necessarily implies a change in the craft and gear combination for any substantial increase in the output. The development of the fishing industry on scientific grounds and thereby increasing the catch necessarily requires a technological change in fisheries meaning a change in the craft and gear combination. Mechanisation of fishing craft, introduction of mechanized boats of new designs, use of improved gear materials and gear designs, adoption of modern techniques are all contributing to the development of fishing industry on scientific lines and thereby bring about increased catch (Rajasenan, 1987**)**.

On the basis of the distance of operation, crafts were divided into three categories: Crafts for small distance or coastal fisheries, crafts for middle distance or offshore fisheries and craft for distant fisheries or high sea fisheries. The crafts

used for small distance are of 12 metres length, can be mechanized or non mechanized depending on the type of operation and generally they take daily trips whereby the crafts for middle distance vary between 12 metres to 30 metres in length they usually have to operate for more than a week and hence preservation facilities are provided on board. Meanwhile, crafts meant for distant fisheries are generally very large and is above 30 metres in length. They are self containing with processing facilities for they remain in the sea for about 3 to 4 months and are highly sea worthy to face all year sea conditions.

Depending an surf conditions, nature and availability of fish stock and the relative economic condition of fishermen the use of the instruments of production vary in coastal region (Suresh, 1999) .Crafts are usually classified as indigenous and mechanized crafts on the basis of operation the non mechanized crafts are again divided into three categories; they are (1) Catamarans, (2) Dugout Canoes and (3) Plank – Built Canoes.

3.2.1 Catamarans

Catamarans are mainly used by fishermen residing south of Kollam stretching up to coastal areas of Kanyakumari District in Tamilnadu. Dugout and plank built canoes are used by fishermen all over coastal Kerala It is a keel less craft formed by lashing together many logs, carved and shaped like a canoe. Two wooden supporters called Kadamarams are used for lashing them together is of Egyptian Origin. The word Catamaran is derived from the Tamil word "Cattumaram" which means tree or wood together (Kurien, 1978). This traditional craft is used commonly by the fishermen of Thiruvananthapuram and Kollam District of Kerala.

The length of Catamaran ranges from 7 to 8.5 metres and width from 1.5 to 1.11 metres. The big catamaran can carry more than two persons usually paddled by two men whereas in a three log craft, only a single person goes fishing. For fishing in Catamaran, gill nets and hook and line fishing are the two important gears used. In addition to this, they also use the drift net. Fishermen use

Cattamaran only once a day, they go for fishing in the evening and return in the early morning. But sometimes they go more than once due to the availability of a particular species of fish.

The three - log Kattumaram is quite unique and is used exclusively in the belt between Mampally in Thiruvananthapuram and Pallithottam in Kollam. It is essentially a near shore craft propelled by rowing. The sail is normally net used. Another interesting feature is that the vast majority of the fishermen who use the three log catamaran are Muslims while those who use the four log catamaran are generally Christians. The three log Kattumaram was actually the standard on the west coast about 50 years back. The four-log Cattamaran gained prominence only when the fishermen started going deeper and used the sail more often **(**SIFFS, 1991).

3.2.2 Dugout Canoe

The Dugout Canoe is the most prominent traditional craft, of indigenous origin. This is used all over Kerala to catch the different species of fish both near the shore as well as in deep waters. It is made by scooping out the wood from a large single log of mango or jungle jack making the keel portion thicker than the sides. In Kerala the size of the dugout canoes varies between 8 to 13 metres and is called "Odam or vanchi," the middle size of 9 to 10 metres, called 'Thonies' and the smallest is 8 to 9 metres called 'Beputhonie' (Mathur,1978). In Malappuram District a very unusual craft that looks very similar to the dugout is used as an alternative to dugout medium. Hornell (1938) called it the "Pseudo dugout". Seven to eleven fishermen can work on large dug-out canoes whereas the smaller one can accommodate three to six fishermen.

The dug-out canoes are generally used for fishing during October to May when the weather is clear. They are used eight months in a year (Directorate of Fisheries,1969**)** big paddles are used for propulsion as well as for control. "Beputhoni' is mostly used for hook and line fishing they are also used for gill netting. A smaller dug-out canoe with a capacity to carry only five people, is used

for operation of 'Ayila vala' which is 220 meters long and 8 meters wide (Kurien et al, 1962) the method and design used for operating the chala vala and ayila vala are one and the same but the mesh size of the ayila vala is larger than that of the chala vala (Noble, 1974).

3.2.3 Plank built canoe

The dugout canoes are enlarged by placing wooden planks with or without ribs inside. Plank built canoes are constructed by seaming together planks of wood using coir ropes and copper nails (Bhushan, 1979). Black pitch coating is used to make them water tight. Depending on the size and methods of planks used plank built canoes are grouped under two classes (Mathur, 1978). Both are called "Kettuvallam". The first type is 7 to 12 metres length and the other is 7 to 16 metres in length. The large ones are operated by 12 – 15 fishermen while the small ones carry a crew of 4 -6 persons. The cost of the canoe ranges between Rs. 5,000/- to Rs. 20,000/- and has a life span of about 5 to 7 years. The larger ones are usually used from July to October and the smaller ones are used from September to March / April.

The distribution pattern is an interesting feature showing that plank built canoes is located more in Alappuzha District. The distribution of the different types of traditional crafts are not uniform in Kerala due to the differences in Production techniques in different areas as well as the inequality in the possession of capital. The life span of these crafts also varies considerably.

The Catamarans normally last for only about 10 years, since they are made of light wood. The dug-outs on the other hand survive for about 20 to 25 years. The Plank – built boats have a relatively shorter life span compared to the dug-outs. They last for about 10-15 years. It is generally said that, the life span varies considerably depending on the quality of wood, the make, the use and the maintenance as well as the general care of the operators (Korakandy, 1994). a district-wise distribution of country crafts in Kerala during 1990 is shown in the table 3.1.

Table 3.1 District-wise distribution of country crafts in Kerala 1990

Sl.No	District	No.of Fishing Crafts by type							
		Motorised country crafts				Non-motorised country crafts			
1	Trivandrum	2109	410	169	2688	1889	117	9113	11119
2	Kollam	1356	416	107	1879	480	285	836	1601
3	Alapuzha	2163	-	-	2163	1473	-	-	1473
4	Ernakulam	465	-	-	465	1740	-	-	1740
5	Trissur	145	453	-	598	235	1283	-	1518
6	Malappuram	-	702	-	702	205	2116	-	2321
7	Kozhikode	-	1526	-	1526	-	3615	-	3615
8	Kannur	42	746	-	788	532	965	-	1497
9	Kasargode	76	489	-	565	469	784	-	1253
	Total	6356	4742	-	11374	7023	9165	9949	26137

Source: Kerala fisheries facts and figures, (1990)

3.2.4 Gears

In the traditional fishing sector a wide variety of fishing gears are used by fishermen. The gears have evolved from the knowledge and skill they gained through the long experience of shooting and feeding habits of each variety of fish. The principal fishing gears employed with traditional sector of the fishing industry in Kerala are gillnets, boat seines, shore seines and hooks and lines. Besides several other minor gears, such as cast nets, stake nets and Chinese nets are used locally. These gears are used in combination with the crafts depending upon the seasons' availability of fish as well as the biological characteristics of species. The nature of fish caught or well as the size of the fish caught is determined on the basis of the mesh size of nets, the thickness of yarn with which the net is fabricated as well as the shape of the net. For hook and line the size of the hook

and length of line are determinants. In the back waters of districts like Ernakulam, Trichur and Alleppey, there were certain traditional gears in operation like the Stake nets, Chinese nets and Cast nets. Some of the notable features of these traditional gears are given in table3.2

Table 3.2 Major characteristics of gears in traditional marine fishery

No	Gear	Average size (Length in metres)	Mesh size (in cms)
1	Fixed nets	12 – 30	1 – 2 at cod end
2	Stake nets		
	Seine nets		
	(i) Boat seines		
	(a) Kollivala	73	1 at cod end 2 at mouth
		50 - 65	2 at cod end
		49	2 at cod end
		(b) Thanguvala	
	(a) Kambavala	(c) Madivala	0.80 at cod end
	(b) Aray nets	(ii) Shore seines	0.60 to 1.20
3	Cast nets	2.50 – 6 in radius	1.20
4	Drift nets	48 - 125	5 – 6
5	Long line & hand line	Several hooks are used depending on the length of the line.	–

Source: Bhushan, (1979)

3.2.5 Gillnets

The gillnets are single walled nets which can be set either just above the seabed when fishing for demersal species or anywhere from mid water to the

surface when pelagic fish are being sought (Sainsbury,1971). Gillnets are of set, floating or drifting types depending upon the way they are used. This drifting type of gillnets are attached to the side of a Catamaran or canoe and the craft and the net is allowed to drift along with the current. Fish is caught in the net when they swim into it and get their gills entangled in the mesh. The drifting type of gill nets is specifically used in catching mackerel. They are unique in its ability to cover large areas of water and can catch even scattered fishes. The gill nets are used all along the Kerala Coast. These nets are locally called as Ayila – Chalavala, Olukkuvala (gill net for seers, eel and cat fish), Thirandivala (Gillnet for skates and rays), Nettalvala (gillnet for white baits), Baminvala (gillnet for threadfins) and Sravuvala (gill net for sharks) (Korakandy, 1994).The gillnets used all along the Kerala Coast can be operated by a minimum of two persons on a Catamaran and a maximum of 12 persons on a large canoe.

3.2.6 Boat Seines

The Boat Seines are a kind of encircling nets which are either conical bell shaped, or bag shaped with or without wings made from cotton or nylon filaments. The open end of the boat seines has larger mesh size which decreases towards the closed end. The most striking feature of boat seines in Kerala is that they are equipped with a strong central bag preventing the fish from escaping and two long wings attached on either side. They are operated with the help of two canoes or Catamarans, which pull at either ends of the wings and keep the mouth of the net open and allows the fish to swim towards the narrower end. Scaring devices of wood or coconut leaves are used to beat the water or side of boats, to drive the fish into nets. Boat seines are used in Kerala to fish for pelagic and mid water shoaling species (Sainsbury, 1971). All over Kerala coast this net is used specially for fishing sardines, mackerels, prawns, soles (Mathur, 1978). Depending on the size of net and craft used boat seine can be operated by as few as five persons to a maximum of twenty persons. Some popular variants of boat seines, employed for catching certain specific species are Muyyamvala, Mattikolli vala, Odakolli vala, Peyittan vala, Ettavala and Avoli Vala these are generally shot at a depth of 10 to 20 fathoms.

3.2.7 Shore Seines

The shore seines are bag shaped nets operated from the shores with two coir wings of over 1500 m in length. The shore seines, popularly known as 'Karamadis' or 'Kambavalas' in Kerala are operated with the help of a boat or canoe. Traditionally the shore seines had a very important position especially in Southern Kerala. But during the last two decades, they have steadily lost their importance and have decreased in number (SIFFS, 1991). The working of the shore seine is that one wing of the net remains in the beach and the other wing is taken out in the canoe drawing it in a semicircular manner and finally brings the other end to the shore. After the net has been laid the two ends are simultaneously and gradually pulled in by fishermen (Kurien, 1978). A canoe with a crew of six to eight persons are used to place the net in the sea, and twenty five to forty persons are employed for pulling in the net. The calmer seasons between November and March / April are preferred for using this net with which the pelagic and shoaling fishes are caught (Korakandy, 1994).

3.2.8 Hooks and lines

The Hook and lines, which is the most traditional methods of fishing in Kerala has been used since ages for catching a large variety of fishes like sharks, seer, skates and rays, eelfish, cat fish etc. A long length of line is setout to which, short lengths of line carry baited hooks are attached to every two to six feet. The fishes are attracted by the bait hooked and held by the mouth, until they are brought aboard the operating vessel which periodically hauls the gear (Sainsbury, 1971). The type of fish caught depends upon the depth to which the line is set as well as the size of the hook.

Kerala is typical of using three different types of fishing lines they are (1) Hand Lines (Kaichunda) (2) Long Lines (Beppu or Ayiram Chunda) (3) Chain lines (Changala Chunda).

The hand line is the simplest fishing line and is generally cast from anchored canoes in shallow as well as deep waters of the sea (Kurien, 1978) the

long line consists of a master line with equidistant thinner branch lines to which the fishing hooks are attached. The number of hooks attached depends upon the length of the line. The chain lines are used for catching sharks and they use especially strong hook and lines (Mathur, 1979).

Hooks and lines are used for fishing in deeper water or in uneven grounds. Where other fishing methods are not easily possible In Kerala this method is carried out only by very few fishermen, because to catch larger quantity fishes fishermen will have to go to greater depths. Moreover they will have to spend too much time, fishing and this makes the work very arduous. But this hook and line fishing is the primary occupation of the Beppukar or Cundakar of Malabar (Mathur, 1979).

3.3 Development in fishing crafts and gears and technology

The strong belief that the bulk of fishery potential of the state which lay unexploited was in the regions 50m depth contour led to the technical development in the industry. For the exploitation of these resources (Korakandy, 1991). For a proper development of the primary marine fishing industry of Kerala, development of suitable crafts, gears and techniques became unavoidable.

In Kerala fisheries, the modernization programme started in 1953 and mechanization in capture fisheries was confined basically at three levels.

1. Craft Movement (Method of Propulsion)
2. Development of Gears and
3. Tackling Techniques (Suresh Kumar, 1999)

These changes have considerably helped in improving the productive capacity of the fishing sector. The new techniques have raised the productive capacity by four ways.

1. Use of machine power enables the fishermen to reach the fishing ground early thereby raising the fishing time.

2. The new technology enables the fishermen to increase the distance range of fishing operations.

3. Fishermen could succeed in capturing the bottom dwelling or crustacean species like prawns, crabs, lobsters, etc. since the new technology has raised the depth range of operations.

4. The fishermen become less fatigued which thereby increases the productivity.

The development efforts for the evolution of suitable crafts gears and techniques are divided into three distinct periods.

a. 1953 to 1963.

b. 1963 to 1979 and

c. 1979 onwards

From 1953 to 1963 a major part of research and development during this period was undertaken by the Indo-Norwegian project which started functioning from the Neendakara – Sakthi Kulangara region near Kollam in 1953. The work was primarily the mechanization of fishing crafts. The possibility of utilizing existing crafts by fitting suitable engines. But to this the fishermen showed no interest and they preferred the specially built motor boats to become available. Many experiments were carried out but the experiments did not reap success, and finally, the idea of mechanizing existing local crafts were abandoned with little success in mechanization of existing crafts, project started to concentrate on the development of suitable new designs. Import of bascule 22 ft boats with 4 H.P. semi Diesel engines from Norway was made in 1954. Simultaneously construction of similar boats was undertaken at the boat building yard in Neendakara. The material used for building was Anjili and the nets used were the traditional gillnets for sardine and mackerel. In March 1955 the first four mechanized boats were issued to four fishermen and in August 1957, 63 such boats were issued to the

local fishermen. But after 1957, project stopped the construction of this type of boat due to poor response from Araya fishermen of Neendakara region.

Later by the end of 1957 project began constructing 25 ft boat with 8-10 H.P full diesel engine. By the end of 1958 ,19 such vessels were introduced in 1961 23 ½ ft with 8-10 HP was introduced. By 1962 the project introduced a 25 ft. boat fitted with 16 H.P. diesel engine capable of using a small shrimp trawl. With the introduction of this craft and trawl nets there was some appreciation of mechanized fishing over non mechanized fishing (Achari & Menon, 1963) and there was a complete shift in favour of mechanization and trawl fishing. The project had to design very small trawl nets to meet the new demand from the fishermen.

The discovery of shrimp grounds and their export potential led the project to design more types of mechanized vessels exclusively for shrimp trawling. The nets and fishing gear which was initially imported from Norway was started to be made through co-operatives. In November 1961 the Government of India & Norway signed a third supplementary agreement. Where in the projects' activities were shifted to Cochin. The administration of the Project came under the direct control of the Government of India. Since 1963, the project activities were more exploratory and experimental fishing than the evolution of any further craft types. This work was undertaken by the Central Institute of Fisheries Technology (CIFT).

3.4 Development under the FAO / EPTA Programme

On the basis of an agreement between the Government of India and the Food and Agricultural Organization of the United Nation in 1953, FAO appointed Mr. Paul B. Ziener, a naval architect, to advise and assist the government on problems of boat design. Later FAO sent a second naval architect in 1955, Mr. K. Rasmussen. They concluded that it was practically impossible to mechanize catamarans and canoes the FAO experts reached the conclusion that the only

possibility of carrying out mechanized fishing from the long surf-beaten coasts seem to be the development of a surf-boat.

Between 1954 and 1958, the FAO experts in India tried to develop three Proto types of mechanized surf boats for India. But each one of these had some technical snags and operations from these proto types proved financially unsound. The FAO besides attempting to develop the mechanized surf boats had also tried to develop a number of new designs of mechanized boats from 1953 to 1963. In 1962 a finalized design of the craft was developed. It had a 40 H.P. diesel engine, a crew requirement of five persons, and could fish at a depth of 20 fathoms (120 ft) and could stay in the sea for about 65 hours at full power. Among the various craft designs standardized, the four most important designs that became very popular in the state are the 25 ft. gill-netter, the 32 ft trawler the 32 ft gill netter and the 36 ft trawler.

From 1963 to 1979-The technical changes which took place during this period was indigenous in nature. The technical changes were in response to the changes in the economic sphere of the marine fishery sector. This period marked the development of medium and large fishing vessels, indigenous engines for fishing vessels, research on alternative materials for boat building, new and efficient designs of fishing gear and new methods of fishing. This was in response of fishing. This was in response to the development of export market, especially for shrimps which resulted in large volumes of capital flowing into capture fisheries which necessitated the increased need for fishing vessels. The local capitalists developed indigenous engines for mechanized boats. The legacy of research and development (R & D) carried out by foreign institutions and experts were continued by National institutions within the "Technological standards" determined by them. After 1979 most of the research was carried out under the auspices of the CIFT Cochin. The CIFT carried out most of the research and development activities according to the recommendation made by FAO experts. The activities during this period focused mainly on

1) new designs of mechanized crafts
2) Indigenous engines
3) Alternative materials for boat building
4) New materials and designs of net and
5) New methods of fishing

Table 3.3. Comparative Costs of major craft types standardized by the CIFT

Size of the craft	Type of craft	Cost of parts (Rs.)				Total cost (Rs.)
		Hull *	Engine	Gear	Navigational and life saving equipment	
25 ft	Opening Fishing	12000	20000	5000	400	37400
30 ft	Fishing boat	29000	22000-30000	15000	2700	68700-76700
32 Ft	Trawler	45000	22000-40000	16000	3200	86000-104200
32 ft	Fishing boat	45000	22000-50000	16000	3200	86000-104200
36 ft	Trawler	59000	62000-70000	20000	4000	145000-153000
40 ft	Trawler	60000	75000	25000	4500	164500
45 ft	Drifter / Trawler	71500	90000	30000	4500	196000
50 ft	Combination vessel	150000	140000	35000	15000	340000

Sources : CIFT, (1980)

The comparative cost of major crafts are given in table 3.3. The export market for shrimp grew steadily during this period. The trawlers built during this period were mostly small boats, which could operate in the inshore waters only. Demand for vessels capable of operation in offshore waters and could catch shrimp and other varieties of fish both in the pelagic and demersal waters was felt during this period. There was a growing export demand

for fish in the international markets. The export demand for fish and marine products rose by about nearly four times during 1963-1979, and value of exports rose by eighteen fold. Domestic demand also surmounted. All this was the natural outcome of growing population and resultant urbanization in the sixties and seventies. The emerging "Law of the sea" which made it obligatory for the coastal states to make full use of the living resources of the seas around their coasts also inspired the planners to go in for introducing larger combination vessels.

Teak and Aini were the most common timbers used in the construction of fishing vessels even by the end of sixties. The price of timber was rising very sharply over the years and this necessitated using alternative materials for the construction of vessels. Venteak, a cheaper wood was substituted in the place of Teak and Aini and the result was a reduction in the total cost by about 75 per cent. The use of fiberglass, ferro cement, aluminum alloy and steel came to the forefront as building materials for boat building by the CIFT. They also found the possibility of using aluminum alloy sheet in place of costly copper sheets for sheathing the hull. A toxic wood plastic composite for boat scantling and the indigenous resin preservative for wooden craft to protect the boats from degenerating organisms has been developed by the institute.

Mechanization of craft also brought in the development of suitable net-making materials stronger than treated cotton and also the evolution of suitable designs of nets for various types and sizes of boats. The Indo Norwegian project began importing gear materials from Norway and fabricates nets from the project site at Neendakara. The non rotting character of synthetic fibres resulted in an increase in the life span of the nets to about three years. Synthetic fibres also had the properties of fineness, pliability, elasticity, durability and invisibility for gillnet and fineness for trawl nets to minimize hydraulic resistance.

With mechanization gaining momentum CIFT made significant advancements in gear design. Prior to 1977 CIFT prepared over thirty designs of trawl nets for operation. The catching efficiency of these gears got improved with changes in rigging pattern, by adding false head rope etc. Modifications made the

evolution of new concepts in trawl net designs like the long wing trawl, bulged belly trawl, six scan trawl, double rig shrimp trawl, etc. The CIFT also made many improvements in the design and use of other boards for operation with different sizes of trawls from different size group of vessels.

The growing demand for lobsters for processing for export, necessitated the development of effective means for exploiting lobster resources in the country. A suitable non-injurious gear for the exploitation of lobsters along the south-west coast of India was developed leading to the development of gillnets for lobster fishing. Similarly gillnets for seer fishing and sardines was also developed.The CIFT developed purse seine design nets to be operated from small class of boats, which are engaged in trawling as an alternative when shrimping fails and during sardine and mackerel seasons. It can be operated by a group of 20 persons from two mechanized boats or non mechanized thangu valloms. A method of stunning the hooked fish to prevent escaping by applying electrical impulse was also developed by the institute during this period. A lobster's trap was developed which is fabricated out of M.S. Rod frame mounted with 2.5 m square welded mesh and is provided with a complete coating of plastic to make it completely impervious to sea water. It has a catching efficiency of two fields as compared with the traditional type. This was greatly favoured by the traditional fishermen.

3.5 Transition in fishing Methods

Changes in the methods of fishing became the direct outcome of mechanization of craft. Certain of the fishing methods developed along with improvements in crafts were

1) Gill netting
2) Boat seining
3) Bottom trawling
4) Pelagic trawling or purse seining
5) Long lining
6) Lift netting
7) Pumps fishing

The only substantial difference observed in the process of fishing with gill net and boat seines in mechanized boats from that of traditional fishing was that in mechanized boats, the size of the nets will be bigger.

A very active fishing technique for harvesting prawn is bottom trawling if a trawl net is pulled along behind a boat in the sea bed it is trawling (FAO, 1980) A trawl net is a large one having a bag at the end of the net. It is wider at the open part and tapering through the body of the net to the closed end. The fishes are trapped at the closed end. The mouth of the net, looks like a oval opening, when viewed from the front, and the two wings of the net stretch out in front on either side to widen the area swept. The floats are fixed around the upper edge of the mouth along the headline. Around the bottom of the mouth is the ground rope, which is weighted to remain at the bottom. Horizontal spread of the mouth of net is attained by the "otter boards" or doors towed ahead of the net and set at an angle of attack to the towing direction thereby providing the outward force necessary to spread the wings to which they are fastened (Suresh, 1999). Bottom trawling is categorized into Stern trawling, otter trawling, out rigger trawling and pair or bull trawling.In stern trawling craft is maintained on a straight course while hauling and setting and the pull is along the direction of the motion of the craft. This method is advantageous. Since some of the voyage time can be used for fishing thereby lessening fuel costs. In otter trawling, a large trawl net whose sides are held open by otter boards, capable of fishing more because of its flexibility to side ways. Otter trawling requires huge engine power and hence it is not popular in the coast of Kerala. In out rigger trawling the outrigger booms are tied to the main mast of the vessel with trawl nets on both sides. These nets are towed from the ends of the outrigger booms on each side of the craft.

In this type of trawling, by using the power required for a single trawl net, two trawl nets can be used. In pair or bull trawling, two boats, pull the trawl. The mouth of the net is kept open the by the outward pull provided by the correct lateral spacing of the vessels. This method, uses a large net and also can catch more fish, because a single boat towing in front and at the centre of a trawl net will frighten some of the fishes away with the noise of its engine while two boats

towing in the front and at the sides of the net will make noises, which will scare the fish towards the center and straight into the net.

3.6 Mid water trawling

Pelagic or mid water trawling is used to catch pelagic species found in mid waters. For catching pelagic fishes purse seine technique is used. The process is by setting out a long net to form a meshed wall around the shoal of the fish which has been spotted. When the net has encircled the fish, its bottom is being pulled together to hold the catch. Floatation is provided by large number of floats fastened to the float line. Weights are fixed on the lead line which runs along the bottom of the net to sink the net so that it forms the desired wall. Below the lead line. A purse line runs through rings connected by short length of rope to the lead line. The purse line is pulled from the pursing winches through the rings in order to close up the bottom of the net. A disadvantage of this method is that since the mesh size of the nets are small; it brings about indiscriminate fishing of even small and spawning fish.

3.7 Research and Development Efforts

The 'process' of technological change in the Industry consisted predominantly the activities of research and development for fisheries resources, fishing crafts, fishing gears, fishing techniques etc. The research and development effort for fishery resources was mostly carried out by the CMFRI, Pelagic Fisheries Project and the Indo-Norwegian Project. The Surveys which these institutions have carried out establishes the vast potential for exploiting prawns and other pelagic / demersal resources in the state. The INP after initial experimentation introduced a number of new designs of small and medium mechanized boats for trawling for shrimp/prawn in the inshore waters. Moreover the use of new materials in the making of gears enhanced the durability and gave flexibility in the mesh size of nets. Thus a "technical package" which was 'nouveau' regarding crafts, gear and new methods of fishing was gifted to the society.

The efficiency of trawling was increased enormously through mechanization and manifold technical improvements. The organizational structures by which fish reach the market and the consumer involves landing and first sales and often processing also. With the growth of technology changes have crept in to the various methods by which the harvested catch can be preserved. Landing involves manual unloading from boats pulled up on the beach or floating near the shore. In the third world it often involves individuals wading into the sea. Unloading from larger boats is generally done with mechanical aids, as well as vessels' own derricks, land based powered cranes and winches may be employed In many traditional situations a significant part of the production does not enter into commerce, but goes to feed the families, relatives and business contacts of fishermen. As much as twenty percent of production in India has been reported as going directly to domestic consumption (Indian Institute of Management, 1985).

3.8 Overcapitalisation

The world fishing fleet consisted of about 4 million units; of which 1.3 million were decked vessels of various types, tonnage and power, and 2.7 million were undecked (open) boats. While virtually all decked vessels were mechanized, only about one-third of the undecked fishing boats were powered, generally with outboard engines. The remaining two-thirds were traditional craft of various types, operated by sail and oars. About 86 per cent of the decked vessels were concentrated in Asia, followed by Europe (7.8 per cent), North and Central America (3.8 per cent), Africa (1.3 per cent), South America (0.6 per cent) and Oceania (0.4 per cent) (FAO, 2006). The issue of overcapacity in fishing fleets and their reduction to the levels that should be in balance with long- term sustainable exploitation of resources has received global attention during the past two decades. Many countries have adopted policies for limiting the growth of national fishing capacity in order to protect the aquatic resources and to make fishing economically viable for the harvesting enterprises

The trend in the growth rate of fishing units given in table 3.4 indicates the possible phasing out of non-mechanised canoes, which ultimately reflected a

negative growth of 52 per cent during 1995 to 2003-04. This downward trend is compensated in the motorized sector implying large scale motorisation of existing traditional crafts.

Table 3.4. Operation of fishing crafts in India from 1985-2007

Sector	1985	1995	1999	2003-04	2006-07
Non-motorized	161963	151554	81264	76596	104270
Motorized	6928	39303	44578	50922	75591
Mechanized	26733	37901	53684	49070	58911
Total	195624	228758	280491	176588	238772

Source: Korakandy, (2008)
CMFRI Marine census report, (2007)
Sathiadhas, (2005)

However, during 2006-07 a further increase in the fishing craft (26.04) compared to the last two years. Mechanized crafts displayed a major boom during 1980s and till 2000 when the technical efficiency of a particular gear is better than other, the lesser efficient gears gradually disappear from the operation. Approximately two-thirds of total production is from mechanized fishing units (using trawls, gill-nets and purse-seines), while the rest is from motorized fishing units (using gill-nets, lines and purse-seines with outboard motors) and from unpowered fishing units. The seasonal nature of fishery, the risk and uncertainties associated with marine fishing entangle the fishermen in low-income trap. Marine fisheries scenario can be described in terms of too many vessels chasing too few fishes. Overcapitalisation and tehnological innovations in the mechanized sector and motorised sectors, and under employment in non-mechanised sector is rampant issues that marginalize fisherfolk. The fishermen involved in active fishing is more than the absorbing capacity of the fisheries sector and has led to

lower per capita production, increased pressure on fishing which results in juvenile fishing, large level discards causing serious threats to resource sustainability and environment stability.

There was an enormous increase in the number of fishing units operating in Kerala for the last 18 years. The total number of mechanized and non-mechanised crafts increased from 34732 in 1985 to 55501 in 2003. There was also rise in motorized crafts from 5337 in 1985 to 29395 in 2003, i.e. about 300 per cent increase (table3.5)

Table 3.5 Details of fishing crafts in Kerala from 1985-2003

Sector	1985	1995	1999	2002-03	2006-07
Non-motorised	25363	13633	28456	21956	9522
Motorised	5337	13634	17362	29395	14151
Mechanised	4042	5241	4206	4510	5504
Total	34732	32508	50024	55501	29177

Source: Korakandy(2008)
Rajasenan,(2005)
Economic Review, (2007)

The permissible limit as estimated by Kalawar committee in 1985 were 20000 non-motorised crafts, 2960 motorised crafts and 1145 mechanised crafts. The enormous increase in the number of crafts does not have resulted in boosting the marine fish production proportionately (Rajasenan, 2005). However, a very high reduction of the crafts of all types have been identified during 2006-07 in comparison to 2002-03 and the state‘s number of crafts are coming closer to the Kalawar committee recommendation but with lesser number of traditional crafts.

