An Over View of Kerala Fisheries - with Particular Emphasis on Aquaculture

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The State of Kerala situated in the South West part of peninsular India, has a slender stretch of land with a long surf beaten coast on the western side and a lush green mountain range on the eastern side. The State has a geographical area of 38863 sq. km. The comparatively narrow continental shelf sprawls over an area of 39139 sq.km. Kerala being a maritime State has tremendous potential resources teeming with fish. The inland fishing is also a time old practice in the extensive network of backwaters and also in the westerly flowing rivers. Kerala fisheries, developed over the years stand great scope for further expansion by way of more rational and fuller utilization of the resources.

Much to be done for over all development and well being of the fisheries sector in the State. The declining fisheries wealth has to be recouped.

Resource Analysis

The State of Kerala is abundantly rich with marine, brackish water and fresh water resources. These water bodies are inhabited by a wide variety of aquatic fauna & flora and the State occupies one of the foremost positions in the aquatic biodiversity. The long coastline and the extensive inland waters of the State have brought people belonging to different ethnic groups in contact with fishing.

Marine

The coast of Kerala constitutes approximately 10 percent of India's total coastline. This coastline of 590 km and the Exclusive Economic Zone (EEZ) extends up to 200 nautical miles far beyond the continental shelf, which covers an area of 218536 sq km provide opportunities in traditional fishing in inshore waters from ages. The continental shelf area is 39139 sq.km, the area within the 18m depth range accounts

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for 5000 sq.km, the area between 18-73m is approximately 25000 sq.km and 73-182 is the balance area.

The profile of the shelf is with uniform gradient up to 80m depth and thereafter the slope appears more. The south-west coastal region has certain unique features that influence the fishery fluctuations of the important commercial species to a great extent. The area is subjected to two monsoons viz. the south-west monsoon and the north-east monsoon. The south-west monsoon coincides with the period of upwelling and phytoplankton bloom, which results in a large number of fish and crustaceans in the area. However, maximum utilization is only in 50m depth i.e., around 22 km from the coastline.

Inland

Geographically, inland fisheries have great scope in the State. An inimitable feature of the State is the occurrence of 49 interconnected backwaters (Kayals) which have an area of 46129 ha. The total brackish water resources of the State is estimated as 1, 43,696 ha.

The State is endowed with a total area of about 2, 26,274 ha of fresh water resources consisting of rivers, fresh water lakes, reservoirs, minor irrigation tanks, ponds etc. Of these about 1,30,000 ha area is ideally suited for fresh water fish culture.

Brackish Water Resources

In Kerala the total brackish water resources covers a total area of about 1,43,696 ha, which includes the lower reaches of rivers, the brackish water lakes, the backwaters and the adjacent low lying fields & prawn filtration fields, mangrove swamps etc.

It was estimated that Kerala had a total area of about 65000 ha of brackish water area available for effective use of brackish water aquaculture.

Fresh Water Resources

The State is endowed with 44 rivers, innumerable irrigation tanks, reservoirs, streams & waterfalls, private & public ponds, quarry ponds and water-logged paddy fields. Besides these, 9 fresh water lakes are available, from which the drinking water supply of the State are met with. The Highland area of the State has the speciality of cold-water resource. The rivers have an area of about 0.85 lakh ha of which 41 are westerly flowing & 3 are easterly flowing. The Total area of the 53 reservoirs comes to around 0.43 lakh ha.

Table -1

FRESH WATER RESOURCES OF KERALA

Sl. No.	Type	Number	Area
1.	Rivers	44	85000
2.	Reservoirs	53	42890
3.	Irrigation tanks	852	2835
4.	Check dams	80	260
5.	Private ponds	35763	21985
6.	Quarry ponds	870	341
7.	Panchayat ponds	6848	1487
8.	Holy ponds	2689	480
9.	Village ponds & Other water holds	185	496
10.	Fresh water lakes	9	1620
11.	Bunds/Barrier/Anicut/Shutter Water holds	70	880
12.	Puncha/kole lands	0	68000
	Total		**226274**

Fish Resources

Marine

Marine waters offer a very lucrative fishery. South – west monsoon coupled with northwesterly winds and the oceanic currents cause upwelling along the coast which brings the nutrient rich deep waters to the surface, with flourishing primary production and followed by a good fishery. Kerala coast has

Table 2						
MARINE FISH PRODUCTION IN KERALA FROM 2001-02 to 2005-06						
Sl.No.	**Name of Fish**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
1.	Elasmobranches	2991	3197	3066	3044	3160
2.	Cat fish	150	121	154	154	167
3.	Sardine	266682	209101	274003	271057	215216
4.	Anchovilla	34925	29173	35869	35312	30168
5.	Saurida & saurus	5856	6817	6021	5916	5552
6.	Perches	30212	40119	31020	30437	30400
7.	Scianids	8863	6093	9056	8992	9887
8.	Ribbon Fish	18364	16082	18815	18657	15679
9.	Caranx	25110	24855	25721	25419	26987
10.	Mackerel	42446	54537	43551	43017	44202
11.	Seer fish	2326	3499	2389	2371	2427
12.	Tunnica	11014	15444	11314	11208	11923
13.	Prawn	56445	56977	56731	56717	49743
14.	Other crustacean	--	891	344	332	398
15.	Others	88399	136380	90471	89230	112954
	Total	593783	603286	608525	601863	558913

major fisheries of the shrimps, cuttle fish, sardines, mackerels, anchovies, soles, sharks, rays etc. On an average 6.02 lakh tones of marine fish is produced annually by the Sate, which accounts for about 25 per cent of the Country's total marine fish production. Marine fish production in Kerala from 2001-02 to 2005-06 is given in Table 2.

The mechanized sector plays an important role in the fishery contributing to about 66 percent followed by the motorized sector contributing 27 per cent and the artisan sector contributing 7 per cent. The overall contribution of pelagic fin fishes constitute 56 per cent of the total marine landings while the demersal fishes constitute 22 per cent, crustaceans 17 per cent and mollusks 5 per cent. The Indian oil sardine *(Sardinella longiceps)* recorded an all time high landing of 0.2 lakh tonnes.

The Marine fisheries is at cross roads now. The inshore waters are under heavy or excessive fishing pressures. Most of the resources are optimally exploited. A few are slightly over exploited.

While there is no scope for increasing fishing efforts in the coastal areas up to 50 m depth zone, there are few deep-sea resources which are presently under exploited.

Inland

It has already been pointed out that the State is endowed with immense fresh water resources. Besides, there are estuaries, backwaters, brackish water area, pokkali & prawn filtration fields and private shrimp farms. All these bodies of water provide rich sources of inland fisheries.

Inland fish production provides significant contribution to animal protein supplies in rural areas of the State. Most of the inland production is consumed locally and marketed domestically. The Inland sector of the State contribute around 0.78

lakh metric tonnes of fish annually, which accounts for a value of Rs. 30,000 lakh.

Brackish water fish resources

Estuaries and backwaters have saline waters and only those fishes, which can withstand changes in salinity, thrive best. The brackish water fishery resources consist of 75 species of which 57 species are from fish, 6 species of shrimp, 1 species of prawn, 5 species of crabs and 6 species of bivalves, 28 species were identified as commercially important. Some species of sardine and anchovies, mullets, catfishes, perches, pearl spot, prawns, oysters, mussels, crabs and clams are the most common.

Fresh water fish resources

The rivers, rivulets, streams etc., originating from the Western Ghats are well known for their richness of biodiversity including fresh water fish species. Altogether 210 primary fishes (excluding the marine migrants) are found in the inland waters, of which 53 species are endemic. Majority of these fish species had ornamental value also. Today the Western Ghats is recognized as one of the 25 "biodiversity hotspots" in the world.

The cultivable food fishes native to Kerala includes Thooli (*Labeo dussumieri*), Kooral (*Gonoproktopus curmuca*), Manjakoori (*Horabagrus brachysoma*), Kuyil (*Tor khudree*), Katti (*Tor mussallah*), Pulivaka (*Channa micropeltes*), Musi (*Clarius batrachus*), Manalvaka (*Channa leucopunctatus*), Brahmanakandi (*Lepidopygopsis typus*), Wynad Musi (*Silurius wynadensis*), etc.

Several endemic fishes such as *Mastacembalus armatus, Horabagrus brachysoma, Mesonoemacheilus guntheri, M. monilis, Tetradon travancoricus, Puntius denisonii, P. aurilius, P. jerdoni, Barilius bakeri, Tor khudree, Tor mussallah* etc., have high ornamental value and now these also attain the status of dollar minting fishes.

A large number of new fish species has been reported recently from the State. Some of them are *Garra periyarensis, G. surendranathani, Mesonemacheilus menoni, M. periyarensis, Travancoria elongate,Salarius reticulates and Puntius muvattupuzhaensis*.

Table 3

District Wise Distribution of Marine Fishermen Population and Percentage of Active Fishermen In Kerala During 2005-06

Sl. No.	Districts	Male	Female	Children	Total	Active fishermen	% of Active fishermen
1.	Trivandrum	67070	59257	52683	179011	48927	27.33
2.	Kollam	41714	35279	20677	97690	19738	20.21
3.	Alappuzha	46393	42348	28693	117434	34309	29.22
4.	Ernakulam	30824	28896	18043	77763	15295	19.67
5.	Thrissur	30479	30709	17483	78671	8645	10.99
6.	Malappuram	33467	27213	24873	85553	27283	31.89
7.	Kozhikode	40982	35748	27373	104103	20130	19.34
8.	Kannur	22132	20112	17190	59434	5811	9.78
9.	Kasargod	18375	17349	10725	46449	10345	22.27
	Total	**331435**	**296912**	**217740**	**846088**	**190483**	**---**

Table 4

District Wise Distribution Of Inland Fishermen Population And Percentage Of Active Fishermen In Kerala During 2005-06

Sl. No.	Districts	Male	Female	Children	Total	Active fishermen	% of Active fishermen
1.	Trivandrum	462	535	451	1454	---	---
2.	Kollam	14545	13692	8782	37019	9383	25.35
3.	Pathanamthitta	1086	943	439	2468	321	13.00
4.	Alappuzha	26982	25859	13911	66752	8786	13.16
5.	Kottayam	10547	10012	6239	26798	5986	22.34
6.	Idukki	319	322	202	843	162	19.21
7.	Ernakulam	25608	25045	18088	68741	9396	13.67
8.	Thrissur	8566	7832	4938	21336	1702	7.98
9.	Palakkad	934	918	943	2795	542	19.39
10.	Malappuram	1983	1727	934	4644	1659	35.72
11.	Kozhikode	4475	4715	3666	12856	1779	13.84
12.	Waynadu	94	101	97	292	---	---
13.	Kannur	2659	2812	1511	6982	1685	24.13
14.	Kasargod	425	402	187	1014	504	49.70
	Total	**98685**	**94916**	**60393**	**253994**	**41905**	**---**

Cold water Fish resources

The high land waters of the State have cold water and that can sustain only the so-called cold-water fishes, and hence have a fishery different from that of the plains. Thenmala reservoir, Kulathupuzha river, Palaruvi, Aruvikkara, Gavi, Munnar, Pookkottulake, Malampuzha and many other streams and rivulets are the home grounds of such fishes. Commercially important fishes include *Salmo sp., Tor sp., Schizothorax sp. Acrossochelius sp, Puntius sp.,* etc.

Human Resources

The human resources include both artisanal and mechanized group of fishermen. The population of fisher folk of Kerala is about 12 lakhs, which includes 8.46 lakhs in the marine sector and 3.2.lakh in the inland sector. Out of this the number of active fishermen is estimated as 2.54 lakhs, of this 1.91 lakh is in the marine sector and 0.42 lakh is in the inland sector. The fishermen settlements are spread over in 222 fishing villages in marine sector and 113 villages in the inland sector. Geographically the fishing activities are mainly spread over 200 Grama Panchayats, 1 Municipality and 4 Corporations.

Human Resources – Marine Sector

Those who depend upon the marine sector of the State for the livelihood constitutes about 8.46 lakh, which comes to about 2.51% of the State's total population. The number of fishermen households is estimated to be 1.61 lakhs. The number of active fishermen is 1.91 lakh and almost an equal number of people are presently engaged

in fishery related activities such as vending, processing and marketing. The density of population in the marine fishing villages works out to 2162 per sq. km as against 819 of the average density of Kerala.

Human Resources – Inland Sector

The total population of fisher folk, who earn their livelihood from the inland waters of the State comes around 2.54 lakhs, which accounts 0.67% of the State's total population. The active fishermen of the inland sector are estimated as 0.42 lakh.

