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
maritime 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 penaeid 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)

<table>
<thead>
<tr>
<th>Year</th>
<th>Marine</th>
<th>Inland</th>
<th>Total</th>
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<tbody>
<tr>
<td>2001-2002</td>
<td>5.94</td>
<td>0.78</td>
<td>6.72</td>
</tr>
<tr>
<td>2002-2003</td>
<td>6.03</td>
<td>0.75</td>
<td>6.78</td>
</tr>
<tr>
<td>2003-2004</td>
<td>6.08</td>
<td>0.76</td>
<td>6.84</td>
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<tr>
<td>2004-2005</td>
<td>6.02</td>
<td>0.76</td>
<td>6.78</td>
</tr>
<tr>
<td>2005-2006</td>
<td>5.29</td>
<td>0.78</td>
<td>6.07</td>
</tr>
<tr>
<td>2006-2007</td>
<td>5.61</td>
<td>0.79</td>
<td>6.4</td>
</tr>
<tr>
<td>2007-2008</td>
<td>5.86</td>
<td>0.81</td>
<td>6.67</td>
</tr>
<tr>
<td>2008-2009</td>
<td>5.83</td>
<td>0.83</td>
<td>6.66</td>
</tr>
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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; Haggan, 1998). The Cod stocks off New

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 tonnes. 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
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 Sakhikulangara 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 Sakhikulangara-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 i.e. 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.