The explosion in trawling led to the over exploitation of marine wealth which had alarming consequences on the traditional sector. Marine fish production, which had reached 4.5 lakh tonnes in 1973, steadily declined to 2.83 lakh tones by 1987. Prawn production, which was 86,000 tonnes in 1973, declined to 25,000 tonnes over the same period. Traditional fishermen were especially

hard-hit. The average output per fisherman per year, which was 3.8 tonnes in 1965, drastically fell to 1.6 tonnes by the early eighties.

The traditional sector which dominated the fishery till 1983 thereafter declined with the fast development of the motorised sector. In 1985, the traditional sector contributed only 24 percent of the fish catch in the state while the contribution by the motorised sector was 43 per cent and the mechanised sector 33 per cent. In 1995 the contribution by the mechanised sector increased to 57 per cent, reducing the contribution by the motorised sector to 39 per cent. The traditional sector suffered further decline. In 1995 the motorised, mechanised and traditional sectors contributed 51, 44 and 5 per cent respectively changes in the last decade have resulted in the new phenomenon of over capitalisation of a major segment of the artisanal fishery. It has also led to the energy intensification of fishing operations making them economically unsustainable both for the large number of artisanal fishermen as well as the new entrants into the fishery. The ecological sustainability of these operations is also an issue. The total number of motorised crafts especially plywood and plank canoes increased while the catch stagnated, the major part of which is contributed by the ring seine and trawler. Consequently, per unit catch is continuing to decline and the landings are tending to become centralised in major landing centres. On the other side, per unit investment and cost of operation specifically fuel cost has increased significantly thus making fishing units vulnerable for losses. The non-mechanised sector has 81 per cent overcapacity, the motorised sector has 60 per cent overcapacity and the mechanised sector has 55 per cent overcapacity (Modayil, 2006).

Increased investment means increased debts and increased efforts to earn the returns to the investment. This further escalates the fishing pressure on the coastal resources. Increased demand and consequently high price have resulted in accelerated investment in the harvest operations as the increase in the price compensates even the decline in catch. The overall per capita investments of an active fishermen in 2003-04 was Rs 86290 ranging from Rs 17024 in the non-motorised sector to Rs 219319 in the mechanized sector, showing rising trend (table 3.6). Whereas the investment per head in mechanized sector was Rs

125689, motorized and mechanized sectors invested Rs 26835 and Rs 13979 respectively

Table 3.6 Per capita investment on fishing equipments per active fishermen in India 1997-2004

Sector	1997-1998	2003-2004
Non-motorised	13979	17024
Motorized	26835	19454
Mechanised	125689	219319
Overall	40363	86290

Source: Sathiadhas, (2005)

The capital investment has increased more than proportionate to the increase in fleet size not only due to increase in price level and consequent increase in capital requirements but also diversification of fishing units opting for bigger OAL boats with high HP and other accessories. The inshore capture fisheries have already reached a saturation point making it difficult to expand further. One positive development is the increase in the depth of fishing by both the mechanised and motorised crafts in the recent years and the harvest of deep-sea prawn and lobster by the mechanised sector. The cost and earning profile of the selected craft and gear combinations in Kerala has been worked out to identify the investment option (CMFRI, 2007-08). The lowest investment option in Kerala is found to be a thermocol-drift gillnet unit with an investment of Rs 10000/- getting an average catch of about 18 kg and earning an average revenue of Rs 320/ trip. Similarly highest investment option is a multi-day trawler with an average of Rs 24 lahks, incurring an operating expense of Rs 78000/ trip of 5 days, getting an average catch of 2400 kg and fetching an average revenue of Rs 1.07lakhs.

3.9 Important craft- gear combinations in marine fisheries of Kerala

Motorisation has adversely affected dugout canoes, plank canoes and catamarans. Plywood which emerged as a strong alternative for dugout and plank canoes affected the relevance of catamarans. A clear trend towards adoption of plywood boats instead of other traditional crafts is visible. There is also a proportional change in fishing gears along with the changes in crafts. In the place of dominance by shore seines, boat seines and small gillnets till the seventies and even till the eighties; ring seines, trawl nets and mini-trawl nets along with larger gillnets and long lines control the present fishery. A significant craft-gear combination used in the present day in the marine fisheries sector of Kerala is shown in table 3.7

Table3.7 Important craft-gear combinations in marine fisheries of Kerala

Craft	Fishing Gear
Mechanised fleet 1. Mechanised Trawlers Small (8.5-9.7m LOA; 90hp) Medium (9.7-16.7m LOA; 100-158hp) Large (16.7-21m LOA; 177hp)	Shrimp trawls – 5 types Fish trawls – 3 types Cephalopod trawl – 1 type Gastropod – 1 type
2. Mechanised Gill-netter-liner (9.7-21m LOA; 110-140hp)	Gill nets; long lines; hand lines
3. Mechanised pursed seiner (15.2-16.7m LOA; 110-156hp)	Large mesh (45mm) Purse seines for tuna, seer fish, mackerel and carangids.
Motorised (IBM or OBM) traditional fleet 4. Crafts with inboard engine (Steel or wood hull; 18.3-25.8m LOA; 90-140hp)	Ring seines (18mm mesh) For sardines and mackerel
5. Crafts with OBM (Wood, steel, fibre glass hull; 12.2-21.23m; 22+22hp; 40+22hp; 40+22+22hp; 40+40+22hp or 40+40+40hp)	Ring seines (18mm mesh size) for sardines, mackerel carangids and prawns.
6. Crafts with OBM (wood and fibre glass hull; 9.9-22hp)	Ring seines (8-12mm) for anchovies; Mini trawls; Gillnets; Cooks and lines; Encircling nets; Boat seines and shore seines.
Non motorized traditional fleet 7. Catamaran blank canoe Dugout canoe FRP canoes	Encircling nets; Boat seines and shore seines; Gillnets; Hooks and lines; cast nets.

Source: CMFRI, (2008)

3.10 Marine landings in Kerala

Marine fish landings in 1950 was 202047 tonnes and on 1956 with a landing 152213 tonnes, a declining trend was observed. Since 1957 there was a rising trend in the landings reaching 364829 tonnes in 1970. from 1970 onwards again a rising trend was observed with landings reaching 420836 tonnes in 1975. a downward trend starting from 331047 tonnes in 1976 to 303286 tonnes in 1987 .After 1988 a sudden spurt in catch was observed, with 647526 tonnes in 1989 and this trend continued throughout the ninetees . By 2000, landings rose further to 604113 tonnes . The marine fish landings from 1950-2008 is given in table 3.8 .

Table 3.8 Marine fish landings from 1951-2008

(Quantity in tonnes)

Year	Quantity	Year	Quantity
1950	202047	1979	330509
1951	191032	1980	279543
1952	129345	1981	274395
1953	111999	1982	325367
1954	117034	1983	385817
1955	105457	1984	394372
1956	152213	1985	325536
1957	309926	1986	382791
1958	294655	1987	303286
1959	191375	1988	468808
1960	344605	1989	647526
1961	267494	1990	662890
1962	191421	1991	564161

1963	202380	1992	560742
1964	317974	1993	574739
1965	339173	1994	540813
1966	346744	1995	531646
1967	364829	1996	572005
1968	345301	1997	574774
1969	294787	1998	542696
1970	392880	1999	507287
1971	445347	2000	604113
1972	295618	2001-2002	671822
1973	448269	2002-2003	678322
1974	420257	2003-2004	608525
1975	420836	2004-2005	601863
1976	331047	2005-2006	558913
1977	345037	2006-2007	598056
1978	333739	2007-2008	586286

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

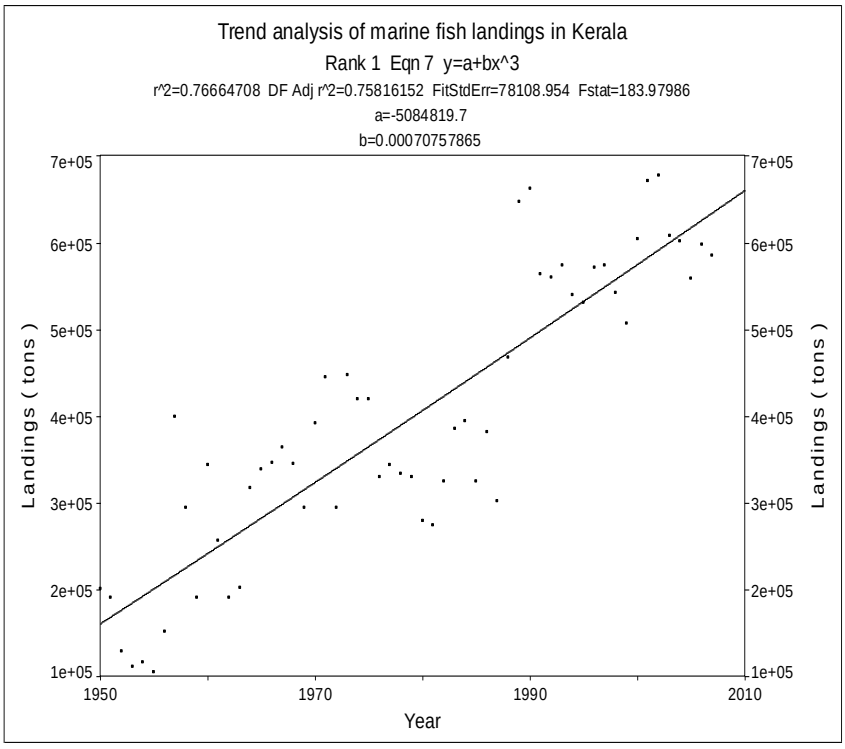
2) Economic review (various years), government of Kerala.

3.10.1 Trend analysis of marine fish landings in Kerala

The wide variation seen in landings kindles inquisitiveness to analyze the reasons which led to this fluctuation. There are regional variations in the artisanal fishing fleet of Kerala which arose mainly due to the technological changes and the requirements of global demand. Similarly the three zones- north, central and south has its own uniqueness in using different types of fishing gears and crafts. Southern coast of Kerala is famous for catamarans which are best suited for surf ridden and deep waters. The central coast of Kerala is popular for

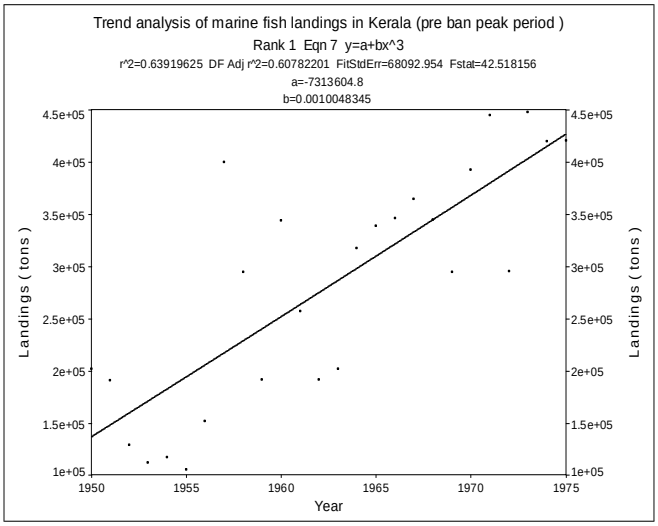
plank-built canoes, which requires a calm sea and dug out canoes dominate the north zone. To analyze the trend in the marine fish landings for the past 58 years, the period from 1971 to 1975 is taken together and termed as pre-ban peak period ,the period from 1976 to 1987 is the pre ban period. 1988 is the year of ban imposition and hence the period from 1989 to 1999 is post ban period 1, and the period from 2000 to 2009 is post ban period 2. The trend analysis of landings for the various years was found out in order to identify the factors responsible for the variations in landings during the different periods (figure 3.1)

Figure 3.1 marine fish landings in Kerala (1950-2010)



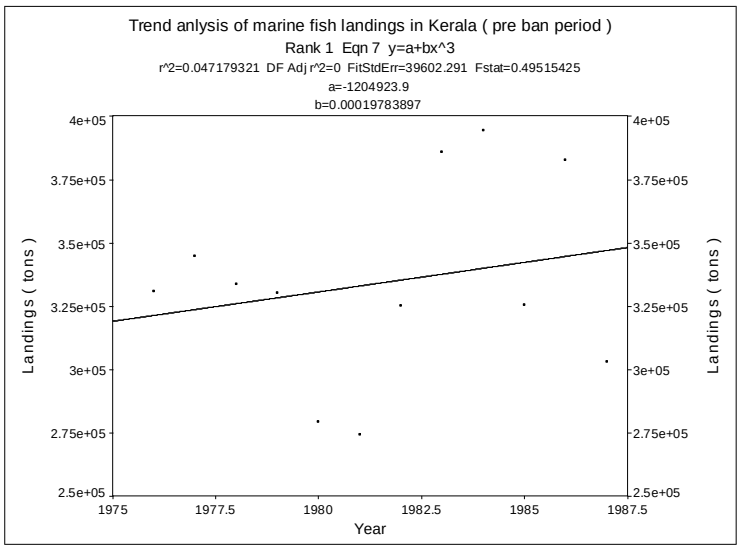
The period1971-75 is termed pre ban peak period because from 1971 there was an upsurge in fishery development with the introduction of the Indo-Norwegian project .During this period total landings as well as the landings of commercially important species showed vast increase. During 1973-75 production of prawns was 74,000tones.(Figure 3.2)

Figure3.2.marinefishlandingsinkerala(1950-1975)



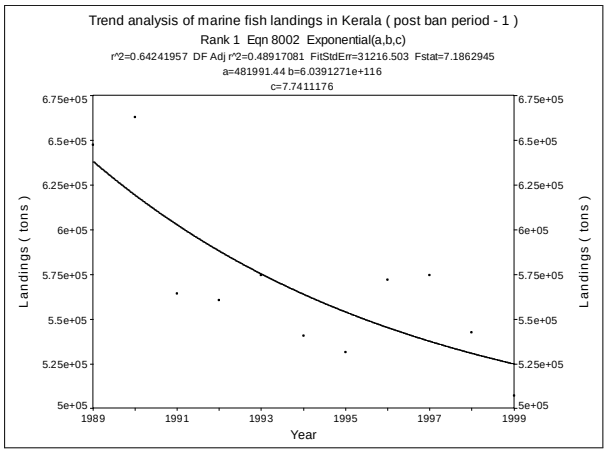
From 1976- 87 which we call as pre ban period experienced a mild fall in the total landings. Analyzing the annual marine fish landings in the state for the past 15 years from 1974 – 1988, a variation was seen from 2.74 lakh tones in 1981 to 4.69 lakh tones in 1988. Starting from 4.20 lakh tones in the beginning of the period, the landings dropped to 2.74 lakh tones in 1981 which is the minimum so far experienced. Thereafter landings started picking up reaching to 3.93 lakh tonnes in 1984, and further dipping to 3.03 lakh tones in 1987 and then jumping to 4.69 lakh tones in 1988. (figure 3.3)

Figure 3.3 Trend analysis of marine fish landings in Kerala (1975-1987)



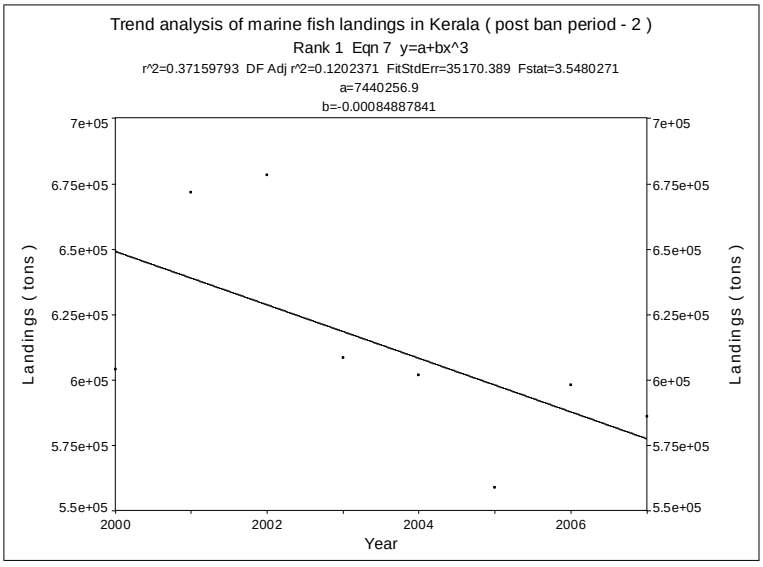
On 1988 ban was introduced and the succeeding 11years till 1999 is termed as post ban period (1) showing steady increase in landings since the introduction of the ban. Heavy landings of oil sardine and mackerel by purse seines and ring seines. By 1990 heavy landings was observed since ring seine picked up momentum. Lean landings were observed during 1992 with 5.61 lakh tones. Influenced by high income generating catches such as shrimps and cephalopods, fishers extended their area of operation of the trawlers and concentrated on targeted fishing. Even though trawl landings and the effort expended was maximum during 1994,a heavy decline in oil sardine landings (from 49675 tones in 1993 to 1554 tones in 1994) was observed. Trawl landings and maximum effort were expended during 1994. The increased use of trawl nets caught more ribbon fishes, mackerels, penaeid prawns and cephalopods. Maximum number of mini trawls was operated during this period. Till 1999 a constant trend with an average catch of 5.6 lakh tones annually could be noticed. The major contribution came from Indian mackerel, oil sardines, carangids, perches, penaeid prawns and cephalopods. The maximum landings of mackerel were in 1996 with 1.28 lakh tones. Oil sardine was keeping an increasing trend .during 1996 trawl operations was reduced to half compared to 1988 even though there was a hike in trawl landings due to the effect of multiday trawl operations. Purse seine landings crossed 8,100 tones in 1996 after a break of six years as a result of increased operation of units, resulting in less catch per unit effort.(figure 3.4)

Figure 3. 4 Trend analysis of marine fish landings in Kerala (1989-1999)



The period from 2000-09, termed as post ban period 2 was one of considerable increase in landings specially till 2005 but after 2005 there is a fall in landings which remained at a more or less constant trend . The number of active fishermen rose from 80700 in 1961 to 1,90483 in 2006 at the same time the number of trawlers increased enormously from 172 in 1961 to 3982 in 2006. The landings of oil sardine increased considerably to 241411 tones in 2000. Oil sardine landings crossed 2 lakh tones during 2000-04. Penaeid prawn landings showed remarkable decline during 2004 whereas cephalopods landings crossed 41000 tones for the first time in 2004. This was mainly the effect of targeted fishing for squids and cuttlefishes as a result of their entry into export market. During 2005, the landing was 5.36 lakh tones and a peak landing was observed in 2008 with 6.70 lakh tones .The heavily landed species were sardines, mackerels, perches, other clupeids, penaeid prawns, carangids and ribbon fishes, cephalopods, tunnies and flatfishes. During 2007 purse seines and multi gear operations showed manifold improvement while trawl net, driftnet/gillnet, hooks and lines and ring seines showed a declining trend during 2007 in the mechanized sector. In the motorized sector gillnets, ring seines and mini trawl nets contributed heavily while landings of hooks and lines and boat seines showed a decreasing trend.(figure 3.5)

Figure 3.5 Trend analysis of marine fish landings in Kerala(2000-2007)



3.11 Methods of marketing and processing over the years

Marketing and processing methods in many traditional situations especially in third world countries are by small numbers of merchants. There will be often only a single merchant at each landing point. These types of monopoly situations are highly disadvantageous to fishermen. Also there is the possibility for one merchant to the only available source of necessary materials like fishing gear and food supplies and fishermen's dealings with such, merchants can be largely verbal or look transactions in which all prices are controlled by the merchant (Coull ,1974)

Till the second half of the twentieth century, most fish have always been consumed in a fresh state. Indications from prehistory suggest that some have been preserved, or cured, for other than immediate use. When this practice originated, is lost in history. Drying and salting have been widely practiced and was supplemented to smoking and preservation with spices. Among African tribes the most general practice was drying in the sun over smoky fires (Cutting, 1955) . In the North Atlantic area, salting has been extensively used as well as drying and salting, there has also been extensive wet salting in barrels for the more easily spoiled fatty pelagic species like herring. In third world countries they still follow the long established traditional methods of processing since, more sophisticated methods of processing are often technologically and economically unfeasible.

In the modern days other processing means have become available to preserve the food value better and to present the products for sale in more attractive ways. From the nineteenth century, fish canning became important for species like salmon, sardines, sprats and anchovy in Europe. It is also employed extensively by the Japanese and the USSR. USSR has developed large scale floating capacity in canning. There was considerable expansion of certain smoked fish products, which was materialized due to improved means of transport allowing a wider market to be reached by fish cured by methods which only preserved them in the short term. 'Cold Smoked' herring, smoked mackerel,

haddock and salmon became important market sectors in industrialized countries and smoked salmon was ranked as a luxury item .Since the second world war, the most notable development has been the expansion of freezing, which maintains the food value best, but this method is very costly and moreover it requires elaborate infrastructure. The two biggest sectors in tonnage of production are finfish. This includes, tuna, which is often frozen whole and is associated mainly with distant water fisheries. Japan is the main market; another major sector is fillets, dominated by gadoids which are very popular in the markets of developed countries in the western world. The removal of bones by filleting has become a very important practice for the affluent society markets of the western countries. Preparation of fish portions and fish sticks are very popular in the USA. These are linked to freezing and also to the availability of retail outlets like freezer cabinets in supermarkets

In the developed countries it is deployed on a large scale by the distant water fleets of the USSR which has special freezer carriers and factory freezer ships. Freezing at sea is very costly and hence in western countries, most of the frozen fish are processed on land and caught almost near to the shore in countries such as Canada, Norway and Iceland. The biggest processing sector today in tonnage handled is that of reduction to meat and oil which started initially as a by product industry for fish offal or surplus fish in the catches.Fish and its products can also be diverted to other low- value outlets. It can be used as a good land fertilizer, especially as a surplus outlet there is also a good market for pet food in developed countries. In Finland and Canada, low-value fish and fish offal is used on a considerable scale in fur forming of species like mink and for cheap fund is one of the important factors in making fur farming viable. In advanced countries, there has been a prominent move towards ready- to cook products like fish cutlets and fish steaks and fish fillets, which reach the consumer in airtight packs. Modern developments have developed the capacity to produce ‘surimi’ imitations of luxury products like roe, crab meat and scallops from cheaper species like mackerel. Sardines and Pollack (Australian Bureau of Agricultural and Resource economics, 1998) For fish, it is very much important that freezing should be rapid

to avoid the build up of ice crystals which could disrupt the tissues and this has entailed the development of the blast freezing process.

The 5000 mechanised vessels in the state employs around 30000 crew. A significant number of them comes from Tamil Nadu. Most of the crew of mechanised sector work as crew in artisanal sector during monsoon trawling ban. Income of the crew depends on the existing sharing pattern. The post-harvest activities of the crew members in the trawlers are related to sorting the catch according to species, size and value, chilling the high quality varieties in insulated ice containers, drying a part of the catch onboard, and adding salt to the fish meal and by-catch for preservation.

Onboard the traditional boat, post-harvest work was generally confined to icing and keeping the catch away from direct sun. The crew also transports the catches to the auction site. It is important to note that these norms of division are situated in the context of communitarian livelihood and common property norms and do not change as rapidly as technology. Fish vendors are a major source of supply of fish for the communities within and close to the coastal areas. This is mainly due to predominance of artisanal fishery and largely decentralized nature of landings in the region. Earlier when most men had smaller crafts, the landings were small and women could easily buy the fish. With technological changes came large crafts fitted with OBMs and landings were much more than a single woman could handle. This coupled with increasing centralisation of landings made them compete with big traders and increase the distance travelled for procurement. Fish resources becoming scarce, competition became stronger and whatever available is at higher prices leading to an increase in the working capital required. The fish auctions were increasingly conducted on a ready-cash basis, which again leads to marginalisation of women, as they were not able to participate in auctions when the landings are large.

The vending pattern also varies. Women fish vendors walk, go by bus or hire a mini-truck. This self-arrangement of transport facility is another one of their coping strategies. In the selling place they face stiff competition from M80 (motor cycle)/cycle vendors and other women vendors. Recently the Matsyafed has been plying buses meant for the women fish venders to take the product from the landing centers to the markets in certain locations. The vendors selling fresh fish from the nearby coast are especially affected by those selling iced fish from distant markets. They also face problems of illegal toll collection, unnecessary charges by the labour union and harassment by police and civil authorities in some markets.

The bamboo basket (kutta), which they were using earlier, is now replaced by aluminium vessel. The key intermediaries in fish marketing are: auctioneer, wholesaler, retailer and the vendor. Several other intermediaries like local fish collectors and fishermen cooperatives also exist in several markets. . Ice and transportation form the largest share of the wholesaler‘s costs. The retailers sell the fish directly to consumer recently, there has been a vertical mobility in this category towards M-80 fish vendors with increase in capital investment in their transport infrastructure. This also helped in increasing the possibility of doing higher volume of business, reaching the supply and marketing centre ahead of others and accessing other supply centres when there is shortage of supply in the regular one. These also have increased the risk and cost of transport. This category of post-harvest workers usually comes from outside the fishing community and the majority of them are Muslims. There are still cycle fish vendors who could not move in the above-mentioned way, doing retailing either in a market or at house-to-house level.

Women are involved in an array of activities in pre harvesting (net making), harvesting to post harvesting, with the majority of them in post harvesting that too in fish vending. There is considerable - gender based division of labour, which also varies among different vanishing due to development in technology or contested by the entry religions.. The women with different coping strategies like flexibly grouping among themselves, trying their best to stick to

their livelihood, as there are no viable alternative jobs. They are facing additional burden in terms of increased distance travelled, the time spent for their trade and indebtedness. Developments in processing industry have given opportunity to diversify as peelers and hands in processing industry. Women have traditionally undertaken a number of land-based occupations in the fishing communities, such as net-making, fish-curing and vending. They are involved in fish harvesting in the inland waters and are particularly skilled at shrimp peeling, which is an important activity in a booming export trade. The common occupation in which women engage are beach work, peeling, drying, net making, fish curing, processing plant workers etc. It can be only through social organization, social awareness training, micro-enterprise development and access to institutional credit, women's social and economic role could be considerably enhanced. Economic progress could be achieved through economic and social development. Although women comprise about half of the population, their role in development is not significant because of lack of empowerment and political organisation. Fisherwomen are generally engaged in marketing but their social status remains poor. Schemes for providing micro-credit to women through credit institutions could not make much headway in promoting their status for several reasons. Besides their domestic chores, they perform the difficult function of selling a highly perishable commodity like fish in most of the coastal villages where chilling and freezing facilities are least available Small-scale women dry fish processors and women working as labourers in dry fish trade are among the poor in post harvest sector. The livelihood of one section of post harvest workers is substantially eroded over years due to fishery infrastructure development, which has led to a predominant use of ice, improved transport facilities and centralisation of landing. Fish sorters are usually women seen in mechanised landing centres sorting by catch of trawlers. They are found in good numbers in North Kerala, with the bulk landings of demersal fish has the tradition of being involved in dry fish trade for many decades. Peeling sheds are pre-processing plants supplying output to export processing plants They get this job only when the supply is available. The cost of peeling in Kerala is said to be higher than that in other states, the yielded advantage is not enough to exceed the cost of long distance

transport and losses involved in transporting prawns from other states. As a result the quantity of prawn arriving from other states has drastically reduced. This may have its effects on peelers in Kerala.

Technological changes in the fishing industry in terms of trawling and purse seining and diversification of the coastal economy has led to the unsustainable development. It is imperative to analyse how far the technological transition has affected the sustainability of resources since the introduction of motorized traditional crafts and mass harvesting gears like purse seines and ring seines in recent years have enabled fishing to be carried throughout the year. When resources are being over-exploited or exploited in an irresponsible manner, a failure to act will have negative consequences in the future. Reducing fish stocks to biologically and ecologically harmful levels will result in a loss of potential benefits as food, income, employment etc, both immediately and also in the long run. The following chapters seeks the extent to which resource sustainability has been affected as a result of the newly introduced technology and the measures for conservation so as to safeguard the wellbeing of fisher folk as well as fish resources.

Chapter 4

UNSUSTAINABLE EXPLOITATION OF RESOURCES IN THE WAKE OF MECHANISATION

Environmental sustainability is important for development since humans are inextricably bound up with nature. Thus environment is important for the survival of healthy and social life (Veron, 1998). In order to become sustainable, economic and social development should retain the ecological and resource potential to support future generations. The development of one group should have no adverse environmental effects on contemporaries. The environmentalists of the 1960s and 1970s were concentrated on the contradictions between development and environmental protection. The mainstream concept of the 1980s and 1990s assumed that there is no inevitable contradiction between development and environmental protection. Growth can be made more environmentally sustainable and resource efficient through the development of appropriate technologies and substitutes for non renewable resources (Pearce and Warfod, 1993). Fishery sector is not an exception to this contradiction.

4.1. Fishing sector of Kerala

The transition that has taken place in Kerala fishery was largely influenced by many co-related factors like marine ecological conditions of different areas, foreign guided par aided government policies, value system and skills of different fishers group and the changing tastes of the global seafood markets. Until the dawn of sixties, the fishery scenario was dominated by catamarans, dugout and plank canoes on the craft side and shore seines, boat seines,gillnets,cast nets, hook and line and other small fishing gears. There were as many as 22 major craft-gear combinations used by the artisanal fishermen to harvest the resources of the coastal waters in Kerala in the dawn of the1980s and they accounted for over 70

percent of the fish harvest of the state of about 400,000 tones (Kurien and Willmann,1982).All these were labor intensive units and demanded nominal capital. These fishing implements required very low investment and hence the major share of catch goes to the fishermen who work on them.

With the introduction of trawlers and purse seines investment started to rise. Suddenly the ownership of the crafts was taken by outside people who targeted extra high profits from fishery. The havoc created by the unchecked technological advancement to maximize profits further intensified the competition. Fishermen adopted many strategies to withstand the competition steered by outside business interests, which includes horse power enhancement of outboard motors, using of larger nets and adoption of more convenient crafts.

In Kerala coming from north to south the sea becomes rough and surf becomes stronger. The heterogeneity of the fish species increases and the volume comes smaller in the southern parts than the central and northern parts. Similarly crafts and gears tend to be smaller while coming towards the south, with more varieties leading to the evolution of more flexible fishing operations. This makes the fishery in the southern districts labour intensive and small scale than the central and northern districts. During the fifties the fishing operations prevalent in the state was in subsistence nature. The modernization efforts touched the traditional sector effectively with the introduction of nylon nets (Singapore nets) instead of cotton nets in 1962. This was an awakening for the traditional sector leading to increased fish production in 1970.