Fishing fleet

The introduction of mechanized bottom trawling for exploiting the marine fishery resources beyond the traditional fishing grounds was an important event in the State fisheries. This fishing technique was primarily for harvesting shrimps and attained wide popularity in the subsequent years and led to the development of an organized fishing industry in the State. The increasing demand of the shrimps in the export market attracted the entrepreneurs to invest in a sector that resulted an unhealthy competition and subsequent spurt in the number of trawlers and other mechanized boats. There was enormous increase in the number of fishing crafts operating in Kerala during the last couple of decades. Perhaps, the State will have the largest fishing fleet density in the country. The State Government had banned introduction of new fishing vessel for inshore fishing since 1986, but the total number of fishing vessels increased from 34,000 in 1988-89 to 55,500 in 2002-03. In the case of motorized craft, the increase during the period was from 9914 to 29,395. A survey conducted by the Department of Fisheries during 2006-07 gives a different picture in which is noticed a remarkable reduction in the number of fishing vessels in all the categories of fishing crafts.The considerable increase in number of crafts are not reflected as proportionate increase in fish production. Hence, further investments in marine sector may be only for replacement of the existing crafts and gears and equipping the existing vessels with fish finding and navigational devices and storage facilities to enable them to undertake a successful offshore fishing.

Fishing Crafts In The Marine Sector

Sl. No.	Type of Fishing Craft	Number*
1.	Non motorized Craft	9,552
2.	Motorized craft	14,151
3.	Mechanized boats	3,451

* 2006-07 State Fisheries Department

In the inland sector the fishing, fleet is not organized as that of the marine sector. Here only non-motorized/traditional type of vessels are operated. Plank built canoes and dug out canoes are the common crafts.

Fishing fleet - Marine

The fishing fleet in the marine sector can be categorized into three types namely, mechanized, motorized and non-motorized. Trawlers, Gill nets and Purse seines come under the category of mechanized fishing vessels, where engine power is also used for fishing. The total number of mechanized boats operating in the State is enumerated as 3451 Nos. Motorized craft includes Plywood canoes, which are used power only for propulsion through outboard motors (OBM) and Inboard engine fitted vessels (inboard vallom).

There are 3 main types of non-motorized traditional crafts, namely, catamarans, dug out canoes and plank built canoes.

Fishing fleet - Inland

In the inland sector only non-motorized/ traditional type of vessels are operated. Plank built canoes and dug out canoes are the common crafts. Catamarans were occasionally operated in the Paravoor backwater of the Kollam district. Cast netting, Drag netting, Gillnetting, Crab trapping, dive fishing, clam fishing, oyster fishing, line fishing etc, are practised with these crafts.

Infrastructure facilities

Fishermen community of the State was the 'Out liers' of the well proclaimed 'Kerala Development Model'. In order to uplift them the State Government paid adequate attention to create social infrastructure facilities to this weaker section right from the 3rd five year plan onwards.

Fishing Harbours, Fish landing centers, Fisheries roads, Fisheries dispensaries, Guide lights, Community resource centres, Fisheries Research institutes and Schools are the major infra structure facilities.

Fishing harbours

Kochi & Neendakara are the two major fishing harbours for mechanized sector and the Thankasserry fishing harbour is the only one for the traditional sector. Munambam, Mopla bay, Chombal, Kayamkulam, etc, are medium harbours. New fishing harbours are being constructed at Ponnani, Thalai, Muthalappozhy etc. Recently, sanction was accorded by the Central Government for a new fishing harbour at Chettuva in Thrissur district.

Neendakara fishing harbour provides landing and berthing facilities to the existing fleet of mechanized crafts operating from Kollam region and Vizhinjam harbour is being intended to develop deep-sea fishing.

Fish Landing Centers

The fish caught by the traditional fisherman is landed all along the coast usually on the open beach, which has neither jetties nor any other facilities. Government of Kerala has taken up a few projects for establishing 'Fish landing Centers' in the State. 7 landing centers have been constructed with improved facilities for mechanized & motorized crafts. These landing centers are having provision for auction hall, repairing shed, water & electricity, parking etc.

Guide lights

Guide lights are very useful to fishermen to return to their destination during night hours. Hence the State Government has constructed 16 guide lights during 1960 through Public Works Department. Many of them are now not functioning due to technical problems and the Department of Fisheries is planning to construct new guide lights in place of these.

Fisheries roads

Roads form a vital link in the movements of fish and fishery products and establish connectivity with fishing harbours, landing centers and markets. With this in view, the fisheries department constructed many fishery roads in the coastal belt of the State.

Fisheries dispensaries

The State Government has established 37 fisheries dispensaries in various coastal villages. The local bodies provide land for the dispensary, department of Fisheries construct the building & other facilities and the dispensaries are run by public health department.

Fisheries Schools and Research institutes

The fishermen population has been left behind in the process of attaining the total literacy level in Kerala. The dropout of children from the primary school level is very high. In order to improve the standard of education of fisher folk, State Government Started 'Fisheries School' under Fisheries department. Now there are 10 Fisheries schools through out Kerala under the control of Department of Fisheries.

The headquarters of major Central Fisheries Research Institutes are situated at Kochi in Kerala. They are Central Marine Fisheries Research Institute (CMFRI), Kochi, Central Institute for Fisheries Technology (CIFT), Kochi, Integrated Fisheries Project (IFP), Kochi, Central Institute for Fisheries Nautical Science and Engineering (CIFNET), Kochi, National Institute for Oceanography (NIO), Kochi and National Physical Oceanography Laboratory (NPOL), Kochi.

Besides these, two sub centres of CMFRI are also situated in Kerala, one at Vizhinjam, Trivandrum district and other at Kozhikkode beach. At Vizhinjam, CMFRI runs a very good Marine aquarium, which attracts the public considerably. A sub centre of Central Inland Fisheries Research Institute (CIFRI) was functioning at Alappuzha.

The headquarters of Marine Product Export Development Agency (MPEDA) is situated at Kochi and it has two sub centers in Kerala. Similarly, Export Inspection Agency (EIA) has their centre at Kochi and Sub center at Kollam. A Regional office of Fisheries Survey of India (FSI) is functioning at Kochi. The Integrated Fisheries Project has also its headquarter at Kochi.

Cochin University of Science and Technology has an exclusive marine science campus at Ernakulam, where postgraduate courses are conducted under various fields under fisheries science and related faculties. In its main campus at Kalamassery, a postgraduate course on Ship Technology is also conducted for general students and Naval Cadets as well. Doctoral and Postdoctoral research is going on here. Kerala University also conducts a post graduate course in Aquatic biology and Fisheries. The course conducted under the Department of Aquatic Biology and Fisheries, Kariavattom (Trivandrum district) include doctoral and post doctoral studies in Fisheries Science, aquaculture and the applications of Biotechnology in Fisheries and aquaculture. Many Colleges under Calicut University and MG University are conducting graduate and postgraduate level fishery courses.

More over many institutes under private sectors, offer a variety of many courses in relation to Nautical Sciences. All these facilities cater to the over all development of the fisheries scenario of the State.

Fish markets

A recent survey conducted by the Department of Fisheries has shown that there are 2703 fish markets in the State which includes 185 whole sale markets, 2518 retail markets and 1126 way side markets. Department of Fisheries provides assistance to local bodies to construct and upgrade Markets.

Four markets were constructed in the inland sector viz. Nedumangadu, Vaikom, Kundara and Perambra with modern facilities such as ice plants and cold storages, retail outlets, fish handling sheds, etc, with the assistance from the Central Government.

Fish booths

The supply of quality fish and fishery products to the consumers of the distant areas always pose risk because it is one of the most perishable commodities. In order to tackle this problem and to cater to a new direction of fish marketing, fish booths are set up in many parts of the State.

Industrial Fisheries units

Industrial fisheries units include processing plants, peeling sheds, Ice plants, curing yards, drying yards, depuration units, chitin-chitosan plant, Cold storages, boat building yards, diesel bunks, kerosene bunks etc. Ice plants, cold storages, freezing plants and processing plants are developed for the promotion of shrimp fishing industry in the state. Ice is required in large quantities to prevent spoilage. Easy availability of ice will help better utilization of shrimp harvest.

In the co-operative sector Matsyafed has an Ice and Freezing Plant at Kochi with a cold storage capacity of 600 tonnes. The plant has a flake ice unit with a capacity of 15 tonnes per day, a plate freezer of 5 tonnes capacity, a tunnel freezer of 3 tonnes capacity and IQF unit with 2.5 tonnes capacity.

Out of 106 processing plants engaged in the export of seafood products 44 units enjoy the distinction of being approved by the European Union. Majority of these industrial fisheries units are not fully utilizing their installed capacities due to various reasons.

Ornamental fish trading units

Aquarium keeping is picking up as a hobby among the people of the State. This is evident from the coming up of new ornamental trade units in all parts of the State. There has occurred a spurt in the number of aquarium trade/ pet units in the State after the Aqua shows conducted by the State Fisheries Department during the past few years.

Fishery Regulations In Kerala

Fishery regulations are inevitable for management and sustainable fishery development. Kerala was one of the first earliest States to enact the Marine Fishing Regulation Act (1980) for enforcing regulatory measures for restricting the number of fishing crafts and to ban the use of destructive nets. The State has been successfully implementing the Monsoon Trawl Ban for the last so many years.

The Act empowers the State Government for the restriction or prohibition of:

1. Fishing within a specified area in the territorial waters of the sea using specified craft and gears.

2. The number of fishing vessels, which may be used for fishing in any specified area in the territorial waters.
3. The catching in any specified area of such species of fish and for such periods.
4. Fishing by un licensed vessels and
5. For registration and licensing of fishing vessels and cancellation, suspension and amendment of license already issued.

The laws relating to inland fishing in Kerala are contained in the 'Indian Fisheries Act (1897)' and the 'Travancore Cochin Fisheries Act (1950) and the rules and orders there under. The former Act extends to Malabar area viz., Palakkad, Malappuram, Kozhikode, Kannur, Kasargod and Wayanad districts of the State and latter to the remaining districts of the State. Both Acts contain more or less similar provisions.

The important provisions common to both the Acts are those that empower the State to make rules prohibiting or regulating:-

1. Erection of fixed engines
2. Dimension and kind of nets to be used or mode of using them.
3. Fishing in any specified area for a period not exceeding two years and
4. Applying the rules so made to waters specified by notification.

The Indian Fisheries Act is a century old one and in marine regulation the State has jurisdiction only up to 12 nautical mile beyond which the things are to be considered by the Union Govt. The entire law relating to fisheries need updation to contain technological improvements as well as resource constraints in the field of fisheries.

Present Status

The potential marine fishery resources of the State are estimated as 7.51 lakh tonnes against which the present level of exploitation is 6.02 lakh tonnes.The inland fish production is to the tune of 0.77 lakh tonnes. The fisheries sector contributes about 2 % of the State's net domestic product and provides employment to 10.89 lakh people (which are more than 3.5 % of the State's population) of which 2.26 lakh people are full time fishermen. The State accounts for 19 % of the Marine Product Exported from the country. The contribution of the State to fish production in the country is about 28 %.

Capture Fisheries

The marine fish production in the state has been generally stagnant for the past years with an average production of 5.88 lakh tonnes, now experience a marginal increase for the last 3 years and now covering around 6.0 lakh tonnes showing that exploitation has reached maximum sustainable levels.

The fish catches from the Kerala coast include more than 300 different species, the commercially important species about forty only. The high value species among the fish catches are still a few. Prominent among them are seer fish, Pomfret and prawn. Ribbon fishes are also now a target group and nearly 60-70 percent of the landings in frozen form are exported to China, Japan and other South East Asian countries.

The quantity of these high value species in the total catch ultimately decides the income of the fishermen. Unfortunately, the share of these high value varieties in the total marine fish catch has been remaining stagnant. The annual potential of prawn yield is estimated at 64482 tonnes while the average catch during 2004-05 was 53361 tonnes. The catch of Sardine, the most important variety consumed mainly by the poorer section of the society, reached the maximum potential in recent years.

The case of inland fishery production shows a sign of improvement from 0.48 lakh tonnes (1994-95) to 0.77 lakh tonnes (2004-05), which accounts for about 13 % of the total fish production of the State.

Marine product export from the State has increased from 49,094 MT valued at Rs. 414 Crores in 1992-93 to 97311 MT valued at Rs. 1258 Crores in 2005-06. The State contributes 19 % by volume and 17 % by value to the country's Marine Product Export.

The population pressure on the aquatic resources of the State is the highest as compared to other

states in the country. The per capita availability of fishable area is 10 ha, against the national average of 37 ha. The sector also plays a very important role in the food economy of the State as 90 % of the population consumes fish. The per capita consumption of fish in the State is the highest in the Country with 24 Kg against the national average of 9 Kg.

Culture Fisheries

Being the principal Marine fish producer and exporter State in the country for a long time, Kerala occupies an inimitable position in the fisheries map of India. But in the last couple of years the state has lost its crown due to the depleting fish stock from the conventional fishing grounds. In this context aquaculture is viewed as a second option for increasing fish/shrimp/prawn production. The technological development in the inland fisheries paved the way for making use of inland water resources spread over the different districts of the State for aquaculture development.

Aquaculture currently enjoys the distinction of being one of the fast growing food production sectors in the State. But following the wide spread out breaks of viral diseases, the rate of development has declined sharply. Serious concerns were voiced at this time about the future of this sector. The State government is now in the process to formulate a 'Master plan for aquaculture'.

Mariculture

In Kerala the marine fisheries has been stagnant over the last couple of years and is likely to remain at the present level or may show further decline. The only way to tide over the situation is to enhance production through culture. Mariculture is expected to be a major aquaculture activity in the coastal areas in the coming years for generating additional income and to develop a sound economic base for the poor fisher folk.

