



## **Review on Fishery in Kerala Perspective**

Mohanty, Rajlaxmi

National Council for Applied Economic Research

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by

**Rajlaxmi Mohanty**

(email-[rajlaxmi.mohanty09@gmail.com](mailto:rajlaxmi.mohanty09@gmail.com))

National Council of Applied Economic Research  
New Delhi India

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### **Abstract:**

This paper investigates Kerala fishery sector and its impact on ecosystem, and socioeconomic impact of ban on fisheries on the fishing labour and their dependence on fishing as livelihood. The paper analyses the viability of various mechanized fishing units in the State of Kerala using different economic and financial indicators. The study aims to provide a background to fisheries in Kerala with focus on seafood export from the State using commodity, quantity, value and country wise data. The study also aims to map the flow of key export species from landing site to the port of dispatch in order to list the main factors that determines the seafood export chains in the state. The report ends with brief note on the degree of dependence of the poor within the fishing community on seafood industry and suggestions on improving the livelihood security of fish workers with resource conservation.

**Keywords:** Livelihood security, Resource conservation, ecosystem, export fish products

## Introduction:

Fisheries and aquaculture make crucial contributions to the world's wellbeing and prosperity. According to the FAO, Fisheries and Aquaculture Department 2012, in the year 2010, the total fisheries and aquaculture supply in the world was about 148 million tonnes of fish (with a total value of US\$217.5 billion) out of which about 128 million tonnes were utilized for human consumption. As, our study is based on Kerala perspective fishery, in the below table-1 represents production fish over the years, how marine and inland fishery fluctuate in global and national sphere.

Table 1 Total Fish production (Inland & Marine) Lakhs tonnes

Inland Production						
	2006	2007	2008	2009	2010	2011
World	98000000	100000000	102000000	104000000	112000000	115000000
India	37.55	38.45	42.07	46.39	48.1	50.7
Kerala	0.78	0.80	0.91	1.03	1.17	1.21
Marine Production						
	2006	2007	2008	2009	2010	2011
World	802000000	804000000	795000000	792000000	774000000	789000000
India	28.16	30.24	29.2	29.78	31.03	32.2
Kerala	5.59	5.98	5.86	5.83	5.70	5.60
Total production						
	2006	2007	2008	2009	2010	2011
World	900000000	903000000	897000000	896000000	886000000	904000000
India	65.71	68.69	71.27	76.17	79.13	82.9
Kerala	6.37	6.78	6.77	6.86	6.87	6.81

Sources: FAO Fisheries and Aquaculture and Department of Fisheries Kerala

The demand of fish and fishery products are growing globally and the Asia contributes the largest share in the global sphere. A closer look at the statistics shown in below table -2 indicate that the growth in the global inland capture fisheries is wholly attributable to Asian countries.

Table 2  
Inland capture fisheries production by continent and major producer

Continent/country	2004	2010	Variation 2004-2010
	(Tonnes)	(Tonnes)	(Tonnes)
Vietnam	3073600	5157600	20,84,000
China	2097167	2289343	1,92,176
India	527290	1468757	9,41,467

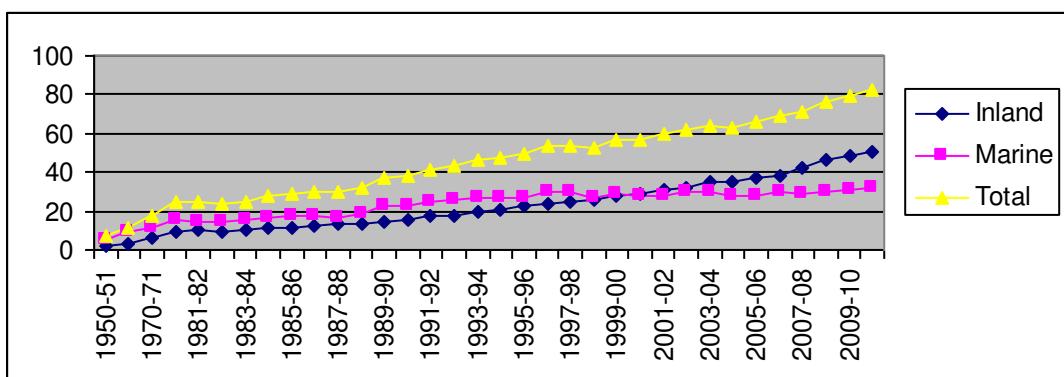
Bangladesh	732067	1119094	3,87,027
Myanmar	454260	1002430	5,48,170
<b>Asia</b>	<b>68,84,384</b>	<b>1,10,37,224</b>	41,52,840
<b>Africa</b>	<b>2332948</b>	<b>2567427</b>	2,34,479
<b>Americas</b>	<b>600942</b>	<b>543428</b>	-57,514
<b>Europe</b>	<b>314034</b>	<b>386850</b>	72,816
<b>Oceania</b>	<b>17668</b>	<b>16975</b>	-693
<b>World total</b>	<b>1,01,49,976</b>	<b>1,45,51,904</b>	<b>44,01,928</b>

Sources: FAO Fisheries and Aquaculture

### India Fisheries Development:

India is endowed with a long coast line 8129 kms, total fisheries export US\$2.85 billion and fisherman population around 14,485,354. India is one of the major fish producing countries in the world and is placed at third position in inland fish production. During 2010-11, India's total fish production was 82.9 lakhs tonnes of which 32.2 lakhs tonnes was from marine sector and 50.7 lakhs tones was from Inland sector respectively (fig-1). It is significant that whereas, the fisheries sector has contributed 1.07% of National GDP, 5.30% of the GDP has resulted from Agriculture sector. Per capita fish availability is 9.0 (Kg.), the annual export earnings from fisheries is 7,200 (crore) and employment generated through this sector is 14 million.