The1980s was a turmoil period in Kerala fishery with developments including motorization and emergence of fishermen organizations. Adoption of active gears like ring seine and mini trawl nets in central and northern districts and trammel nets, monofilament nets (kangoose vala) and fish attracting lanterns in the southern districts are the notable changes of 1990s. conservation and management measures for the sustainable exploitation of marine resources attracted worldwide attention due to the poor conditions prevailing in the fisheries sector leading to a slight increase in production in early 2000s.

Fishermen tried to shift into inboard fitted canoes and concentrated in stay fishing inorder to reduce the operating costs and enhance efficiency of fishing. Thus , marine fish landings in Kerala showed wide fluctuations over the years especially during the post mechanization period as a result of technology adoption, fishing efforts and its impact on the stock and marine ecology.

The fish landings over the years failed to show significant improvement despite increasing fishing efforts wherein total output cannot be increased by merely enhancing the production capacity. In 1965 the annual average catch per fisherman was 3,800 kg. It reduced into 2,128 kg in 1980 but increased to 3,052 kg in 1990 and 3,407 kg in 2002. This means that more and more additional investment made in the fishery largely remains unproductive in economic terms and destructive in ecological terms. Despite additional investments in fishing the average annual catch per fisherman remains low than the 1965 level. The only consolation fisherman received during these years is the increase in price at a good level.

4.2 Marine Resource Potential

Kerala is blessed with nature's bounty for building a magnificent and lively fisheries economy. The state has a long coast-line (590 Km), extensive lakes and backwaters, two monsoons, and numerous west flowing rivers. The marine resources of the state sprawls over 36000 sq.km fishable area on the continental shelf upto 200m depth, almost equivalent to the land surface of the state. The coastal region within the 50m depth is 12570 sq.km and the remaining is the offshore/deep sea area (50m-200m depth). Of the total inshore potential in the south west coast of India the share of Kerala is placed at 5.71 lakh tones (against 4 lakh tones in 1977) as given in table 4.1

Table 4. 1 . Marine resource potential (000 tonnes)

	Demersal 0-50 beyond 50m		Pelagic 0-50 beyond 50m		Shelf region total	300-500 Depth resources	Total
Indian EEZ	10.36	6.49	11.74	7.42	3601	299	3900
SWC	3.61	1.12	5.89	2.49	1307		1307
Kerala	2.29	0.56	3.42	1.24	751		751

Source: Economic Review, (2006)

4.3 Fishing sector- fluctuation in share of each sub-sector

By 1969-70 the share of mechanized sector in the total fish landings was 12 percent in quantity and 25 percent in value. It employed at that time about 7,800 workers representing 8 percent of the fishermen in the state Kurien (1985). Up to the event of purse seining in 1979, mechanized sector concentrated only in demersal species. The contribution of mechanized sector, which kept a very low profile from 1956-1968 began to grow steadily and by the year 1977, the annual growth rate was 158.7 percent. This was mainly because the trawler units diversified their target species, shifted towards cuttlefish and squid. As the mechanized sector grew steadily, production from the traditional sector declined steadily at a negative growth rate of 3.34 percent. This implies that the share of catch earlier enjoyed by the traditional sector has been taken away from it. Its share went down from 303,000 tonnes to just 145,859 tonnes by this time. The annual per head catch in mechanized sector during 1980 was 7.22 tonnes while it was 1.28 tonnes in the non-mechanized (non-motorized) sector. In 1990 the catch per fishermen in mechanized sector further increased to 24.12tonnes while it decreased to mere 0.32 tonnes for the traditional fishermen.

The serious decline in the productivity of artisanal fishermen was mainly due to competition with the trawlers for space, the entry of purse seines which not

only created competition for resource and space but also for price for the same species Kalawar Commission (1984). This induced the traditional fishermen to opt for motorized units and the next few years witnessed the emergence of motorized sub-sector in every nook and corner of the Kerala coast. With increased pace of motorization the traditional non-motorized fishermen were thrown out from the scene with motorized units taking over the resources which the traditional fishermen were enjoying. A good proportion of traditional fishermen were shifted towards the motorized sector occupying the same area and resources. The economically weaker section of the fishermen as well as the fishermen who disliked to be shifted towards the motorized sector, paid the cost of resource depletion. There are various reasons that accounted for the depletion of resources in the fishing sector. The major reasons are taken up in the following sections.

4.4 Reasons for Resource Depletion

Fish species of about 800 species are landed along the Kerala coast of which 200 are commercially important comprising of pelagics, demersals, crustaceans and cephalopods. Pelagic group dominate landings (71 per cent) comprising the oil sardine and lesser sardines, anchovies, mackerel, tunas, ribbon fishes and carangids. Demersals (14 per cent) including sharks, rays, threadfin breams, lizard fishes, sciaenid and soles. The wide fluctuations observed in the total marine fish landings were due to a process of stress and strain which the resources were undergoing. The fluctuations in the landings points to the problem of over fishing. Studies reveal that over fishing can be due to three possibilities. When fishing does not become economically viable due to the operation of more units than required, even though landings are not adversely affected, economic over fishing sets in the clashes among different sectors of fisheries and reduction in the average size of fin and shell fish caught are again signs of economic and size over fishing (George,1988) .

4.4.1 Natural Calamities

The tsunami of 2004 also gave a severe blow to the coastal marine fishery sector bringing huge loss of lives, fishing gears and fishing crafts.

Table.4.2 .Marine fish landings of tsunami- affected coastal belt of Kerala during pre-and post-tsunami period.

Name of gear	2004 January - March		2005 January - March	
	Landings (t)	Effort (units)	Landings (t)	Effort (units)
Mechanized Multidaytrawl net	19363	17588	5771	7500
Trawl net	5429	10945	1364	6577
Handtrawlnet	181	2586	300	3586
Purse seine	198	244	1	5
Driftnet/gillnet	225	187	409	362
Hooks lines	422	443	230	144
Ring seines	5690	1905	2428	144
Motorized Driftnet/gillnet	1950	43763	1949	47650
Gillnet	6675	42285	7953	34726
Hooks&lines	3927	67588	1854	54195
Ring seines	2572	1412	415	281
Boat seines	333	588	79	203
Mini-ring seines	1971	2381	14953	16356
Trawl net	1372	17238	801	10983
Others	0	0	1	23
Non-mechanized Gillnet	1134	58143	1097	80394
Shore seines	7939	14067	119	6455
Hooks&lines	102	28591	145	38394
Others	16	1240	55	4207

Source: Ammini et al (2010)

A comparative study on the landings along the tsunami affected districts during January-march 2004 with the corresponding period of 2005 showed a vast difference of 20,000 tonnes (Ammini et al ,2010). In unit operations also the same level of depletion was reflected. Even though the unit operations of mechanized and motorized driftnets increased in 2005 catch remained more or less same resulting in low catch per unit effort. Mini-ring seines (discovala) of mesh size 10mm of Alappuzha district alone had a reverse situation by harvesting fingerlings of oil sardines

4.4.2 Artisanal Gears and Resource Depletion

The introduction of ban on trawling coincided with the introduction of highly efficient mass harvesting gear, the ring seine, by the traditional motorized sector resulted in a massive increase in pelagic fish production. Encouraged by the returns the motorized sector using ring seines increased the dimensions of the gear and also the capacity of engines fitted to boats were altered for quick mobility and faster access to the fishing ground. Since 1986 boat seine landings were witnessing heavy depletion mainly due to the introduction of ring seine. Drift nets, hooks and line, long line, troll line, scoop net, traps etc are the dominant gears in Thiruvananthapuram whereas Alappuzha dominates the ownership of large drift nets. The phenomenal growth in fleet size, fishing effort and capacity in both the sectors led to overcapitalization and overcapacity, adversely affecting the economic efficiency. Ring seines started operating towards the end of 1985. Studies by CMFRI provides information on young fishes and juvenile prawns caught by various gears during selected periods of time. The destructive fishing though local in nature, is harmful to fish stocks and ultimately lead to recruitment overfishing. The boat seines and shore seines (6-8mm mesh) operating along Trivandrum coast caught an average 11 tonnes of young fishes every year (Menon and Pillai, 1996). Declining size of the harvested species and catch per unit effort also prove biological overfishing. compared to 1961-62, total catch has increased in eighties and nineties and stabilized in 2000s, it is due to changes in the species composition of the catch (table 4.3) and not due to increase in the catch of species which are traditionally

being considered as commercially important.Carangids, whitebait, perches, cephalopods and others are the groups that have maintained the total catch in several years in period 2 and period 3 in spite of considerable decline in the catch of oil sardine, which contributed nearly half of the total landings in 1960-75, along with decline in landings of catfish, silver bellies, cephalopods, other sardines, etc. The period-wise percentage shares of different species in the total landings are given as pie diagrams in figures 4.1, 4.2, 4.3 and 4.4. The drastic changes that happened in the species composition are explicit in the figure.

Table4.3 Period wise percentage contribution of different species in the total landings

Period	**1960-1975**	**1976-1987**	**1988-1999**	**2001-2006**
Oil sardine	47.6	32.4	14.1	29.28
Mackerel	8.09	5.09	13.15	8.78
White bait	2.97	5.89	6.55	5.51
Other sardine	4.31	3.5	3.51	12.36
Carangids	2.25	4.92	11.59	5.19
Tunnies	0.79	2.81	2.86	2.14
Seerfish	0.66	1.56	1.08	0.44
Ribbonfish	2.65	3.93	1.99	2.84
Catfish	2.91	2.98	0.34	0.03
Perches	1.15	5.96	9.07	5.51
Croakers	1.5	2.32	2.13	1.24
Lizardfish	0.43	1.62	1.93	0.03
Elasmobranchs	2.26	1.97	0.82	0.52
Flatfish	2.7	2.5	3.24	2.02
Bigjawed Jumper	0.77	0.3	0.25	0.29
Silverbellies	2.87	1.52	0.93	1.32
Goatfish	0.31	0.12	0.78	0.53
Penaeid prawn	10.49	10.86	9.52	8.75
Cephalopod	0.17	1.56	5.21	2.98
Others	5.14	8.22	10.96	10.24
Total	100	100	100	100

Source: Rajasenan, (2009)

Figure 4.1 Period wise change in species composition (1960-75)

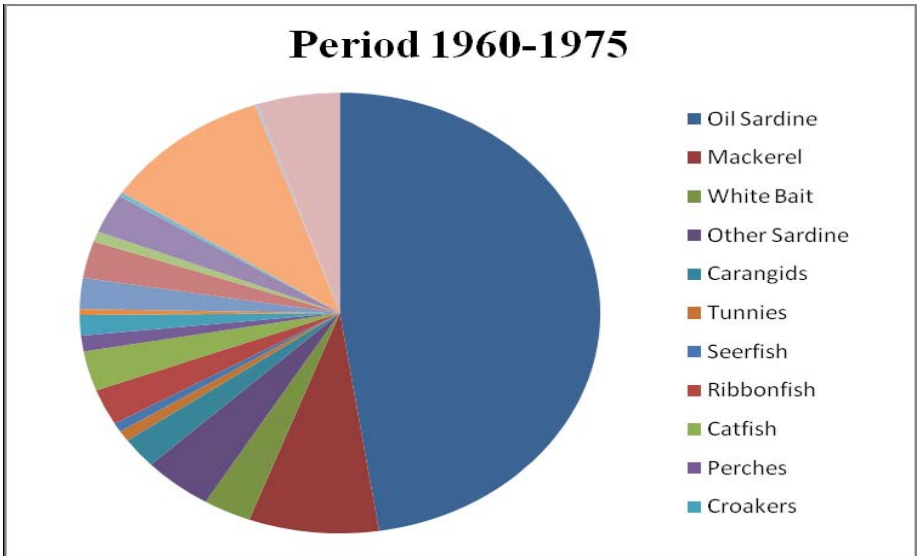


Figure 4.2 Period wise change in species composition (1976-87)

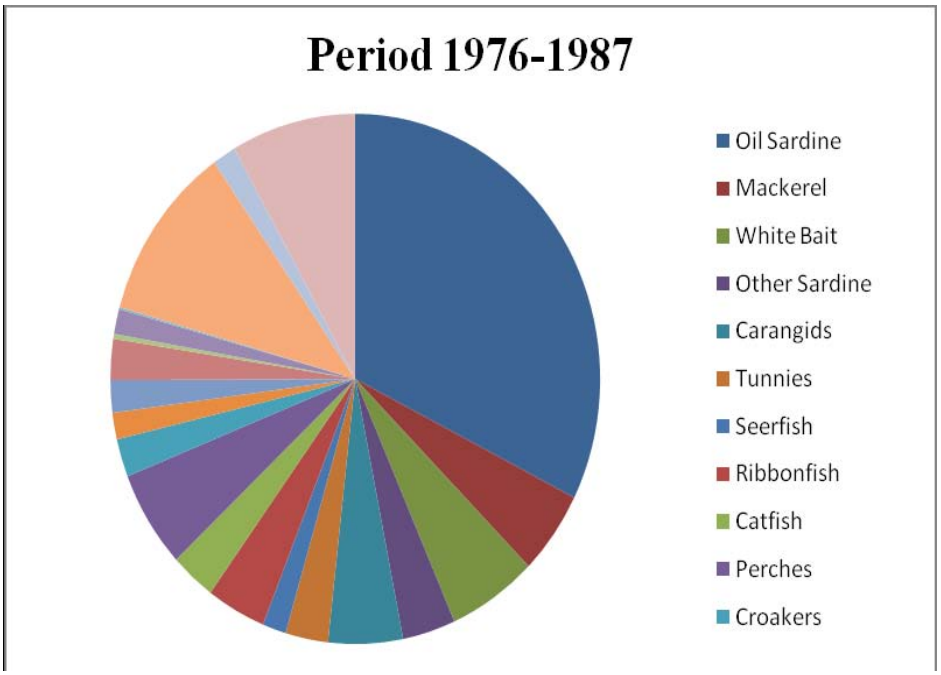


Figure 4.3 Period wise change in species composition (1988-99)

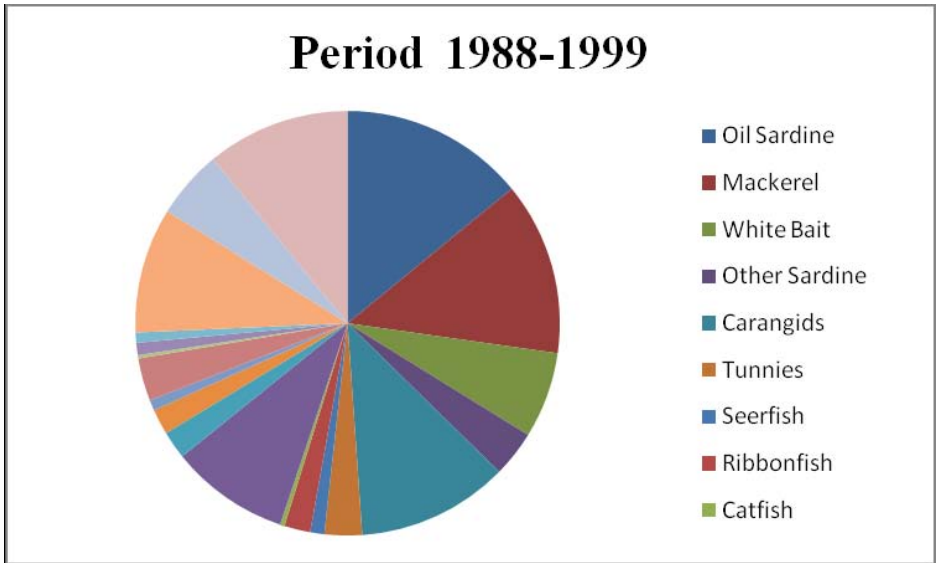
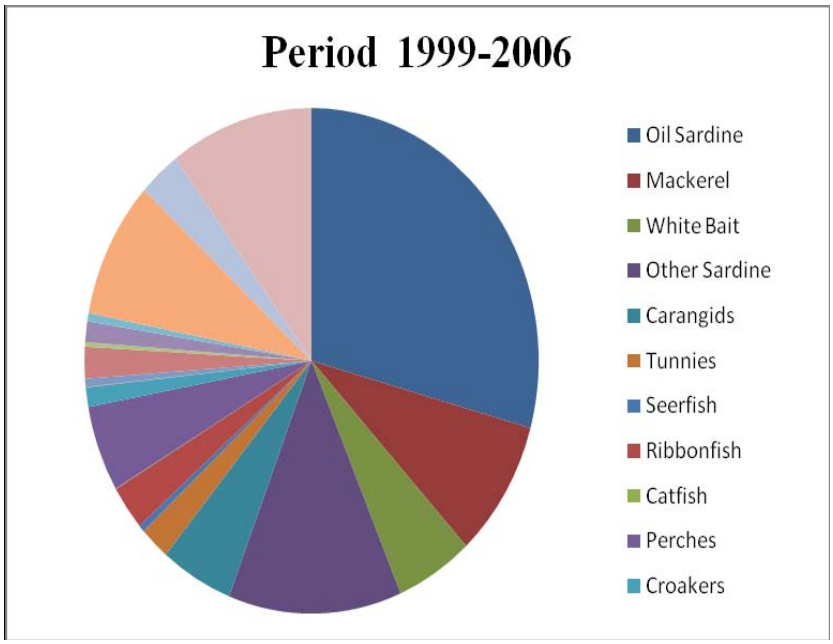


Figure 4.4 Period wise change in species composition (1999-2006)



The ICSSR sponsored study undertaken by Rajasenan in 2009 analysed the Catch per Unit Effort (CPUE), which is another symptom of biological overfishing of mechanized boats. The studies by Babu Paul et. al (1985), Kurien and Achari (1989) observed that overfishing has set in Kerala fishery by the latter half of seventies. The studies reported that the CPUE ranged between 25.96 Kg. per hour in 1971, and 96.45 Kg per hour in 1975. Whereas in 1979, it was assessed to be 56.75 Kg. per hour, but declined to 22.48 Kg. per hour in 1980 as reported by Babu Paul et. al (1985). In 1989, Kurien and Achari conducted a study in Neendakara, the main prawn landing centre in Kerala, and reported a decline of CPUE from 83 Kg. per hour of fishing effort in 1973 to 20 Kg. per hour in 1984. Further, the CPUE for the total catch also showed a decline from a maximum of 186 Kg. per hour in 1971 to 17 Kg. per hour in 1980.

However, it was noticed that the Catch per Unit Effort improved during the onset of 2000, which maybe attributed to the reduction in the overall fishing units. However, the CPUE during the post ban periods since 1988 showed an increase from 74 percent to 86 percent indicating unsustainable practices in fisheries sector namely biological overfishing in Kerala.

Although the declining CPUE of species clearly indicates the detrimental effect of biological overfishing, it may lead to incorrect conclusions if other factors are ignored. The total catch of certain species may drop as a result of changes in target species in response to new market conditions. (Aquero, 1987). However details of the studies conducted in the case of prawn fishery sector in Kerala showed no evidence for this, but on the other hand it revealed a continuous rise in the indices of local prices of prawn both in local as well as international market. The details of the studies are presented in Appendix.

4.4.3 Bottom Trawling and Purse Seining

Pelagic and demersal fishing refers to fishing practices that take place at different depths in the water column of the oceans. The difference in depth affects that species of fish that are caught and the equipment used to catch them. Pelagic zone refers to any part of water that is not close to and significantly affected by this proximity. The demersal zone is water next to the sea floor and affected by this proximity. Pelagic fishing is undertaken from boats and consists of either net or line fishing catching less fish but is more environmentally friendly catching only the targeted species. While demersal fishing is performed either by boats dragging nets along the seabed or by baited traps being sunk, left for a period of time, and then retrieved. This is considered as a destructive method of fishing as it traps all animals, regardless of whether they are the targeted species and cause irreparable damage to the ocean environment, destroying plants and corals. Trawl nets dominate the central and north zones. Out of a total of 2900 trawl nets 834 are located in Alappuzha. Multiday operations of trawlers and multi gear operations are used widely in the present day. 1287 boat seines out of a total of 1772 are owned by fisher folk of Thiruvananthapuram. Among all the reasons mentioned above trawling is the major factor that led to drastic change in the fishery sector because it is often considered as the factor for technological change and modernization. Hence it is imperative to analyse the impact of trawling on landings.

4.5 Impact of Trawling on selected species

The annual landings of the selected species are given in Table 4.5. It was found that elasmobranches, catfish, silver bellies, and big jawed jumper which are typical demersal fishes experienced a downward trend in landings. Penaeid prawn was showing a rising but more or less constant trend. Important pelagics like oil sardine, other sardines and ribbonfish showed rising trend in landings.

Table 4.4 Year wise landings of commercially important species

(quantity in million tones)

Year	Elasmo branchs	catfish	Oil sardine	Other sardine	Ribbon fish	Silver bellies	Big jawed jumper	Penaeid prawns
1985	5972	5170	79225	2473	25140	3417	1041	26684
1986	6034	8594	40613	8934	11880	6007	1438	37188
1987	4473	4660	44717	8697	15295	6027	618	52866
1988	6761	9960	60508	12701	8952	6493	821	67498
1989	4680	4097	184879	13752	7179	5354	1320	53317
1990	6968	2739	179276	12900	9751	6195	2340	45483
1991	3441	1744	106263	23730	2167	5643	623	60318
1992	3323	1029	54118	16967	6162	4480	675	51068
1993	4432	597	49675	22819	7290	6458	907	47988
1994	5887	499	1554	16482	15435	4238	1135	71871
1995	4109	308	13328	46131	4641	4005	561	43224
1996	4422	390	30607	6737	21884	4536	2208	46143
1997	3915	192	93636	15573	18976	4732	1791	56131
1998	4110	213	77795	17889	16579	5118	3016	58523
1999	3677	248	143152	290290	16542	6154	1645	42133
2000	2832	103	241411	5975	19264	4519	1460	56462
2001	4545	150	157337	2679	31775	6040	896	45864
2002	4105	392	219468	5956	24232	6887	406	42217
2003	4856	261	264372	15706	15107	5223	599	42862
2004	3644	172	224706	17731	12863	4185	447	30577
2005	3024	152	171747	97872	18550	0	0	53569
2006	3149	167	149375	64995	15611	0	0	47752
2007	3287	176	162376	74284	16534	0	0	51480
2008	3213	172	156120	70115	16092	0	0	49022

Source:compiled from C.M.F.R.I. *data for various years*

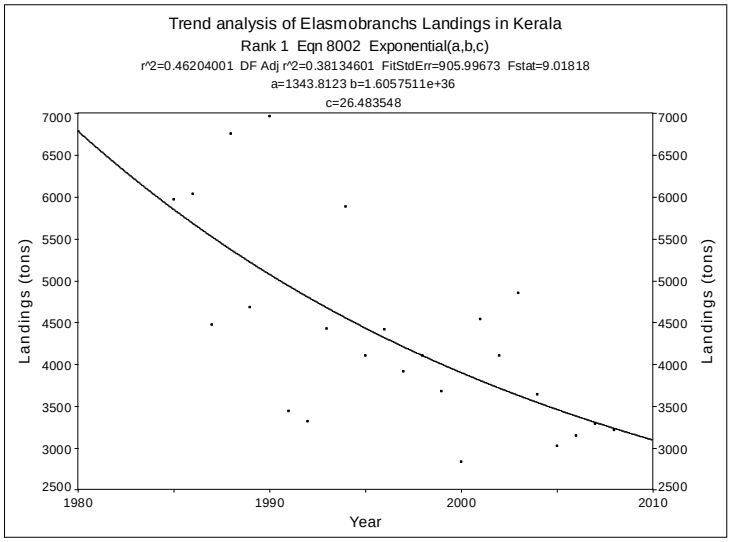
The fish species that are usually fished for in the pelagic zone are those that school in large numbers. They tend to have the typical torpedo body shape characteristic of fish living in the open ocean. Fish species that are targeted in the demersal zone are usually flatter fish than those in the pelagic zone, their body shapes adapted for bottom feeding.

To analyse the trend observed in the landings of commercially important fish species , the annual landings from 1985 to 2008 of 8 commercially important species, 3 pelagic and 5 demersal species was analyzed using linear trend. The

trend analysis of major commercial species is given on the basis of the annual landings .

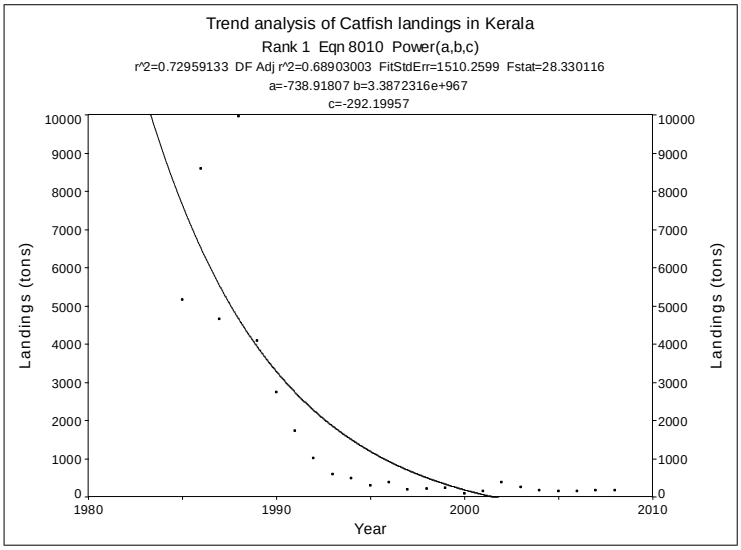
A gradually falling trend has been observed in the landings of elasmobranches. The landing which stood at 5972 million tonnes in 1985 rose to 6968 million tonnes in 1990, but afterwards started declining steadily and never reached the 1990 level afterwards. In 2000, landings went down to 2832 million tones. Even though there was a mild increase in landings since 2001, the landings reached 3213 million tonnes in 2008. Trawl nets are mainly used to catch this species. (figure 4.5)

Figure 4.5.Trend analysis of elasmobranches landings



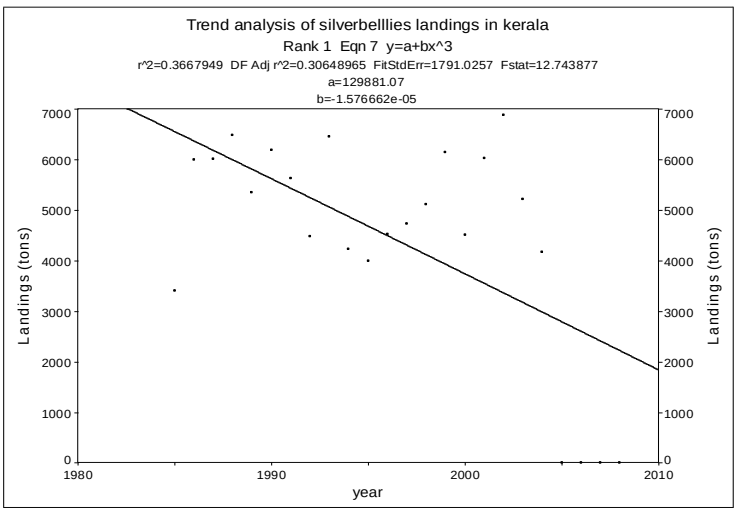
Cat fish landings which began with 5170 million tonnes in 1985 increased to 9960 million tonnes in 1988 which was the highest ever landings since 1985, but afterwards there was a sudden drop in the landings which was very drastic, reaching 213 million tones in 1998 and further dropping to 172 million tones in 2008. The slope of the curve points to the sudden fall in landings of cat fish which came to a mere 103 million tonnes in 2000. cat fish is mainly caught through trawl nets (figure 4.6)

Figure 4.6 Trend analysis of catfish landings



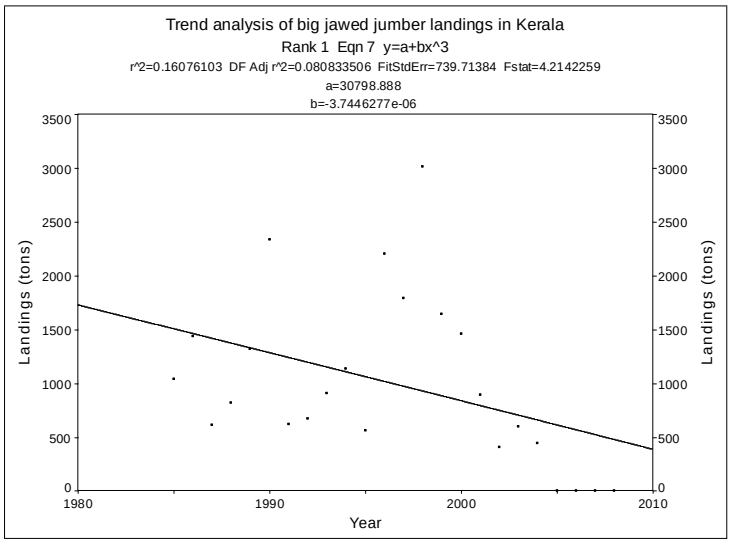
Silver bellies recorded a landing of 3417 million tones in 1985 rose to 6493 million tonnes in 1988. But since 1989 a falling trend was observed till 1998. Since 1999 improved landings was observed with 6154 million tonnes in 1999 to 6887million tonnes in 2002. The trend line which is shallower in its slope points to the gradual decline in landings observed by silver bellies. With 4185 million tonnes in 2004, landings dropped to zero since 2005 onwards till the present year. Most of the landings of silver bellies are through trawl nets. (figure 4.7)

Figure 4.7 Trend analysis of silver bellies landings



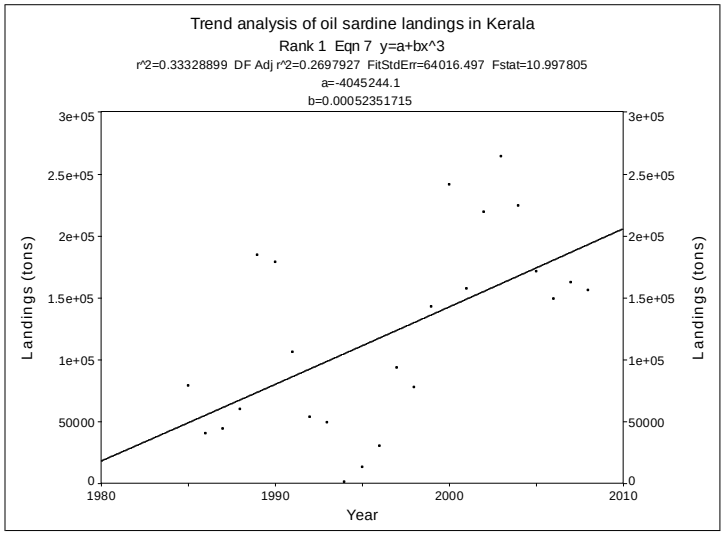
The highest landings registered by big jawed jumper over the years were 3016 million tonnes in 1998. Afterwards a very abrupt decline in landings is observed reaching 447 million tonnes in 2004 and after 2004 the landings of big jawed jumper reached zero by 2005 and this trend is continuing. The major landing method used for capturing big jawed jumper is by trawl nets. (figure 4.8)