Despite its high potential, little or virtually no attention is given to this sector. Whatever taking place are as an experimental or pilot or demonstration basis by the Department of Fisheries and research institutes like CMFRI. Many mariculture technologies are simple, easy to adopt and eco-friendly. However, not much area is presently used for commercial rearing of marine organisms.

Status of Shell fish farming in the seas of Kerala

During the last few decades technologies of mariculture for shell fishes like mussel and pearl oyster have been developed by CMFRI. But its commercialization has attained its potential levels.

Mussel farming

Experiments in Kerala by CMFRI, adopting rope culture of the green mussel and brown mussel at Vizhinjam (Trivandrum), Anthakaranazhi (Alappuzha) and Kasargod have succeeded in producing harvestable stocks in a period of 5 months to 8 months. Floating rafts of 6 X 6 m or 8 X 8 m fabricated out of Teak pole and Bamboo poles duly buoyed and anchored firmly are used for suspending culture ropes in the coastal seas at depth ranging from 5 – 15 m. Even though the technology was standardized during middle 70's, mariculture production of mussel is not yet popular due to various reasons.

Pearl oyster farming

The technology for culture pearl was developed by CMFRI in 1973. In 1976 Department of Fisheries had made attempts to adopt the technology developed by CMFRI and implemented a pilot project at Vizhinjam in Thiruvananthapuram district. The projects were started with great ambition but were closed down since the achievements made were far short of the target.

Status of Seaweed Farming in Kerala

Nutrient rich but calm and protected waters are suitable for seaweed cultivation. The CMFRI has been successful to develop technology for commercial level seaweed culture. ADAK has now taken up a pilot project for cultivating *Kapaphycus alvarezii* at 10 selected sites from Varkala (Trivandrum) to Cheruvathur (Kasargod). Initial reports indicate good chances of success.

Coastal Aquaculture

To augment production from the aquatic resources, in the form of shrimps, crabs, bivalves

and fishes from the low lying, barren, unproductive or marginally productive coastal saline lands, swamps and other brackish water bodies are to be brought under coastal aquaculture. Traditional brackish water aquaculture – the Prawn filtration in Pokkali fields – is an age old practice in Kerala. Modern coastal aquaculture is an offshoot of the traditional aquaculture and it is largely confined to shrimp aquaculture.

Status of shrimp farming in Kerala

The State of Kerala has a hoary tradition in shrimp farming. Traditional shrimp farming known as 'Chemmeen kettu' is practised in pokkali fields of Ernakulam district since time immemorial. The State has a potential brackish water area of 65000 ha suitable for shrimp farming. At national level Kerala enjoys the 4th position in aquaculture production of shrimp during 2004-05.

Scientific shrimp farming with selective stocking and supplementary feeding is yet to pick up in the State. Social constrains and legal problems connected with CRZ and recurrence of shrimp diseases are the major threats to the development of this sector.

Traditional Prawn filtration practices

The Pokkali fields, a unique eco system cover an area of 1,25,000 ha, where the age old shrimp filtration practice known as 'chemmeen kettu' is carried out after the harvest of paddy. The Pokkali fields are concentrated in Ernakulam, Alappuzha, parts of Kottayam and Thrissur districts. In the traditional system of culture shrimp and fish seeds brought in through tidal water are trapped in the pokkali fields and are allowed to grow for 4 to 5 months. In this traditional system no selective stocking and supplementary feeding are done.

By adopting improved traditional farming with selective stocking and supplementary feeding, the production of shrimp from these traditional fields is increased greatly.

Area coverage and shrimp production

According to the information available with MPEDA 13990.53 ha is under shrimp culture during 2000-2001. This comes around to only 22 % of the potential area. Both Public and private sectors are engaged with shrimp farming in Kerala. 7327 metric tones of shrimps are produced at the rate of 530 kg/ha/crop largely through a low input extensive system of farming.

Shrimp farms in Public Sector

The details of brackish water farms in public sector are furnished below. Njarakkal brackish water farm in Ernakulam district is one of the oldest fish farms in the country. The fish farm at Poyya in Thrissur district presently managed by ADAK is a modern farm constructed under UNDP assistance. Malippuram, Palaikari and Njarakkal farms are managed by Matsyafed. The remaining farms under

Public Sector - Brackishwater Fish Farms In Kerala

Sl. No.	Name of the Farm	Area	Ownership	District
1	Govt. Fish Farm, Ayiramthengu	15.78	Dept.of fisheries	Kollam
2	Arattupuzha Farm	40.00	Dept. of Fisheries	Alappuzha
3	Malippuram Fish Farm	21.40	Matsyafed	Ernakulam
4	Njarakkal Fish Farm	18.40	Matsyafed	Ernakulam
5	Edakochi Fish Farm	10.93	Matsyafed	Ernakulam
6	Palaikari Fish Farm	48.00	Matsyafed	Kottayam
7	Model Shrimp Farm	49.09	ADAK	Thrissur
8	PoyyaKadappuram Farm	8.08	Dept. of Fisheries	Thrissur
9	Chakkamkandam Farm	3.24	Dept. of Fisheries	Thrissur
10	Eranjholi Fish Farm	10.97	ADAK	Kannur

Details of Shrimp Farms in Private Sector									
Sl.No	Name of District	0-2 ha		2-5 ha		5-10ha		> 10 ha	
		No. of	Area	No. of	Area	No. of	Area	No. of	Area
1.	Kollam	246	118.00	8	22.60	2	17.2	..	..
2.	Alappuzha	129	92.20	14	45.00	3	28.4	8	219
3.	Ernakulam	551	928.98	413	1895.5	179	1774.9	134	1351.3
4.	Thrissur	386	442.62	157	464	53	361.8	13	922.3
5.	Malappuram	1	2.00	..	..	..	..	..	..
6.	Kozhikode	10	15.50	4	15.3	..	..	..	..
7.	Kannur	39	50.30	22	82	9	68	2	51.2
8.	Kasargod	30	14.20	..	..	1	7.8	..	..
	Total	**1392**	**1663.80**	**618**	**2524.4**	**247**	**2258**	**157**	**2543.8**

the Department of Fisheries are leased out to private entrepreneurs and prawn filtration is carried out. The total area of the public sector farm is about 226 ha, which comes around only to 1.62 % of the total culture area.

Shrimp farms in private sector

The district wise details of private sector shrimp farms are furnished below. Out of a total of 2414 farms in private sector more than 58% belongs to the category of small farms with an area of less than 2 ha. In Kollam district almost 90% of the farms belong to this category. 44% of farms belong to 2.5-5 ha category. Bigger farms of more than 10 ha area are mostly prawn filtration fields belonging to Ernakulam, Thrissur and Alappuzha districts. More than 4000 ha of farms belong to small and marginal farmers.

Shrimp Hatcheries

Quality prawn seed is a critical input required for successful shrimp aquaculture. In order to ensure availability of quality shrimp seeds commercial shrimp hatcheries are established in the public as well as private sector. At present an area of more than 15000 ha is identified as suitable for shrimp culture. At the rate of stocking density of 40,000 seeds per ha as directed by Aquaculture Authority of India, the total seed requirement will be in the tune of 600 million of *Penaeus monodon*. The details of shrimp hatcheries are furnished in the Table.

The State has 28 shrimp hatcheries with a production capacity of 459 million seeds. Out of these 6 hatcheries are established in public sector. The remaining 22 hatcheries are in private sector. It can be also noted that these hatcheries are producing seeds only to the limit of 20 – 30 % of their installed capacity. At least a few of the private hatcheries are functioning as 'sales depots' of the seed imported from neighbouring states.

Aquaculture Authority and farm licensing

Aquaculture Authority of India has so far issued licenses to 604 farmers for shrimp farming in the state. The district-wise details of licenses issued are furnished below.

Details of Licenses issued for Shrimp Farming by National Aquaculture Authority		
Sl.No.	Name of district	No. of licenses issued
1	Kollam	201
2	Kottayam	3
3	Alappuzha	150
4	Ernakulam	118
5	Thrissur	44
6	Malappuram	7
7	Kozhikode	9
8	Kannur	67
9	Kasaragod	5
	Total	604

Shrimp health management

Disease monitoring and shrimp health management are crucial in the light of frequent outbreak of white spot disease in shrimp farms. An exclusive center for Fish Disease Diagnosis and Management under the School of Environment Studies, CUSAT is functioning at Kochi.

Various Central Institutes based at Kochi such as Central Institute of Fisheries Technology (CIFT) and Central Maine Fisheries Research Institute (CMFRI) also render quality control and assurance services. MPEDA also provides diagnostic PCR facilities for the benefit of farmers. ADAK has one PCR lab at North Paravoor which has already started functioning. Assistance is also provided to those entrepreneurs who are interested in establishing PCR labs.

Status of other Shell fish farming in Kerala

Brown mussel (*Perna indica*) is available in plenty in the Southern coast; green mussel (*Perna viridis*) is abundantly distributed in the Northern coast. The Indian backwater oyster (*Crassostrea madrasensis*) is an ideal oyster species suitable for farming. Mud crab (*Scylla serrata*) is suitable for crab fattening and culture.

ADAK and BFFDA are promoting mussel/oyster farming in Kerala. ADAK is implementing a project on 'Mussel farming in the back waters of Kerala' under 'Tsunami Emergency Assistance Project' in eight districts by organizing Self Help Groups (SHG) of fisher folk.

Candidate species for aquaculture

There are 2 species of mussel, 5 species of clams, 1 species of edible oyster and 2 species of crabs distributed in the brackish water areas suitable for aquaculture. Natural seeds are widely distributed all along the coast of Kerala.

Crab fattening /Culture

Mud crab fattening and culture are gaining popularity in the State. Baby crabs collected from estuaries and back water areas and juvenile & water crab caught during commercial operations form the seed material. A hatchery for production of crab seed has been established on experimental basis by the CMFRI.

There is a good demand for live crab in the export market and it fetches high price. The technology support for crab culture is available from CMFRI, Fisheries Department, BFFDA and ADAK. In Kerala, farming the younger ones in the grow out system is being carried out on a limited scale in Vypin island and Chellanum region in Ernakulam district.

Mussel culture

Mussel culture has prospects in Kollam, Alappuzha, Ernakulam, Kozhikkode, Kannur and Kasargod Districts. Technology for mussel farming was standardized by CMFRI, BFFDAs, ADAK, Department of Fisheries and Local bodies to promote mussel farming through women SHG's. ADAK has implemented a project on 'Mussel farming in the back waters of Kerala' under 'Tsunami Emergency Assistance Project' in eight districts by organizing Self Help Groups (SHG) of fisher folk.

Oyster farming

Oyster fishery of Kerala is limited to back waters like Dharmodam, Kayamkulam, Ashtamudi, Paravoor, Kadalundi etc. *C. madrasensis* is the most prominent species. Oyster farming technology has been developed by CMFRI and Kerala was the first Sate in the country to commercialize this technology. More than 80 percent of the oyster farmers in Kerala are women. There are tremendous potentials for oyster farming in Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikkode and Kannur districts but culture operations are possible only for six months during the pre monsoon period. Dependence on wild seed and marketing lacunae are the major constraints at present.

Brackish water fish culture

Production of seeds or young ones is one of the vital aspects of any farming. Even though a vast number of brackish water resources are available in Kerala, the development of brackish water fish culture is in its infant stage. The main obstacle for

the development of this sector is the non availability of quality seeds. During the bygone years the technologies for seed production of non fish culture organisms were developed and standardized, the same for the finfish are not perfected.

Inland Aquaculture

In Kerala the inland aquaculture has not attained the status as a major fish producing system. Perhaps Kerala is one of the least developed Inland aquaculture States in India. Most of the Inland aquaculture activities in the State could be regarded as rural aquaculture. Fresh water aquaculture in village tanks and ponds follow the improved traditional or semi intensive composite culture/ poly culture systems and they serve only to meet the house hold needs and to some extent as additional income for family. This very little recognition of inland aquaculture in the State is due to pre-eminence of marine fisheries.

Status of Freshwater Prawn Farming in Kerala

Kerala has a longstanding tradition in freshwater prawn fishery in Vembanadu lake, the natural habitat of Scampi (*Macrobrachium rosenbergii*). The state has made the debut in commercial hatchery in the country for scampi seed production at Azheekode in Thrissur district.

However, the State has not been able to take advantage out of these pioneer developments and is lagging behind the States like Andhra Pradesh, Tamilnadu, Gujarat etc. At national level Kerala enjoys the 5th position in aquaculture production of freshwater prawns.

Fresh water prawn culture had, in fact started as a poly-culture activity in fresh water fish farms. Its demand in the international market has motivated some enterprising farmers to go for monoculture using natural seeds. The pace of development was slow during the initial period.

Freshwater prawn hatcheries

Quality prawn seed is a vital input required for the development of prawn aquaculture. It was in 1980 that the first commercial freshwater prawn hatchery in India was established at Azheekode in Thrissur district under the Department of Fisheries, Kerala. Subsequently the seed production trials carried out at the College of Fisheries, Panangad, Kochi was instrumental for improving and perfecting a commercial seed production technology which is being widely adopted all over the country.