Fig-1 Fish Production of Marine and Inland in India. (1950-2011) (lakhs tonnes)

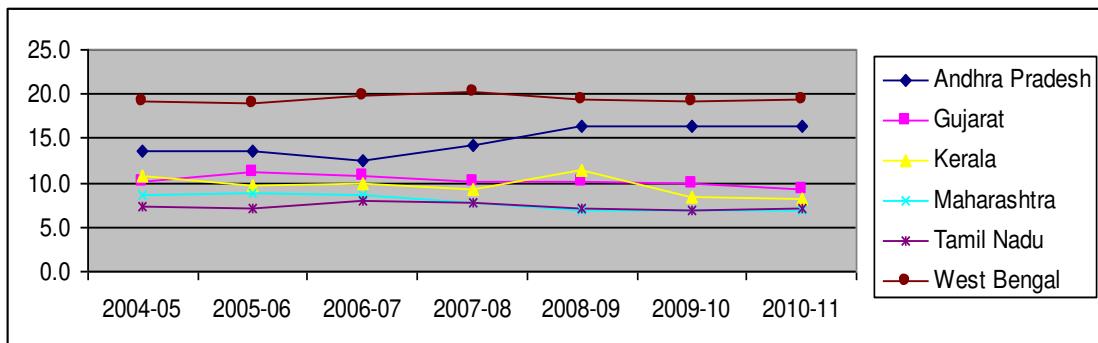


Souces: Indiastat.

The above trend shows that although overall fish production in India is rising, the marine fish production has been declining over the years as marine fisheries are passing through a critical phase due to the present rate of biodiversity loss and fishing practices throughout the world. However, it has not affected in land fisheries and the same is rising after the 2001-02.

A graphical presentation of top six fish producing states of India from 2004-05 to 2010-11 is shown below.

Fig-2 percentage share of top six fish producing states of India (lakhs tonnes)



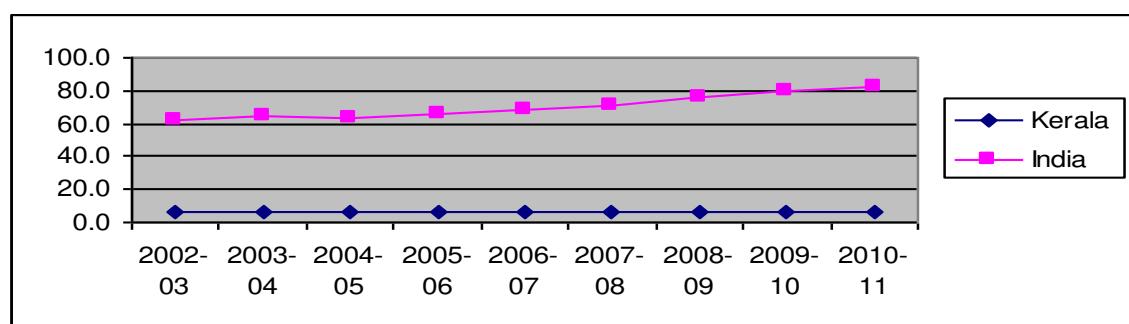
Sources: DEPARTMENT OF ANIMAL HUSBANDRY, DAIRYING & FISHERIES, Govt. of India.

The above fig-2 shows Andhra Pradesh and West Bengal are leading at the top fish producing states. In case of Kerala, it is noticed that though there is rise in fish production the year 2008-09, after that the production has progressively declined. In case of Tamil Nadu, Gujarat and Maharashtra there is also significant fall over the years.

### An Overview of the Fisheries Sector in Kerala

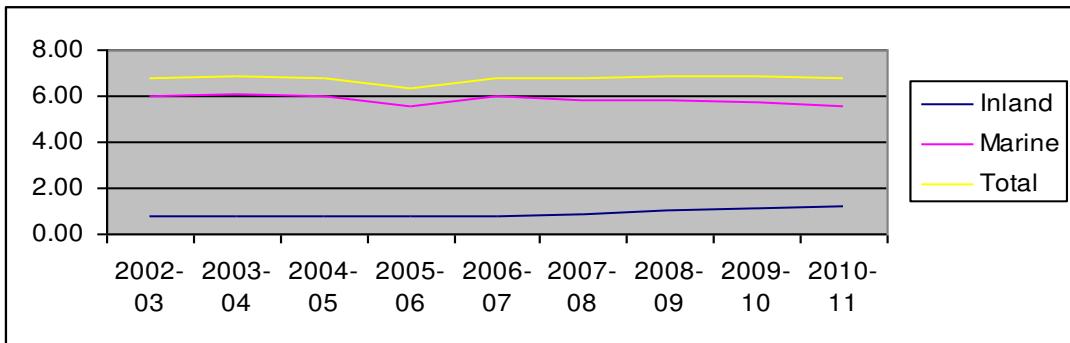
In Kerala, fishing industry occupies an important position in its economy. Kerala's share in the national marine fish production is about 20-25%. The water resources of the state comprise of coastline of 590 km length. Fisheries sector contribute 3% of the GSDP of the state. The share of Kerala is 8.2% to India on total fish production.

Fig-3 Total Fish production in India and Kerala from 2002-2011



The above Fig-3 represents, total fish production in Kerala is declining over the years, whereas in the national prospective, the total fish production of India is rising after 2006-07. Significantly, Kerala still occupies second highest contributor of marine fish after Tamil Nadu. However, it is noticeable that during 2010-11, 5.6 lakhs tonnes of marine fish were produced in Kerala showing decrease of 0.10 lakhs tonnes (1.75%) than the previous year. The below Fig-4 shows the inland fish production has risen from 2007-08, while the marine fish production tends to fluctuate.