Figure 4.8 Trend analysis of big jawed jumper landings



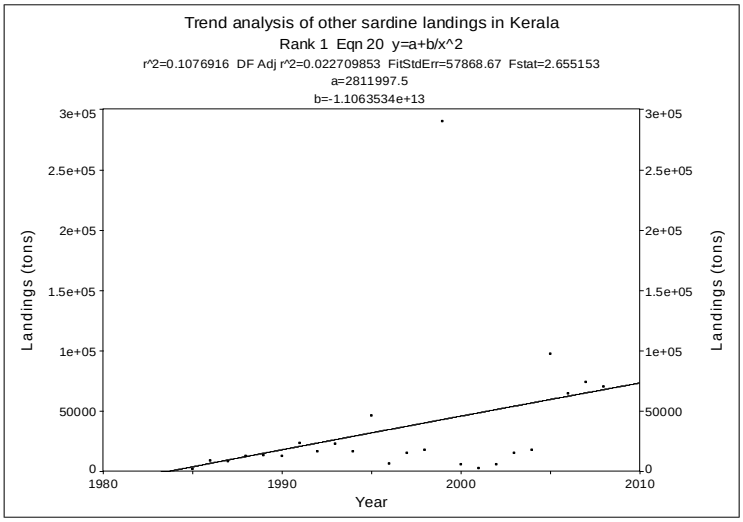
The contribution of oil sardine landings varied between 0.78 lakh tones in 1985 and 2.64 lakh tones in 2003. The highest ever landings of oil sardine was in 2003. In 2008 landings dropped to 156120 million tonnes. The motorization of country crafts is responsible for the heavy landings of oil sardines during 1985-1989 period. The share of outboard ring seine was 1.89lakh tones. Motorised ring seines played a major role in the landings of oil sardine with maximum of 1.98 lakh tones in 2000. The trend line is gradually rising upwards. (figure 4.9)

Figure 4.9 Trend analysis of oil sardine landings



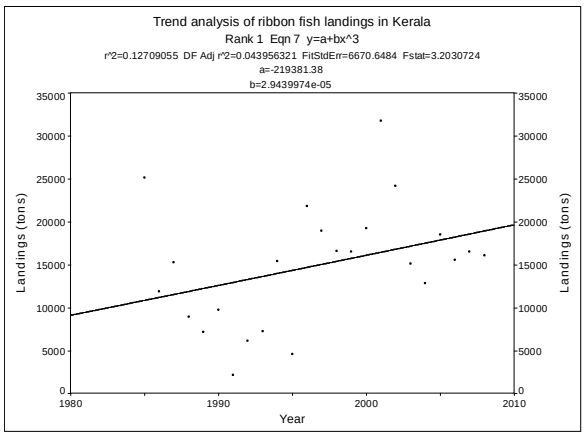
From 2473 million tones landing in 1985, the landings of other sardine reached a high of 290290 million tones in 1999. Afterwards a sudden declining trend is observed which got reverted in 2005 by 97872 million tones in landings. The trend line slopes upwards from left to right with a smooth and gradual slope. This pelagic species is mostly caught by boat seines. Boat seines have become more active in the Malabar region (figure 4.10)

Figure 4.10 Trend analysis of other sardine landings



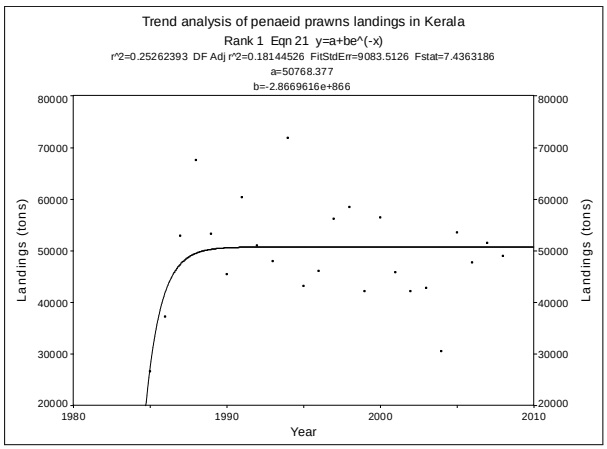
The landings of ribbon fish which was 25140 million tones in 1985 reached 31775 million tones in 2001. With a mild fall in landings to 16092 million tones in 2008 its landing is moving at a more or less steady pace. Major contributors of this species were drift nets/ gillnets (figure 4.11)

Figure 4.11 Trend analysis of Ribbon fish landings



Penaeid prawn landings showed remarkably rising trend all through the period of analysis. In 1985, the landings were 26684 million tones, reached a high of 71871 million tones in 1994 and afterwards a more or less steady level of landings is observed. The slope of trend line clearly indicates that the landings are steady. The clayey sea floor and good access to low saline backwaters make Cochin and Malabar the richest prawn fishery grounds of the world (figure 4.12)

Figure 4.12 Trend analysis of penaeid prawns landings



The annual percentage contribution of trawl to the landings of commercial species makes it clear that the four species, which contributed 30 per cent of their total landings by trawls, showed a downward falling trend due to trawling. For all the four heavily or moderately depleting species identified in the current analysis trawl net is the major gear used in catching them. Balakrishnan Nair Committee strongly suggested that trawling in any form in this region of inshore waters should be strictly banned, throughout the year also any type of purse seining should also be banned.Mini Purse seines have been operated in large numbers by the motorized traditional craft. These units should be allowed to fish only beyond 10m depth and should be completely phased out. The use of gears such as trammel net, gill net and boat seine (thanguvala) which are less harmful to resources are to be encouraged to operate in order to avoid the inshore resources facing any under exploitation. Even though, the initial stress in mechanization was to reduce the physical human effort involved in harvesting from deeper regions which was beyond the reach of the traditional craft and for harvesting multi species, soon with an increase in the mechanization spree there developed the tendency of increasing the engine power, which favoured sweeping larger areas in a smaller period of time, attained by increasing the trawling speed and size of the net and reducing the non productive time of voyage. But unfortunately, the vessels coagregated in the near shore waters, which are the most productive regions . The causes for the declining fish production was also attributed to the declining man days, because of the high running cost, other factors like over exploitation of marine resources, intrusion of foreign trawlers, declining demand from foreign markets, lack of sufficient conveniences in harbour and processing centre, unscientific trawling ban etc. were expressed as the prominent reasons for the declining catch. The different options suggested for the improvement and advancement of fishing sector includes, introduction of ban for foreign trawlers to limit and control the number of vehicles, allotting specific time for fishing activities, banning night trawling, fishing by over night stay etc.

4.5.1 Extent of Depletion

Landings which stood at 202047 tonnes in 1950 increased to 420836 tonnes in 1975. from 1976 till1987 , the marine fish landings showed a downward trend , but by 1988 the catch was rising up again and settled around the MSY

level of 5.71 tonnes all through the 1990s and 2000s (Refer table 3.8). For the purpose of analysis the period is classified into four broad time spans. Quarterly and annual landings data on 8 commercially important pelagic species and 11 demersal species from 1960 are taken. The years from 1971-2007 is taken to show over fishing and resource depletion. The 1971-75 period is denoted as 'initial peak period' since this is the period of initial fishery upsurge throughout the years due to early attempts of development of the fishery sector since independence. The first 12 year period from 1976-1987 is denoted as 'pre ban period' and the period 1988-1999 denotes 'post ban period'.

A wide periodisation is made use of so that the effect of fishery independent factors whose effect remains only for two or three years can be nullified. Long term changes observed in catches is due to fishery dependent factors. To test the depletion in mechanized prawn fishery these two 29 year periods are again split into three arts of six years each. The period 1976-81 is called 'first pre ban period' , the phase 1982-1987 is called as 'the second pre ban period', the period 1988-93 is the first 'post ban period', 1994-99 is the 'second post ban period' and 2000-06 phase is the 'third post ban period'. For comparing the catch in the next three periods the mean figure of this initial peak period is taken as the base.

The catch data on landings itself gives an impression on the unsustainable fishery practices and resultant overfishing which has stepped into the coastal fishery sector of the state by late seventies. Despite increased fishing effort , 1976-87 period witnessed a reduction in landing below 400000 tonnes and even below 300000 tonnes in certain years. Increased fishing effort is inferred to be the major unsustainable practice which contributed to falling stock in this period. Enormous increase in the number of trawlers, introduction of purse seiners, massive growth of motorized fishing and more efficient gears were witnessed during this period (table 4.5). The declining catch despite increasing effort is a true testimony of over fishing and unsustainable fishery practices in coastal waters. The catch level which reached 60000 tonnes in 1989 and 1990 could not be sustained beyond 1990,with landings remaining more or less near MSY, even with an increase in fishing effort.

Table 4.5. Increase in fishing activity (1961-2006)

year	No: of trawlers	No:of purse seiners	No:of Gill Netters	*Ring seiners*	others	Total Mechanized crafts	Total Motorized crafts	Total Non motorised	No: Of Active fishermen
I961	172							21000	80700
1966	729		196		18	943			
1972								23708	110492
1973	1325	>90	200						
1980	2630	37	362		9	3038		30000	131101
1982	2747	60	567		59	3433			125008
1987*	2510	51	846		141	3548	9657	26137	
1989*	3497		728			4225	10858	18931	147875
1999-2000						4194	28829	21751	185000
2000-2001						4150	29144	21854	
2001-2002						4150	29395	21956	
2003						4510	29395	21956	1.79lakh
2006	3982	54	428	*443*	597	5504	14151	9522	190483

Source: Economic Review, 2001-2007, Rajasenan 2001
$ Department of Animal husbandry, XI Quinquennial Livestock census 1972 Annexure VI
CMFRI 1987
$$ Department of Animal husbandry, XI Quinquennial Livestock census 1982 Annexure VI
** Balakrishnan Nair 1989*
*** Kurian and Achari 1990 # Economic review 2*

Table 4.6: Annual catch potential of important species (0-50m Depth) and annual catch from 1971- 2006 (quantity in'000 tonnes)

Source: Rajasenan, (2009)

A close look at the total landings of most of the commercially important species in all years from 1950, the period 1971-75 is identified as the initial peak period in table 4.6 the 31 years from 1976-2006 are split up into six equal compartments of 6 years each ie. two pre ban periods and four post ban periods. Average landings in 1976-81,1982-87,(pre-ban periods) 1988-93, 1994-99 and 2000-06 (post-ban periods) are compared with the initial peak period 1971-75 with around 1944 trawlers and less than 30000 non motorised traditional craft, the industry could harvest 448000 tonnes of fish. During 1976-81 and 1982-87 there was an erosion in both pelagic and demersal species landings. All pelagic varieties except carangids, tunnies and seer fish experienced depletion. Among the major demersal varieties all except perches, cephalopods showed decline. In the first pre ban period catfish experienced maximum depletion whereas peneaid prawns which is an important commercial specie declined by 36 percent and another important commercial specie of pelagic variety mackerel dropped by 43 percent. There was an overall decline in total landings by 21 percent.

The downward trend continued in the period 1982-87 where the depletion in pelagic varieties such as oil sardine, other sardine, mackerels etc are much higher than that in the first pre ban period. Demersal species like elasmobranches, cat fish and peneaid prawns showed further decline.landings of peneaid prawns, and cat fish became half of 1971-75 levels. The percentage decline in total harvest was 21 in the first pre ban period and 13 in the second pre ban period.

Even though there was an increase in total catch by 1.4 times in the first post ban period, many commercial species like oil sardine, other sardine, elasmobranches, catfish, peneaid prawn etc could not restore their 1971-75 level nor in 1976-81 and 1982-87 but also in 1988-93, 1994-99 and 2000-06. oil sardine and other sardine among pelagic varieties and elasmobranches, catfish and peneaid prawn among demersal species are showing the tendency of depletion. Throughout this five time periods their average landings have

never crossed their peak level average of 1971-75 pointing to unsustainable fishery practices in our coastal waters. The catch data from 1983-2006, MSY and peak period landings of these species are given in table 4.7

Table 4.7 Year wise landings MSY and peak period landings of depleting species (Quantity in million tones)

Year	Oil Sardine	Other Sardine	Ribbon Fish	Elsamob ranches	Catfish	Big Jawed Jumper	Silver Belly	Penaeid Prawn
MSY	111.27	12.64	18.58	7.58	8.82	NA	7.41	64.48
1971-75	123.30	29.10	19.40	8.30	22.30	3.32	11.00	58.80
1983	154.88	5.32	1.11	8.54	15.33	1.10	9.50	29.75
1984	147.14	6.02	6.46	7.64	11.58	1.65	3.91	35.53
1985	79.23	2.47	25.14	5.97	5.17	1.04	3.42	26.68
1986	40.61	8.93	11.88	6.03	8.59	1.44	6.01	37.19
1987	44.72	8.70	15.30	4.47	4.66	0.62	6.03	52.87
1988	60.51	12.70	8.95	6.76	9.96	0.82	6.49	67.49
1989	184.88	13.75	7.18	4.68	4.10	1.32	5.35	53.32
1990	179.28	12.90	9.75	6.97	2.74	2.34	6.20	45.48
1991	106.26	23.73	2.17	3.44	1.74	0.62	5.64	60.32
1992	16.97	54.12	6.16	3.32	1.03	0.68	4.48	51.07
1993	49.68	22.82	7.29	4.43	0.60	0.91	6.55	47.99
1994	1.55	16.48	15.44	5.89	0.50	1.14	4.24	71.87
1995	13.33	46.13	4.64	4.11	0.31	0.56	4.01	43.22
1996	30.61	6.74	21.88	4.42	0.39	2.21	4.54	46.14
1997	93.64	15.57	18.98	3.92	0.19	1.79	4.73	56.13
1998	77.80	19.89	16.58	4.11	0.21	3.02	5.12	58.52
1999	143.15	29.09	16.54	3.68	0.25	1.65	6.15	56.31
2001	138.48	12.19	7.95	3.64	1.45	2.23	5.32	54.16
2002	160.31	3.49	10.42	4.80	1.60	1.86	6.47	60.22
2003	157.73	6.62	8.28	3.47	1.51	2.95	4.53	59.86
2004	154.43	7.75	9.98	3.99	1.72	1.22	4.79	59.99
2005	134.24	5.14	8.40	4.16	1.89	1.56	5.32	52.85
2006	145.92	5.89	8.90	4.34	3.51	1.42	4.98	53.56

Source: Rajasenan, (2009).

It is understood from the above discussion based on the periodisation adopted that though there is increase in fishing activity, landings has not

increased correspondingly. At the same there is fall in the landings of commercially important demersal and pelagic species.

In order to cross-check the extent of depletion, a further break up of the period is done. To study the extent of depletion in species in different time periods the annual catch data of each specie in period 2 (1976-1987), and period 3 (1988-2006) are compared with its average catch in the initial peak period or period 1 (1971-75) i.e. (peak period average current year catch/ peak period average) the mean and upper and lower bounds of confidence intervals for a period are negative are considered as species having no depletion in the period. The species for which only the upper bound is positive and the mean and lower bound are negative are taken as species having mild depletion. The species for which only the lower bound is negative and the mean and lower bound is negative and the mean and the upper bound are positive are termed as species having moderate depletion and the species for which all the three co efficient are positive are termed as species having heavy depletion (table 4.8).

In the analysis it is clearly seen that oil sardine is only moderately depleting in period 1976-87, has heavy depletion in the period 1988-89,and only moderate depletion in the period 2000-06. Other sardine, catfish, elasmobranches, etc are having heavy depletion in first two periods while oil sardine has no depletion, cat fish moderate depletion and Elasmobranches with moderate depletion in the last period. Similarly, tunnies, seer fish, perches and cephalopods are species having no depletion in the two periods but in 2000-06 shows that cephalopod continued with the earlier trend, tunnies changes to high depletion, seerfish and perches with mild depletion.

Table 4.8 Depletion status of important species in period 2 and period 3 on the basis of the initial peak periods(1970- 75) landings.

Fish	Period	Mean and C interval	Remark
Oil Sardine	1976-1987	0.1254 (-0.0807 0.3316	Moderate Depletion
	1988-1999	0.3331 (0.0224 0.6437)	Heavy Depletion
	2000-2006	0.1788 (-0.0536 0.4112)	Moderate Depletion
Mackerel	1976-1987	0.5128 (0.4242 0.6014)	Heavy Depletion
	1988-1999	-1.1552 (-1.6352 - 0.6752)	No Depletion
	2000-2006	-0.4787 (-1.5123 0.5549)	Mild Depletion
Other Sardine	1976-1987	0.5989 (0.4104 0.7874)	Heavy Depletion
	1988-1999	0.3224 (0.097 0.5452)	Heavy Depletion
	2000-2006	0.4121 (0.1730 0.6512)	Heavy Depletion
Carangids	1976-1987	-0.7627 (-1.9243 0.399)	Mild Depletion
	1988-1999	-5.7184 (-6.8399 - 4.5968)	No Depletion
	2000-2006	0.255 (-1.3211 1.8311)	Moderate Depletion
Tunnies	1976-1987	-1.2079 (-1.7425 - 0.6733)	No Depletion

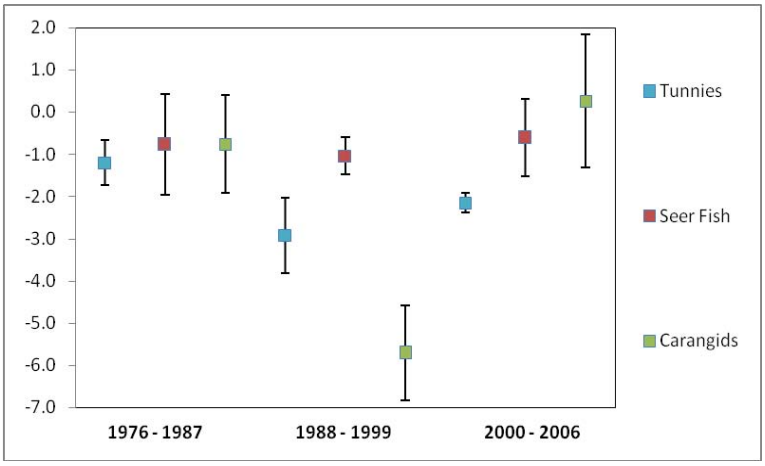
	1988-1999	-2.922 (-3.818 - 2.0259)	No Depletion
	2000-2006	-2.1521 (-2.3780 - 1.9261)	No Depletion
Seer fish	1976-1987	-0.7731 (-1.1235 0.4227	No Depletion
	1988-1999	-1.0412 (-1.4761 - 0.6063)	Heavy Depletion
	2000-2006	-0.6087 (-1.5231 0.3057)	Mild Depletion
Ribbon fish	1976-1987	0.3307 (0.2118 0.6249)	Heavy Depletion
	1988-1999	0.4183 (0.2118 0.6249)	Heavy Depletion
	2000-2006	0.4184 (0.3226 0.5142)	Heavy Depletion
Catfish	1976-1987	0.553 (0.4608 0.6451)	Heavy Depletion
	1988-1999	0.9176 0.8369 0.9984)	Heavy Depletion
	2000-2006	0.8198 (0.7263 0.9133)	Heavy Depletion
Perches	1976-1987	-0.9524 (-1.6896 - 0.2152)	No Depletion
	1988-1999	-4.008 (-4.8187 - 3.1829)	No Depletion
	2000-2006	-0.4419 (-2.7231 1.8392)	Mild Depletion
Elasmobranches	1976-1987	0.1937	Heavy Depletion

		(0.0859 0.3015)	
	1988-1999	0.4386	Heavy Depletion
		(0.3438 0.5334)	
	2000-2006	0.4896	Moderate Depletion
		(-0.1891 1.1682)	
Penaeid Prawn	1976-1987	0.3759	Heavy Depletion
		(0.2656 0.4862)	
	1988-1999	0.0718	Moderate Depletion
		(-0.0318 0.1767)	
	2000-2006	0.0359	Moderate Depletion
		(-0.1416 0.2134)	
Cephalopod	1976-1987	-2.99	No Depletion
		(-4.8118 - 1.1797)	
	1988-1999	-21.1374	No Depletion
		(-24.932 - 7.3431)	
	2000-2006	-5.2574	No Depletion
		(-6.2231 - 4.2918)	
Total	1976-1987	0.1688	Heavy Depletion
		(0.106 0.2317)	
	1988-1999	-0.4055	No Depletion
		(-.4836 - 0.3275)	
	2000-2006	-0.3391	No Depletion
		(-0.3923 - 0.2859)	

Source: Rajasenan, (2009)

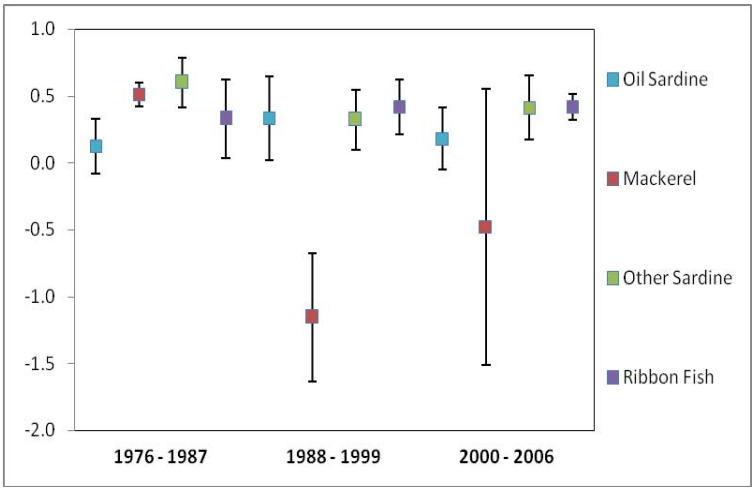
The error bars on the basis of the above analysis, are also plotted, for species whose landings show similar catch pattern, to get a quick look at the extent of depletion happened in them in the pre ban and the post ban periods. It can be easily identified from the error bars of depleting species; catfish is found to be the most depleted species in terms of absolute depletion. The error bars are given in figures 4.13, 4.14, 4.15 and 4.16 .

Figure 4.13 Error bars of pelagic species



Pre-ban and Post-ban Periods

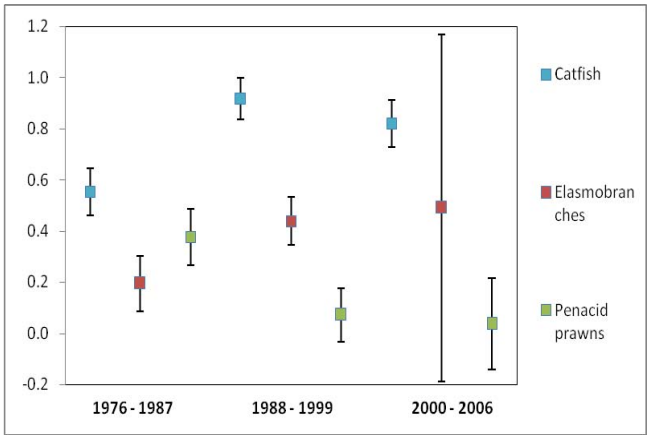
Figure 4.14 Error bars of pelagic species



Pre-ban and Post-ban Periods

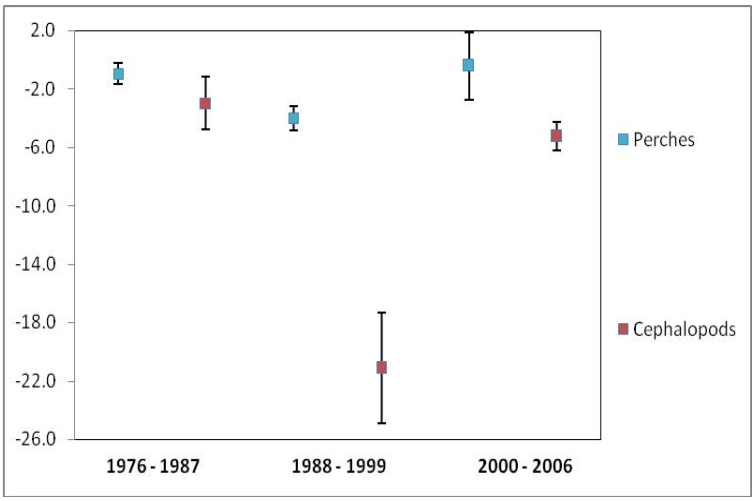
In figure 4.14 most of the points in all the error bars except that of mackerel in the post ban period (1988-2006) are lying above zero indicating their depletion where as in figure 4.13 it can be seen that all the points in all the error bars except some points in those of carangids and white bait in pre ban period (1976-87) are lying below zero indicating that they are not depleted.

Figure 4.15 Error bars of demersal species



Pre-ban and Post-ban periods

Figure 4.16 Error bars of perches and cephalopods



Pre-ban and Post-ban Periods

4.5.2 Field evidence supporting depletion

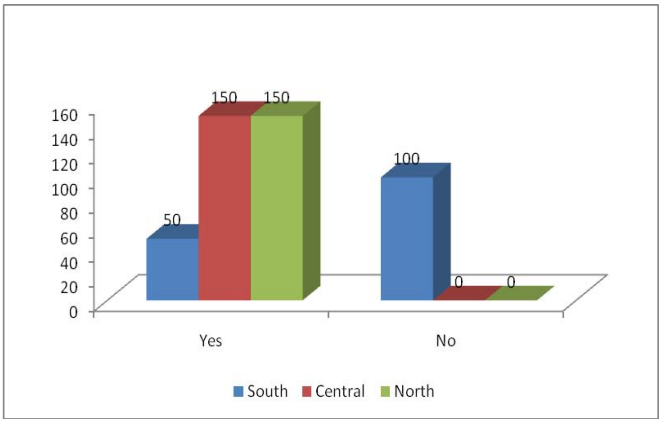
According to the observations made from the primary survey, depletion of particular fish species has been observed by the respondent which was prominent during certain years rather than seasons. All the respondents remarked that resource depletion has been affecting the day to day life in the village. Greater quantum of depletion has been identified in the inshore waters, rather than in territorial waters. Bottom trawling and purse seining in resource depletion has been analysed and can substantiated it by the views expressed by respondents given in table 4.9

Table 4. 9.distribution of area of depletion

Where have you Observed greater depletion	Frequency	Percent
Inshore areas	383	87.8%
Territorial waters	53	12.2%

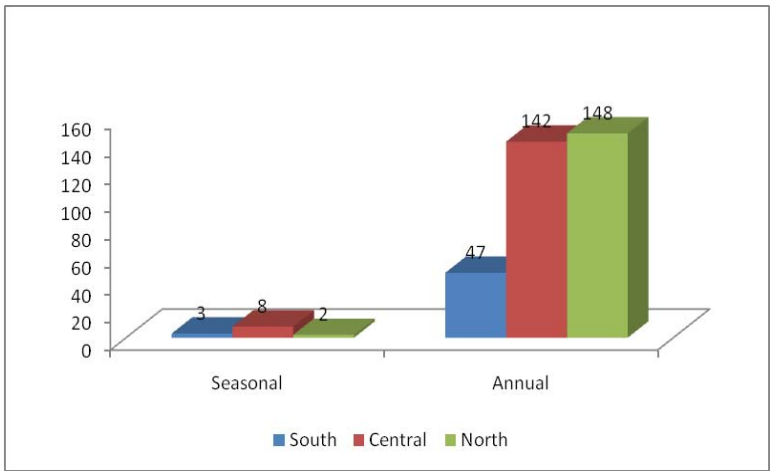
Source: Survey data

Figure 4.17 Depletion of any fish species



In the central and north zone depletion of certain fish species has been observed by all the respondents. 74.9 percent of the respondents observed depletion of fish was prominent in the whole year rather than seasonal. 31.6percent from central zone and 32.9 percent from north zone responded that depletion of fish was prominent throughout the year.

Figure 4. 18 Depletion observed in any particular season



4.6 Reasons for declining fish production from the respondents point of view.

Reasons for declining fish production from respondents point of view is given in table 4.10.

Table 4. 10 Causes for Declining Fish Production & Distribution

	Sum	Mean	Rank
Over exploitation of marine resources	1012	2.28	2
Intrusion of foreign trawlers	459	1.57	1
Declining demand from foreign markets	662	2.48	4
Due to high running cost, man days are declining	744	3.28	7
Lack of sufficient convenience in harbor & processing centre	812	4.32	10
Lack of skilled and trained laborers	797	5.69	12
Unscientific trawling ban	432	2.82	5
Governments disinterest	31	7.75	14
Exploitation by middlemen	27	6.75	13
Unable to rise the standards set by foreign countries	4	4.00	8
Restless fishing activity	351	2.37	3
Lack of proper administrative order	6	3.00	6
Declining fish, fish not available	595	4.02	9
Falling price for fish products in market	5	5.00	11
Exporting companies	0		
Others	0		

Source: survey data

Most of the mechanized boats had all latest technologies like wireless, mobile and cold stores. Path finders and sonar or eco sounders for detecting fish sources has been used in trawler boats. Large scale intrusion of foreign trawlers leading to over exploitation, restless fishing activity, insufficient convenience in harbor and processing centres were considered as the main reason for declining fish production in the state. Fishermen of some areas were using very harmful methods like dynamite and poisoning for catching fish, which should be restricted.

Natural calamity, artisanal gears, trawls etc are the major factors that accounted for the depletion of fish resources. Among these, trawls played a crucial role as it is the major player in mechanization. The analysis on the extent of resource depletion has pointed out that the species, which were captured by trawls showed heavy depletion. The sustainability aspect not only touches upon the fishery resources but also the socio-economic condition of fishermen which points to the need for more efficient intervention, the continuation of trawl ban with more effective implementation measures, ban for foreign trawlers, specific time for fishing etc, and common property rights were voiced by some activists in the discussion. All types of stakeholders of fishing sector are concerned about the sustainability aspect and hence the need for conserving the fishery resource for which management of the same shall be the best strategy through government intervention.