Area coverage under Freshwater prawn farming

A number of schemes are implemented by various agencies such as ADAK, MPEDA, Department of Fisheries and FFDAs for the promotion of scampi farming. In the initial years, the Department of Fisheries motivated the farmers for supplementary stocking of scampi seed in composite fish culture of Indian Major Carps (I.M.C).

During 1999-2000, 1600 metric tones of scampi were produced through supplementary stocking of scampi seed along with Indian Major Carps. The revenue generated during the year is of the order of Rs.28 crores.

During the last few years there has been revived interest in scampi culture as an economic activity generating income and employment to the farmers. Freshwater prawn culture has attracted increased attention because of its potential as a foreign exchange earner. There is a growing demand in the export market for cultured scampi.

Freshwater prawn farming in reservoirs

Freshwater prawns are cultured in reservoirs of Palakkad district on a pilot basis. Scampi seeds are stocked in Malampuzha, Meenkara, Kanjirapuzha, Mangalam, Pothundy and Chulliyar reservoirs along with Indian Major Carps (IMC) and Exotic Carps (EC).

Meenkara and Chulliar which are small and shallow reservoirs, yielded good results. The details of stocking and harvest of freshwater prawns in Meenkara reservoir during the last five years are furnished below.

Details of Freshwater Prawn Culture in Meenkara Reservoir During 1998-99 – 2003-04						
Years of stocking	No. of PL stocked (Nos.)	Cost of seed (Rs.)	Years of capture	Quantity harvested (kg)	Revenue generated (Rs.)	Per ha production (Kg/ha)
1998-99	1,00,000	56,580	1999-2000	1752.15	332762	6.77
2000-01	2,13,000	1,51,650	2000-01	762.70	166770	2.94
2001-02	1,50,000	1,04,765	2001-02	867.50	216875	3.35
2002-03	70,000	35,000	2002-03	1339.63	334907	5.17
2003-04	72,000	36,000	2003-04	1264.26	316154	4.88

The average annual per ha production of freshwater prawn was 4.62 kg against a stocking rate of 467 nos/ha. The prawns have grown to a size ranging from 150 –600 gms. The average size of prawns harvested from the reservoir was 250 gms. The income of Reservoir fishermen co-operative has increased to a level of Rs. 13.67 lakhs exclusively from the sale of freshwater prawns during the period.

Kerala has tremendous potential for the development of freshwater prawn aquaculture. Adequate emphasis is to be given for the application of appropriate aquaculture technologies in different agro climatic conditions to increase prawn production and attract the much needed investment in the sector. Financial agencies, particularly commercial banks, have a crucial role in the promotion of freshwater prawn aquaculture by extending liberal credit to enterprising farmers.

With rational utilization of available resources the state has the potential to emerge as a leader in freshwater prawn farming in the country.

Status of Freshwater Fish Farming in Kerala

There is ample scope for the development of freshwater fish culture in Kerala. The extensive polders and low lying paddy fields of Kuttanadu and Kole lands of Thrissur and Malappuram district can be utilized for rotational fish farming after paddy. Notwithstanding the FFDAs functioning in 14 districts of the State it is disappointing to note that fresh water fish farming has remained largely unrecognized.

Even though local fishes are available in the State for the prosperity of fresh water fish culture, at present the culturing of Indian Major Carps is a synonym to fresh water fish culture in Kerala.

Fish Seed Farms and Hatcheries

Fish seed is the basic input for fish culture. Non-availability of quality fish seed at the right time is a serious problem for aquaculture development. Under this circumstance Department of Fisheries initiated schemes for the establishment of fish seed farms and hatcheries in the state in public as well as private sector. At present there are 51 fish seed farms with a production capacity of 136 million seeds But majority of these seed farms have not reached to the level of their installed capacity.

Fresh Water Fish Culture in Reservoirs

It is very essential to increase fish production in the inland sector. It could be possible only through promoting fish culture in all available water bodies in the inland sector particularly in reservoirs. Attempts to develop reservoir fisheries in Kerala started as early as 1960 under the Department of Fisheries. In 1992 the Indo-German Reservoir Fisheries Development Project (IGRFD) started activities with its head quarters at Malampuzha under an agreement between the Government of India and Government of Germany.

In 1992 the orientation phase of the project started implementation during which the project focused on the development of Malampuzha,

Pothundi, Chulliar, Peechi and Vazhani reservoirs. In 1995, the project started its implementation phase in five additional reservoirs viz. Mangalam, Meenkara, Peruvannamuzhi, Kanjirapuzha and Walayar.

The productivity of small reservoirs in Kerala was increased to a level of 53.5 kg/ha/yr, on an average. In individual reservoirs like Chulliar and Meenkara the productivity level has been raised to 227 kg/ha/yr, and 76.5 kg/ha/yr (1992-93 to 1995-96).

This level of productivity is among the highest ever reported at the national level. This is an indication that if given proper technical and financial support, the production from small reservoir can be increased substantially so that the fishermen can undertake reservoir fishing as a viable avocation.

Non-availability of reservoirs for conducting fish culture is a major hurdle for development. Recently the Power Department has agreed in principle to let use the hydal power reservoirs for fishing purpose. KSEB have approved in principle to allow fish culture activities in the 11 (eleven) reservoirs under their control in an appropriate way by organizing co-operatives / SHG's of fishermen who are residing in the vicinity of those reservoirs.

Development of Fish culture in Ponds.

Of late there has been a shift in the emphasis towards the development of freshwater aquaculture and accordingly FFDAs have been established in all 14 districts to promote and popularize pond aquaculture in the State. FFDAs are provided with necessary funds, extension service units and required infrastructure so as to develop fresh water culture in each district.

Development of cold water aquaculture in high ranges

A recent survey conducted by the Department of Fisheries revealed that the State has good potential for the development of tourism fisheries, cold water fisheries and sport fishing activities in high ranges. The Fisheries Resource Management Society (FIRMA) in association with National Cold Water Research Institute, Nainital has chalked out programmes to set up a Mahseer Hatchery on a Pilot scale at Pookote lake in Wayanad district. The programme aims at propagating the depleted mahaseer fish resources in selected reservoirs and streams in the high ranges, initiating angling for recreation and organizing angling associations to promote tourism fisheries. Similarly, there is a proposal to establish a Trout Hatchery at Mattupetty in Idukki District to develop trout fisheries in high altitude rivers, reservoirs, lakes etc.

The Tata's has made sporadic efforts for the development of trout culture in hill streams especially at Munnar areas of Idukki district. Trout seed production is carried out on a limited scale at Rajamalli on the foothills of Anamudi in Munnar. The Angling Association of Munnar organized to develop sport fisheries in the region releases the trout seeds in various rivulets. Organized efforts are needed for the development of trout fisheries in the high ranges of the State.

Ornamental Fisheries

Kerala with its highly conducive climatic conditions provides scope for the development of ornamental fisheries. In the beginning of the last decade, aquarium keeping was at the infant stage in Kerala. The export of ornamental fish was below Rs. 1 crore. Recognizing the vast potential, Department of Fisheries organized International aqua shows for creating public awareness and providing a platform for the direct interaction with various organizations and institutions for the upliftment of the sector.

Augmenting the pace, a centrally sponsored Scheme through Fish Farmers Development Agency (FFDA) has been taken up by the State Department of Fisheries in all the 14 districts for providing training programme in ornamental fish culture to fish farmers in all districts.

In the Government sector, the Fisheries complex, Pannivelichira in Pathanamthitta district and Government model fish farm, Pallom in Kottayam district have now been developed into centres of production of fresh water ornamental fishes. The giant fish shaped aquarium near Malampuzha garden is one of the best attractions in this tourist centre of Palakkad.

In Trivandrum district, the construction of a modern fresh water aquarium is almost completed

at Neyyardam. In Kollam district a very good aquarium is maintained by Matsyafed at Thenmala near the reservoir area which also attains the attraction of both local and foreign tourists.

It is estimated that 163 ornamental fisheries and trade units are functioning in the state. Aquarium keeping is picking up as a hobby among the people. Under the circumstance a scheme on ornamental fish breeding and marketing is implemented through Matsyafed by organizing fisherwomen groups/ societies.

In order to highlight the trade and export of ornamental fisheries, two Aqua techno park for ornamental fisheries, one each at Kollam and Ernakulam have been envisioned to be implemented through Fisheries Resource Management Society (FIRMA) for imparting technical and financial support for the propagation of ornamental fisheries on a commercial basis.

Challenges And Problems

Deep-sea fishing not tapped

Despite our efforts for the development of deep sea fishing by creating infrastructure by resource survey, training of Co-operatives, construction of harbours, provision for charter, joint venture, test fishing etc, deep sea fishing is yet to make any worthwhile impact on fish production. The fish resources in offshore and deep sea are not exploited due to lack of large sized vessels and fishing technology suitable for exploitation of deep-sea resources such as Tunas and Cephalopods. Giving license to foreign fishing companies for deep-sea fishing on liberal terms and conditions have created hue and cry from various corners.

Cold Storage Facilities inadequate

Inadequacy of cold storage facilities and cold chain in the landing centers the fishermen are not in a position to take the advantages of bumber catches and hence they are forced to sell it at throw away prices.

Lack of facilities in Landing Centers/Fishing Harbours

Due to the lack of facilities in the landing centers/ fishing harbours etc. in catering to the standards of quality stipulated by USA and other countries the marine product export scenario of the state have faced serious problems at times. Instances are not rare when the consignments from India are rejected on quality grounds. Such a situation may adversely affect the sustainability of fishing operation in the State.

Role of middlemen in fish marketing

The fish marketing scenario of the State is largely in the hands of middlemen and big merchants. The right for first sales is not vested with the fishermen. The middlemen take away a great chunk of the proceeds. The fishermen's share in the consumer's rupee range from 25% to 65%. The commission agents are making undue advantages at the expense of primary producers and consumers. Availability of fresh fish to consumers at reasonable prices is still a distant reality.

Deep Sea Fishing Policy

Government of India accorded permission to liberally import used vessels of running condition for fishing in the Indian seas. This decision was tactfully utilized by many of the Indian and foreign businessmen involving in the seller-buyer business of vessels. The result was that many a foreign ship of Taiwan, Thailand and such other countries extensively exploited our valuable fishery resources and sooner it reached a stage of depletion of the harvestable stock.

Absence of strategies for the effective utilization of the by catch

It has already been pointed out that ever so many other species of fishes are getting destroyed in the avaricious attempts to catch the shrimp resources. It has indicated that there are 5 species of fish items comprising 45 families in the discarded items after picking shrimp alone. The strategies for the landings and utilization of these trash fish or by catch are yet to be developed.

Unauthorized introduction of new fishing vessels

The existing marine fishing fleet of Kerala is far above the recommended level, and the Kalawar committee in 1994 proposed to limit the number of trawling boats to 1145 motorized crafts to 2690 and

non-motorized crafts to 20,000. Yet, a large number of mechanized and motorized fishing vessels are constructed or being constructed without the permission of the authorities. There was no control over construction of new crafts.

Usage of banned fishing practices and banned gears

Bottom trawling, night trawling, purse seining, etc, and the usage of mesh size below 20 mm in any type of gears are banned in the State with powerful Act & Rules. However, the effective enforcement of these laws are yet to be realised.

Illegal fishing practices in the inland waters

The backwaters of Kerala face excessive, unauthorized & indiscriminate fishing pressure and illegal & detrimental fishing practices. Fishing by explosives & poisoning, electro fishing & light fishing etc. are wide spread in the backwaters. Stake nets are being operated during flood tides. The number of the stationary gears reached many fold of its authorized numbers. Even the gears are used with less than 5 mm size meshes.

Handicaps in an effective mechanism for marine & back water patrolling

The implementing Agency, i.e. Fisheries Department is not well equipped with patrolling facilities. The department does not own efficient vessels for patrolling. Funds for the patrolling operations are limited.

Depletion of fishery stocks of commercial species

Many species, which constitute considerable quantum of the commercial catches during the previous years, now show depletion or even under the threat of extinction due to the mixed effects of various anthropogenic activities.

Aquatic pollution

Backwaters, rivers and even the seas are the ultimate reservoirs of wastes generated by the modern civilization. Lack of facilities for monitoring the marine & estuarine pollution is becoming a severe threat, which may pose hazards to the aquatic living resources. The non-biodegradable pollutants alter the aquatic eco-system to a considerable extent.

Aquaculture potential yet to be tapped fully

The potential for marine, brackish water, freshwater, cold-water aquaculture and ornamental fisheries are not adequately tapped. Though cage farming is picking up as a diversified form of aquaculture in many parts of the country, cage aquaculture is yet to be developed in the State. Though oyster farming was practised in various pockets of the backwaters, it has not reached any where near its potential.

Lack of financial and marketing support in freshwater aquaculture

Lack of marketing support and consumer awareness are continuing problems that stand in the way of development of fresh water aquaculture of carps. Similarly the financial institutions in the State are not quite willing to back up bankable aquaculture projects.

Decreasing share of the state in the marine products export

The State's share in marine products export at national level is on the declining trend. Marine product export from Kerala has decreased from 1392 M.T valued at Rs.1045.2 crore in 2002-03 to 76627 M.T valued at Rs.1099.13 crore in 2003-04. Promotional programs for exportable varieties have to be augmented.