Fig-4 Fish production in Kerala (2002-2011) in lakhs tonnes



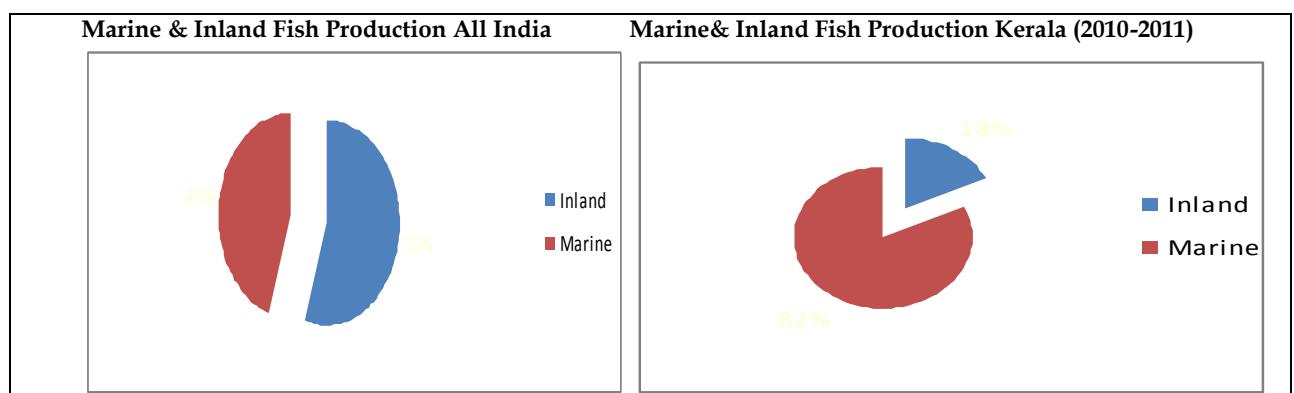
Sources: Department of Fisheries Kerala

### Economic Aspect:

#### Marine fishing in Kerala

Kerala is coastal state and is bordered on the west by the Arabian sea consisting rich marine flora and fauna. The share of marine fish production in Kerala contributes 82% of the total fish production of Kerala. On the contrary, India's marine fish production is 45% that contributes the total fish production. Gradually, over the years (shown the above fig-4) marine species are diminishing.

Fig -5 Percentage share of Marine & Inland Fish Production (2010-10)



Sources: Department of Fisheries Kerala

The main factors which are adversely affecting and causing decline in the marine fish production in Kerala over the years, may be on account of the following:-

- The global phenomena of loss of marine bio-diversity and consequent decrease in the fodder on which the marine fisheries are generally dependent for their survival,
- Water pollution and emission of affluent to the sea has also caused adverse effect on the overall health of marine fisheries,
- The coastline of Kerala connecting the Bay of Bengal and the Indian Ocean through the Palk Strait and across it constitutes one of the major sea routes and there are

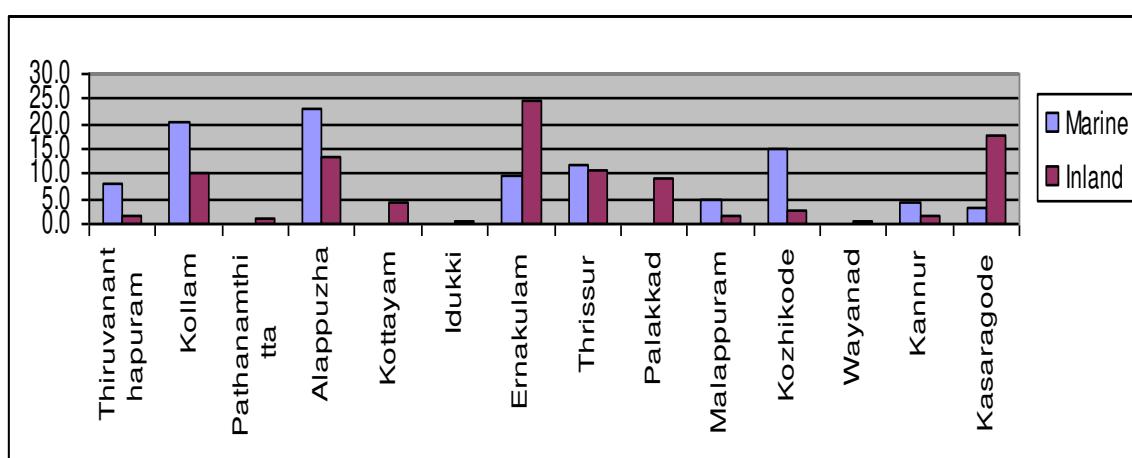
numerous instances of affluent emission and spillage from the Ships, which has affected the marine bio-diversity, thereby causing decline in the marine fisheries.

- d) Stagnation in the marine fisheries on account of high level of wasteful catch and destruction of egg bearing and juvenile marine fish.
- e) Above all, the over dependency on marine fisheries by local population, which has resulted in the excessive and indiscriminate fishing in the Kerala coastline. Due to the reasons that marine fisheries cannot be steadied and increased due to human factors such artificial breeding and fish cultivation, as is the case in Inland fishing. The health of marine fisheries is intrinsically linked with various natural phenomena and thus, to ensure the long term benefit to the marine fisheries, one has to eradicate the various environmental hazards presently being encountered.
- f) Fish farmers and their communities are also often exposed to more prolonged hazards such as the spread of fish disease, mining, industry and urbanization, which ultimately affect aquatic life in the sea.
- g) Some fishing techniques such as dredging and trawling cause widespread damage to marine habitats and organisms living on the sea floor.

Marine ecosystems are in global decline. The main reason is unsustainable fishing practices, which follow from the following factors: inappropriate incentives, high demand for limited resources, poverty, inadequate knowledge, ineffective governance, and interactions between fishery sector and other aspects of the environment (FAO 2002).

As Kerala share on marine's fishery is much higher than inland fishery, though marine's fishery is diminishing over the years, but it has the comparative advantage on marine fishery. Marine fish production is identified across the districts in Kerala.