Chapter 5

SOCIO-ECONOMIC CONDITION OF FISHERMEN AND THE NEED FOR MANAGEMENT MEASURES

The technological change that has crept into the fishing sector and the fisheries sector in Kerala has been analyzed so as to get a better understanding on the people who solely depend upon this sector for their livelihood. Development can result only by adopting a new technology or a new method of production. This adoption of a new technology and shift from the old technique to a newer one always causes some pain and dislocation which will be existent for a very short interval. Once the fruits of modernization start to be enjoyed by the people, the pain inflicted by change gradually gives way to happiness and better living standards. In this backdrop the present Chapter analyses the status of the fishery sector and the fisher folk in the wake of mechanization through an analysis of the socio-economic changes that has set in to the life of the fisher folk. The lives of fisher folk is highly swayed like the waves in the oceans and seas. The harvest is 'fluctuating fortune' for which the price of first sale cannot be predicted.

5.1 Fisher folk –Socio Economic Conditions

5.1.1 Social variables

Four major areas where fishermen stand at a greater disadvantage compared to other communities in the state are (1) Habitat and housing (2) Sanitation and health (3) Literacy and education and (4) Safety at sea. Bene et al (2007) realize that a large majority of small-scale fishers and fish workers are rural dwellers, As a Consequence geographical isolation and low or poor provision of public infrastructure and services (lack of roads, hospitals, market facilities etc) have been grater challenges for them. Transformation of assets into

incomes and in turn their transformation into dimensions of well being is all subject to risk. (Dercon, 2001).

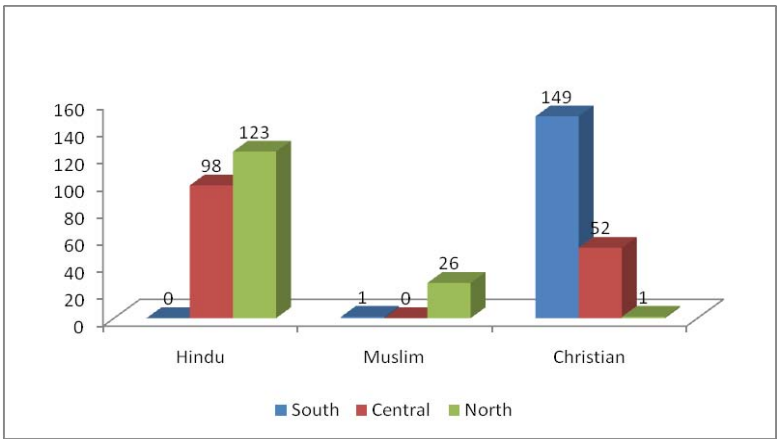
Table 5.1 Age wise distribution

	South (%)	Central (%)	North (%)	Total (%)
Below 30 Years	10 (2.2)	4 (0.9)	9 (2)	23 (5.1)
30 - 40 Years	25 (5.6)	26 (5.8)	52 (11.6)	103 (22.9)
40 - 50 Years	45 (10)	61 (13.6)	59 (13.1)	165 (36.7)
50 - 60 Years	56 (12.4)	54 (12)	26 (5.8)	136 (30.2)
Above 60 Years	14 (3.1)	5 (1.1)	4 (0.9)	23 (5.1)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

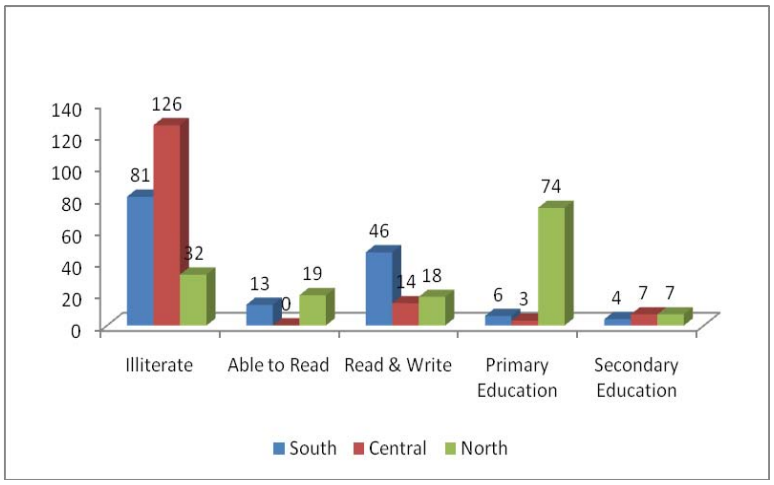
Table 5.1 reveals that 36.7 percent respondents belonged to the age group 40-50 years and 30.2 percent belonged to 50-60 years age group. The survey data highlights the existence of Hindu community with 49.1 percent, followed by 44.9 percent of Christian community and 6 percent of Muslim community. The caste dimensions in the study highlights the heterogeneity among the fishermen community in Kerala. The southern coastal region is dominated by Christians, the central region dominated by Hindus and a mix of Christians, and the northern region by Hindus (figure 5.1)

Figure 5.1 Percentage respondents in each caste



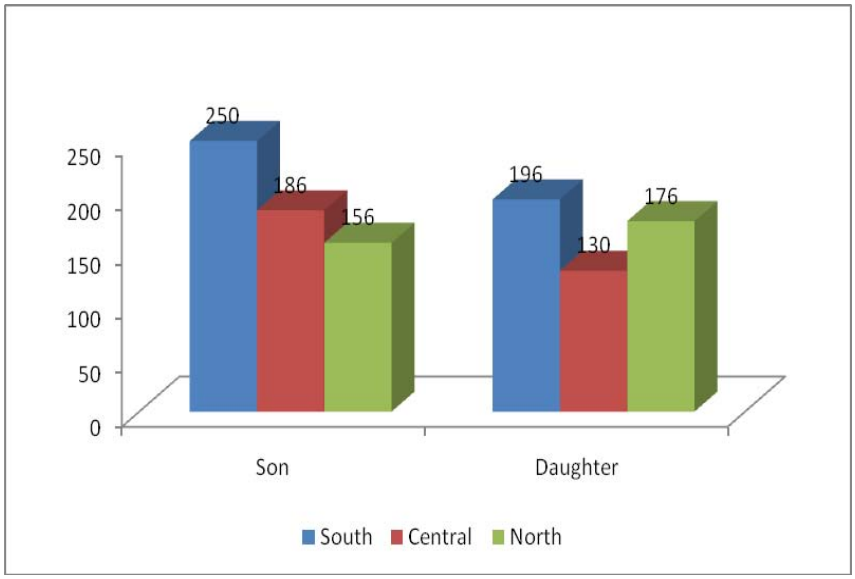
Quality of life is reflected in the level of educational attainment. Only 4 percent of the total population had secondary education. 53.1 percent of the sample did not receive any formal education .7.1 percent were able to read and 17.3 percent could read and write. Low level of education as well as illiteracy obstructed their passage to the outside world for seeking alternate employment opportunities (figure 5.2)

Figure 5.2 Distribution on the basis of education



On comparison of the three zones nearly 55.6 percent of the respondents had 5-6 members in the family. The poor quality of life is reflected in the gender percentage of children where in the South and Central zone the percentage of sons in families was found to be higher than daughters. In South 22.9 percent of the children were sons followed by 17 percent in central zone and 14.3 percent in the North zone (figure 5.3)

Figure 5.3 Gender wise distribution of children



The coastal communities are generally isolated from other sections of the population. This is clearly evident from the place where they live. They seem to be cut off from the mainstream population. They generally cluster around the coastal area where they usually go for fishing. 98 percent of the sample were residing in village areas rather than in towns and cities and this is given in table 5.2

Table 5.2 Place of Living

	South (%)	Central (%)	North (%)	Total (%)
City	4 (0.9)	0 (0)	4 (0.9)	8 (1.8)
Town	1 (0.2)	0 (0)	0 (0)	1 (0.2)
Village	145 (32.2)	150 (33.3)	146 (32.4)	441 (98)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

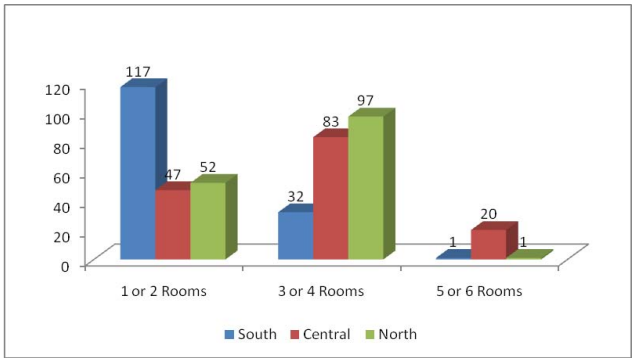
Ownership of house has been assigned much priority in Kerala society. This is very much reflected in the sample where, 30.7 percent from the south zone lived in their own houses while it was 27.1 percent in central zone and 20.9 percent in the north zone. Out of the total sample 78.7 percent were living in own houses, 20 percent in parents house, 0.7 percent in relations house and 0.7 percent in rented houses. (table 5.3). In the south zone nearly 26 percent of the sample had houses with 1-2 rooms, while in the central and north zone 18.4 percent and 21.6 percent respectively had 3-4 roomed houses. With regard to number of rooms the central and north zone is better. (figure 5.4)

Table 5.3 Status of the House Occupied by the sample

	South (%)	Central (%)	North (%)	Total (%)
Own House	138 (30.7)	122 (27.1)	94 (20.9)	354 (78.7)
Parent's House	10 (2.2)	26 (5.8)	54 (12)	90 (20)
Relative's House	2 (0.4)	0 (0)	1 (0.2)	3 (0.7)
Rented House	0 (0)	2 (0.4)	1 (0.2)	3 (0.7)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

Figure 5.4 Distribution of number of rooms in house.



As far as the type of house occupied by the fishermen, 63 households (14 per cent) in the south zone, 84 households (18.7 per cent) in the central zone and 67 households (14.9 per cent) in the north zone had sheet roofing (figure 5.5). Only very few households 3 (0.7 per cent) in central and 2 (0.4 per cent) in the north zone had thatched roof. 142(31.6 per cent) in the south, 120 (26.7 per cent) in the central and 120 (26.7 percent) households in the north zone had walls built in cement (table 5.4). Only 10 households (2.2 per cent) had mud walls and 6 households (1.3 per cent) had walls by screen. Mud floor was found in 4 (0.9 per cent) households, in south, 10(2.2 per cent) in central and 5 (1.1 per cent) in the north zone (figure 5.6). Housing conditions of fisher folk needs to be improved since they are at any time subjected to natural calamities from which they certainly need to be safeguarded.

Figure 5.5 Type of roofing

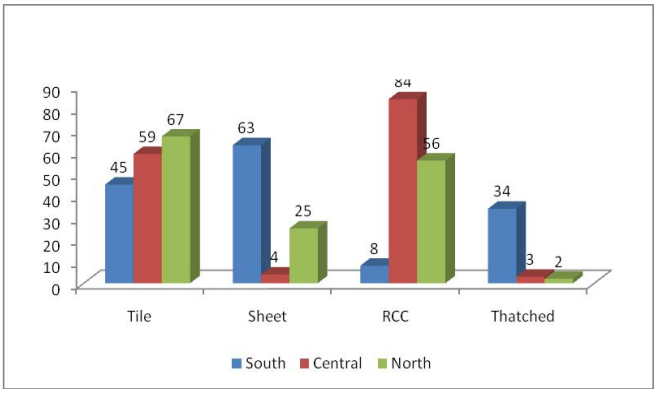
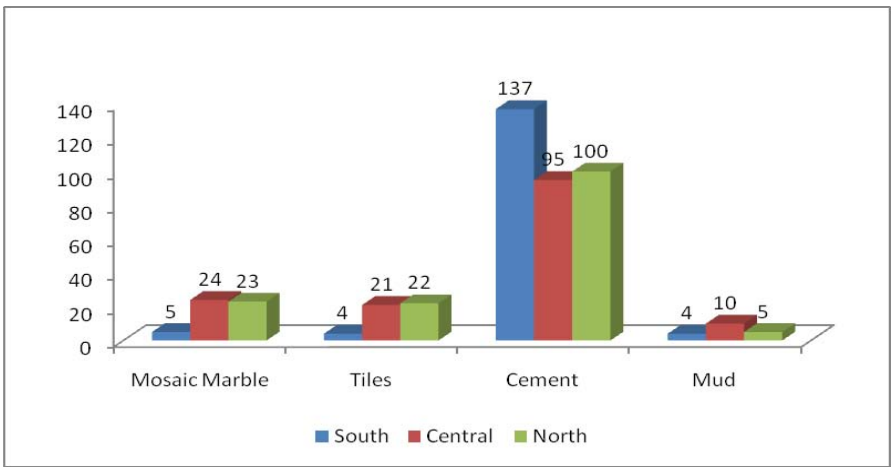


Table 5.4 Nature of house possessed- Wall

	South (%)	Central (%)	North (%)	Total (%)
Cement	142 (31.6)	120 (26.7)	120 (26.7)	382 (84.9)
Mud	4 (0.9)	4 (0.9)	2 (0.4)	10 (2.2)
Brick	4 (0.9)	21 (4.7)	27 (6)	52 (11.6)
Screen	0 (0)	5 (1.1)	1 (0.2)	6 (1.3)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

Figure 5.6 Nature of floor



Availability of kitchen facility is an indirect indication of the living standards. Almost 100 per cent of the households of south zone has separate cooking area, whereas it was 120 households(26.7 per cent) in the central zone and 141 households (31.3 per cent) in the north zone (figure 5.7)

Figure 5.7 Separate kitchen facility

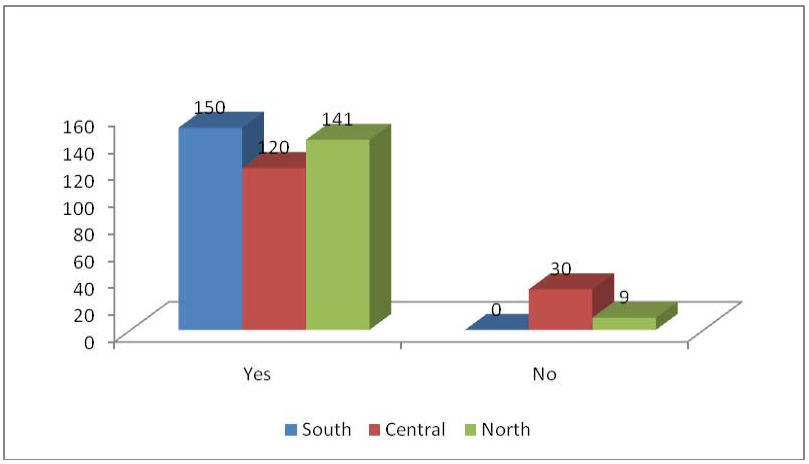


Table 5.5 Fuel source for the sample

	South (%)	Central (%)	North (%)	Total (%)
Wood	116 (25.8)	40 (8.9)	63 (14)	219 (48.7)
LPG	32 (7.1)	102 (22.7)	30 (6.7)	164 (36.4)
Biogas	2 (0.4)	0 (0)	1 (0.2)	3 (0.7)
Electricity	0 (0)	0 (0)	3 (0.7)	3 (0.7)
Kerosene	0 (0)	8 (1.8)	53 (11.8)	61 (13.6)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parantheses shows percentage
Source: survey data

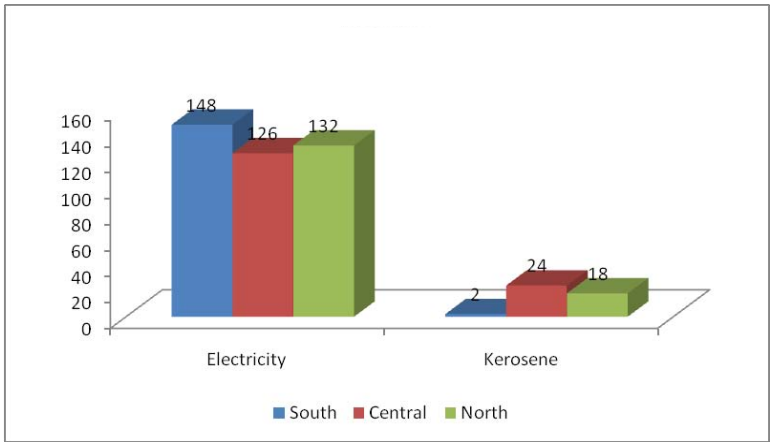
Wood was the commonly used fuel fo cooking in the north and south zone. 116 households (25.8 per cent) of south zone preferred wood to kerosene and 32 households (7.1 per cent) were using LPG in south zone,102 households(22.7 per cent) from central zone were using LPG. Kerosene was preferred less in the south and central zone but was preferred by north zone households (11.8 per cent) (table 5.5). On strengthening state plans for human development , as part of UNDP-planning commission sponsored project, fisher folk human development

report was prepared in Kerala for the first time which reveals that the main source of water is public facilities (48.4 per cent) and 61.3 per cent of the fishermen families in Kerala are provided with latrine facilities (Economic Review, 2009). The very basic amenities to housing are naturally toilet facilities and access to good drinking water which are unfortunately of low standards in fishing villages. .In coastal villages proper functioning of septic tanks are less effective due to the high water table in sandy soil as well as leaking of sewage into wells used for drinking water (Kurien, 1995). The basic amenities related to housing such as electric lighting, toilet facilities and access to water were of low standards in fishing villages compared to the state as a whole.

The survey highlights the dependency of fishing communities on public sources for their water requirements such as tap water and pipe connection facilities. But availability of water is scarce in these fishing villages. Taps could be seen erected much below the ground level in order to get water. In the present survey 222 households (49.3 per cent) depends solely on public taps for drinking water But during rainy seasons this is leading to severe health problems. Studies show that respiratory infections, skin infections, hook worm manifestation and diarrhea disorders are very rampant in the coastal areas of the state (Soman, 1984).

Electric lighting has not reached many households in the coastal areas even today. In the sample 44 households (9.8 percent) are still using kerosene lamps for lighting purposes since electric connections has not reached them or they are unable to afford the expenses of electrification. 2 households (0.4 per cent) in the south , 24 households (5.3 per cent) in the central zone and 18 households (4 percent) in the north zone are yet without electric connection. (figure 5.8)

Figure 5.8 Source of Lighting



The hardships and problems which the fishermen communities face in the coastal areas of Kerala stresses the need to improve the infrastructure facilities, bringing improvements in social climate and thereby enhancing the economic conditions and providing support for sustaining the enhanced levels. Since fishermen prefers life on the sea-front, from where he can observe the sea and approach it, and where he lands his craft, amenities should be provided where he is located.

5.1.2 Economic variables

Ownership of house is an important physical asset and hence the pattern of ownership acquires much relevance. Of the total respondents, 70.4 percent of them gained ownership through pattayam, showing the improvement which they have gained over the years. 18.4 percent gained ownership from ancestors, 8.2 percent purchased house and 2.9 percent received ownership through church (figure 5.9)

Figure 5.9 pattern of ownership of house plot.

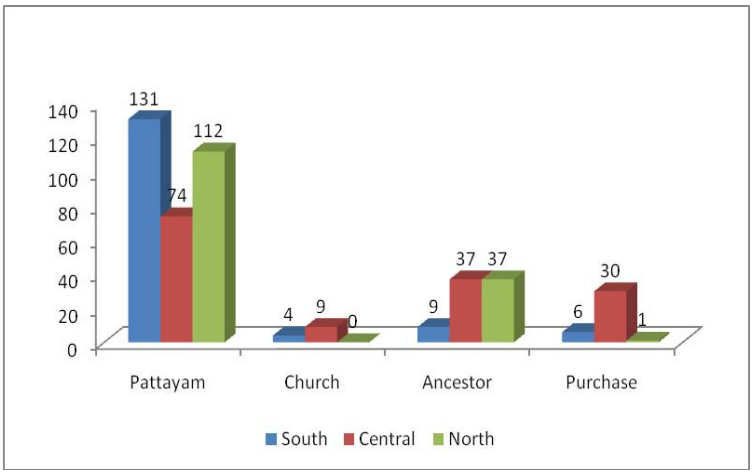


Table 5.6 Ownership of Agricultural Land

	South (%)	**Central (%)**	**North (%)**	**Total (%)**
Yes	3 (0.7)	8 (1.8)	3 (0.7)	14 (3.1)
No	147 (32.7)	142 (31.6)	147 (32.7)	436 (96.9)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

In all the three zones , only 14 fishermen had ownership of agricultural land similarly only 3 out of the total sample had ownership of irrigated land. (table 5.6 & table 5.7)

Table 5.7 Ownership of Irrigated Land

	South (%)	Central (%)	North (%)	Total (%)
Yes	1 (0.2)	1 (0.2)	1 (0.2)	3 (0.7)
No	149 (33.1)	149 (33.1)	149 (33.1)	447 (99.3)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

Marine fisheries provide substantial employment in production and post-harvest sectors. Pre-harvest operations include boat building and repairing, net mending, supply and repair of engines, diesel, kerosene and essential items at the leading centers. Auctioneers at landing and whole sale centres,those involve transportation,loading,unloading,packing, distribution of ice ,commission agents, whole salers, retailers etc come under the post-harvest sector (Sathiadas, 1997)

During harvesting season, the maximum earnings of the fishermen went above Rs 20000 for 2.9 per cent in the south and 1.1 percent in the north zone. In the central zone the maximum income received was Rs 20000. 61.3 per cent of the respondents received income between Rs 5000 and Rs 10000 (table 5.8). During off-season 11.1 per cent of the sample did not have any source of income. Lack of alternate employment opportunities and reluctance to take up other jobs are the major reasons for these low earnings (table 5.9)

Table 5.8 Earning Pattern – In Season

	South (%)	Central (%)	North (%)	Total (%)
Below 5000 Rupees	15 (3.3)	23 (5.1)	2 (0.4)	40 (8.9)
5000 - 10000 Rupees	70 (15.6)	121 (26.9)	85 (18.9)	276 (61.3)
10000 - 15000 Rupees	39 (8.7)	2 (0.4)	45 (10)	86 (19.1)
15000 - 20000 Rupees	13 (2.9)	4 (0.9)	13 (2.9)	30 (6.7)
Above 20000 Rupees	13 (2.9)	0 (0)	5 (1.1)	18 (4)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

Table 5.9 Earning Pattern – off Season

	South (%)	Central (%)	North (%)	Total (%)
No Earning	35 (7.8)	15 (3.3)	0 (0)	50 (11.1)
Below 1000 Rupees	32 (7.1)	71 (15.8)	19 (4.2)	122 (27.1)
1000 - 2000 Rupees	24 (5.3)	55 (12.2)	56 (12.4)	135 (30)
2000 - 3000 Rupees	24 (5.3)	2 (0.4)	2 (0.4)	28 (6.2)
3000 - 4000 Rupees	5 (1.1)	1 (0.2)	37 (8.2)	43 (9.6)
Above 4000 Rupees	30 (6.7)	6 (1.3)	36 (8)	72 (16)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

52.7 per cent of the sample needed Rs3000-6000 to meet the regular expenses. In the south zone 16.9 per cent of the sample needed between 6000-9000 whereas it was only 8.2 per cent in the central zone and 6.7 percent in the north zone (table 5.10)

Table 5.10 Expenditure of House Hold

	South (%)	Central (%)	North (%)	Total (%)
Below 3000 Rupees	1 (0.2)	4 (0.9)	53 (11.8)	58 (12.9)
3000 - 6000 Rupees	66 (14.7)	104 (23.1)	67 (14.9)	237 (52.7)
6000 - 9000 Rupees	76 (16.9)	37 (8.2)	30 (6.7)	143 (31.8)
9000 - 12000 Rupees	5 (1.1)	5 (1.1)	0 (0)	10 (2.2)
Above 12000 Rupees	2 (0.4)	0 (0)	0 (0)	2 (0.4)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

In the south zone 30.4 per cent of women from fisher folk families went for work. While the percentage of women taking up work in the central (3.8 per cent) and north zone (0.4 percent) was much lower. In the north zone women of sample households very rarely took up a work as compared to the other two zones. In central zone, a typical feature noted was most of the fisheries household women were working in ice plants, packing plants or fish processing units and also as domestic servants. Due to lack of alternate employment opportunities, they prefer to stick to fishery related occupations. (table 5.11)

Table 5.11 employment pattern of womenfolk

Sector	frequency	Percent
Selling of fish	137	61.7
Net making	35	15.8
Fish processing	6	2.7
Peeling shed	15	6.8
Fish oil extraction	0	0.0
Others specify	69	31.1

Source: survey data

From among the total sample, 77.8 percent respondents had been working in traditional sector initially has got attached to mechanized/modernized sector. Only 22.2 percent came directly to the mechanized /modernized sector.

Table 5.12 Number of Respondents who Came from Traditional sector

	Frequency	Percent
Yes	350	77.8
No	100	22.2
Total	450	100.0

Source: survey data

Mechanization has improved the well being of the fisher folk. Increase in income was enjoyed by 80 percent of the sample who switched over from the traditional sector as a result of mechanization.

Table 5.13 Experienced an increase in income

	Frequency	**Percent**	**p - values**
Yes	280	80.0	<0.001
No	70	20.0	
Total	350	100.0	

Source: survey data

Income is the main factor which holds them from quitting the industry apart from occupational attachment. The income calculated among the different occupational categories (as given in table 5.14) shows that average annual income is the highest among mechanized sector (Rs 34105), followed by motorized operators (Rs 24199) and low among the artisanal sector at Rs 17089. There is

slight difference among the average income among mechanized and motorized labourers.

Table 5.14 Average annual income among sectors (in Rs)

Sectors	North zone	Central zone	South zone
MOFO	26652	22875	23070
MOFL	19384	17447	20432
NMF	14500	18100	18669
MEFO	34250	32100	35966
MEFL	29000	22500	19666
BOTH	22436	22845	21500

Source: survey data

The annual income (given in table 5.15) for the different sectors among the fish economy ranks highest to the mechanized sector with an average income as Rs 35000, as a result of increasing investment and the use of modern fishing equipments to harvest the fish resources. Motorized sector ranks second followed by the mechanized labourers. Also among the fishing equipments in the motorized sector, mainly large fishing units are able to earn an income of Rs 24199. The small owners of the motorized fishing units earn less compared to their counterparts. It goes without saying that income variation depends on the demand and supply of the resource, apart from the harvest value and price that prevails in the market.

Table 5.15 Average income of sectors(in Rs)

Sectors	Income	Rank
MOFO	24199	2
MOFL	19087.7	5
NMF	17089.7	6
MEFO	34105.3	1
MEFL	23722	3
BOTH	22260	4

Source: survey data

The expenditure pattern of the fishermen households across various categories of the items listed in table 5.16 focuses on the rate of interest burden on loans availed by the fishermen community for their various requirements. Nearly 7-9 per cent of their annual income is set aside for the payment of interest in all the areas surveyed. A trend has been witnessed among the fishermen communities that they cherish the hope of loan waiver possibility from the part of various Government Departments and/or co-operative institutions affiliated to the state. This hope instigates many to abstain from making repayment of the existing debt, apart from their seasonal, occupational scenario. It is witnessed that the expenditure for medical treatment is the highest in the central zone (followed by south zone and North zone) where there is crowding and congestion in the dwellings leading to the spread of contagious diseases. Food expenditure figures the highest in the expenditure list with the fishermen families in the northern districts of the state leading as a result of large family status and number of dependents

Table 5.16 Expenditure pattern

North zone	Central zone		South zone
Food	76.54%	72.81%	73.72%
Clothes	6.90%	10%	9.05%
Medical	0.80%	2.80%	2.11%
Interest burden	7.60%	8.98%	8.60%
Others	8.16%	5.73%	6.50%

Source: survey data

The other items in the expenditure list constitute the expenses incurred for social events, meeting emergency situations, education of their children etc. It has been seen that due to the modernization and changes in the life styles of the urban areas in districts like Ernakulam, increasing expenditure on clothes by the fishermen families has been observed. This focuses on the demonstration effect exhibited by the communities on their changing life style.

Traditional fishing gear was owned by 18.2 per cent of the sample household, motorized fishing gear by 23.8 per cent and mechanized fishing gears by 25.3 per cent. Ownership of traditional fishing gear was highest (12.7 percent) in the central zone followed by north zone (2.9 per cent) and south zone (2.7 per cent). Motorized fishing gear was owned by 11.6 per cent fishermen of north zone, followed by south zone (10.4 per cent) and central zone (1.8 per cent.). Ownership of mechanized fishing gear was highest in the central zone (14.9 per cent), north zone (9.3 per cent) and south zone (1.1 percent). The remaining 19.1 per cent (south zone), 4 per cent (central zone) and 9.6 per cent (north zone) did not have any possession of gear ownership, as they were workers alone (table 5.17)

Table 5.17 Type of fishing gear owned

	South (%)	Central (%)	North (%)	Total (%)
Traditional Fishing	12 (2.7)	57 (12.7)	13 (2.9)	82 (18.2)
Motorized Fishing	47 (10.4)	8 (1.8)	52 (11.6)	107 (23.8)
Mechanized Fishing	5 (1.1)	67 (14.9)	42 (9.3)	114 (25.3)
No Gear Owned	86 (19.1)	18 (4)	43 (9.6)	147 (32.7)
Total	150 (33.3)	150 (33.3)	150 (33.3)	450 (100)

The values in parentheses shows percentage
Source: survey data

Annual maintenance for the craft takes a good sum of their savings and usually puts them into debt trap.Depending on the type of fishing gear owned, expense incurred for the maintenance also varies.In the south zone motorised sector being dominant, 1.8 percent of the owners were spending below Rs10000, 7.3 percent were spending between Rs 10000-25000 and 2 percent were spending between Rs 25000-50000. 20.9 percent of owners incurred an annual expenditure between Rs 10000-25000.This is shown in table 5.18

Table 5.18 Maintenance of craft

	South (%)	Central (%)	North (%)	Total (%)
Below 10000 Rupees	8 (1.8)	7 (1.6)	25 (5.6)	40 (8.9)
10000 - 25000 Rupees	33 (7.3)	39 (8.7)	22 (4.9)	94 (20.9)
25000 - 50000 Rupees	9 (2)	20 (4.4)	11 (2.4)	40 (8.9)
50000 – 100000 Rupees	0 (0)	14 (3.1)	34 (7.6)	48 (10.7)
Above 100000 Rupees	0 (0)	35 (7.8)	20 (4.4)	55 (12.2)
Total	50 (11.1)	115 (25.6)	112 (24.9)	277 (61.6)

The values in parentheses shows percentage
Source: survey data

Debt burden has increasingly crept into the lives of marine fisher folk along with mechanization. With improvements in production methods expenses have also increased. Spiraling fuel prices are taking a good sum of the savings of the fisher folk. The general price rise which suffocates the common man is affecting the marginalized sections in a big way. The rising price of ice, high electricity bills, fuel price hike, etc, suffocates them leading to increased burrowing not to live a luxurious life, but to have a basic subsistence, capable of satisfying the basic amenities of life, enabling them to live like other human beings. From where the borrowings are made is as much important as the debt. The easy access to borrowings is an important factor which determines this.