Potential from tourism and sports fisheries are not explored

Even though, tourism has made rapid strides in the State, tourism fisheries is still a non-starter in Kerala. Angling fisheries and payavo fisheries potential of the State are yet to be tapped. These are some of the favourite activities of the foreign tourists. The reservoirs located at high ranges, the mountain streams, back waters, streams, lakes etc, can be developed into centers of tourism fisheries.

Unhygienic conditions prevalent in fish markets

Domestic fish markets do not cop with the demands of the modern society. The drainage and the waste disposal facilities of such markets were pathetic. There are insufficient facilities for parking vehicles, public comfort stations, storage facilities for fish and other perishable commodities etc. in such markets.

Under utilization of the installed capacity of the processing plants

The installed capacity of the processing & pre processing plants and cold storages are not fully utilized. One estimate shows that less than 40% of these facilities were utilized due to varying reasons.

High fishing costs

High diesel price and low kerosene quotas makes fishing operations less economic.

General backwardness of coastal communities

Lack of sufficient housing and other social infrastructure facilities like drinking water, sanitation, electricity etc, still haunt the coastal villages. The fishermen communities were the outliers of the well-proclaimed "Kerala developmental model".

Threat to biodiversity

The biodiversity of these river systems is alarmingly declining due to a variety of reasons viz. obstruction in river courses, regulation and diversification of water flow, sand mining & habitat destruction, deforestation to soil erosion and unethical fishing practices.

Dwindling of water bodies

The most serious anthropogenic alterations, that take place in the inland waters are their alarming reduction to 73% of its original area. The vertical shrinkage of backwaters by siltation and progressive shallowing of backwaters have rendered them to 35% of original depth.

Kudumbasree approach for economic empowerment of fisher folks need to take roots in the coastal areas.

New self-employment programmes are being implemented with a view to empowering fisher women by organizing Self Help Groups (SHG) in coastal Panchayats.

Destruction of mangroves

Mangrove forests are acting as the excellent breeding and nursery grounds of great variety of finfish and shellfishes. Destruction of it led to the depletion of these fishery resources.

Clandestine introduction of exotic fishes

The clandestine introduction of exotic fishes and their intrusion in the natural waters are a matter of grave concern. The biodiversity of fish wealth is under threat due to the competition of such fishes with the indigenous fauna for food and habitat.

Lack of insurance schemes in shrimp/fish culture

Insurance companies totally neglect aquaculture industry from their area of coverage due to technical and other reasons. This contributes one such reason for the backlashes of the aquaculture development in the State.

Conclusion

Much to be done for over all development and well being of the fisheries sector in the State. The declining fisheries wealth has to be recouped. The species, which are under a threat of extinction, must be propagated for which adoption of suitable method is desirable. Rotation of crops like "Oru Nellum Oru Meenum Scheme" (Paddy & fish) has shown positive results in enhancing the production. The captive breeding and ranching programme is successful in propagation of fish species.

Even though the present expansion of fisheries sector in the State is much better than the past, there is much scope for modernization and diversification of the existing scenario. There is great need to introduce deep sea fishing technologies and diversification of existing fishing fleet, addition of the recent trends in fish processing industry to cop with the inter national standards, efforts for boosting the coastal & inland aqua culture sector and introduction of cold storages and cold chain and modernization of the fish markets.

As rare species of ornamental fishes have high demand in the domestic and foreign markets, this has to be exploited in the best possible way. Production of value added fish product is another area where the State has high potential. This enables us to generate more income and employment opportunities. In order to avoid a major catastrophe in the rare species of fish diversity of the State into oblivion, some earnest efforts are required to conserve, preserve and propagate them.

Free Trade Preparedness for a Developing Fishery Economy*

K. Prasadachandran Pillai**

Under the WTO regime, negotiations for Free Trade Agreements (FTA) between countries and country groupings such as the ASEAN, European Union, etc are on. The aims of the whole exercises are to eliminate all subsidies going into the products, to taper off all tariff barriers (TB) such as customs and import duties, anti-dumping duties and avoidance of non-tariff barriers (NTB) such as quotas and stringent quality standards arbitrarily specified when and where repulsion of import is found convenient for the importing country. The philosophy is to have fair play and square-shooting in pricing and trading practices by avoiding hidden unfairness in product packages. The subsidies given in production processes, raw materials and capital goods, support prices for agriculture products or waiver of sales tax, export subsidies and excise duties are intended as support measures for primary producers and manufacturers to sustain and develop while operating in the given socio-economic context within the nation. In the WTO parlance, subsidies are abhorred as practices of nations to provide an unfair price advantage over the producers of the goods or substitutes manufactured within the importing countries. Hence it is argued that subsidies are indirectly contributing to unfair trade practices.

On the other hand, customs duties, import duties, export concessions and incentives, etc are construed as direct barriers to free trade. They are import deterrents aimed at protecting domestic producers from foreign ones who have a price advantage. They vary substantially from country to country, product to product and supplier country to supplier country.

Assuring fishermen's welfare and social security as well as incentivising him for refraining from fishing will be an ideal tool in conservation of fish stocks....

**The views expressed here are personal to the author and may not reflect those of the organization represented.*

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Rich-Poor bilateral trade

One of the important points that developing economies such as India while entering into 'free' trade with developed countries is that the former are bound to be in a very disadvantageous position while selling or buying. Fairness in deals is almost non-existent when a poor man trades things with a rich man. The poor man offers mostly raw materials which 'is readily available elsewhere, at even cheaper rates' while the rich man condescends to give away the 'best quality' product in the world at the 'most competitive rates' with 'no substitute in quality and price elsewhere'. The poor has to take whatever is given to him by way of price to goods sold or purchased with all sorts of strings attached to the deal and products. The classic case of Captain Cook and the early traders when they 'discovered' Hawaiian islands getting ship loads of dry fish in exchange of a few nails is worth remembering.

The United Nations Conference on Trade and Development [UNCTAD] in its report for 2007 on free trade agreements cautions the developing countries against entering into FTAs with developed or industrialized countries, saying it could not only weaken the multilateral trading system, but also reduce the scope for national policies. But the note of caution seems limited to the North-South bilateral or regional trade agreements: "Rather than subscribing to the new regionalism", developing countries may examine other areas of cooperation with partners in the same geographical region and at a similar level of economic development and integration into the global economy". The UNCTAD says that in the case of an FTA between developed and developing countries the latter would loose out in competition and their domestic industries would get overwhelmingly exposed on account of foreign competition. However, these cautions notwithstanding, the number of FTAs rose from a mere 20 in 1990 to 86 in 2000 and to 159 in 2007, pointing to a clear wave in favour of regional or bilateral arrangements. This has been attributed to a growing frustration among developing countries over the stalemate in the multilateral negotiations under the World Trade Organization.*

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Having had so much of circumspection, it is high time that we had a deep introspection into our own situations in fish production, handling, processing and trade — domestic as well as export. Being more familiar with situation in Kerala though it may not be typical for India, what is prevalent in Kerala is discussed in the ensuing deliberation.

The Domestic Scene

Kerala has a million strong fishing community of which 1.75 lakhs are active fishermen, and the rest their dependants. Thus the sustenance and survival of a million poor people depends on the fate of the fishing industry. These marginalized people have little access to the job markets of the mainstream society. This only aggravates their socio-economic plight.

Since independence, the fishing industry has witnessed great changes in its every aspect. The crafts have increased and improved in design, endurance and efficiency. Same is the case of gear and propulsion. The combined increases in efficiency, capacity and size has had its commensurate impact in total production of fish, of course discounting the natural vagaries in abundance. The capture fishery production has been taken to the M.S.Y levels or perhaps beyond.

All odds against the producer

Dangerously enough, almost all the factors that contribute to this industry work against the fishermen's interests from capital and operational costs to returns. Ownership of crafts and gear by fishermen is well below 20% and that too overburdened by loans and pledges of all future catches. All the elements of operational costs are forbiddingly high. The cost of fuel, which tops his operational expenses continue to increase. Increases in the price of crude oil thus directly hits a fishermen's sustenance. Scarcity or price hike of power directly increases the cost of ice and freezing, and immediately lowers the price of fish.

The fishermen is at the receiving end again, his produce being the most perishable one and preservation and storage costs are formidably high so he has to sell his catches in an "as is where is condition" in a buyers' market. The trading of landed fish is not at all transparent. The price is controlled entirely by auctioneers or buyers. The price advantages in the export trade are seldom

handed over to the producer, but any disadvantage in processing or export is immediately transferred to the fishermen. On whatever price fixed for a catch, all the operational costs (mainly fuel, ice, water costs and ration advance) are summarily deducted first and the rest of the money, if any, is made available to divide between capital share, crew share and debt service. Thus all these factors contribute to perpetuate the fisherman's poverty and indebtedness. The fisherman inherits poverty, acquires a lot more of poverty in his life long subsistence enterprise, and bequeaths a very vast estate of poverty to successors.

The post harvest scenario is none the better. Almost all the harbours and landing centers except a few private jetties are constructed by the government. Hygienic maintenance is practically non-existant, except in one or two fishing harbours. Due to poor sanitational conditions and bad handling practices, degradation of harbours and landing centers start from the day of commissioning. This heavily contributes to fish spoilage and wastage, leading to high value erosion.

Processing and storage facilities are far from sufficient and hence most of the fish for the domestic market reaches there as 'fresh' fish or rather, unprocessed fish. Even the varieties that reaches the export processors looses much of their freshness thus disabling them from getting manifold increased prices.

There has been a steady increase in the consumer prices in the domestic market. The prices of almost all varieties of fish including common oil-sardines have more than tripled over the past decade. The consumer is now willing to pay more for any fish. The urban and sub-urban consumers are willing to give some more if the seller does the dressing and cleaning of fish. But this increase in consumer price does not reflect significantly in the returns of neither the fisherman or the small fish vendors.

The seafood export trade is gradually stabilizing itself. During the 70s and 80s, there was an influx of fortune hunters and fast buck seekers. They had inflicted very grave injuries to the export industry and the nation as a seafood exporter. Hundreds of them rented plants, availed large loans, obtained sizeable export incentives, shipped a few consignments of worthless stuff and left the scene cheating the buyers, fellow exporters, suppliers and banks simultaneously. Even those who were not such swindlers often used the huge export incentives to undercut fellow exporters – thus subsidies were indirectly passed on to the foreign buyers. The government has been pampering the export industry to such a great extent that Sri Baby John, former Minister and then a leading exporter wrote an article titled "Seafood – a subsidy oriented industry", in one of the annual numbers of the Seafood Export Journal!

Now even after a gradual elimination of fast buck seekers and small time businessmen, the industry has not gained the health and professionalism to return better price support down the line to the producers, mainly because our poor small exporters are doing business with rich mammoth business houses, in competition with small exporters from fellow developing countries. The importers are in a strong position to dictate prices and quality standards which are often used for tariff politics of their governments.

With this background, the governments both in the Centre as well as in the States would do well to prepare our fishery economy to brace up and face the fallouts of the oncoming free trade agreements with other countries or groups.

Making Responsible Fisheries affordable.

One of the important things the advocates of Code of Conduct for Responsible Fisheries tend to forget is that it is a very costly affair for a vast majority of people involved in fisheries. Majority of the signatory nations can ill afford the huge infrastructural investments the CCRF warrants, not to mention the costs of technology upgradation, costs of resource conservation and HRD. Still the government of India and the States can do a lot to improve the socio-economic condition of fishermen by providing them with welfare and social security programmes. This will enable them to depend less on fishing for a living and help reducing the fishing pressure. This will also help them afford to have good fishing and handling practices, thereby avoiding high value erosion, and to have real value addition. Besides the general revenues of the government, the exporters and traders must also be made to contribute to these welfare measures, since they will also benefit from the good fishing and handling practices rendered affordable to the

fishermen. The exporters should willingly take these statutory contributions into their production costs and charge them on their export prices as they do in the case of the administered prices of electricity or water. They should not approach the courts to evade this responsibility unlike they did in the case of the Kerala Fishermen's Welfare Fund Act.

Handling and Processing Interventions

The capital and technology investments for good quality handling, processing, storage, transportation and marketing are too high and unaffordable to the fishermen community. But if these investments are made by the government and implemented well advisedly, a considerable number of people in the coastal communities will obtain gainful employment, add to the fishermen family income and reducing their exclusive dependance on fishing for livelihood. If these are implemented as community facilities and managed by stake holder groups, charging user fee for timely maintenance, will go a long way in providing good quality fish and products to the consumers – domestic and abroad. This will also effect considerable value savings and value addition. If properly managed, this will ensure better returns to the primary producers – the fishermen. Similar community facilities can be set up in places with justifiable supply of fish – the fishing harbours, landing centers and clusters of fish farms. The activities involved can be undertaken by stakeholder groups such as S.H.Gs and Co-ops.

Pricing and marketing interventions

Transparent, straight forward trading practices and institutional financing of fishing and handling operations are absolutely essential to ensure better returns to fishermen and healthy development of the industry. At present pricing and quality assessment at landing and trading points are highly arbitrary. There is no fair arbitrator for price and quality. The State government will do well to put in place Fish Price and Quality Assurance Authority (FPQAA) with statutory support with Prices and Quality Arbitrators at action points, with stakeholder committees to oversee their performance.