Fig-6 District wise percentage share of marine and inland fish production of 2010-2011



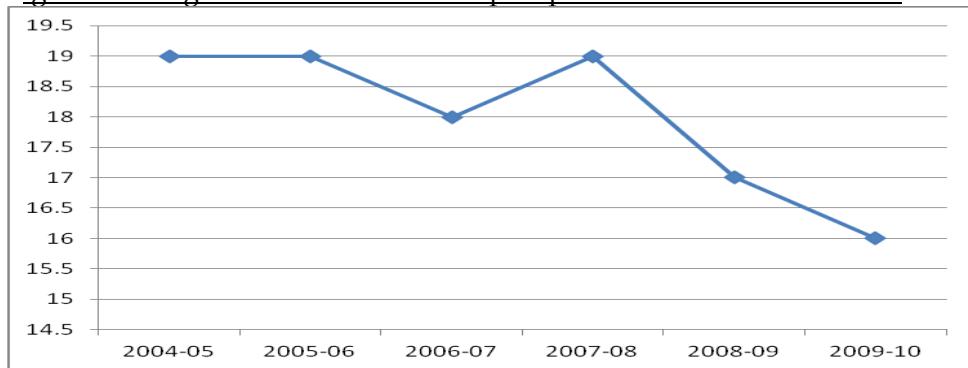
Sources: Department of Fisheries Kerala

The above Fig-6 shows that the share of marine fish production is highest in Alappuzha (23.1%) followed by Kollam (20.3 %) and Kozhikode (15.0%) respectively. On the other hand, the share of inland fish production is highest in Ernakulam (24.4%) followed by Kasaragode (17.8%) and Alappuzha (13.2 %) respectively. The above result signifies fish production (marine and inland) is highest in Alappuzha. As the Alappuzha is situated 62 kilometres (39 miles) to the south of Kochi and 155 kilometers (96 miles) north of Trivandrum. It is geographically surrounded by freshwater rivers and Arabian sea, the length of the coast line is 82 km also the geographical climate and better transport access by air, rail, road enhance the city.

#### Export of Marine Products in Kerala

During 2010-11 the share of marine fish production to the total fish production of the state was 82% and is one of the major contributors to foreign exchange earnings through sea food exports. The state has two major fishing harbours at Cochin and Sakthikulangara and about 220 fish landing centres distributed over 335 fishing villages. Of the 10 lakh active fishermen spread over nine coastal states, 2.5 lakh fishermen belong to Kerala. There are some predominant species which are more in demand like sardine, mackerel, ribbon fish and shrimps (most exported items) are produced in Kerala coast. Some migratory marine fish like Pelagic fin fishes (contributes total fish landings-71%), Molluscs, Demersal fin fishes and Crustaceans are the most sellable item in the international market. During 2009-10 Kerala export on marine products 15.8% to India's marine products. The percentage share marine export product of Kerala over India is decreasing. This is shown in the below Fig-7.

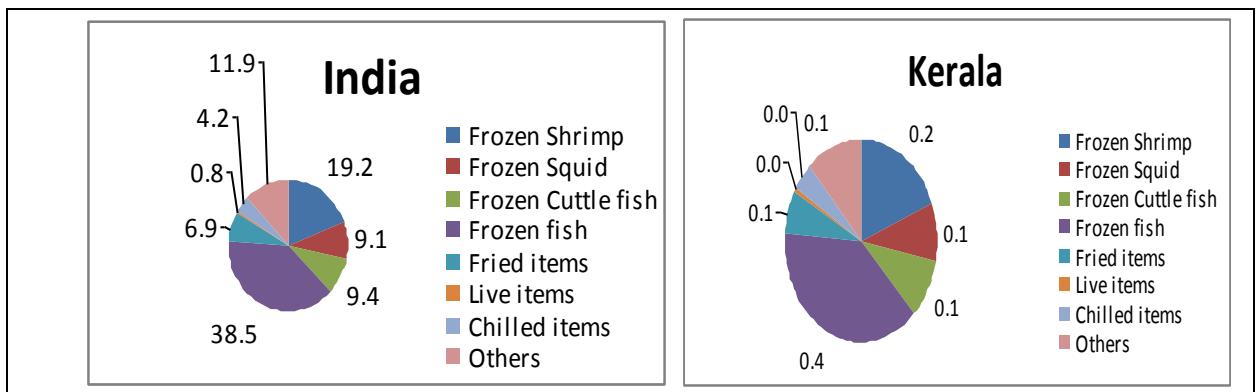
Fig-7 Percentage share share marine export product of Kerala over India



Sources: Department of Fisheries Kerala

Fish is a globally traded good. For many developing countries, it is an important net export good, but significantly, in most of these countries management is poor. The most valuable component of seafood trade is shrimp, with world trade in 2000 valued at more than \$10 billion (FAO 2002b). In India major export in marine products is frozen fish to frozen shrimp.

Fig-8 Percentage share of item wise export of marine products during 2009-10



Sources: Department of Fisheries Kerala

This is shown in the above Fig- 8 that the most traded item is frozen fish, notwithstanding that shrimps, which are most sellable in international market, are also found in abundance in India including the Kerala coastline. Though shrimps can be bred in the coastal climate like in Kerala and Tamilnadu, due to excessive by catch, pollution, adversely affecting the shrimp farming in India.

Shrimp farming is an [aquaculture](#) business for the cultivation of marine shrimp or prawns for human consumption. The total global production of farmed shrimp reached more than 1.6 million tonnes in 2003, representing a value of nearly 9 billion U.S. dollars. About 75% of farmed shrimp are produced in [Asia](#), in particular in [China](#), [Thailand](#) and in the [Philippines](#). The other 25% are produced mainly in [Latin America](#), where [Brazil](#) is the largest producer. The largest exporting nation is [Thailand](#)

### Aquaculture in Kerala

The Agency for Development of Aquaculture, Kerala (ADAK) was established in 1989. Kerala government has also launched matsyakeralam scheme with the objective of increase in export of fish and fish products, to create new employment opportunities in rural areas through the development of inland and brackish water aquaculture. The brackish water shrimp culture is practised in Pokkali fields of Kerala. Integration of rice-fish farming gives high return to the farmers. It also helps to improve rice yield due to organic fertilisation through fish excreta and also control of unwanted algae. Yet, marine aquaculture needs to strengthen, especially for shrimps farming. Role of Aquaculture should be introduced in Kerala for high demand on marine product like shrimp.