In order to meet the expenses of maintenance and repairs 83.3 percent of the owners had to borrow money (figure 5.10). 45.6 per cent resorted to borrowings from friends and relatives, 29.1 per cent borrowed from co-operative banks and 8.7 percent borrowed from Kudumbasree. In south zone Kudumbasree and friends and relatives were the main lenders whereas in central zone Kudumbasree and co-operative banks were depended for credit and in the north zone co-operative banks and friends and relatives were sought after more by the borrowers (figure 5.11)

Figure 5.10 Money borrowed by respondents

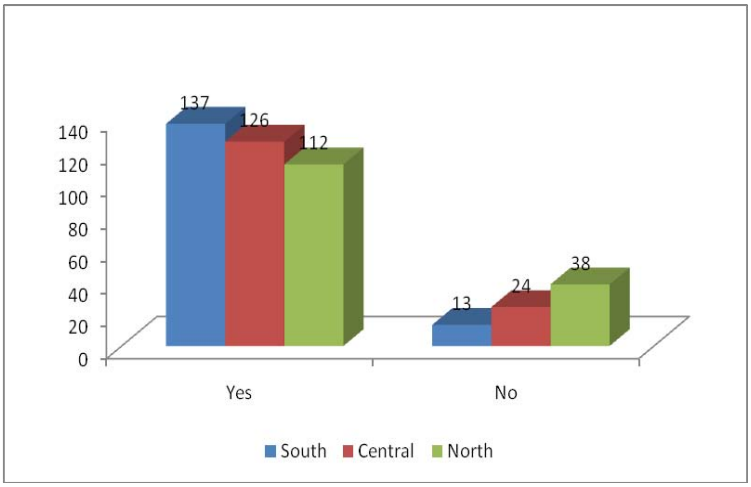
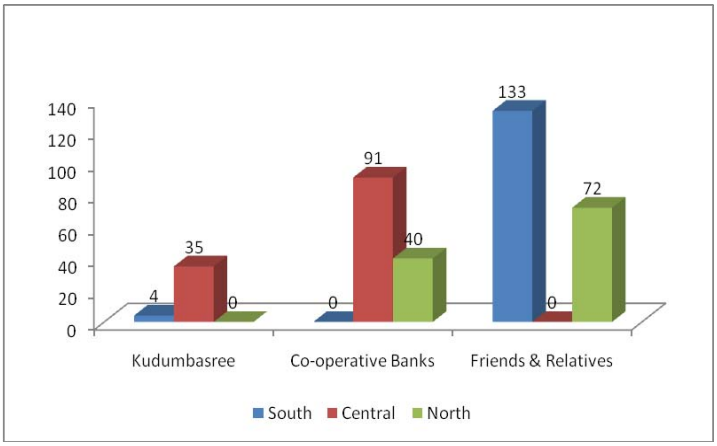


Figure 5.11 source of borrowing



Money borrowed was charged varying rate of interest in the 3 zones. Borrowings made at 2 per cent rate of interest were 30.4 percent in the south zone, whereas there was none from central and north zone. 27.1 per cent of the borrowers from central and north zone borrowed at 8-10 percent interest rate. A high of 11-12 per cent was charged in the central and north zone and 25.8 per cent borrowed. (table 5.19)

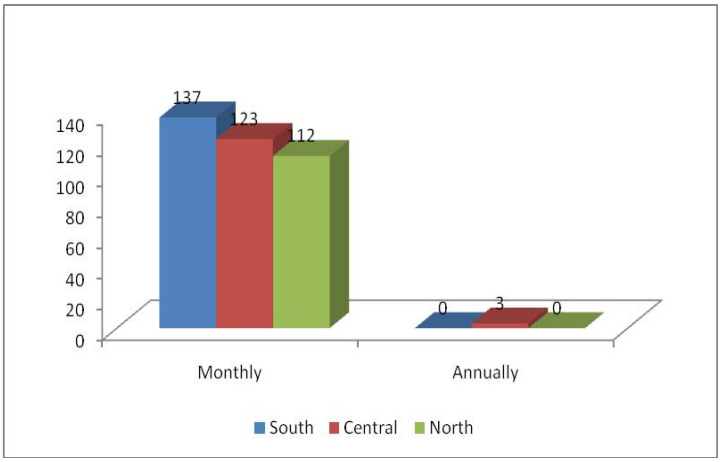
Table 5.19 Interest payments per month

	South (%)	Central (%)	North (%)	Total (%)
2 Percentage	137 (30.4)	0 (0)	0 (0)	137 (30.4)
8 - 10 Percentage	0 (0)	70 (15.6)	52 (11.6)	122 (27.1)
11 - 12 Percentage	0 (0)	56 (12.4)	60 (13.3)	116 (25.8)
Total	137 (30.4)	126 (28)	112 (24.9)	375 (83.3)

The values in parentheses shows percentage
Source: survey data

The mode of repayment of loans was uniform in the south central and north zones. 82.7 per cent preferred monthly repayment of loans whereas only 0.7 percent paid back loans annually.this is given below in figure 5.12

Figure 5.12 mode of repayment.



The repayment period of borrowings ranged from one year to 15 years. All the above described indicators are pointing to the fact that even though technological changes has taken place which has brought improvements in the life of few has not totally being made available to fishermen communities. Poor life quality certainly leads to ecological imbalances, health problems, pollution problems, lack of sanitation facilities and lack of good drinking water, social and political disturbances .Preservation and sustainable resource management can be possible where a fairly reasonable standard of living is enjoyed by the community. Gradual but steady course of development programs alone can bring out the fishers from this clustered settlement pattern, generally isolated from the main stream. Educational standards, income levels and generation of alternative employment opportunities can certainly cause changes in their lives.

Savings has much relevance in the life of fishers. Since only with enough savings can they tide over lean season. 30.9 per cent had savings less than Rs10000/-. 28.7 per cent reported that they saved between Rs10000-30000. A high savings of Rs100000/- was reported by 26.7 per cent and 13.8 percent saved between Rs 30000-100000

Table 5.20 Percentage distribution according to total savings

Present total savings	Frequency	Percent
<10000	139	30.9
10000-30000	129	28.7
30000-1,00,000	62	13.8
1,00,000	120	26.7

Source: survey data

Even though there are many alternatives to put their savings into,93.1 percent depends on chits,73.3 percent on cooperative banks, none have reported of having saved in post-offices. 33.3 percent preferred to keep their savings at home itself. 100 percent of the sample preferred saving in cash form than in other means since their life is encountered with uncertainties often happening. Equally reliable form of savings was to entrust the savings with friends and relatives, private chits, cooperative banks, and commercial banks were shown equal preference (33.3 percent) (table 5.21). On comparison of savings to region, category of work, and ownership pattern, it was found that high variations in savings has been seen among the 3 regions ,wherein south zone showed the highest total savings followed by central zone and north zone. With reference to the category where they belong to, savings of the mechanized sector households was higher followed to by traditional mechanized and traditional non mechanized. Higher level of savings was observed among the owner category.

Table 5.21 Percentage distribution according to where to save

Where do save	frequency	Percent
Bank	211	46.9
Post office	0	0.0
Chits	419	93.1
Co-Operative banks	330	73.3
At home	150	33.3
Others	240	53.3

Source: survey data

When man encounters uncertainties it is quite natural to be cautious. This is very much true for the fisher folk who are swaying with the waves for their daily livelihood, conflicting for fish in the sea. This is very much reflected in their attitude toward savings. The attitude of the sample towards saving is given below.

Table 5.22. Percentage distribution of the sample according to saving

Saving		Frequency	Percent
Do family save	Yes	450	100.0
Do family save	Yes	450	100.0
How often save	Weekly monthly	450	100.0
For what purpose do save	Marriage of daughter & Business	36	8.0
	Education of children, Marriage of daughters & Business		

Source: survey data

100 percent of the respondents said that they save either weekly or monthly. Only 8 percent of them responded that the purpose for which they save was to educate their children, to marry off their daughters and to invest in business. On an average 46 percent saved between Rs 1000-3000 per month and 13.1 percent saved or set apart more than Rs5000 per month. (table 5.23)

Table 5.23 Percentage distribution according to average monthly savings

Average monthly savings	Count	Percent
Up to 1000	94	20.9
1001-3000	207	46.0
3000-5,000	90	20.0
Above 5000	59	13.1

Source: survey data

Table 5.24 Percentage distribution according to total savings as on the date of interview

Total savings on the date of interview	Count	Percent
Up to 2000	95	21.1
2001-5000	164	36.4
5001-10,000	92	20.4
Above 10,000	99	22.0

Source: survey data

The total savings respondents had at the time of interview was 36.4 percent had savings between 2000-5000 and 22 percent had more than Rs10000. 20.4 per cent had savings between 5000-10000

The earning pattern of fisher folk during in-season shows a higher correlation to the present total savings whereas earnings during off-season showed had correlation to the total savings and amount borrowed. The expenditure of household depends on the present total savings in hand, total savings and amount of borrowings. There is a strong correlation between the present total savings and household expenditure.

Table 5.25 Correlation between earning pattern and household expenditure

		Present Total Savings	**Average Monthly Savings**	**Total Savings**	**Amount Borrowed**
Earning Pattern - Season I	Correlation	**0.137**	0.037	0.020	0.033
	p -value	0.005	0.433	0.721	0.519
Earning Pattern - Season II	Correlation	0.094	0.027	**0.170**	**0.204**
	p -value	0.071	0.590	0.003	0.000
Expenditure of House Hold	Correlation	**0.253**	0.050	**0.213**	**-0.193**
	p -value	0.000	0.440	0.000	0.000

Table 5.26 Distribution of No. of Boats / Vallom do work

		No. of Vehicles		**No. of Owners**	
		Frequency	**%**	**Frequency**	**%**
Current Year	Nil	111	24.7	111	24.7
	1	320	71.1	321	71.3
	2+	19	4.2	18	4.0
Last Year	Nil	111	24.7	112	24.9
	1	315	70.0	315	70.0
	2+	24	5.3	23	5.1

Source: survey data

The very specialty of the fisher folk is that even during resource depletion, they expect that a bumper catch can occur suddenly and this pulls them to stay .Above all since they have invested capital in fishing assets, it is very difficult for them to look for other jobs during lean seasons so they are very sticky to their occupation, specially the fishing asset owners. In the current year (71.1 percent) as well as in the last year (70 percent) of the fisher folk preferred working in one vehicle only. In the last year 71.3 percent worked with one single owner, in the current year 70 percent of the fisher folk preferred staying with a single owner.

4.2. Impact of Mechanization

Mechanised sector absorbed nearly 77.8 percent of the fisher folk from the traditional sector. and got themselves adapted to mechanised sector. The fishermen who came from the traditional sector to the mechanized sector found a reduction in workload and increase in income. Moreover they could go for fishing into newer areas and their work hours were made light.(table 5.27)

Table 5.27 the Changes that are Experienced

	Sum	Mean	Rank
Reduction in work load	177	1.11	1
Increase in income	527	1.70	2
More job opportunities are generated	473	2.97	5
Able to go fishing into newer areas	818	2.83	3
Able catch more and different species	24	4.80	7
Experience & skill not much needed	18	4.50	6
Possibility for improve employment	23	5.75	8
Work hours made light	416	2.85	4
Gets working knowledge in modern technology	7	7.00	9
Others	0		

Source: survey data

Figure 5.13 changes that are experienced

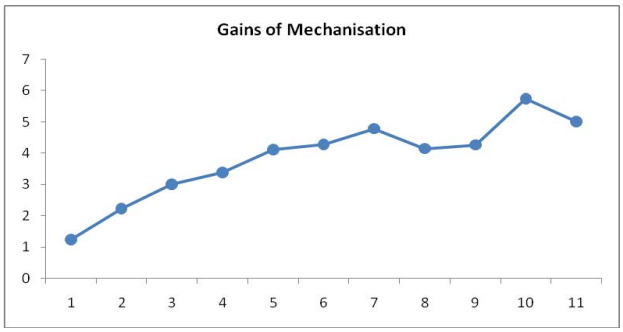
80 percent of the sample claimed that their incomes increased considerably, along with increased production as a result of mechanisation. They were able to go fishing into newer areas as a result of mechanisation. The respondents claimed that exports increased considerably as a result of mechanisation. Another positive attribute was that, there was considerable reduction in time for fishing operations as a result of mechanisation. (table 5.28)

Table 5.28 Gains of Mechanisation

	Sum	Mean	Rank
Income increased	545	1.25	1
Reduction in work load	788	2.23	2
Production increased	1080	3.01	3
Increase in exports	641	3.39	4
Creation of increased job opportunities	642	4.12	5
Enables fishing into newer areas	1170	4.29	8
More varieties of fish can be caught	378	4.78	9
Consumption increased	581	4.15	6
Reduction in time for fishing operations	640	4.27	7
More youngsters are attracted to this sector	132	5.74	11
Others	5	5.00	10

Source: survey data

Figure 5.14 gains of mechanisation



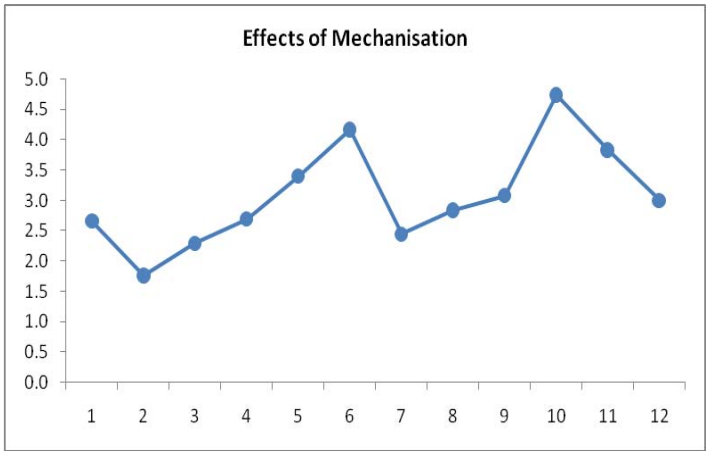
A reduction in labor days, fall in the price of products, entry of foreigners, entry of more boat owners as well as over exploitation of sea resources were assigned to be the prime results of mechanization by the respondents. They also were much aware of the ill effects of mechanization and moaned about over exploitation of sea resources.. As a result of mechanization there was huge destruction of sea resources. The entry of foreigners, exploitation by middlemen, lack of opportunity for old generation, knowledge of technical skill, increased debt etc were attributed as the effects of mechanization.(table 5.29)

Table 5. 29 Effects of Mechanization

	Sum	Mean	Rank
Entry or more boat owners	830	2.66	4
Reduction in labor days	289	1.76	1
Fall in price of products	408	2.29	2
Over exploitation of sea resources	881	2.69	5
Destruction of sea resources	949	3.40	9
Exploitation by owners	75	4.17	11
Entry of foreigners	623	2.44	3
Exploitation by middlemen	375	2.84	6
Older generation loose opportunity	114	3.08	8
Requires technical knowledge	199	4.74	12
Debt is increasing	437	3.83	10
Others	3	3.00	7

Source: survey data

Figure 5.15 Effects of mechanisation



5.3 Need for conservation measures

Technology and modernization have changed the fishery sector drastically. They have resulted into the resource depletion so that the sustainability of the fishery resources has been questioned. Overcapacity naturally leads to over fishing which is very dangerous to the resource. Though it helped to improve the earnings in the fishery sector, fisher folks are not the real beneficiaries. All these urgently invite the attention of all stakeholders to conserve the fishery resources for its sustainability.

Many environmental problems originate from lack of development where poverty is the primary cause of environmental degradation and environmental degradation in turn reinforces poverty. The poor, whose livelihoods are often directly dependants on natural resources, are hit adversely by environmental degradation. Mechanization of craft and gear started early in fifties in the state, under the Indo-Norwegian Project in Quilon. During the sixties, cotton webbing gave way to nylon webbing and later many improvements came in the quality of webbing and net making. Purse- seining got introduced in late seventies and in eighties motorization of country crafts was started, significant changes also occurred in the type of gear used by the country crafts in the past two years.

Thanguvala got converted into mini purse-seine and valloms are converted into mini trawlers.

Moreover drought has deleterious effect on the marine resource, good showers are expected to drain in to the sea valuable nutrients which in turn trigger the food chain leading to better production of phytoplankton and availability of fishery resources feeding on them. Since trawling affects the bottom eco system and catches juveniles of prawn and fin fishes of economic importance which would if left unfished, grows to maturity and reproduce. Indiscriminate trawling affects the secondary productivity and reduces the biological efficiency of the ecosystem by affecting the growth potential of the resources. Hence strict size restrictions on shell and fin fish caught by the trawlers should be imposed in addition to prohibition of trawling in the inshore waters (Balakrishnan Nair Committee, 1989). The declining production was attributed to resource over exploitation by the trawlers. The artisanal and mechanized groups concentrate on exploiting different resources. The artisanal fishermen are interested on pelagics whereas the mechanized exploit the demersals. But since their area of operation was overlapping there arose a competition for space and destruction of shrimp stocks through trawling during the monsoon season and this is an additional factor contributing to production setback in the artisanal sector. The fishery scientists pointed out the possibility of over fishing of prawns and the need for adopting regulatory measures to conserve the resources. The artisanal fishermen made a hue and cry for introducing strict measures for conservation as well as management of stock. They demanded a ban on monsoon trawling to avoid the destruction of eggs and juveniles of the breeding species during the period June, July and August.

Kerala's coastal ecosystems are threatened. The almost complete destruction of mangroves in coastal areas as well as the reclamation and pollution of backwaters have not only hampered a unique ecosystem but have also affected the livelihood of the fisher folk. Commercial maritime fishing by mechanized

trawlers caused over exploitation of fish stock, leading to violent conflicts between trawler owners and artisanal fisher folk (Kurien, 1993). Hence the urgency warranting immediate measures for a rational exploitation and judicious management of the resources became the need of the day.

The traditional fishermen were of the unanimous view that trawling method was destroying the sea bottom contour, the natural fish breeding habitat and bottom fish fauna of the resource rich territorial area of the coastal seas of Kerala. The increase in number of trawlers, purse seiners, motorized fishing crafts and gears did not bring about a corresponding increase in catch in relation to the efforts put in. The rising trend in landings, immediately after trawl ban introduction points clearly to the need of trawling ban as a management necessity to overcome the unsustainable practices in fishing prevalent in the country.

Over the last five decades fishing industry in Kerala witnessed many fluctuations in the availability of resources due to fishery independent factors such as temperature, rainfall, salinity and currents and fishery dependent factors including the nature, size and shape of the gear, its mesh size and the number of gears employed for harvesting the resources. Fishery dependent factors are mainly due to human intervention in the exploitation of the resources and hence can be controllable. Many undesirable practices like dynamiting and poisoning are committed in the fishery sector. The changes in the pattern of landings, size variations, species composition of the resources etc. depend to a great extent on the fishery dependent factors, in this backdrop a meaningful resource management measure becomes a cry of urgency so as to bring about renewability of resources and maximize sustainability of yield.

The task of promoting employment even at the risk of some inefficiency, as an objective in third world fisheries has been underscored by Panayotou (1982). In countries with no effective means of redistributing income, employment in open access natural resource sectors is for many their last and only means of

sharing in the national wealth. To exclude them from the fishery is to deny them their subsistence share. Under conditions of surplus labor even the exclusion of potential entrants is hard to be justified. Hence it is good to suggest maximum fishing employment as an approximate objective of fisheries management in the absence of alternative employment opportunities (Panayotou, 1985).

Basically there are two motivations for the management of fisheries. The obvious need to maintain the resource in the long term by measures directed at biological conservations and the requirement of defining selective entitlement are the various regulations to restrict access or ownership to particular social groups or individuals. Fishermen coming from close-knit communities find it difficult to turn towards other occupations. Management measures introduced in the form of labor-saving type of gear puts the fishermen out of employment, even if that leads to a more efficient fishery. A modernized industry with ports and labor facilities and larger fish landings will generate employment in other sectors of the economy like boat building, and repairs in processing and packing, in ice plants, net manufacture, marketing and transport. This sort of employment in the main industry and ancillary industries are promoted by proper fisheries management.

An increase in the national income can be brought effective by suitable management measures which thereby lead to an increase in the foreign exchange earnings. For meeting the foreign exchange needs many third world countries decided to export their easily exploitable natural resources. In this backdrop export promotion and earning more foreign exchange became the chief objective of fisheries development in third world countries. In India this became the leading objective since the third Five year plan. In developed countries there is a rising demand for luxury species such as shrimp, lobster, prawn and tuna for the past twenty years. The export of these products to developed countries has benefited the developing countries which otherwise would not have a sufficiently large effective domestic market to absorb them. The development of backward coastal regions has been an important objective of fisheries management according to

FAO. Fishing industry has also accorded great importance for prohibiting balanced regional development, promotion of national self reliance, promotion of social welfare, enhancement of public revenue and promoting nations pride and pleasure. All these factors stress the importance of proper management of natural resource due to its importance and the depletion which it is going to face. Expert Committee studies conducted so far in the state clearly pointed out the devastating effects of trawl fishing depicting the direct and indirect impacts on the marine ecosystem and micro-organisms. Trawlers operating along the Kerala coast kill and destroy an average 2.5 lakh tones of marine organisms annually, comprising of 232 species. Separate studies from 2001 to 2004 for the State Government and also for the Central Government on the "Impact of Trawling on the Sea Bottom and its Living Communities" reveal that trawling destroys 2500 tones of juvenile squid and cuttle fishes, 5000 tones of shrimp juveniles.

On the backdrop of the studies, scientists and techno-administrators advocate the need for reducing the fishing effort for conserving the resources since, any increased effort will not bring a proportionate return. The excessive pressure exerted on sea bottom through intensive bottom trawling will affect recoupment and regeneration. Balakrishnan Nair Committee (1989) strongly feels that, during monsoon months, total ban of mechanized fishing efforts violently disturbing the sea bottom is necessary in the interest of conservation of resources.on the backdrop of these studies trawling ban was introduced .The period of trawl ban from 1988 to 2007 is given (table 5.30).

Table 5.30. Trawl ban periods from 1988 to 2007

Year	From	To	Days	Remarks
1988	02.07.1988	31.08.1988	61	Except Neendakara
1989	20.07.1989	31.08.1989	43	Complete
1990	28.06.1990	21.07.1990	24	”
1991	15.07.1991	13.08.1991	30	”
1992	21.06.1992	03.08.1992	44	”
1993	15.06.1993	15.07.1993	45	”
1994	15.06.1994	29.07.1994	45	”
1995	15.06.1995	29.07.1995	45	”
1996	15.06.1996	29.07.1996	45	”
1997	15.06.1997	29.07.1997	45	”
1998	15.06.1998	29.07.1998	45	”
1999	15.06.1999	29.07.1999	45	”
2000	15.06.2000	29.07.2000	45	”
2001	15.06.2001	29.07.2001	45	”
2002	15.06.2002	29.07.2002	45	”
2003	15.06.2003	29.07.2003	45	”
2004	15.06.2004	29.07.2004	45	”
2005	15.06.2005	29.07.2005	45	”
2006	15.06.2006	15.08.2006	62	”
2007	15.06.2007	31.07.2007	47	”

Source: marine fisheries statistics (2007)

The basic biological measures like prohibition of taking juvenile or under sized fish and of catching fish outside a defined season, when they are after out of condition (Coull, 1974). In China, there are records from 2000 years ago of the prohibition of the catching of under sized fish (Huming Yu, 1991).It is necessary to ensure that sufficient survival of young ones of fish should grow to maturity when it can breed at least once in its lifetime. As certain fishing gears/methods destroy spawners and juveniles, it should be ensured that species of commercial importance is exploited only above its size at first maturity for which Minimum Legal Size (MLS) should be adhered during landing and marketing. As revealed in the field survey coastal fishermen are well aware of their ecosystem, the changes happening to it from varying sources like backwater reclamation for development purposes, pollution of backwaters due to large scale discharge of industrial waste, kerosene pollution from motorized boats, destruction of the sea bottom by the trawlers, depletion in both the number and size of some species, etc.

Effective implementation of conservation measures would go a long way in conserving the commercially important species and thereby safeguarding the people for whom fishing is the main source of livelihood an also for whom fish is the main source of animal protein intake. Since socioeconomic sustainability, and ecological sustainability are under threat it is clear that seasonal trawl ban alone cannot protect the fishery sector of Kerala, by assuring livelihood security to the 1.85 lakh active fishermen population (and their dependents) who are directly depending on it and an equal number engaged in support and ancillary activities. Along with other conservation measures efforts should, be taken to promote various aspects of social well being such as community independence, gender equity, sea safety, strengthening of management information system, assigning priority to conservation oriented extension services etc so as to assure socio-economic sustainability via ecological sustainability.In this context an attempt is made to evaluate the need for conservation of resources and the trawl ban by seeking the responses of fisher folk.

5.4 Opinions on changing the present system of trawl ban

While collecting the opinions of fishermen on the present system of ban, most of them wanted to ban night time fishing. A few of them from central zone confided that when the sea is always disturbed by the movement of boats and nets. The fishes and other living organism in the sea and sea bed will be constantly disturbed and this affects their quality. Reduction in the size of species like prawns, sardine, mackerel, big-jawed jumper etc was apparent in the survey. More over since our state too is experiencing terrorist tendencies it is only good and safe to bring about a ban on nighttime fishing. Some of them argued for fixing specific time for fishing and some others totally did not like the idea of staying in the sea, still some others wanted to change the ban months, the use of certain equipment's causing destruction should be banned was demanded by certain others. There should be a move to reduce the number of vehicles was put forward by still few. Opinion regarding changing the present system of trawl ban is given in table 5.31.

Table 5.31 Opinion Regarding Changing the Present System of Trawl Ban

	Sum	**Mean**	**Rank**
Ban months should be changed	280	1.01	1
Reduce the number of vehicles	232	1.89	3
Fix specific time for fishing	506	1.73	2
Ban night time fishing	784	2.62	5
Restrict the fishing practice of staying in the sea	1025	3.66	6
Ban foreign trawlers	1017	3.91	7
Introduce proper licensing system	137	2.45	4
Ban equipment causing destruction	1353	4.90	8
Others	140	5.19	9

Source: Field data

Regarding the effectiveness of trawl ban, 47.6 percent of the respondents had the view that, seasonal trawl ban has been effective in the conservation of depleting species. But 50.9 percent of the respondents was of the opinion that, trawl ban had only a partial impact. 100 percent of the respondents said that the present resource depletion is affecting their lives harder and 90.4 percent respondents strongly remarked that along with seasonal trawl ban, others measures should also be effectively implemented and trawl ban is very much a necessary measure.

5.5 Conservation of resources and trawl ban

Much can be done, both by the government as well as the people using the resource –living on it- depending on it, to preserve and conserve the resource so that future generations can also be privileged to use the resource, rather than make that resource "once upon a time" story. For attaining this end, many efforts have been put forward by the governments. Studies and commissions were in force, finally leading to the decision of trawl ban. The respondents of the three areas were unanimous in their opinion, that a trawl ban during breeding season is very much necessary. But, they were all, saying that, some changes should be there regarding the months in which it is introduced – few of them, said that, instead of ban only a regulation was required and some wanted to increase the number of ban days to 90. Others said that since the ban is unscientific, it has to be stopped. Opinion concerning the present system of trawl ban is given in table 5.32

Table 5.32 Opinion about the Present System of Trawl Ban

	Sum	Mean	Rank
Increase to 90 days	300	2.00	4
Change in ban months	150	1.00	1
Stop the ban, since it is unscientific	600	2.00	4
Complete ban needed	900	3.00	6
Instead of ban, only regulation is needed	150	1.00	1
Others	150	1.00	1

Source: Field data

5.8 Suggestions for betterment and advancement of fishing sector

Technological change which has taken place brought in improvements in the life of few has not been totally made available to fishermen communities. For the betterment and advancement of fishing sector many suggestions have been put forward by the fisher folk which includes banning foreign trawlers, introduction of proper licensing and registration, limiting and controlling the number of vehicles, allotting specific areas for different categories of fishing etc. Table 5.33 blots the opinion given by fisher folk for bettering this sector.

Table 5.33 Suggestions for better Development & Advancement of Fishing Sector

	Sum	Mean	Rank
Limit and control the number of vehicles	774	2.30	3
Proper licensing and registration should be practiced	322	1.95	2
Ban foreign trawlers	846	1.90	1
Allot different areas specifically for different categories for fishing	402	3.30	4
Allot specific time for fishing	1027	3.39	5
Night trawling and fishing by overnight stay should be stopped	991	3.63	6
Suitable training should be provided for labourers	96	3.84	7
Regulate the rushing entry of capitalists	1207	3.84	8
Make available financial help from Govt. and other financial institutions	556	4.06	9
Governments attention should be diverted to this sector urgently	215	5.24	10
Others	0		

Source: Field data

The poor life quality of the fisher folk certainly leads to ecological imbalances, health problems, pollution problems, lack of sanitation facilities and lack of good drinking water, social and political disturbances. Preservation and sustainable resource management can be more possible where a fairly reasonable standard of living is enjoyed by the community. Gradual but steady course of development programs alone can bring out the fishers from this clustered settlement pattern, generally isolated from the main stream. Improvements in educational standards, income levels and generation of alternative employment opportunities can certainly cause changes in their lives.