Import inspection

At present, there is no system in place to regularly check the import consignments regarding the species, quality and quantity, contamination by foreign microbes not permitted in the country as well as antibiotics & pollutants and the origin of the fish. Very few samples are being sent to CIFT for some of the above factors but it has not been made mandatory. Again the procedures are also not well laid down. Therefore, it is absolutely essential that a Fishery Import Regulatory Authority, with properly laid down procedures and parameters mentioned above, is to be established and made operational before imports are allowed.

Central subject and the State 'subjects'

International trade being a central subject, the Government in the Ministry of Commerce is concerned about the fish only till it reaches the sea and airports of the country. Once it crosses the State's boundaries, fish becomes a state subject and is the concern of the State Governments. If the fish reaches the local markets either in fresh or processed condition, it could heavily impact the domestic fish prices and thereby the returns of fishermen and fish farmers for their own produce. Again there already are problems including health hazards posed by contaminated fish reaching Kerala from neighbouring states. Hence the State Fisheries Departments (DoF), should take upon themselves the task of monitoring the movement of fish from the point of import, processing plants, marketing chains till the consumer. The DoF should also verify the quantity of fish imported by a processor, quantity re-exported as well as production losses and wastages. Sales of 'second quality' fish and products in the domestic market should be banned.

Processors and exporters should be made to enter into forward contracts with fishermen societies, groups and boat owners based on the demand, price situation and currency situation. This can be implemented through the Fish Price and Quality Assurance Act and Rules. If the fishermen have a before hand knowledge of the possible price he will get, he can exercise the two options intelligently to fish or not to fish. He can go fishing when he can expect good returns and refrain from fishing when the returns are not too good and thus save a lot of operational costs and precious fuel. Assuring fishermen's welfare and social security as well as incentivising him for refraining from fishing will be an ideal tool in conservation of fish stocks, reducing wastage of fuel and to immunize them from the ill-effects of FTAs to a great extent.

Pelagic Fisheries of India

N.G.K. Pillai* & U.Ganga **

. . . it is clear that the pelagic fisheries is an important contributor to the livelihood and nutritional security of both coastal fishers, consumers and the resources have to be optimally and sustainably harvested.

The pelagic fishes live most part of their life in the surface or subsurface waters. This group exhibits rich species diversity and abundance in the Indian EEZ. Though 240 species constitute the pelagic fisheries along the Indian coast, it is only about 60 species belonging to 8 groups support major fisheries (Table1). During the last decade, pelagic finfishes contributed to 46-56% (average: 51%) of the total marine fish production, of which almost 70% was fished from within the 50 m depth zone (Table 2). Small pelagics such as the Indian oil sardine, Indian mackerel and Bombay- duck contributed 26% of the total marine fish landings (1990-2005). The dependence of a large number of artisanal fishers and the coastal population on the pelagic fisheries underlines the socio-economic importance of these low value fishes. Besides these, large growing pelagic fishes such as tunas, billfishes, seerfishes and pelagic sharks are high unit value fishes contributing significantly to the export earnings of the country.

Unique biological characteristics:

The pelagics (except pelagic sharks) are characterized by certain unique combination of biological features, which include formation of large schools, feeding on plankton or nekton, fast growth rate and short life span (0.5-4 years). Most of them are either continuous spawners or have prolonged spawning periods with high fecundity. Many of them are migratory and generally show shoaling behaviour. The most prominent feature of the pelagic fisheries is their extreme annual fluctuations.

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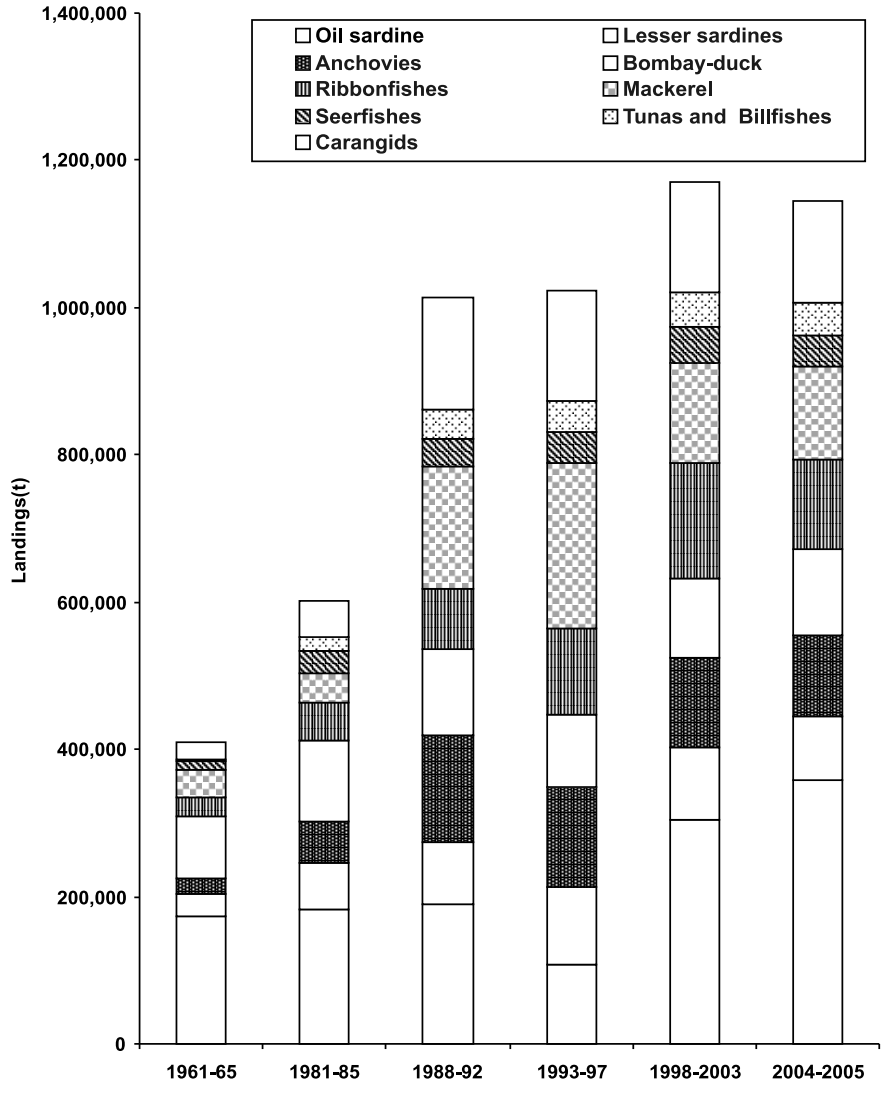

Fig. 1. Trend in major pelagic landings (in tons) in India, 1961- 2005

Production trends

A comparison of the average annual production of major pelagic finfish groups from the initial stages of mechanization in 1960s through the 80s to 1994, shows an increasing trend with respect to all the groups. Compared to 1960s, the production almost doubled or even thribled with respect to many groups in the 1980s, but since late 1990s catches have stabilized (Fig.1). The increased production in the early eighties could be attributed mainly to the introduction of purseseine fishing, while that of the late eighties and nineties to the motorisation of country crafts, introduction of innovative gears like ringseine and commencement of stay-over fishing. Substantial increase was noticed in the case of Anchovies, Bombay-duck, Tunas and Billfishes till 1992 and that of Ribbonfishes and Mackerel till 1993-94 while Oil sardine and Mackerel showed only marginal increase.

Mode of exploitation

Canoes, Pablo type boats, catamarans, trawlers and purseseiners are used in the exploitation of pelagic resources. The gears used are purse seine, ring seine, shoreseine, boatseine, gillnet, drift gillnet, hooks & line, troll line, pole & line and dol net. Considerable quantities of pelagic fishes are also landed by pair trawls and high-opening fish trawl nets operated from the shrimp trawlers as well as gillnets of various mesh sizes operated from motorized/mechanized crafts.

The average annual pelagic fish landings (1990 –2005) is given in Table 3. Region- wise, the southwest coast (Goa, Karnataka and Kerala) is most productive (41%) followed by the northwest (Gujarat and Maharashtra 25%), southeast (Tamil nadu, Pondicherry and Andhra Pradesh 23%) and northeast (West Bengal and Orissa 11%). The trend of exploitation of pelagic stocks by the non-mechanised (traditional), motorised traditional and mechanised sectors are given in ensuing Table 4.

Table 1. Details of major families of pelagic fishes and species/groups		
Family	Group/species	Number of species
Clupeidae	Oil sardine*	1
	Lesser sardines* (including rainbow sardines)	14
	Hilsa spp. & other shad	15
	Whitebaits*	24
	Thryssa and Thrissocles spp.	10
	Wolf herrings	2
	Other clupeids	40
Scombridae	Coastal tunas	5
	Oceanic tunas	3
	Seerfishes & wahoo	5
	Mackerels*	3
Trichiuridae	Ribbonfishes*	8
Carangidae*	Round scads	2
	Golden scads	6
	Hardtail scad (or horse mackerel)	1
	Jacks	17
	Black pomfret	1
	Others	19
Harpodontidae	Bombay-duck*	2
Stromateidae	Pomfrets	2
Coryphaenidae	Dolphinfishes	2
Rachycentridae	Cobia	1
Mugildae	Mullets	22
Sphyraenidae	Baracudas	7
Exocoetidae	Flying fishes	10
Bregmacerotidae	Unicorn cod	1
	Others	19
	Total pelagics	**242**

***Annual catches exceed 1 lakh tons**

Table 2. Growth in pelagic fish production from 1950 to 2005				
Period	Production (tonnes)		Relative growth (%)	
	Pelagics	Overall	Pelagics	Overall
1950-59	362,548	618,501	-	-
1960-69	527,211	814,721	+ 45	+ 31
1970-79	643,142	1,243,707	+ 22	+ 27
1980-89	819,093	1,579,836	+ 27	+ 27
1990-99	1,116,792	2,258,874	+ 36	+ 43
2000-05	1,326,055	2,516,608	+19	+11

Source: Pillai and Pillai (2000)

Table 3.
Average landings of pelagic finfishes (in tonnes) and their percentage contribution during 1990 – 2006.

Groups	**Catch (T)**	**%**
Oilsardine	236214	18.60
Mackerel	162540	12.80
Carangids	141169	11.11
Ribbonfish	135749	10.69
Anchovies	115013	9.05
Bombay duck	111302	8.76
Lesser sardine	96780	7.62
Other pelagic	77310	6.09
Other clupeids	47328	3.73
Tunas & billfishes	47271	3.72
Seerfish	44015	3.46
Hilsa	26066	2.05
Wolfherring	15284	1.20
Baracuda	14258	1.12
Total pelagics	**1270299**	

Source: CMFRI

Table 4. Sector- wise effort, catch & catch/hr of pelagic groups in respect of non-motorized (traditional), motorized and mechanised units in India during 1999-2005

	Mechanized	Motorized	Non-motorized(traditional)
Total catch (T)	763994	550911	227498
Effort (AFH)(hr)	17435308	17697995	10961736
Effort (Units)	1076745	4102995	3015025
% contribution	49.5	35.7	14.8
Catch/hour (kg)	44	32	22

Source: Pillai, 2006.

Status of pelagic fishery resources

The landing pattern of the pelagics can be categorized as follows: (a) fisheries which have fluctuated very widely (Oil sardine, Bombay- duck and Indian mackerel); (b) fisheries which have increased the landings fairly consistently (Lesser sardines, *Hilsa spp.,* Whitebaits, *Thryssa spp., Coilia dussumieri*, Carangids and Ribbonfishes); and (c) the only pelagic fishery which has declined (unicorn cod Bregmaceros mclellandi).

Indian oil sardine

The Indian oil sardine is a very important pelagic fish species which contribute to about 15% of the total marine fish production in the country. The oil sardine fishery has been most strikingly characterized by wide fluctuations in the annual landings from the very early years of exploitation. The resuscitation of the oil sardine stock after an ever-lowest landing of 47,000 T in 1994 was manifest from the heavy recruitment that followed, which culminated to a highest production of 4.04 lakh tonnes in 2003. Since late 80s it has become an established fishery on the east coast with the average (1985 to 1996) annual landings of the Oil sardine on the west coast being 128,282 t (86%) and the east coast 21,262 T (14%). Till the end of 1970s, artisanal fishing gears mainly boat and beach seines, cast nets and small meshed gill nets were the major gears operated along the southwest coast. With the introduction of mass harvesting gears like purse-seines in the late 70s and ring seines in the late 80s along with a steady rise in the motorization of the traditional fishing crafts, many of these traditional fishing methods have become redundant. Along the east coast mainly boat-seines, gillnets and bag nets dominate.

The lesser sardines comprise several species of *Sardinella* contribute to a lucrative fishery along the southeast and southwest coasts. The dominant species contributing the fishery are *Sardinella albella*, *S.gibbosa S.fimbriata, S.sirm and S.dayi.* The traditional, motorized and mechanized crafts employ a variety of seines, gill nets and trawls to exploit the lesser sardines .