### Vision for fish farming

Our vision on fishery should be sustainable utilization of natural resources on development of fisheries sector, both marine and inland. To achieve the desired economic growth in fishery, food & nutritional security and socio-economic development for fisherman should be strengthened. Some studies say, there should ban on mechanized fishing or commercial fishing to protect the ecosystem. But in the

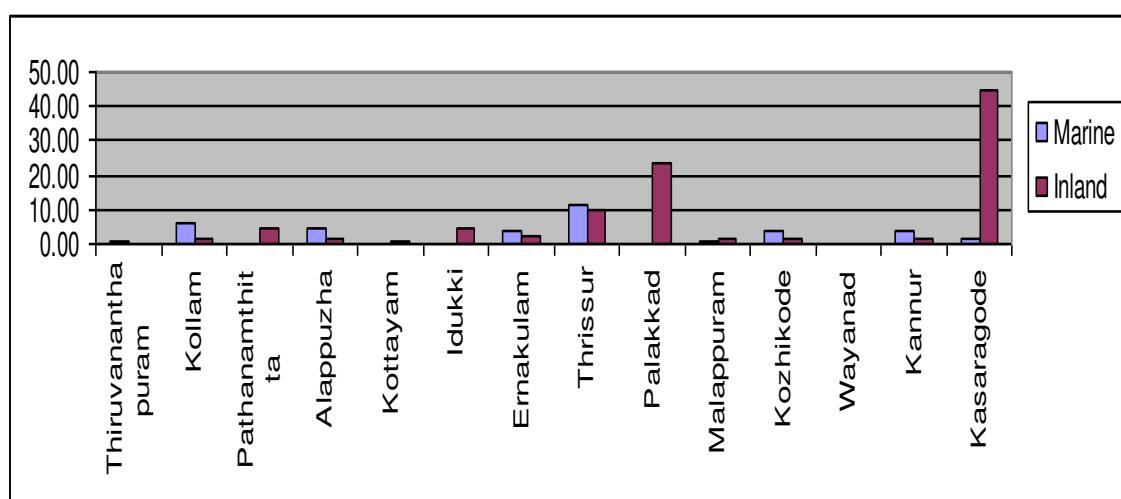
perspective of Kerala, an equitable approach is required considering most of the rural population in Kerala depend on fishing for their livelihood.

### **Social Aspect:**

#### **Kerala fishing communities**

The fishing communities of Kerala also depend on seafood exports for their livelihood. Fishermen population in Kerala is about 11.52 lakh out of 33.38 million of the total population. The productivity (total quantity of fish produced to total labour used-active fishermen) of each districts of Kerala are identified shown in Fig-9.

Fig-9 District wise productivity of marine and inland fish in Kerala (2010-2011)



Sources: Department of Fisheries Kerala

The above figure shows, Palakkad and Kasaragode have highest productivity in Inland fish production. Relatively, Kollam and Alappuzha have highest productivity in Marine fish production. The productivity in Thrissur both Inland and Marine fish production is quite impressive.

Modernization and mechanization of the fisheries in Kerala can improve productivity in the fishing sector. The Government of India and other agencies have already put forces in improving Kerala fishing scenario, by implementing schemes and programmes like Housing Scheme, Matsyakeralam, Insurance cover for fishing implements, Pension to fishermen, modernisation of country crafts, purchase of fishing nets, saving cum relief scheme for the poor fishermen.

Kerala can achieve top position in fish export globally by bridging the gaps between the traditional fishing sector and trawling sector. Though, shifting of focus to export oriented fisheries, would result in marginalization in traditional fishing, it is would be more relevant to understand that such a shift shall also bring modernization in fishing techniques, which would ultimately improve the socio-economic life of the

traditional fishermen and further boost fishing as a source of long term sustainable livelihood and food.

The Kerala Swathanthra Malsya Thozhilali Federaton (KSMTF) was established by the Kerala fishermen union. The basic objective to establish KSMTF is to work for the socio-economic and political development and education of fishermen community in Kerala, who are involved in fishing and marketing of fish both of inland and marine species and to work for the rights and benefits of fish workers.

- 1) Thus, appropriate policy measures and legal framework for the livelihood security of fishermen in the mechanized sector or commercial sector should be framed. Traditional fishermen should be trained with use of trawling nets, i.e. (train them with modern technique within the traditional sector).
- 2) Export of marine products should be done in consonance with environmentally sound management programmes.

Some of the good practices done by countries in relevant exports on marine products:

### **VIETNAM**

In 2011, the total export volume of Vietnam seafood is estimated to hit over 1.5 million MT. But in the other hand, there is huge shortage in raw material in domestic market, due to hiking input costs for aquaculture, disease and bad weather the supply of raw fish has declined. In order to achieve the export of marine fish for the satisfaction and requirement of international markets, VASEP proposed some solutions as follows:

#### *Enhancing domestic fishery production and processing capacity*

- Focus on planning and developing aquaculture, environmental protection and consistent management of quality of seed, feed, veterinary drugs in farming shrimp, pangasius and other species to ensure quality and food safety and hygiene.
- Reduce 10-20 percent of post-harvest losses to increase supply of raw material for processing.
- Apply modern technologies in aquaculture to raise productivity and quality and lower the price of raw material; increase value-added products with highly economic value in accordance with consuming trend in international markets.