5.9 Indian fisheries legislation

The need for fisheries legislation was emphasized as long back as in 1873 when the attention of the Government of India was drawn towards widespread slaughter of fish, fry and fingerlings. Indian Fisheries Act in 1897 to regulate riverine fisheries and fisheries in inshore waters, to prohibit the use of poisons and dynamite in fishing, and to protect fish resources in selected waters, restricting the creation and use of fixed engines for catching fish, the construction of weirs, to put a limit on mesh size, size of fish and catch and the declaration of closed season and sanctuaries. The Indian fisheries legislation, in general, seems to target the fishing vessel rather than the fishery per se**.**In the marine sector, the enactments include Merchant Shipping Act 1958, Marine Products Export Development Authority Act 1972, and the Marine Fishing Regulation Act of the Maritime States 1980 as well as the Maritime Zone of India (Regulation of Fishing by Foreign Vessels) Act 1981.

The main emphasis of MFRAs of maritime states of India is regulating fishing vessels in the 12-nautical mile territorial sea, mainly to protect the interests of fishermen on board traditional fishing vessels.

5.9.1 Majumdar Committee (1976)

The committee was appointed to study the situation regarding conflicts between traditional and modern workers. It proposed the Marine Fishing Regulation Bill, and suggested a seasonal ban on trawlers. The committee suggested the bill should be passed by the Parliament. The Government shifted the responsibility to the state and for state it became a problem because whenever there was a ban it was challenged on the grounds that they were fishing beyond 22 kilometers

5.9.2 New Deep Sea Fishing Policy (1991)

In March 1991, the Indian government announced NDSP as part of the economic reforms programme. The policy involved three schemes - leasing out of foreign fishing vessels to operate in the Indian EEZ, engaging foreign fishing vessels for test fishing and forming joint ventures between foreign companies and Indian companies on 49:51 equity basis in deep sea fishing, processing and marketing. Government of India started giving licenses to joint venture, lease and test fishing vessels. This was opposed by millions of fishers all over the coastal states.

5.9.3 Murari Committee (1995)

The committee studied the proposal of the NDSP and the opposition that was made to it. The parliament members from all the political parties were members of the Committee. It came up with 21 recommendations, some of them being:- No renewal, extension or new licenses be issued in future to joint venture/ charter/ lease/ test fishing vessels; The present licenses be cancelled as per going through the legal procedures; Upgrade the skill of the fishing community to equip them with exploiting the deep sea resources; Stop pollutions; Supply of fuel at subsidised rate; Fishing regulations in the entire EEZ; A separate ministry to deal with the entire fisheries; Monsoon trawl ban. The area already being exploited or which may be exploited in the medium term by fishermen operating traditional craft or mechanized vessels below 20m size should not be permitted for

exploitation by any vessels above 20m length except currently operated Indian vessels which may operate in the current areas for only three years.

5.9.4 Marine fishing policy (2004) adopted the strategy

1) To augment marine fish production of the country to the sustainable in a responsible manner so as to boost export of sea food from the country and also to increase per capita fish protein intake of the masses,

2) To ensure socio-economic security of the artisan fishermen whose livelihood solely depends on this vocation,

3) To ensure sustainable development of marine fisheries with due concern for ecological integrity and biodiversity.

It also highlighted to promote exploitation in the deep-sea and oceanic water for reducing fishing pressures and the resources within 50m depth zone are showing the symptoms of depletion.

5.10 Institutional dynamics in Kerala

Marine fisheries in Kerala was in the grip of a turmoil. Ihe interest of the traditional fishermen whose sole means of livelihood is fishing was at stake. The technological advancement leading to unhealthy competition and the overall decline in total fish landings during the late seventies resulted in growing conflicts between the fishermen belonging to the mechanized and nonmechanised sectors, for fishing time, space and resources.Trawling, purse seining and ring seining, were identified by the traditional fishermen as the major destructive fishing methods which led to clashes and confrontations among the fishermen. The artisanal fishermen engaged in fishing by means of their traditional craft and gear protested collectively against mechanised means of fishing and demanded total ban on such fishing methods. Both formal and traditional mechanisms for consultation and conflict resolution are in place. The measures included enactment of Kerala Marine Fishing Regulation Act (KMFR

Act, 1980), The Kerala Fishermen Welfare Societies Act (KFWS, 1980), Enactment of Kerala Fishermen Welfare Fund Act, (1985).

The Kerala Marine Fishing Regulation Act (KMFR Act, 1980) the first of its kind in the country was based on the draft bill‘ of the Majumdar Committee constituted by the government of India in 1976 for examining the question of delimiting the areas of fishing for different types of boats. This act provides for a regulation of fishing in the territorial sea along the coastline of the State through registration and licensing, mesh size regulation, prohibition of certain fishing methods, delimitation of fishing zones and declaration of closed seasons. Under the provision of the KMFR Act, the coastal waters up to 20 m depth from the shore north of Quilon to Manjeswar (about 512 Km coast) and 30 m depth south of Quilon (78 Km) were declared to be the exclusive reserve of the artisanal craft while the mechanized boats were to operate beyond this depth and the purse seiners were banned from operating in the territorial waters. The KMFR Act aimed at protecting the interests of the artisanal fishermen, establishing law and order in the sea and ensuring regulation of marine fishing and conservation of resources.

In 1984, a Kerala State Cooperative Federation for Fisheries Development Limited (MATSYAFED) was set up under the Kerala Cooperative Societies Act to activate, coordinate and guide the working of the village societies. The KMFR Act provided for a grass root level nodal agency of the fishermen to organize production, marketing, welfare and credit in order to provide a real thrust to artisanal fishing.

In 1984, a Kerala State Cooperative Federation for Fisheries Development Limited (MATSYAFED) was set up under the Kerala Cooperative Societies Act to activate, coordinate and guide the working of the village societies. Three District Cooperative Societies were registered as primaries to the federation as the FWS were formed outside the Cooperative Societies Act. There have been frequent clashes between the fishermen belonging to the traditional and

mechanised sectors leading to very serious law an order situations and even loss of life and property. A Committee with Chairman D. Babu Paul, I.A.S, the then Government Secretary to Fisheries was appointed in 1982. The committee was of unanimous opinion in respect of recommendations of general nature for the conservation and management of fishery resources of the state.

The Babu Paul Commission Report was submitted the following year. The report did not recommend a ban on bottom trawling during the Monsoon months. The Commission's main recommendations were: mesh size of the trawl nets should not be less than 35mm, the Marine Regulation Act of 1980 should be strictly enforced, registration of all the trawling boats should be ensured, purse seine, ring seine, pelagic and mid-water trawls should be banned within 22 km of the in-shore waters. As the Commission was silent on the issue of the ban on bottom trawling during the monsoon period, which essentially meant that the harmful fishing practices during the spawning season would continue leading to the peril of the marine eco-system, the Federation launched a series of agitations from 1982 to 1983.

In 1987 the Government appointed yet another Commission - the Balakrishnan Nair Commission to study the issue of trawl ban. In 1988, the Commission recommended a ban on trawling during the monsoon period, of 90 days, on an experimental basis for three consecutive years. The Committee recommended a mission oriented study called Save Coastal Resources Project (SCORP).The Silas Committee constituted in 1992 recommended the demarcation of a separate zone as an artisanal exclusive fishing zone and standardization of overpowered artisanal fishing gears like mini trawls and ring seines.

The Deep Sea Fishing Policy of the government of India was opposed by various organizations of the fishers as well as mechanized fishing vessel owners in the country because their operational area was being encroached upon by the larger chartered vessels and the vessels operating through joint ventures, lease etc;

there was over-exploitation of resources by these large mechanized vessels and under-reporting of catch. These also caused damages to the craft and gear of traditional fishers. The government appointed the Murari Committee to review the deep-sea fishing policy, made 21 recommendations, which were approved by the cabinet in 1997. These included placing limits on the operation of shrimp trawlers, deep-sea fishing regulations for the conservation and management of marine resources, assistance for the traditional and small mechanized sector by providing fuel subsidies, and no renewal or issue of fresh licenses to charters or JVs. However, few of these recommendations have been implemented.

The Sudershan committee had also called for regulation of deep-sea and coastal fishing, mandatory catch-reporting system for deep-sea vessels operating in India‘s exclusive economic zone (EEZ), comprehensive legislation covering conservation and utilization of marine fishery resources and a code of conduct for fishing vessels, at the state and national level. The Aquarian Reforms Committee (2000) headed by K Ravindran, constituted by the Kerala government to recommend basic reforms in the fisheries **se**ctor and submitted their report.

In July 2004, an expert committee headed by M.S. Swaminathan to carry out a comprehensive review of the CRZ and submitted its report in February, 2005. The Committee had observed that CRZ legislation should be established and recognized the traditional rights of the fishing community. It recommended the expansion of Coastal Zone to include the territorial waters. It also recommended introducing Coastal Management Zones by replacing the concept of Coastal Regulation Zones. The zone demarcation proposed by Swaminathan Committee could not be accepted by a state like Kerala where the population density is high.

The purpose of Kerala Monsoon Fishery (Pelagic) Protection Act, 2007, is to grant traditional fishermen the right to conduct pelagic fishery during the monsoon season using traditional and modified traditional crafts and gear within

the territorial waters. Authorized officers may enter, search and confiscate any vessel if they have reason to believe that the misuse of such fishery has been harmful to fish breeding and fish wealth, and the Government may order to ban the right to conduct pelagic fishery

Fisheries legal regime should establish institutional arrangements and procedures necessary to reduce potential conflicts and facilitate their resolution whenever required. The issue of sustainability is a concern for the fisher folk. They point out the need for government intervention, the continuation of trawl ban with more effective implementation measures, ban for foreign trawlers, specific time for fishing etc. The common property rights were also mentioned by some activists in the discussion. All types of stakeholders of fishing sector are worried about the sustainability aspect and hence they emphasize the need for conserving the fishery resource for which management of the same is the best strategy through government intervention.

Chapter 6

CONCLUSION AND RECOMMENDATIONS

The transition that has taken place in Kerala fishery was largely influenced by many co-related factors like marine ecological conditions of different areas, foreign guided par aided government policies, value system and skills of different fishers group and the changing tastes of the global seafood markets. The havoc created by the unchecked technological advancement failed to show significant improvement in fish landings over the years despite increasing fishing efforts wherein total output cannot be increased by merely enhancing the production capacity. With increased pace of motorization the traditional non-motorized fishermen were thrown out from the scene with motorized units taking over the resources which the traditional fishermen were enjoying. A good proportion of traditional fishermen were shifted towards the motorized sector occupying the same area and resources. The economically weaker section of the fishermen as well as the fishermen who disliked to be shifted towards the motorized sector, paid the cost of resource depletion.

In the above context the present study made an attempt to see the impact of technological change and modernization on fishery sector and fishermen. The major findings of the study are discussed below.

6.1 Major Findings

6.1.1. Impact on Fishery Sector and Sustainability

* The transition that took place was largely influenced by many co-related factors like marine ecological conditions of different areas, value system and skills of different fishers group and the changing tastes of the global seafood markets.

* The sudden spurt in demand and the lucrative price offered for in foreign markets attracted investors from outside the fishing sector who had enough capital for investment, for the sake of reaping immediate returns ruthlessly exploited the marine resources leading to the depletion of many economically important fish species- a natural resource - which certainly needs time for recuperation.

* The result of trend analysis on the marine fish landings of Kerala shows the reasons for the variations in landings. It was shown that trawling was found to exert a very dangerous impact on the landings (especially on the bottom dwelling species) and the changes observed in the post ban period landings in the state indicated the effectiveness of trawl ban for the conservation of resources. Ban has the potential to regenerate fish stocks, especially the demersal fish and shrimp resources.

* The resource depletion experienced is mainly due to the introduction of trawling, purse seining, natural calamities and pollution. Analyzing the landings of 8 commercially important species, it was found that elasmobranches, cat fish, silver bellies etc which were caught mainly by trawl nets, and contributed 30 per cent of their total landings by trawls, was showing a declining trend whereas oil sardine, other sardine and ribbon fish, which are mainly caught by ring seine, boat seine and drift nets showed a rising trend. The landing of penaeid prawn alone was an exception.

* Based on the inferences made by the scientific community linking exante and expost analysis of depletion of 14 species in relation to the catch data of the initial period (1971-75). It shows that there is evidence of biological over-fishing in coastal waters. To analyse the extent of depletion of selected fish species and to understand how far sustainability of fish resources are at stake the average landings in 1976-81 and 1982-87,(pre ban periods) and 1988-93, 1994-99 and 2000-06 (post ban periods) on comparison with the initial peak period 1971 -75 shows that

each species showed decline in each period when compared to the initial period. The reduction in oil sardine has been 6,18,14,51 and 34 per cent in the five periods, other sardine has been 42, 78, 41, 23 and 15 per cent , ribbon fish was 27, 39 ,64,19 and 13 per cent. Elasmobranches registered depletion of 18,22,41,48 percent in the period up to 1994-99 but the third post ban period has not shown any depletion. This may be due to the beneficial effect of trawl ban happening to this important specie. In two pre ban periods and two initial post ban periods Perches did not show any depletion but showed 21 per cent depletion in the third post ban period. The depletion of cat fish was by 52, 59, 85, 99 and 99 percent respectively in the five periods. The figures on depletion status worked out show that other sardines, cat fish and ribbon fish showed heavy depletion during the 1987-2006. Mild depletion was showed by mackerel, seer fish and perches. Carangids, elasmobranches, oil sardine and penaeid prawn showed moderate depletion. Only two species tunnies and cephalopods did not show any depletion during the period.

6.1.2 Impact on Fisherfolk

- To what extent technological changes and modernization affects the humans who are solely dependent on this natural resource for a living, and how far a responsible management of conservation measure is imperative in this context . With the changes in technology, fisher folk also got themselves adapted to the new work pattern, sale and processing.

- Fall in price of products and reduction in labor days were the main effects of mechanization. Over exploitation of resources,increasing debt, exploitation by owners and by middlemen, entry of foreigners were the major effects of mechanization on the community inter alia further marginalization of the traditional fishing community.

- The survey result shows that 77.8 per cent of the respondent fishermen came from the traditional sector to the mechanized sector. And even during off-

season they remained with the same owner and did not seek alternate employment opportunities, which points to the labor stickiness of fishermen which is mainly due to ownership of fishing assets and resultant indebtedness, poor quality of living etc. The fisher folk who came from the traditional sector found a reduction in workload, as the physical exertion was comparatively less. They could also get more leisure time as the work hours were light.

- Analysis show that 80 per cent of the respondents claimed that their incomes have increased considerably, but this increased income does not get reflected in their standard of living. Poor quality of living is one of the main reasons for over dependence on fishery. 98 per cent of the sample respondents were living in village areas rather than in towns and cities. Over crowding, insufficient amenities of living, very low educational attainment, insufficient transport facilities to fishing villages are the major players acting on their downward swing in life. The preference of this marginalized community to live very near the seas often subject them to natural calamities like tsunami which has come to Kerala coast too.

- Crowded settlement pattern and lack of proper sanitary conditions and drinking water often ends up in epidemic health problems, for which a good sum of money has to be set apart by fisher folk families for medical treatment. It is disheartening to observe that among the sample households nearly 9.8 percent households were without electric connection in houses. This insufficiency would certainly reflect in the life conditions and educational attainments of the community. Low education level was observed in the sample. Only 4 percent of the total sample received secondary education and 53.1 percent did not receive any formal education.

- The income earnings during in season ranged between 5000-10,000 rupees per month for 61.3 percent of the households whereas during off season, 11.1 percent of the fishers ending up with no income. For 52.7 percent of the sample households an average income between 3000-6000 rupees was

needed for meeting the expenses. A very positive sign observed was with regard to ownership of houses where 70.4 percent of the sample respondents have gained ownership through pattayam.

- Three occupational categorizations were observed in the sample such as owners, workers, ownership on partnership or share basis. Borrowings are unavoidable in fishermen households. Since, during off season, regular expenditure of the households is met from borrowed money and past savings. Along with mechanization, debt-burden has also increased in the lives of the fisher folk. Borrowings have increased considerably and that too at very high interest rates.

- Much variation in savings has been observed among the three zones. South zone showed the highest total savings when compared to the other two zones. Fisher folk showed a high inclination towards savings which is mainly attributed to the uncertain nature of work in which they are involved in. Ownership of fishing assets on partnership basis was more prevalent in the North Zone with 27.8 percent. In fishing sector more of a collective ownership of the modes of production is observed. The tendency is generally to own craft and gear on a sharing basis of 15-20 persons sharing in the purchase of a craft and becoming owners and workers at the same time. This pattern is dominant in the traditional sector, due to the fact that investment requirements are very high, which leads to choice of collective ownership. Thus the status of the owner and owner-worker is very narrow and vulnerable. The motivation behind organization of production in the traditional sector is subsistence. The limited accumulation of resource which they make do not create much difference in the economic lives of fishermen.

- The main source of borrowing in the South zone and North zone was from friends and relatives whereas it was cooperative banks in the Central zone. Technological improvements have increased the post-harvest activities of the fisher folk. In the North zone, fisher women rarely took up work which

was in contrast to the other two zones. 30.4 percent for the south zone 3.8 percent for the central zone, who have supplemented to family income mainly by working in ice plants, packing plants etc. They were sticking to fishery related occupations mainly due to lack of employment opportunities as well as other socio cultural impediments prevailing in the coastal areas.

- The correlation analysis on the earning pattern (during off-season) and present total savings shows strong correlation between the two variables (0.204) There is also correlation (0.170) between total savings and earnings in off- season as well as with borrowings.

- The high price offered for marine products and increased demand resulted in accelerated investments in the harvest operations. Higher investments has also concommitment issues leading to increased efforts to earn more returns to pay off the investments. This leads to increased fishing pressure on coastal resources as well as the sustainability of the resources. Using destructive fishing methods, harvesting immature and undersized fishes, degradation of habitats, post harvest losses, discards, by-catches have also led to increased fishing pressure on resources leading to depletion. The Indian Mackerel Rastrelliger Kangurta is able to adapt to rise in sea surface temperature by extending its distribution towards northern latitudes and by descending to depths resulting in alarming reduction of catches of this species. The mesh size used in trawl and ring seines is lower than the prescribed limit in many cases and this has to be discouraged to conserve the resources and for strict implementation of Marine Regulation Act (1980) is required for this. The coastal waters of Kerala is open to heavy fishing pressure by trawlers and ring seiners . Trawling adversely affects the flora and fauna of the bottom sea.

- Modernization of fisheries has generated indirect employment in the coastal areas, but it has not benefited the fishing community as well as a negative bias to the fisher women faction. Marketing of fish, making and

repairing nets, curing and processing, peeling etc are post-harvest sector activities. Many are found to work from outside this sector in these activities.

- Despite stagnation in fish output, the continuous increase in fish prices brings higher income flow to the fishery sector. A part of this is appropriated as operating cost, marketing cost, cost of capital etc. Since nearly half of the catch is by the mechanized trawler, and the income distribution is highly skewed in favour of the mechanized trawler. Almost all goods and services for household needs are purchased from outside the sector and for making the payment they have only income from their catch. Efforts should be taken to produce these goods and services utilizing the surplus labor available in the fishery sector thereby helping them to tide over the income differences arising out of the seasonality nature of the occupation. Improving the transport facilities will enable the womenfolk to go out for jobs outside this sector. Since fisher folk live close to seas, where they go for fishing they will be naturally cut off from the main stream population. This leads to an isolated and marginalized existence. Traditional technologies got replaced by modern capital-intensive technologies, shifting fishing technology from eco-friendly to eco-destructive, active gear to passive gear and low cost to high cost putting a heavy burden on the outliers of the mainstream.

6.1.3 Sustainability and Conservation measures

Since a good number of people are dependant on this sector for their sole survival and livelihood, conservation measures along with infrastructure developments, betterment of housing conditions, gender dignity etc can go a long way in lifting up the fisher folk masses from this deprived environment. Regarding the human face of the people and respecting their occupation can do a great deal in lifting up their socio-economic status at par with any other agricultural occupations.

* Resource depletion was obvious from the views expressed by the respondents (77.8 per cent). Respondents from South Zone expressed that certain varieties of fish like Tuna, shrimp,'vala' and kanava were fast disappearing. In the present scenario, socio-economic sustainability as well as ecological sustainability is under threat which clearly states that seasonal trawl ban alone cannot protect the fishery sector of Kerala.

* The problems of excess fleet, fishing technologies leading to inter-sectoral and intra-sectoral conflicts, unregulated increase in fishing effort, widespread capture of juveniles and low value fish, lack of mesh size regulations, impact of climate change on environment as well as resources, inadequate quality controls and global pressures are the issues which needs to be addressed for assuring socio-economic sustainability via ecological sustainability in this gods own country.

6.2 Recommendation

1. Sustainability Measures

Technological changes in the fishing industry in terms of trawling and purse seining and diversification of the coastal economy has led to the unsustainable development. Main threats to sustainable fisheries in Kerala are overcapitalization, over capacity, over investment in the harvest and post harvest sectors of the industry non-implementation of the existing rules and regulations and the lack of alternative employment generation. Hence urgent measures are required to tackle these issues so as to have sustainability of fishery resources.

2. Conservation Measures

Traditional way of conserving the fishery resources have to be emphasized. Optimal fishing models have to be developed both for the marine and inland fishing resources. Local level experiences have to be preserved and adapted to the new and changed environment.

3. Fisheries Management

It was in the context of severe resource depletion and heavy loss to the fishery and the consequent conflicts among resource users that the government was forced to introduce trawl ban and other fishery conservation measures to safeguard the livelihood of the traditional fishermen in particular and the sustainability of the resources in general. Fisheries management experts recognise that the underlying cause of resource over exploitation in the marine fisheries is often of social, economic, institutional and political in origin. Therefore, fisheries management should address the relationship of fisheries resource to human welfare and the conservation of the resources for use by future generations. It has become increasingly evident that fisheries management cannot be effective unless the people who harvest the resources (communities and fishers) are effectively involved in the management process.

4. Community based management

The inherent idea of community based management is that that resource users have the capacity to better manage the resources since they know the resource better. They should be given the primary responsibility of managing the resource since any mismanagement will adversely affect the livelihood of fishermen. They know the system productivity, need for conservation, extent of resilience, adaptability to shocks and stress etc. Thus community based fisheries management does not aim solely on harvesting the benefits, rather they strive to achieve ecosystem‘s health and promote conservation and sustainable use of the resources, an espousal of the co-management system.

5. Common Property Right

The informal system exist at local level constitute part of the common property. It has been playing a decisive role in maintaining the fishery resources so that sustainability was not doubted. No doubt attempts should be made at official level to safeguard the interest of fishing folk and the society through common property rights.

6. Value Added Products

The value added products can help to increase the standard of living of the poor. The fishery sector, in general, suffers from this limitation. Attempts on the part of all agencies to produce value added products and explore new markets are the best solution for the improvement of economic and social status of fishermen.

7. Fishermen Cooperatives

Cooperative system is a successful strategy in traditional sector. In Kerala Matsyafed made such interventions for the upliftment of fishing folk. In addition to this formal institutional set up informal system has also been successful in some coastal communities and hence we should also go for such as system in the Kerala fisheries, particularly among the traditional fishers. There should be more coverage of such societies among fishermen.

6.3 Contribution of the Researcher

The present study analyzed the impact of technological change and modernization on fishing sector as well as on fishing community. By analyzing the impact on fishing sector, the study explored the issue of sustainability and the need for conservation measures. The findings of the study hint on the need for specie-specific and region-specific management and institutional setup with a view to circumventing the resource reduction and livelihood threat of the community.

6.4 Policy Implications

The study has got a lot of policy implications .The major intervention should be in the field of conserving fishery resources. This should be fool-proof if and only if appropriate livelihood options are ascertained to the fishing community who are the outliers of the society. There are discussions and interactions to enact the Common Property Rights of fishing folk, especially in the State economy. Traditional forms that existed in the fishing sector need to be maintained. For all these, adequate policy prescriptions are required.

6.5 Conclusion

Globalization brought about new changes causing structural shift, creating new employment and income generating opportunities. Fishing became a commercialized venture with the advent of globalization. The incremental income generated as a result of subsequent developments got dissipated to various sectors of the fish economy and traditional fishers benefited very little from it. Before commercialization almost all activities relating to fisheries had been carried out by the community themselves and had acquainted with versatile skills and knowledge viz, craft engineering, textile engineering, navigational skills, oceanography, astronomy, engineering, transportation, processing, marketing etc. The advent of commercialization that led to the entry of large scale trade and industry into the sector needs to be revisited for radical change so as to have sustainability of fishery resources and thereby the survival of the fishing community, as high fishing pressure any where in the world is a threat of resources every where in the world.

BIBLIOGRAPHY

Books and Articles

Abraham, Anita(1985),"Subsistence Credit- Survival Strategies Among Traditional Fishermen", Economic and Political Weekly, Vol.20(6).

Achari, T.R.T. (1969), The Impact of Indo-Norwegian Project on the Growth and Development of Fisheries, Agricultural Division, State Planning Board, Government of Kerala, Trivandrum.

Achari, T.R.T. (1987), Maldevelopment of fishery : A case study of Kerala State, India, paper presented at FAO Indopacific Fishery Commission. Symposium on the exploitation and management of Marine fisher resources in South East Asia RAPA/ Report : 1987/10.

Achari, T.R.T. (1989), "Socio-Economic Impact of Motorisation", National Workshop on Technology for Small Scale Fish Workers, 27 and 28 February and 1 March 1989, Trivandrum.

Achari, T.R.T.(1993), "Impact of Motorisation of Traditional Craft on Coastal Fishing and Fisherman Community – Kerala": Development of marine Fisheries for Higher Productivity and Export, Central Institute of Fisheries and Nautical Engineering Training, Cochin.

Achari, T. R. Thankappan.(1986a), Trends in Fisheries Development of Kerala- An Appraisal, Programme for Community Organisation, Trivandrum.

Achari, T. R. Thankappan.(1986b), The Socio-Economic Impact of Modernisation of Country Craft in Purakkad Village- A Case Study, Programme for Community Organisation, Trivandrum.

Achari, T. R. Thankappan. (1933), " Impact of Motorisation of Traditional Craft on Coastal Fishing and Fishermen Community Kerala", In Verghese C.P. and Joy P.S. (ed): Development of Marine Fisheries for Higher Productivity and Export, Central Institute of Fisheries Nautical and Engineering Training, Cochin.

Alagraja, K.et.al.(1994), "Recent Trends in Marine Fish Production in Kerala with Special Reference to Conversation and Management of Resources", Presented at State level; Seminar organised by Kerala Fisheries Society, on 18 March 1994, KFS, PCO Centre, Trivandrum.

Ammini P.L., Srinivasan, J. Ramani, K. Beena, R. and Seynudeen M.B. "Marine Fisheries in Kerala" Marine Fisheries Information Service T&E, Ser : No. 204, 2010.

Anderson, L. (1977b), The Economics of Fishers Management, Johns Hopkins Press, Baltimore.

Anderson, G. Lee. (1977), Economics Of Fisheries Management, John Hopkins Press, Baltimore.

Anon. (1994), " Kerala Newsletter", Fishing Chimes, Vol.14 No.7, pp.55, Chimes house, Visakhapatnam.

Aquero, M. (1987), "Economic Consequences of Excessive Effort", Paper Presented at FAO IPEC, Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, RAPAP/RPORT : 1987/10:552p.

Bailey, C. (1987), "Social Consequences of Excess Finishing Effort", Paper Presented at FAO IPEC, Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, RAPAP/RPORT : 1987/10:552p.

Bailey, J. (1996), " High seas fishing" towards a sustainable regime". Sociologia Ruralis, Volume36, No.2.pp.189-200.

Bene, C. G. Macfadyen and E. H. Allison.(2007), Increasing the contribution of Small Scale fisheries to poverty alleviation and food Security. FAO Fisheries Technical Papers 481.

Berkes, et. al. F, Mahon.R., McConney, P. Pollnac, R.& Pomeroy, R. (2001), Managing Small Scale Fisheries: Alternative Directions and Methods. Ottawa, International Development Research Center.307p.

Bhushan,Bharath. (1979), Technological change in Fishing in Kerala 1953 – 1977, M Phil Dissertation Centre for development Studies Trivandrum.

Botsford, L. W. (1997), The management of fisheries and marine ecosystems. Science 275(5325): 7.

Buckworth, R. (1998), World Fisheries in Crisis. Reinventing Fisheries Management. T. J. Pitcher, Paul, J.B., and Pauly, D. London., Kluwer Academic Publishers.: p3-17.

Chandrasekharan, V.S. ; Nararajan, R (1992), "Small scale fishery of Pichavaram Mangrove swamp, South East Asia" Naga, The ICLARM Quarterly, Vol.15, Manila.

Charles, A.T. (1997), The Path to Sustainable Fisheries. In: 'Peace in the Oceans : Ocean Governance and the Agenda for Peace. The Proceedings of Pacem in Maribus XXIII.' Mann-Borgese, E. (Editor). Costa Rica, Intergovernmental Oceanographic Commission: p201-213.

Charles, A.T. (1998a), Fisheries in Transition. Ocean Yearbook 13. C. Mann-Borgese, A., McConnell, M & Morgan, J.R. (Editors) . University of Chicago Pres, Chicago. p 15-37.

Charles, A.T. (2002), The precautionary approach and 'burden of proof' challenges in fishery management. Bulletin of Marine Science: 70(2). p683-694.

Charles,A.T.(1998b), Living with uncertainty in fisheries: analytical methods, management priorities, and the Canadian groundfishery experience. Fisheries Research: 37(1998). p37-50.

Christie,W.J.(1993), "Developing the Concept of Sustainable fisheries". Journal of Aquatic Ecosystem Health 2: pp. 99-109.

Coull,J.R.(1974), The Background to the IceLandic Fishing dispute Aberdeen University.

Crutchfield, J.A. ; Zellner, A.(1962), Economic aspects of the Pacific Halibut Fishery, Fishery Industrial Research, Vol.1 No.1.

Day, F. (1865), The Fishers of Malabar, London.

Dercon, S. (2001), " Assessing vulnerability to poverty". Jesus College and CSAE, Department of Economics Oxford University.

Devaraj, et. al. (1998), " The New Economic Policy and Perspective for marine Fisheries Research and Development in India". Fishing Chimes, Vol.18, No.5, August, pp.18-28.

Devaraj, M. and Vivekanadan, E.(1999), " Marine Capture fisheries of India: challenges and opportunities". Current Science. Volume.76. No.3 pp. 314-332.

Fairlie,S. Hagler,M. and O'Riordian, B. (1995), The politics of overfishing. The Ecologist 25(2-3): p28.

Friedheim, R. L. (1999), Ocean Governance at the millennium: where we have been - where we should go. Ocean and Coastal Management 42: p747-765.