Anchovies

The anchovies constituted by five genera viz. *Stolephorus, Coilia, Setipinna, Thryssa* and *Thryssina* constitute seasonal fisheries mostly along the coasts of Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra. Among Anchovies, Whitebaits (*Stolephorus and Encrasicholina spp.*) are dominant contributing 48% (average 1985 – 2003) followed by *Coilia dussumieri* (24%), *Thryssa* (26%) and *Settipinna* (2%).

The Indian mackerel

The mackerel fishery comprises a single species viz., *R. kanagurta*. However, *R.brachysoma and R. faughni* also are reported to occur in the catches along the east coast. Till 1980s, exploitation of the resource in the upwelling areas of the southwest coast of India was mainly restricted to the post-monsoon period by traditional crafts using small surface gears like shore-seine, boat-seine and gillnets made of cotton or hemp up to 20-m depth. With the introduction of motorization and purse-seine and ring- seines in the early eighties, the indigenous fishery has undergone a major upheaval

with heavy catches of Juveniles even during the monsoon period. This large scale exploitation of the juveniles is the key factor which limits the yield from the Mackerel stock. Under the present length, at first capture (140 mm), maximum sustainable yield from the resource is 2.2 lakh tonnes.

Tunas and Bill fishes

Tuna production along the mainland coast fluctuated between 30,285 t (1987) and 54,007 T (2000) with an annual average production of 41,443t forming 3.6% of the total pelagic fish production.Of the 8 major species of tunas occurring along the Indian coast, five are coastal/ neretic and three are oceanic and migratory. The commonly occurring coastal tuna species are *Euthynnus affinis* (little tuna), *Auxis thazard* (frigate tuna), *A.rochei* (bullet tuna), *Sarda orientalis* (oriental bonito), *Thunnus tonggol* (long tail tuna) while oceanic species include *Katsuwonus pelamis* (skipjack tuna),*T. albacares* (yellowfin tuna) and *T.obesus* (bigeye). Four genera of billfishes *Istiophorus, Makaira and Tetrapturus* (family *Istiophoridae*) and *Xiphias* (family *Xiphilidae*) occur in the Indian seas and occur as by-catch in the gillnet/hook & line fishery for tunas. Drift gill nets, purseseine and the hooks and line are popular for tuna fishing by mainland fishermen while pole & line and troll lines are operated in Lakshadweep seas targeting Skipjack and Yellowfin tuna.

Seerfishes

The annual seerfish catch showed an increasing trend during the past five decades with fluctuations ranging from a mere 4505 T in 1953 to an all time peak of 54,998 T in 2003 with the increase along the west coast being remarkable. They contribute just 1.85% of the marine fish production but owing to high unit value are major sources of income for gill net and hooks & line fishermen. Out of the four species viz., the king seer (*Scomberomorus commerson*), the spotted seer (*S.guttatus*), streaked seer (*S.lineolatus*) and the wahoo (*Acanthocybium solandri*), the fishery is sustained by the first two species.

Carangids

Carangids have emerged as one of the important pelagic fish groups landed by the mechanized sector and the average annual production (1985-2003) was 133,000 T which constituted 4% of the total marine fish production. There are 46 species of carangids occurring along the Indian coast but commercial fisheries comprise mainly of horse mackerel (*Megalaspis cordyla*), round scads (*Decapterus dayi, D.macrosoma*), selar scads (*Selar crumenophthalmus*), queenfishes (*Carangoides spp.*), trevallies (*Caranx para, C.carangus, Selaroides leptolepis*), leatherjackets (*Scomberoides spp.*) and pompanos (*Trachinotus spp.*). The fisheries are mostly seasonal coinciding with the monsoon and largely from 60 –80 m depths along the mainland coast and 20 - 40 m in Andaman seas. Exploitation is carried by a variety of gears such as trawl nets, drift and bottom-set gill nets, hooks and line, shore seines, ringseines and purseseines.

Ribbonfishes

The ribbonfishes (hair-tail or cutlass) are widely distributed along the Indian coast and form major pelagic fishery resources of the Indian seas. The average Ribbonfish production in 60s was 28,171T, which increased to 65,360 T during the 80s to 120,461 T during 1990s. The average production during 2001-2005 was 159,352 T (Fig.7). *Trichiurus lepturus* is the dominant species (>95%) in the Fishery. Species such as *T. russelli, Lepturacanthus savala, L.gangeticus, Eupleurogrammus muticus* and *E. glossodon* have also been recorded in the Indian waters. The major gears are trawls (70%) followed by the bagnets, gillnets and the purseseines. Nearly 64% of the Ribbonfish landed annually in India are exported in frozen form to China, Japan and other southeast Asian countries, the remaining being either routed for the domestic fresh fish market or sun-dried. The development of export market has led to targeted fishing for Ribbonfishes and to a certain degree of unsustainable exploitation especially on the east coast, as evidenced from increasing component of juvenile Ribbonfishes in trawl landings.

Bombay-duck

Bombay-duck constitutes a fishery of high magnitude along the northwest coast and are conspicuously absent on the southwest and southeast coasts. They form a seasonal fishery on the northeast coast (West Bengal, Orissa and the northern part of Andhra Pradesh). The gillnets,

boatseines and trawls are also employed in this fishery. Though *Harpadon nehereus* was the sole contributor along the northwest coast, another species *H. squamosus* has been recently recorded off Kakinada on the northeast coast.The Bombay-duck is highly perishable because of its high water content, and hence needs speedy disposal. The bulk of the catch is sun-dried and sold in the interior markets while a small portion is converted into manure. Laminated Bombay-ducks are in good demand in some foreign markets.

Pomfrets

Pomfrets belonging to the family *Stromateidae*, comprises silver pomfret (*Pampus argenteus*) and the Chinese pomfret (*P.chinensis*) which form about 2% of all India marine fish landings. They are highly relished table fishes and command high unit value in internal and export markets. Landings are mainly from Gujarat and Maharashtra on the northwest and Orissa on the northeast coasts. On the northwest coast, the principal gear exploiting the adult pomfrets are drift gillnets (140-155 mm mesh size) while the *dol-net* essentially exploits the juveniles. As the fishery on the northwest coast collapsed during 1990s, restriction of *dol-net* operations to minimise recruitment overfishing and regulation of gillnets to minimise growth overfishing was recommended as management measures to be urgently implemented. Recently, the CMFRI recommended minimum legal weight (MLW) of 300 g for export of pomfrets have been implemented by DAH D&F, Ministry of Agriculture, Govt. of India which can go a long way in ensuring the sustainability of the fishery.

Other Pelagics

The Hilsa shad (*Hilsa ilisha*) form a prominent fishery in the northeast coast.The Baracudas (*seapikes*) fishery in India comprises four species, *Sphyraena obtusata, S.baracuda, S.jello and S.forsteri*. The unicorn cod (*Bregmoceros mcclellandi*) fishery is observed on the northwest coast but catches are dwindling.The flyingfish fishery is seasonal and limited to the Coromandel coast in Tamil Nadu supported mainly by the species *Hirundichthys coramandelensis*. Clupeids such as the wolfherring (*Chirocentrus dorab*), Rainbow sardine (*Dussumiera spp.*), *Escualosa, Ilisha, Nematalosa, Opisthopterus, Pellona, Reconda, Dorosoma, Chanos* etc. form minor fisheries constituting about 1.6 % of the total all India landings. The mullets (*Mugil spp.*) form a fishery mainly in the northwest region, which contributed an annual average of 6056 T during 1999-2005.

Research Priorities in the Management of Pelagic Fisheries

Impact of environment on pelagic fisheries

There is strong evidence that annual variations in the year class strength of pelagic fishes in upwelling areas are governed mainly by oceanographic factors such as upwelling intensity, offshore water transport and water column stability and each year the success of pelagic fisheries is a delicate balance between physical oceanographic factors and effects of fishing on the stock.

Seawater temperature, dissolved oxygen levels, salinity, phytoplankton and zooplankton concentrations play a vital role in controlling the distribution and abundance of pelagic fishery resources. The global warming phenomenon has been observed to have significant impact on the change in distribution and abundance patterns of the pelagics like Oil sardine and Mackerel along the Indian coast as manifest in their movement towards more northern latitudes in recent years. Parameters like Sea Surface Temperature (SST) and phytoplankton pigments (*Chlorophyll a*) obtained from satellites and available with agencies like the Indian National Centre for Ocean Information Services (INCOIS) are used in prediction of Potential Fishing Zones (PFZ) for the benefit of the fishermen. Thus, fishery environment data has become crucial to addressing productivity of fishing grounds, annual/long term fluctuations in fish catches and making fishery forecasts and has to be further researched to find practical solutions for fisheries management purposes.

Fish migration

Most of the pelagic finfish species move in large shoals and exhibit certain characteristic migratory pattern. While the small pelagics like Sardines and Anchovies perform migrations along the coast, Mackerels, Scads and Coastal Tunas migrate fairly long distances between inshore and offshore waters. Therefore understanding the migratory patterns of pelagics is crucial for planning a successful fishery and its management. Tagging and recovery is the

best way to study migration and growth of pelagic fishes for which sophisticated acoustic and telemetric tags have been developed. These allow continuous observations of the behaviour and movements of tagged fish and this information can be gainfully applied for fishing as well as resource management activities.

Fish recruitment dynamics and modelling

Fluctuations in pelagic fish landings are partly due to recruitment variations. Many of the world's greatest fisheries particularly for pelagics like the sardines have collapsed owing to recruitment failure caused by high fishing pressure on the spawning stock. There is also a significant influence of environment in determining the recruitment success of pelagic species every year. Hence, time series data on its fishery, fecundity and condition indices are invaluable in developing models to forecast recruitment variations and its impact on fisheries.

Future prospects of pelagic fisheries

The Working Group on the Revalidation of Potential yield of Marine fisheries of the Indian EEZ (Anon., 2000) indicated potential yield of pelagic resources from the Indian EEZ as 1.67 million tonnes of which an average 1.4 million tonnes is harvested mostly from within the 50 m depths. Though a progressive trend is noticeable in production of some pelagics such as Carangids and Ribbonfishes, many of them, especially the Oil sardine, Mackerel, Bombay-duck, Seerfishes and Coastal Tunas have reached the optimum level of exploitation in the conventional inshore fishing grounds. The stock assessment studies conducted for 20 species of exploited pelagic finfishes have shown that the present effort expended is close to or in some cases even exceeded the level of MSY and further increase in effort in the coastal sector would be detrimental to sustain the yield and there is not much scope of further increase in production from this inshore zone. However, the potential yield estimates of oceanic resources is 0.24 million T which is mainly constituted by the oceanic tunas (yellowfin, skipjack and bigeye) with lot of export potential especially in value added or Sashimi (for yellowfin and big eye tunas) form. Hence there is an urgent need to develop an oceanic pelagic fishery with appropriate infrastructure and policy support from the government and fisheries development agencies. Groups such as Whitebaits, Carangids, Baracudas, Billfishes and Pelagic Sharks are also expected to contribute significantly to the additional yield from beyond the conventional fishing zone. There are also certain imbalances in pelagic fish landings vis-a vis their potential, especially on the north east coast of India where demersal fisheries especially shrimp trawling is given more importance which has to be addressed and can lead to increased pelagic fish production for the domestic market as well as export.

With regards to the small pelagics such as Oil Sardine, Mackerel and Anchovies, these are fishes with a large domestic market and crucial to the nutritional security of a large coastal population in India. However, the unpredictable nature of their fisheries has made their markets highly vulnerable to price fluctuations. A lot of valuable protein rich food is wasted during periods of high production due to lack of proper cold storage facilities and efficient domestic market network. Infrastructure facilities for storage and transportation of the catches to the interior markets require further strengthening to handle surplus production of pelagics. This aspect has to be looked into along with introduction and popularisation of cost efficient processing techniques such as improved solar drying and smoking to produce value added products, especially during periods of glut. Considerable knowledge exists in the country on product development for the affluent markets. Small processing plants under community programme could be established in specific locations. High priority should be given to reduce postharvest losses.

Also, with the advent of infrastructural facilities such as fishing harbours, mechanized and motorized crafts, fish finding equipments and more efficient gears, it is observed that more than 50% of the pelagic finfish landings along the west coast of India during the months from July to October is constituted of juveniles. This is unsustainable and restrictions on small meshed gears such as ringseines regarding mesh size regulation, minimum legal length at first capture, craft size and horsepower, net size and area /period of operation are required. From the foregoing account, it is clear that the pelagic fisheries is an important contributor to the livelihood and nutritional security of both coastal fishers, consumers and the resources have to be optimally and sustainably harvested.

The Molluscan fishery of India and its livelihood Enhancement potential

K.K. Appukuttan*

The shell craft industry offers partime employment for women in making garlands, evechains, decorative table lamps, shell curtains, rings, bath stand etc.. using a variety of molluscan shells.

In ancient India, the molluscs were deeply associated with folklore, mythology, social customs and tradition, trade, handicraft and as currency. They were also used as ornaments, utility articles and medicine in addition to the limited use as food item. The sacred chank and pearl oysters are closely linked with Hindu religion and mythology from time immemorial. Till recently chanks, pearl oysters, mussels, oysters and cephalopods were the only molluscan resources exploited on commercial basis. In recent years cephalopods and other molluscs are emerging as important component of fishery resources of India contributing 4-5 % of total fish landings. The demand for cephalopods and few other edible bivalves and gastropods for export trade has also increased substantially. The molluscan shells of several species are in good demand, both for ornamental trade and also for industrial use. In addition to this, the organized efforts from the government agencies and research institutions in the country helped to increase the production of bivalves by adopting scientific farming in coastal waters. The major molluscan resources of India are cephalopods, clams, edible mussels and oysters, pearl oysters, windowpane oysters, sacred chank, whelks, top and turban shells and a variety of ornamental gastropods.