### *Boosting raw material import*

- Vietnam needs to hold initiative in attracting foreign investors who bring raw material into Vietnam to process. Enterprises desire to raise raw material import from US\$500 million at present to US\$2.5- 3 billion per year by 2020 to take advantages of huge processing capacity (over 2.5 million MT per year), the good food safety and hygiene conditions in the region, plentiful and skilful source of labour with low cost.
- Along with importing wild-caught fish (squid, octopus, marine shrimp, marine finfish), Vietnam needs to speed up importing farmed fish (shrimp, finfish) from other countries with low competitiveness in processing industry.
- Promote tight cooperation in catching, aquaculture with foreign countries, ensure raw material preservation before repatriating Vietnam to process and re-export.

### **Challenges in quality, food safety and hygiene and competitive capacity**

- Importers are applying stricter requirements in food safety and hygiene. Controlling food safety and hygiene in production chain by enterprises to ensure quality, food safety and hygiene are causing barriers to Vietnam seafood development. There are some following suggestions by VASEP.
- The government needs to support enterprises in establishing a testing system in production chain, ensuring consistence in applying standards, practices in food safety and hygiene management from raw material producing, sourcing, transporting and processing to export.
- The government should raise awareness of farmers, enterprises and processors for their responsibilities in ensuring quality, food safety and hygiene. Administrative procedures must be simplified to save time and costs in testing exported consignments by competent authorities.
- The government should guarantee a sound banking and credit system to support and encourage farmers and fishermen to expand their production and ensure quality of raw material.

**JAPAN**

## **Food safety**

In Japan, distrust of regulatory food safety has been rising among the public. People's growing concern has been triggered by various problems, including the occurrence of bovine spongiform encephalopathy, commonly known as mad cow disease, in 2001. Against this background, Japan has enacted the Food Safety Basic Law, a comprehensive law to ensure food safety to protect the health of the public. In the wake of the development of the basic law and other related laws, Japan has introduced a risk analysis approach (described above) to the national food safety control programme work. The Food Safety Basic Law assigns responsibility for risk assessment, and the Food Sanitation Law and other related laws identify who are responsible for risk management.

### **Food Safety Commission established under the Food Safety Basic**

#### *Climate change and food safety*

The earth's climate is changing, and this may influence the safety of food harvested from marine and freshwater environments. There are two main areas that have the potential for change: microbial pathogens, and harmful algal blooms.

#### **Microbial pathogens**

Climate change is expected to accelerate the water cycle with increased precipitation in the tropics and at high altitudes, drier conditions in subtropics and increased frequencies of extreme droughts and floods. Events such as floods are likely to disrupt sanitary infrastructure around fish harvesting and aquaculture sites, affecting fish safety. The presence of *Salmonella* in rivers and the marine environment has been related to torrential rains and storm-generated flows, and the pathogen could thus reach aquaculture sites or contaminate fish in coastal waters. Outbreaks of illness caused by *Vibrio parahaemolyticus* in shellfish in Chile have been related to the arrival of warm equatorial water during El Niño events.

#### **Harmful algal blooms**

Harmful algal blooms are a completely natural phenomenon that have occurred throughout recorded history in all parts of the globe. Whereas wild fish stocks are free to swim away from problem areas, caged fish and shellfish are trapped and, thus, can suffer mortalities and/or become toxic. Of greatest concern to human society are algal species that produce potent neurotoxins that can find their way through shellfish and fish to consumers, where they cause a variety of gastrointestinal and

neurological illnesses. Worldwide, almost 2 000 cases of food poisoning from consumption of contaminated fish or shellfish are reported each year. Some 15 percent of these cases prove fatal. In the past three decades, harmful algal blooms seem to have become more frequent, more intense and more widespread, in part ascribed to climate changes. The seafood industry (capture and farmed) must monitor for an increasing number of harmful algal species in the water column and for an increasing number of algal toxins in seafood products. Global climate change is adding a new level of uncertainty to many seafood safety monitoring programmes.

## **THAILAND**

### Canning of shrimps

Thailand is the highest exporter of shrimp. Thailand has been able to achieve this, merely by not producing shrimps, but also by making them value-added products undertaking processing activities such as filleting and canning. Private-sector companies appear unwilling to invest in more sophisticated production equipment in developing countries if their activities are not supported by the public infrastructure.

Companies can and do relocate processing to developing countries including to take advantage of lower labour costs where they have confidence in the local administrative systems (including safety and quality management regimes). Integrated supply chains mean closer collaboration with import markets. This could also mean opportunities for transfers of technology and expertise to developing countries.

Some countries have introduced state-mediated certification procedures to certify their safety and environmental credentials, in particular in their aquaculture industries.

This can be seen as a proactive strategy to respond to safety and quality demands from import markets by promoting themselves as suppliers of safe and high quality fish and seafood, e.g. Thai Quality Shrimp

- 3) Undertaking training programme on sea food quality assurance, microbiological methods, value added products preparations (such as fish pickles, cutlets, fingers, papads), hygienic handling of fish, fabrication of nets, skill development training for rural fish man should implemented.
- 4) High value marine product should be given more priority in farming for export purpose Aquaculture farming technique from Thailand (transfer of technology) for all shrimps species should be implemented, like artificial pond near the sea coast.

- 5) Although, for inland and ornamental fisheries aquaculture is quite active in India, as well as in Kerala. But more focus is required to be given on quality of farming.
- 6) R& D studies in fishery should be enhanced so that rural fishermen could be trained to adopt and utilize such technology in fishing without damaging the environment. Also, on energy-saving technologies carried out by public-private sector initiatives to commercialize economically viable on conventional fishing methods.
- 7) Maintaining the harbours and fish landing center, it is seen the port areas are always over crowded with ships that directly or indirectly affect the fish landing.
- 8) Post-harvest Practices and Trade Responsibilities should be encouraged.
- 9) Free trade Agreement (FTA)s should encouraged in Kerala's fish farming, though traditional fishermen opposed the imports from other countries, but some other alternative should be made for the fisherman livelihood.