Garcia, S. (2000), The FAO definition of sustainable development and the Code of Conduct for Responsible Fisheries: an analysis of the related principles, criteria and indicators. Marine and Freshwater Research 51: p535-41.

Garcia, S., & Moreno, I. (2001), Global overview of marine fisheries. Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem, Reykjavik, Iceland, 1-4 October 2001.

Garcia, S, and Grainger, R. (1996), Fisheries Management and Sustainability: A New Perspective of an old Problem? World Fisheries Congress, Brisbane, Australia, CSIRO Publishing. p631-654.

Garcia, S.M. ; D. Staples (1997), sustainability reference systems and indicators for responsible marine capture fisheries : A Review of Concepts and Elements for a setup guidelines, Marine Fisheries Research 51(5).

Garcia, S. M., and Staples, D. (2000), Sustainability Indicators in Marine Capture Fisheries: introduction to the special issue. Marine and Freshwater Research 51: p381-4.

Garrett, E. S. et. al.,(2002), National Sea Food Inspection Laboratory, Pascagoula, Mississippi U S A.

George M.J. (1980), Prospects of Mechanised fishing in India. Fishermen, Vol.1, No.11.

George, M. J, et, al.,(1980), A Case Study of Overfishing: Depletion of Shrimp Resources along Neendakara Coast Kerala, Marine Fisheries Information Service CMFRI Cochin.

Gladwin, T.N. et. al. (1995), Beyond eco-efficiency: towards socially sustainable business. Sustainable Development 3. pp-35-43.

Gopalan , U.K.(1980), " The Fishery Resources of Kerala and Their Exploitation ", Fisheries Crises and Policy Approach in Kerala , Proceeding of State level seminar held at Trivandrum on August 27,28,1987, PCO Centre, Trivandrum.

Gulati, Leela.(1979), Women and Technological Change, a Case Study of Three Fishing Villages, Working Paper No.99 Centre for Development Studies Thiruvananthapuram.

Gulati, Leela (1984), Fisherwomen on the Kerala Coast – Demographic and Socio-Economic Impact of a Fisheries Development Project, International Labour Organisation, Geneva

Gulland, J. A. (1983), Fish Stock Assessment. London, Wiley.208p.

Gulland, J. (1971.), The fish resources of the ocean. Oxford, Fishing News Books (Intl.).255p.

Gulland. J. A.(1974), The Management of Marine Fisheries, Seientechnica Publishers Bristol

Gunda B.(1984), Fish poisoning in the Carpathian Area and the Balkan peninsula (edited). The fishing Culture of the world. Studies in Ethnology, Cultural Ecology and folklore. Vol.1 Akademiai Kiado Budapest.

Haggan, N. (1998), Reinventing the tree: reflections on the organic growth and creative pruning of fisheries management structures. Reinventing Fisheries Management. T. J. Pitcher, Hart, J.B., & Pauly, D. London, Kluwer Academic Publishers: p20-29.

Hakim, Abdul. (1980), Mechanisation and Cooperative Organisation, their Impact on Traditional Fishermen. M Phil Dissertation Centre for development Studies Trivandrum.

Hannesson, R. (1995), Fishing on the High Seas: Cooperation or competition? Marine Policy 19(5): 5.

Hardy, A.(1959), The open Sea Vol.2, Collins London.

Hector, M.(1979), Overfishing an Economic Analysis, Journal of Agricultural Economics, Vol.3.

Henson S .Saquib, and D. Rajasenan. (2005), Impact of Sanitary Measures on exports of fishery products from India: The Case of Kerala. Agricultural and Rural Development Working Paper World Bank Washington D C

Hicks, J. (1932), The Theory of Wages, London, Mac Millian.

Hinrichsen, D. (1995), Coast in Crisis ". Issues in Science and Technology. Summer.

Huming. Yu.(1991), Fishery Management in P. R. China. Mar. Policy 15(1).

Ibrahim, P. (1992), Fishers Development in India, Classical Publishing Company, New Delhi.

International Union for the Conservation of Nature and Natural Resources (1980). "World Conversation Strategy: living resource conservation for sustainable development". (Gland : I.U.C.N.)

Iyer, Krishna H. et. al.,(1983), Comparative Economic efficiency of Fishing Trawlers of 9.82m (32 ft) 11m(36 ft) Operating along The Kerala Coast; Fish Technology News Letter , Vol.3

Iyer, Krishna H , Rajendran R. and Choudhury Roy R. L.(1968), Comparative Fishing Ability and Economic Efficiency of Mechanised Trawlers Operating along The Kerala Coast; Fish Technology News Letter , Vol.5

James, A. Crutchfield, and Arnold Zellner. (1962), Regulation of the pacific Halibut Fishery in R. Hamlisch (ed) Economic effects of Fishery Regulations, FAO

John, Valsala.(1976), The Marine Products Export Industry in Kerala Some aspects of structure and backward linkages, M Phil Dissertation Centre for development Studies Trivandrum.

John C Sainsbury. (1971), Commercial Fishing Methods- An Introduction to vessels and gears Fishing News Ltd London.

Joseph, K. M. (1973), Economics of Operation of the 17.5 M Indigeneous Steel trawlers along the Kerala Coast, Sea food Export Journal, Vol.7.

Kani. H.(1984), "Fishing with cormorant in Japan. In Gunda B Edited, The fishing Culture of the world. Studies in Ethnology, Cultural Ecology and folklore. Vol.1 Akademiai Kiado Budapest.

Kannan, K. P. (1999), "Poverty Alleviation as advancing basic human capabilities: Kerala, s achievements compared". Centre for Development Studies, Working Paper No.294, Trivandrum

Kaye, S. (2001), International Fisheries Management. The Hague, Kluwer Law International.280p.

Khan, A. (2002), WTO Arrangement on the application of sanitary and phytosanitary Measures : Issues and future Implications. Paper Presented in the national work shop on sanitary and phytosanitary measures , May, Tariff Commission, Dakha Bangladesh.

Klausen, A.M. (1998), Kerala Fishermen and the Indo-Norwegian Pilot Project, Allen and Unwin, London.

Klausen, A. M. (1968), Kerala's Fishermen and The Indo Norwegian Project, University of Forlaget, Oslo.

Korakandy, Ramakrishnan(1976), Some Aspects of Employment Organisation and Productivity in the Fishing Industry of Kerala- A Spatial Analysis Unpublished M Phil Dissertation Jawaharlal Nehru University, New Delhi.

Korakandy, Ramakrishnan(1977), Evolution of a new Capitalist Structure in The Fishing Industry, Sea Food Export Journal Vol.9

Korakandy, Ramakrishnan.(1994), Technological Change and The Development of Marine Fishing Industry In India- A Case Study of Kerala.

Krishnakumar, R. (1999), " Livelihood Issues A landmark Proposal". Frontline, Vol.16:No.02:Jan.16-29.

Kumar, Krishna S. (1980), Strategy and action Programme for a Massive Thrust in Fisheries Development and Fisheries Welfare in Kerala State (1980-83) Government of Kerala Thiruvananthapuram.

Kurien, J. and Willmann, R. (1982), " Economics of Artisanal and Mechanized Fisheries in Kerala: A Study on Costs and Earnings of Fishing Units", FAO/UNDP Publication, Working Paper No.34, Madras.

Kurien , J. (1987), " The Impact of New Technology Introductions into Fishing in Kerala", Fisheries Crises and Policy Approach, Kerala pp.69-98, Proceedings of the State level seminar held at Trivandrum on August 27-28, 1987, Seminar Committee Fisheries Research Cell, PCO Centre, Trivandrum.

Kurien, J. and Achari, T.R.T. (1988), "Fisheries Development Policies and Fishermen's Struggle in Kerala". Social Action Vol.38:1, pp15-36, New Delhi.

Kurien, J and Achari. T.R.T. (1989), "On Ruining the Commons and the Commoner- The Political Economy of Overfishing", Centre for Development Studies, Working Paper No.232 Trivandrum.

Kurien, J. and Achari, T.R.T. (1990), "Overfishing Along Kerala Cost- Causes and Consequences", Economic and Political Weekly, Vol.xxv,pp.2011-2018, Bombay.

Kurien, J (1991), " Ruining the Commons and Response of the Commoners : Coastal Overfishing and Fishermen's Actions in Kerala State, India", United Nations Research Institute For Social Development, Discussion Paper 23, pp 1-37, Geneva.

Kurien , J. (1994), "The Kerala Model: Its Central Tendency and Outlier", Paper Presented at the International Congress on Kerala Studies, Trivandrum.

Kurien , J. (1995), "Collective action for common property resource rejuvenation : The case of people artificial reefs in Kerala State, India", Human Organisation, Vol. No.54, No.2.

Kurien, J.(1998), "Property Rights Resources Management and Governance :Crafting an Institutional Framework for Global Marine Fisheries". Center fir Development Studies and South Indian Federation of Fishermen Societies.

Kurien , J. (2000), " Factoring Social and Cultural Dimensions into Food and Livelihood Security Issues of Marine Fisheries-A case study of Kerala State , India", Center for Development Studies. Working Paper No.299, Trivandrum.

Kurien, J. (2002), "Some thoughts on income generating activities for fishing communities in Kerala". Paper presented in the International Seminar on Income Generating Activities, Department of Applied Economics, CUSAT, India and IVO, Tilburg University, The Netherlands held at Department of Applied Economics CUSAT

Kurien, J. (1998), Small scale Fisheries in the Context of Globalisation. Paper Presented in the 9th Biennial Conference of the international institute of fisheries economics and trade at Tromso Norway.

Kurien, J. (1978), Towards understanding the fish Economy of Kerala State, Working Paper No.68, Centre for Development Study Trivandrum.

Kurien, J.; Jayakumar.(1980), Motorisation Of Traditional Canoes The Purakkad Experiment, Fisheries Research Cell, Thiruvananthapuram.

Lane, D. ; Stephenson, R. (1992), Fisheries Management Science: a framework for the implementation of fisheries management systems. ICES Journal of Marine Science. 56: p1056-1066.

Lane, D., and Stephenson, R. (2000), Institutional arrangements for fisheries: alternate structures and impediments to change. Marine Policy 24: 385-393.

Mathur, P. R. G.(1977), The Mappila Fisher Folk of Kerala, Kerala Historical Society Trivandrum.

Meany, T.F. (1987), "Resource Rent, Common Property and Fisheries Management An Economic Perspective", Paper Presented at FAO IPFC, Symposium on Exploitation and Management of Marine Fishery Resources in Southeast Asian RAPA/REPORT : 1987/10:552 p, Darwin.

Meynen, W. (1989), Fisheries Development, Resource Depletion and Political Mobilisation in Kerala: The problem of alternatives Development and Change, Vol.20

Nair, R. M. and Singh K. (1996), " The Marine fishermen's cooperative societies in Kerala: An exploratory study". Cooperative Management of Natural Resources. (edu. Singh, K and Ballabh, V.), Sage Publication India Private Ltd., New Delhi. Pp. 215-233.

Nayak, N. (1993), Continuity and Change in Artisanal Fishing Communities- A study of Socio-Economic conditions Artisanal Fishing Communities on South West Coast of India Following Motorisation of Fishing Crafts.

Noble. (1974), Fishery And Biology of Mackerel Rastre llinger Kangurata at Cochin. Biological Association Of India.

Panayotou, T. (1982), "Management Concepts for Small – Scale Fisheries" Economic and Social Aspects", FAO Fish. Tech. Pap. 228, Rome.

Panayotou, T . (1985), Production Technology and Economic Efficiency : A Conceptual Framework P. 95-100. In T. Panayotou (ed.) Small-scale Fisheries in Asia, Socio- Economic Analysis and policy, International Development and Research Centre, Ottawa.

Panikkar, P. G. K. and Soman, C.R.(1984), Health status of Kerala: Paradox of Economic Backwardness and Health Development. Center for Development Studies, Trivandrum.

Panikkar, K. K. P.et. al., (1990), "A study of the Economics of different fishing techniques along Kerala coast with special reference to fuel efficiency". CMFRI, Cochin.

Panikkar, K. K. P. and Alagaraja. (1981), Socio Economic Status of Fishermen Community of Calicut Area Marine Fisheries Information Service, CMFRI Cochin.

Pauly, D. ; Christensen,; V. Guenette (2002), Towards sustainability in world fisheries. Nature 418, P 689-695.

Pillai, V.R. (1959), A study Of the Economy of the fisher folk of Kerala, Economic Research Council Thiruvananthapuram.

Platteau, J. P. (1984), The Drive Towards Mechanisation of Small-scale Fisheries in Kerala: A Study of the Transformation of Small-scale Fisheries in Kerala: A Study of the Transformation process of Traditional Village Societies, Development and Change. 15, (1): 656-103.

Platteau et, al., (1979), Credit and Indebtedness among the marine fishermen of South Kerala FUCID/ISI joint Project report. Namur.

Pomeroy, R. (1991), Small-scale Fisheries Management and Development: Towards a community Based Approach. Marine Policy, January, 39- 48

Prakasam, M. S.(1974), Impact of Mechanisation on Fishermen, Voluntary Action, Vol.14.

Prakasam, M. S.(1972), Socio- Economic Metamorphosis of The Arayans. Journal of Social Research, Vol.15.

Rajan, J. B. (2002), "Employment diversification of fishing community : potentials, problems and possibilities". Paper presented in the International Seminar on Income Generating Activities. Department of Applied Economics, CUSAT, India and IVO, Tilburg University, The Netherlands held at Department of Applied Economics, CUSAT.

Rajasenan, D. and Sankaranarayanan, K. C. (1988), "Seasonal and temporal Behaviour of marine fish landings in Kerala. Its economic effects". Asian Economic Review, Vol.XXX, No.3, Asian Economic Review, Hyderabad.

Rajasenan, D. (1989), " Fishery Crisis in Kerala", Economic Times, 12th August, publishing from Bombay.

Rajasenan, D. (1996), "Resources depletion and fishery management – the Kerala experience". India Manager. VOL.XXII, No.1, January-March, Cochin.

Rajasenan, D. (1999), Modernity Vs tradition and the question of Sustainability: the changing paradigms of the Kerala Marine fishing industry.

Rajasenan, D. (2001), Technology and labour process in marine fishery : the Kerala Experience. India Journal of Labour Economics 4(2).

Rajasenan, D. and Mahesh, R. (2002), Fisheries development-income and employment changes: A case of Kerala. Paper presented in the International Seminar on Income Generating Activities. Department of Applied Economics, CUSAT, India and IVO, Tilburg University, The Netherlands held at Department of Applied Economics, CUSAT.

Rajasenan D. (2003a), "Material and value chains of Kerala's Marine Fishery: quality and legal Standards in globalised Fishery Chains". Paper Presented in the International seminar on " Agroindustrial Global Community Chains: Implications for Business Strategies and policies in Kerala, September 18-19 jointly organized by the department of applied Economics, CUSAT and Development Research Institute (IVO), Tilburg University.

Rajasenan, D. and Groot, Gerard.(2005), Kerala Economy, Trajectories, challenges and Implications , Cochin University of Science and Technology.

Sahahra, D. B. S. and Kanakkan, S. (1993), "Costs and Earnings of Trawlers in Kerala-A Case Study" , Marine Fisheries Information Service No.122,pp 14-18 CMFRI Cochin.

Sathiadas, R. et. al., (1995), "Marine fisheries management for sustainable Development", Technology Transfer Series 2, CMFRI, Cochin.

Sathiadas. (1996), Socio Economic Structural Changes in Indian Fisheries and Coastal Zone Management, Proceedings of the seminar on Coastal Zone Management MS University Nagercoil

Sathiadas, R. and Venkataraman.(1981), Impact of Mechanized Fishing on the socio economic condition of fishermen of Sakthikulangara- Neendakara, Kerala CMFRI, Cochin.

Sathiadas R. and Venkataraman (1983), "Indebtedness and utilization of fisheries credit in Sakthikulangara and Neendakara Kerala a case study", Marine Fisheries Information Service, CMFRI, Cochin.

Schaefer, B. Milner. (1954), Some aspects of the dynamics of populations important to the management of Commercial Marine Fisheries

Schafer, B. Milner. (1957), "Some considerations of population dynamics and economics in relation to the management of commercial marine fisheries", Journal of the Fisheries Research Board of Canada, Vol., 14 No. 5.

Schaefer, Milner B.(1959), Biological and Economic Aspects of the Management of Commercial Marine Fisheries, Transactions of the American Fisheries Society.

Scott, Anthony. (1955), The Fishery: Objective of Sole Ownership. Journal Political economy Vol.63.

Silas E.G., M. J. George and T. Jacab. (1984), A review of the Shrimp Fishery of India- A Scientific Basis for the Management of the Resource, P. 83-133. In J. A Galland and P. J. P. Rothschild (eds.) Penaeid Shrimps, their Biology and Management. Fishing News Books Ltd., London.

Smith, H. D. (2000), The Industrialisation of the World Ocean. Ocean and Coastal Management 43: p11-28.

Smith, R (2003), The Role of Institutions in Building Frameworks to Measure Sustainable Development: The Canadian Experience. Workshop on Accounting Frameworks to Measure Sustainable Development. May 14-16, Paris. Environment Accounts and Statistics Division; Statistics Canada. OECD

Srivastava et. al.,(1991), Fishery Sector of India, Oxford and IBH publishing Company, New Delhi.

Srivastava, U. K. and K. Chidambaram. (1989), Marine Fisheries Development : An outlook at turn of the Century and Strategy for Exports. Journal of Agricultural Issues: 1: 93-110.

Tietenberg, Tom (2004), Environmental and Natural Resource Economics, Pearson Education Inc.

Turvey, Ralph. (1964), Optimisation and sub Optimisation in Fishery Regulations, American Economic Review

Vattamattom, Joseph.(1978), Factors that determine the Income of Fishermen- A Case Study of Poonthura Village in Trivandrum District M Phil Dissertation Centre for Development Studies Trivandrum.

Weeber, B. (1998), Ecosystem Management Principles: New Zealand's Marine Legal Framework. Seaviews Conference, New Zealand, Environment and Conservation Organisations. 9p

Yohannan, T. M. and Sivadas, M (1993), "Impact of Ring Net on the Mackeral Fishery at Calicut", Marine Fisheries Information Service No. 119, pp 1-3, CMFRI, Cochin.

Yohannan, T. M. and Sivadas, M (1993), "Marine Fisheries In Kerala", Marine Fisheries Information Service No. 160.

Reports

Babu paul D.et.al., (1982), Reports of Committee to study the Need for Conservation of Marine Fishery Resource During Certain Seasons of the year and Allied Matters, Submitted to the Government of Kerala, Trivandrum.

Balakrishnan Nair et. al., (1989), Reports of the Expert Committee on Marine Fishery Resources Management in Kerala, Submitted to Government of Kerala, Trivandrum.

Balakrishnan Nair et. al., (1991), Reports of the Expert Committee on Ban on Monsoon Trawiling in Kerala, Submitted to Government of Kerala, Trivandrum.

Bostock. T. GreenHalgh, Paul Kleih. U. (2004), Policy Research Implications of libaralisation for developing Countries. Synthesis Report Natural Resource Institute University of Greenwich Canada.

CIESIN, Centre for International Earth Science Information Network (2003), Environmental Treaties and Resource Indicators (ENTRI) website. Palisades, NY: CIESIN. Cited from http://sedac.ciesin.org/entri/

CMFRI (1987), An Appraisal of Marine Fisheries of Kerala. Special Publication Number 35, CMFRI, Cochin.

Directorate of Fisheries. (1969), Master Plan for Fisheries Development. Kerala State Fisheries Directorate Trivandrum.

FAO, (1995), "Precautionary approach to fisheries Part-1 guidelines on the precautionary approach to capture fisheries and species introduction" FAO Fisheries Technical Papes 350/1 FAO Rome.

FAO, (1998), The Japanese Sea Food Market, Globefish Government of India (1971). Evaluation of The Programme of Mechanisation of Fishing Boats, Programme Evaluation Organisation, Planning Commission, New Delhi.

FAO, (2000), State of World Fisheries and Aquaculture (SOFIA). Rome, Food and Agriculture Organisation of the United Nations. 87p.

FAO, (2006), Forestry Management working paper; Sustainable Forest Management and Ecosystem approach; two concepts one goal. Working paper FM 25, FAO of UN Rome.

FAO, (2007), State of the World's Forests 1997. Food and Agriculture Organization of the United Nations.

Government of India .(1996), Handbook on Fisheries Statistics 1996, Ministry of Agriculture, New Delhi.

Government of Kerala. (1973), Department of Animal Husbandry, XI Quinquennial Livestock Census 1972, annexure VI, Schedule III, Trivandrum.

Government of Kerala. (1983), Kerala Fisheries Facts and Figures 1980. Department of Fisheries, Trivandrum.

Government of Kerala. (1991), Kerala Fisheries Fact and Figures 1990. Department of Fisheries, Trivandrum.

Government of Kerala. (1993), Evaluation Study on the Impact of Motoristion of Traditional Fishing Crafts, State Planning Board, Trivandrum.

Government of Kerala. (1996), State Planning Board, Agriculture Division Studies.

Government of Kerala. (2001), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2002), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2003), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2004), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2005), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2006). Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2007), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2008), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2009), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala. (2010), Economic Review, State Planning Board, Government of Kerala.

Government of Kerala (1982), Report on Thirteenth Quinquennial Livestock Census, Department of Animal Husbandry, Government of Kerala, Trivandrum, GoK (1983): Kerala Fisheries- Facts and Figures- 1980, Directorate of Fisheries, Government of Kerala, Trivandrum.

IUCN and WWF. (1998), Creating a Sea Change: The WWF / IUCN Marine Policy. London, UK., World Wildlife Fund and International Union for the Conservation of Nature.: 64p.

Kalawar, A.G. et. al., (1985), Report of Export Committee on Fisheries in Kerala, Submitted to the Government of Kerala, c/o Central Institute of fisheries Education, Bombay

Murari, et.al., (1996), Report of the Committee to Review Deep Sea Fishing Policy, Ministry of Food Processing and Industry, Government of India.

PCO/SIFFS. (1991), Motorisation of Fishing Units-Benefits and Burdens. SIFFS, Trivandrum.

Pearce, Davide W and J. J. Warford(1993), World without end : Economics Environment and Sustainable Development. Washington. D. C: World Bank.

Rajasenan, D (2009), Dynamics and institutions in community based fisheries resource management : A sustainable development option – A study of coastal Kerala, Centre for Rural Development and Appropriate Technology, Cochin University of Science and Technology, Kochi.

SIFFS. (1999), A Census of the Artisanal Marine Fleet of Kerala 1998. South Indian Federation of Fishermen Societies, Trivandrum.

Silas, E.G. (1992), Report of the Expert Committee on Ban on Monsoon Trawling in Kerala Government of Kerala.

State Planning Board. (1969), Comparative Efficiency of Fishing Crafts in Kerala, Government of Kerala Thiruvananthapuram.

State Planning Board (1971), Survey of Fishing Villages

UNEP (2002), Global Environmental Outlook 3. United Nations Environment Programme, Global State of the Environment Report. Nairobi. UNEP: http://www.grida.no/geo/geo3/english/index.htm.

UNEP (2003), GEO: Global Environmental Outlook United Nations Environment Programme 2003. http://www.grida.no/geo/

World Bank. (2005), Synthesis report on food safety and agricultural health standards for developing Country Exports, report No.31207 Washington DC.

WRI (1998) "Resources at risks : Diminishing returns : World Fisheries under pressure, World Resources 1998-99", World Resources Institute, Washington DC.

WTO. (1995), The results of the Uruguay round of multilateral trade negotiations. The legal text Geneva, WTO.

Ph.D.Thesis

Felice, Annie. (1980), Tradition and Modernity in a Fishing Community: Study of Technological Innovation in Fishing on the Fishermen of Vypeen Island

Korakandy, R. (1987), Technological Change and the Development of Primary Fishing Industry of Kerala - Study of Limited Growth, Ph.D. thesis, Submitted to Cochin University of Science and Technology.

Rajasenen, D. (1987), The Fishing Industry in Kerala- Problems and Potentials, Ph.D. thesis Submitted to Cochin University of Science and Technology.

Suja RamaKrishnan,(2003), Socio-Economic Issues and Sustainable Fishery Management. A Case Study of Kerala. Ph.D. thesis Submitted to Cochin University of Science and Technology.

Suresh Kumar, P. (1999), Technology and Labour Process: A Case Study on Fishing Industry in Kerala, Ph.D. thesis Submitted to Cochin University of Science and Technology.

Tavis William Potts, (2003), Sustainability Indicators in Marine Capture Fisheries, Ph.D. thesis Submitted to University of Tasmania.

Veron R (1998), Markets, Environment and Development in South India : Cultivation and Marketing of Pineapple and Cashew in Kerala. Ph.D. thesis Submitted to University of Zurich.

APPENDIX

NUMBER OF GEARS OWNED BY FISHERFOLK

Gear/ District	Trivandrum	Kollam	Alappuzha	Ernakulam	Thrissur	Malappuram	Kozhicode	Kannur	Kasargode	Total
Trawl Net	156	362	834	306	67	520	411	34	210	2900
Boat Seine	1287	35	119	29	87	108	46	0	61	1772
Fixed bag net	141	11	2	344	65	60	36	6	44	709
Drift net	2162	960	852	1556	52	177	362	327	127	6575
*Drift net (large)	13305	419	4172	8	221	795	1880	1293	1069	23162
*Drift net (medium)	48242	7990	7832	18	3164	8217	5769	8800	6727	96759
*Drift net (small)	18250	4203	20706	102	4007	14146	9524	3881	7676	82495
*Total Gilnet pieces	79797	12612	32710	128	7392	23158	17173	13974	15472	202416
Hooks and lines	7510	1147	66	122	0	128	821	125	24	9943
Long lines	1699	395	13	53	0	30	498	109	59	2856
Troll lines	7915	155	11	67	0	4	1	15	18	8186
Shore seines	775	13	350	686	21	361	842	63	191	3302
Scoop net	977	5	54	130	0	5	50	7	3	1231
Traps	23	9	6	0	0	3	0	1	0	42
Others	1112	7	399	278	154	411	265	52	73	2751

*No of pieces

Source: marine fisheries census,2005

TREND IN ANNUAL MARINE LANDINGS 1950-2007.

YEAR	PREBAN PEAK PERIOD 1950-1975	PREBAN PERIOD 1976-1987	POSTBAN PERIOD-1 1989-1999	POSTBAN PERIOD-2 2000-2007
1950	202047	-	-	-
1951	191032	-	-	-
1952	129345	-	-	-
1953	111999	-	-	-
1954	117034	-	-	-
1955	105457	-	-	-
1956	152213	-	-	-
1957	399926	-	-	-
1958	294655	-	-	-
1959	191375	-	-	-
1960	344605	-	-	-
1961	257494	-	-	-
1962	191421	-	-	-
1963	202380	-	-	-
1964	317974	-	-	-
1965	339173	-	-	-
1966	346744	-	-	-
1967	364829	-	-	-
1968	345301	-	-	-
1969	294787	-	-	-
1970	392880	-	-	-
1971	445347	-	-	-
1972	295618	-	-	-
1973	448269	-	-	-
1974	420257	-	-	-
1975	420836	-	-	-
1976	--	331047	-	-
1977	-	345037	-	-
1978	-	333739	-	-
1979	-	330509	-	-
1980	-	279543	-	-

1981	-	274395	-	-
1982	-	325367	-	-
1983	-	385817	-	-
1984	-	394372	-	-
1985	-	325536	-	-
1986	-	382791	-	-
1987	-	303286	-	-
1988	-	-	-	-
1989	-	-	647526	-
1990	-	-	662890	-
1991	-	-	564161	-
1992	-	-	560742	-
1993	-	-	574739	-
1994	-	-	540813	-
1995	-	-	531646	-
1996	-	-	572005	-
1997	-	-	574774	-
1998	--	-	542696	-
1999	-	-	507287	-
2000	-	-	-	604113
2001	-	--	-	671822
2002	-	-	-	678322
2003	-	-	-	608525
2004	-	-	-	601863
2005	-	-	-	558913
2006	-	-	-	598056
2007	-	-	-	586286

Source: compiled from cmfri.

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

Year	Total effort ('000 man hours)	Total Catch ('000 tones)	CPUE of Total catch Kg/Hour	Prawn catch 000 tones	CPUE of Prawn catch Kg/Hour.
1970	146	27	183	2	13
1971	276	51	186	11	40
1973	550	66	120	45	83
1975	1332	151	113	57	43
1980	4843	75	17	37	8

Source: (Sathiadas and Venkat981)

Catch and CPUE of prawns in mechanized trawling sector of Kerala

Year	Mechanized Prawn Catch	Mechanised effort (in Unit operation)	CPUE (kg/ day)
*1971	15904	124960	127
*1972	13617	73103	186
*1973	52102	113696	458
*1974	32084	152465	210
*1975	64520	218766	295
Average for the period	35645	136598	255
1st Pre ban period			
*1976	18028	112512	160
*1977	29761	224392	133
*1978	35533	375284	95
*1979	18262	143466	127
.$1980	40439	659130	61
.$1981	16309	345538	47
Average for the period	26389 (-26)	310054 (127)	104 (-59)
2nd Pre ban period			
.$1982	27403	656955	42
.$1983	23099	393000	59
.$1984	24941	319000	78
.$1985	23402	370000	63
.$1986	25065	402000	62
.$1987	47421	586000	81
Average for the period	28555 (-20)	454493 (233)	64 (-75)
1st Post ban period			
.$1988	49608	863000	57
.$1989	35402	595000	59
.$1990	34158	532000	64
.$1991	44515	553000	80
.$1992	39782	542240	73
#1993	35046	605727	58
Average for the period	39752 (12)	615161 (350)	65 (-74)
2nd Post ban period			
#1994	62096	724675	86
#1995	31220	508853	61
#1996	31024	474248	65
#1997	44093	689524	64
#1998	47261	606992	78
#1999	33666	486898	69
Average for the period	41560 (17)	581865 (326)	71 (-72)
3rd Post ban period			
#2000	45055	550671	81
#2001	52766	612134	86
#2002	56832	672156	84
#2003	56801	537286	105
#2004	56492	691135	81
#2005	49468	635236	77
#2006	53277	589518	90
Average for the period	52956	612591	86

Note : Figures in Parenthesis are percentage change over the initial peak period
Source: Complied from Kalwar, A. G. et. al. (1985).*
Source : Rajasenan, (2009).