### **Environment Aspect:**

#### **Actions to be undertaken on loss biodiversity in sea:**

As we know for our existence, over the years, we have been dependent relied on the oceans – for food, as a waste dump, for recreation, for economic opportunities and so on. With more than half the world's population now living within 100 kilometers of the coast, it's not surprising that our activities are taking their toll on the sea and its overall biodiversity. Human impacts have increased drastically with rapid population growth, substantial developments in technology and significant changes in land use, over-fishing, pollution etc. Further, species which are introduced to marine environment due to human factors either intentionally or accidentally (introduced species) also pose threat to our marine environment. Due to the above reasons, our marine life are threatened or endangered.

Conservation and utilization of both inland and marine fisheries depend on responsible fishing practices. The marine fish catch is stagnating globally, therefore, it is imperative to utilize maximum amount of available resource. In Kerala, species like White fish and White snappers, Cat fish, Sharks and Ribbon fish are extinguishing day by day.

#### **Therefore, our aim should be:**

- 1) Foster best practices in recreational fishery i.e. it needs to recognize that freshwater recreational fisheries differ from commercial fisheries and aquaculture and that, they need to be dealt with in a way that reflects this difference.

- 2) Role of recreational fisheries in sea should be minimized as that affects the marine life and on the contrary and in turn the same can be encouraged in inland fishery.
- 3) The type of fisheries which act as a catalyst to the expanding threats, such as habitat manipulation and destruction, resource overexploitation, and loss of biodiversity etc. should also be minimized.
4. Some of the good practice done in countries should be adopted like follows:-

In New Zealand, fisheries are managed by a quota system that sets catch limits for commercially important species and aims at sustainable management of our fish stocks. The Royal Forest and Bird Protection Society (NZ) publishes the Best Fish Guide to try and encourage us to make more sustainable choices when purchasing seafood. The list evaluates fish stocks and by catch levels and the fishing methods used.

## Possible solutions

### Lower operational costs while fishing

The fishing sector should strive to further lower its fuel consumption and decrease ecosystem impacts. Despite a growing number of initiatives and experimentation with energy-reducing technologies, there is currently no viable alternative to fossil fuels for mechanically powered fishing vessels. However, it is well demonstrated that, through technological improvements, gear modifications and behavioral change, the fishing sector can substantially decrease the damage to aquatic ecosystems, reduce GHG emissions (which is a legal obligation for governments under existing international conventions) and lower operational costs for fuel without excessive negative impacts on fishing efficiency.

### Solutions by fishing methods

#### Demersal trawling

It is also known as bottom trawling or dragging, is one of the most widely used industrial fishing methods around the world. It involves towing a large net across the seabed targeting the species that live on the sea bottom. However, bottom trawling has been identified as one of the most difficult task to manage in terms of bycatch and habitat impacts. There are many techniques and operational adaptations available to reduce the drag and weight of the bottom trawl gear and thereby, to reduce significantly fuel consumption and sea-bed impacts without marked decrease in the catch of the target. Fuel savings of 25–45 percent and gear-drag reductions of 20–35 percent have been reported.

## Scientific Technology:

A new semi-pelagic low-impact and selective trawl gear (CRIPS-trawl) that is under development in Norway gear designs. The new trawl design (CRIPS-trawl) has a reduced bottom contact and less drag compared with a conventional bottom trawl. The trawl doors and the footrope of the trawl are lifted off the bottom. The front panels of the trawl are replaced by herding ropes, and the aft parts are made of square-mesh netting. This will reduce the drag of the trawl while still maintaining the stimulation for herding the fish into the codend. The extension piece and the codend are made of four panels and include a net camera and various selection devices to release unwanted fish from the trawl. The four-panel design improves the stability of the trawl and the selection devices. The net camera gives real-time information of the fish species and sizes entering the codend, and allows the skipper to make informed decisions regarding how to continue the fishing process. The trawl may also be fitted with an active mechanism to release unwanted catch. The trawl concept also includes a cable connection from the vessel to the trawl headline. The cable will carry the video signal from the net camera and acoustic sensors, and it will also increase the vertical opening of the trawl. The concept will later also include an independent system to adjust the distance of the doors from the sea bed.

The objectives is to reduce the amount of tickler chains, avoid excess weight in the beams, and use other stimuli (e.g. electric pulses) as an alternative to chains to scare the target fish off the bottom and into the net. The use of acoustics, light or any other additional stimuli to enhance encounters by target species within the catching zone of trawl nets is worth exploring.

The use of improved location and targeting of fish with the help of **electronic seabed mapping tools** and **integrated global navigation satellite systems** has resulted in avoidance of sensitive bottom habitats and helped to minimize fishing effort and fuel consumption.

**Multibeam acoustic technology**, widely used in sea-bed exploration, has been successfully applied, for example, to mapping scallop beds off the east coast of Canada, thereby substantially reducing the time required to locate the grounds and the actual fishing time.

## Bottom seining

Bottom seining (Danish, Scottish and pair seining) is generally considered to be a more environmentally friendly and fuel-efficient fishing method than bottom otter trawling. The gear is lighter in construction and the area swept is smaller than in bottom trawling. Moreover, because there are no trawl doors or heavy ground gear, there is less force on the sea bed. The light gear and low hauling speed mean that fuel usage can be significantly lower than for a comparable trawling operation. Bottom seine nets are generally also regarded as having low impact on benthic invertebrates. However, the high bycatch of both undersized individuals of the target species and individuals of non-target species can be a problem in some seine fisheries.

### Trap-net

Trap-nets are passive fishing gear that are usually set on traditional sites in the path of migrating fish in relatively shallow coastal waters. Leader-netting herds and guides fish into a holding chamber or pound where they are entrapped. The pontoon trap is a more recent innovation and offers various advantages compared with traditional trap-nets such as being easy to transport, handle and haul, adjustable in terms of size, target species and capture depth, as well as being predator-safe. Future developments may include large-scale, ocean-based fish traps together with the technology to attract fish. Modern trap-net fisheries can be energy efficient, flexible, selective and habitat-friendly, providing catches of high quality as the catch is usually alive when brought aboard the vessel. Live capture provides the operator with a greater number of options to add value to the catch. However, designs and practices need to be developed to prevent the entangling of non-fish species in netting and mooring ropes of the trap.

### Pots

A pot is a small transportable cage or basket with one or more entrances designed to allow the entry of fish, crustaceans or cephalopods, and prevent or retard their escape. Pots are usually set on the bottom, with or without bait. While pot fishing vessels in general have low fuel use, some pot fisheries have high fuel use owing to the need to tend fleets of many pots and lifting them more than once a day, necessitating travelling at high speed over long distances. Pots are extensively used in the capture of crustaceans such as lobster and crab.

Recent tests with **collapsible pots** have shown promising results for Atlantic cod in Canada and for pink cusk-eel (*Genypterus blacodes*) in Argentina. A **floating pot** developed in Scandinavia provides another example of an innovative pot design that has shown significant potential. Floating the pot off the bottom allows the pot to turn with the current so the entrance always faces down current, resulting in a higher catch rate of cod. It also avoids non-target catch of crabs and may also reduce the seabed impacts compared with a pot sitting on the bottom.

### Hook and line

Hook and line refers to gear to which fish, squid or other species are attracted by natural or artificial bait or lures placed on a hook, on which they are caught. Wide variations in hook and line configuration and their mode of operation have made them an effective gear type for a wide variety of species. It is a versatile fishing method, employed by a wide range of vessels from artisanal boats to large mechanized longliners. Hook and line fishing is generally considered an environmentally friendly but labour-intensive fishing method that catches fish of high quality. Fuel consumption in these fisheries is comparatively low although it can increase significantly depending on the distances vessels have to travel to and from the fishing ground (e.g. coastal hook and line fisheries versus high seas tuna longlining). Longline fishing may cause the incidental mortality of seabirds, sea turtles and sharks, many of which are either protected or endangered. But this system is reported to have led not only to a reduced mortality level of sea birds but also to higher catch rates of the target species. There are several other mitigation measures capable of reducing the likelihood of incidental bycatch of seabirds and sea turtles.

### Gillnetting

Bottom-set gillnets, entangling nets and trammelnets are widely used, and improved materials and techniques have allowed the expansion of such gear to rougher grounds (including wrecks and reefs) and deeper waters. Gillnetting is a very versatile and flexible fishing method but can also be labour-intensive. Except with trammelnets, the size selectivity for finfish is generally good, but species selectivity can be poor. In addition, fish are often injured and die during capture; accordingly, catch quality is typically not as good as with pots, traps and longlines, although gillnets may also give catch of good quality when the time the net is left in the water to fish is short.

The above scientific method presents the environment fishing technique in marine prospective. On the contrary, the demand on freshwater are expected to double by 2050 as the world population reaches 9 billion people. Inland waters are characterized by strong competition for freshwater resources from sectors outside the fisheries and aquaculture sector. The continued use of freshwater as a locale for fish production, as

industries and agriculture grow, can be promoted through technological change. There are encouraging signs of this, such as the development of improved fish passes that allow riverine fish to migrate past hydroelectric facilities and improvements in irrigation systems that increase their efficiency.

### *Interactions between fisheries and aquaculture*

The key features of the strategy proposed for implementing an ecosystem approach to fisheries and to aquaculture can be summarized as:

- Adopting participatory approaches at all levels of the planning and Implementation steps;
- ensuring that all the key components of the fishery/aquaculture system are considered, including those related to the ecological, social, economic and governance dimensions, while also taking into account external drivers (e.g. changes in the supply of and demand for inputs and outputs; climate change; and environmental disturbances);
- encouraging the use of the “best available knowledge” in decision-making, including both scientific and traditional knowledge, while promoting risk assessment and management and the notion that decision-making should take place also in cases where detailed scientific knowledge is lacking; promoting the adoption of adaptive management systems, including monitoring performance and creating feedback mechanisms linked to performance, at different time scales, to permit the adjusting of the tactical and strategic aspects of the management/development plans.

### **Conclusion:**

The study suggests in relevance to Kerala fishing scenario, there is an urgency to carry out sea-friendly fishery practices to be adopted soon considering the global decline in the marine fisheries production. However, while doing the same, there should proper checks and balances, as a large number of populations have been dependent of fishing historically and therefore, livelihood concerns of the poor fishermen should be kept in mind. In other words, when in one hand, there should not be any exception to promote in depth research for the protection of the marine eco system and implementation of the results of well recognized and approved research in the State of Kerala through introduction of suitable policy measures and legal framework, on the other hand, there should also be corresponding and alternative policy and law, which would ensure the livelihood of the poor fishermen and their traditional and cultural rights in fishing should not be drastically affected.

Fish being a renewable resource, biologically it would mean that the rate at which the resources are harvested should be in harmony with the rate at which they multiply. Humanly it means that the principles of equity and basic need to get a high priority.

Technologically, it implies utilization the renewable energy resources and methods, which, are environmentally appropriate and less destructive. From the organizational and employment points of view, the policy of increased people's participation and decentralization of investments and planning will offer added impetus.

In the context of Kerala, it is hard to build as new structure of fishing in Kerala, as the rural fishing community is based on traditional thought in fishing. Therefore, it is imperative that some inclusive growth within the traditional fishing sector should be enhanced, by providing improved livelihood opportunities, that way they can earn high income and better life. As loss of biodiversity in sea has been globally acknowledged to be the greatest threat to the environment, the same should be aimed to be attained through appropriate policies and legal framework emanating international treaties/conventional and Central law framed for the said purpose. Also, adequate and applicable policies/legal framework should be made in the State level in order to address various concerns of the local fishermen and to safeguard their religious, cultural and natural practices associated with fishing.

To further the said objective, there should also be the need to educate the traditional fishermen on the modern, eco and environmental friendly fishing techniques/methods through government and non government machineries and through community mobilization among the fishermen group, the government and the large trawler owners.

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