Cephalopod resources

The exploited cephalopod resources of India are mainly squids, cuttlefishes and octopods. Among squids, the neretic Indian squid *Loligo duvauceli* formed bulk of the catch, *Sepia aculeata* and *S. pharonis* contributed major

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share of cuttlefishes and the octopus catch was mainly from *Octopus membranaceous* and *O. dolfossi*. More than 80% of the cephalopod landings is from west coast and major share is from Gujarat and Maharashtra. There was a phenominal growth of cephalopod landings from 91T in 1961 to 1,11,534 T in 2000. The average landings in 1981-85 was 19,000 T contributing 1.3% of total Indian marine fisheries landings. This has increased to an average 45,000 T in 1986-95 and further increased to 1,06,000 T in 1996-2000 period contributing 4.1 % of total landings. This increasing trend can be attributed to the introduction of mechanized trawling in inshore waters and also to the increasing export demand. The potential yield estimated in 2000 for cephalopods is 1,01,259 T and the current yield is 1,12,762 T (2004) This indicate that the exploited stock has reached the optimum level. Trawl net operated up to 100 m depth yield 85 % of the cephalopod landings in India. Other gears used for cephalopod exploitation are hook and line, boat seine and purse seine. Recent deep sea trawl fishing beyond 100 m yielded oceanic squids and it is assumed that huge potential for neretic cephalopods exists. Bulk of the production of cephalopods is exported and very little consumed locally. The estimated export of frozen cuttlefishes and squids in 2004-2005 was 92363 kg worth 951.27 crore rupees. The annual average export of frozen and dried cephalopods form 25% of the total Indian marine export. The main markets for Indian cephalopods are Europe, Japan, and China.

Bivalve resources

The important groups of bivalves exploited are clams, mussles, edible oysters, pearl oysters and windowpane oysters. Clams rank first in abundance and they contribute almost 80% of the total bivalve production. Recently researchers have developed suitable mariculture technologies for farming fast growing species of mussles and edible oysters in coastal waters of India. The pearl production technique was also developed in Indian pearl oysters. Through experimental farming and repeated demonstrations bivalve farming is becoming popular in the coastal areas of the country.

Clams

Clams are widely distributed in the intertidal coastal waters, estuaries and backwaters of India contributing subsistence fisheries. They are hand picked or dredged using hand dredges by men, women and children in the coastal areas. The important species of clams exploited are *Villorita cyprinoides* (Black clam), *Meretrix casta* (Yellow clam), *Meretrix meretrix, Paphia malabarica* (Short–neck clam), *Mercia opima* (Baby clam) and *Anadara granosa* (Blood clam). Giant clam. *Tridacna maxima, T. squamosa, T. crocea* and *Hippopus hippopus* are available in Andaman and Nicobar Islands. Giant clams are now protected species under the schedule I of the Wildlife (Protection) Act 1972 of Ministry of Environment and Forest and hence no exploitation. Among all the maritime states, Kerala contributes a maximum landings of clams mainly from Vemband and Ashtamudi estuaries.

Black clam *Villorita cyprinoides* is exploited mainly from many estuaries of Goa, Kalinadi, Agnashini, Coondapur, Swarna & Udayavara in Karnataka; Kozhikode, Vembanad and Ashtamudi lake in Kerala. Of all these areas, Vembanad lake in Kerala contributed the maximum (96%). The annual catch fluctuate from 1,1652T in 1985 to 42026 T in 2004. Narasimham (1993) estimated subfossil, limeshell deposit in Karnataka estuaries as 62,000T, in Vembanad lake in Kerala as 1,48,000 T, in Pulicut lake, Tamilnadu as 5500T and from other sources as 5500T with annual production ratio of 27800T. The black clam is exploited by hand picking and dredging using hand dredges operated from canoes. Sub-fossil deposits are mainly collected using hand operated dredges and mechanical dredges. The black clam shell and lime shell exploited are mainly used for cement industry and calcium carbide industry. The meat yield of these species is almost 10% and unfortunately the meat is not fully utilized for edible purpose. A meagre portion is used for edible purpose and the rest is either used as fish /shrimp feed or simply discarded. Indiscriminate fishing of juvenile clams is a serious threat in all the estuaries for black clam fishery leading to the depletion of existing stock. Relaying method of clam farming is suggested to replenish the stock in all the estuaries.

The short-neck clam *Paphia malabarica* is exploited from Uppunda, Coondapur, Udayavara and Mulky estuaries in Karnataka and Ashtamudi, Kayamkulam, Dharmadam and Padanne estuaries in Kerala. This species is commercially important since the clam meat export from India fully depends on this species at present. The export of short-neck clam meat started in 1984 with a meagre quantity and the present annual export is around 400-500t earning 3-4 crores rupees as foreign exchange. 80% of the clam meat exported is from Ashtamudi estuary, Kerala. The meat is heat shucked and frozen for exports.

Blood clam *Anadara granosa* is being exploited from Kakinada Bay (Andhra Pradesh) with an annual yield of 1200-1300t. Yellow clam *Meretrix casta* is harvested from Karnataka estuaries, Agnashini, Uppunda, Coondapur, Sita, Udayavara, Mulky, Gurupur and Nethravathi and from Kerala estuaries, Kozhikode, Chettuva, Vembanad and Ashtamudi. In the east coast, Vellar estuary, Muthukad and Pulicat in Tamilnadu and Bheemunipatanam in Andhra Pradesh also contribute yellow clam fishery. Exploitation of *Meretrix meretrix* is reported from Thane to Ratnagiri in Maharashtra, Kalinadi, Agnashini, Uppunda, Coodapur and Sita estuaries in Karnataka and Kakinada bay and Godavari estuary in Andhra Pradesh. *Mercia opima* (Baby clam) production in India is around 500t annually and it is exploited in several creeks in Maharashtra, three creeks in Karnataka, Vellar estuary in Tamilnadu and Kakinada Bay in Andhra Pradesh. Appukuttan et. al (1985) reported *M.opima* fishery from Ashtamudi and the total catch for 1982-84 period was 5436t. Later it was observed that this fishery collapsed due to environmental changes and this species was replaced by *Paphia malabarica.*

Mussels

Two species of mussels, green mussel *Perna viridis* and brown mussel *P.indica* are available in Indian coast and are exploited on commercial basis for edible purpose. *P.viridis* has got a wider distribution along Kerala, Karnataka, Goa, Maharashtra and also in Andamans. *P.indica* has got restricted distribution in south west coast of India from Varkala to Kanyakumari. Kerala is considered as the 'mussel fishery zone' of India since extensive natural mussel leds are available in the Malabar Coast and exploitation is done from time immemorial. The total annual mussel production varies from 10,000T to 15,000T of which 80% is contributed by *P.viridis* from Northern Kerala. In early 70's the Central Marine Fisheries Research Institute, Kochi developed simple, eco-friendly farming techniques through experiments and demonstration trials in different parts of the country in the coastal waters and estuaries. Repeated demonstration with full participation of fisher folk has proved this technology successful and the farmer groups started adopting mussel farming in estuaries and coastal waters. This has become a successful group farming activity by Self Help Groups of Malabar coast with technical support from CMFRI, BFFDA, ADAK and financial assistance from Co-operative banks and other financial institutions. Adoption of the technology was easy since it was simple, low cost, require no additional feed, ecofriendly, short culture period of 4-6 months and good market demand. The production of green mussel through farming was 2t in 1996 and this has reached 7500t in 2006 mainly through group farming activities in Kerala.

Edible oyster

Out of 6 species of edible oysters recorded from Indian coasts, the Indian edible oyster *Crassostrea madrasensis, C.rivularis, C.gryphoides* and *Saccostrea cucullata* are commercially exploited. *C.madrasensis* is widely distributed and ranks first in abundance and exploitation. The standing stock of this species is estimated as 27,000T from Kerala and Andhra Pradesh (Narasimham, 1993). *C.gryphoides* is found in exploitable quantities in Karnataka, Maharashtra, Goa and Gujarat. *S.cucullata* is widely distributed in marine intertidal zone all along the mainland of India and also in Andaman and Nicobar Islands. The estimated annual production is only 2000T from the wild. Demonstration of farming technique of oysters in estuaries of Kerala, Karnataka and Maharashtra was done by the Central Marine Fisheries Research Institute and subsequently this simple method of oyster farming is being taken up by farmer groups

(SSG's) in all these maritime states. In southern part of Kerala many women SSG's have taken up oyster farming with the support of Government agencies like BFFDA, ADAK and Matsyafed.

Pearl Oyster

Out of the seven species of pearl oysters recorded from India, *Pinctada fucata, P.margaritifera* and *P.maxima* produce pearls of good quality. Natural pearl beds were in existence from time immemorial in Gulf of Mannar and Gulf of Kutch and regular pearl fishery existed in these areas till 1966. The pearl fishery Gulf of Mannar dates back to 2000 years and after 1966 this fishery collapsed and till date it is not revived. Observing the failure of pearl fishery in Gulf of Mannar and Gulf of Kutch, the Central Marine Fisheries Research Institute developed techno-economically viable pearl production methods in *P.fucata*. The technology was tested successfully through experimental trials, pilot projects and demonstration programmes. Even then, the pearl production has not been taken up as a commercial venture. The longer gestation period for pearl production, smaller size of pearls produced, uninterrupted supply of pearl oyster seed, lack of leasing policy for pearl farming and lack of protected areas for farming were some of the factors affecting commercialization. Meanwhile the Central Marine Fisheries Research Institute has upgraded the technology and succeeded in producing >6mm pearls in west coast, production of *in vitro* pearls using tissue culture technology, production of image or mabe pearls and also hatchery production of pearl oyster seed. The Central Institute of Fisheries Technology, Kochi has developed technology for production of pearl nucleus using indigenous molluscan shells. *P.margaritifera*, the black-lip pearl oyster is available in Andaman and Nicobar Islands and attempts are being made to produce black pearls from this species.

Windowpane Oysters

Windowpane oyster *Placenta placenta* was exploited on commercial basis from Gulf of Kutch, Nauxin Bay (Goa) and Kakinada Bay yielding approximately 10000 to 11000T every year. In addition to these places it occurs in Malabar coast, Tuticorin, Nagapatanam and Andamans. This species is now brought under protected species of endangered animals under schedule I of Wildlife (Protection) Act 1972 brought into force from July, 2001 by Govt. of India. Commercial exploitation of this species is not done now. The shell of this bivalve is used to manufacture many curios in shell craft industry and it produces tiny pearls of good quality, mainly used as medicine.

Gastropod Resources

The major gastropod resources exploited on commercial basis or forming past of by catch of shrimp tranters are sacred chank *Xancus pyrum*, Top and Turbo shells of Andaman and Nicobar Islands, *Welks Babylonia spirata* and *B.Zelanica*, *Chicoreus ramosus* and number of ornamental gastropods used in shell craft industry.

Sacred Chanks

Among gastropods *Xancus pyrum*, the sacred chank is the most important resource in terms of its economic importance, fishery and abundance. At least 5 varieties of sacred chanks are fished around Indian coasts based on its variations in the shell morphology mainly due to environmental characteristics. Chank fishery exists in Gulf of Mannar, Tanjavur, South Arcot and Chingelpet in Tamilnadu, Thiruvananthapuram coast in Kerala, Gulf of Kutch in Gujarat and Andaman and Nicobar Islands. Chanks are collected mainly by skin diving in East Coast along the Thirunelveli and Ramanathapuram coast during fair season. On the Thiruvananthapuram coast also divers collect chank during fair season. In addition, in certain years, longlines were exclusively used for chank collection in Thiruvananthapuram coast. Chanks are also caught in set gillnets and tramelnets as by catch. Alagarswami and Meyyappan (1989) estimated an average chank production from Indian coasts as 1,25,600 nos of which 70% is from Tamilnadu coast. Devaraj and Ravichandran (1988) estimated the potential stock of chanks from Gulf of Mannar as 2 million adult chanks of which only 44.83% is being exploited. The chank fishery is controlled by state governments by issuing license for collection by diving.

The chanks are mainly used for manufacture of shell bangles which has got a ready market in Bengal. Women of Bengal wear chank bangle following a very old Hindu custom. The sinistral

chank, a rare freak chank with left side operculam opening is considered very much sacred and there is a good demand for this shell in Hindu temples for worship. The chank shell is also used for making curios. The operculam of chank is used for making incense sticks and glue and has got export demand.

Whelks

Babylonia commonly known as whelk shells or *'Baiga'* is an edible gastropod caught mainly as bycatch of shrimp trawlers. Two species of whelks, *B. spirata* and *B. zelanica* are exploited from Indian waters. These two species are caught in good quantities at Sakthikulangara- Neendakara area in Kerala. These species are also reported from Gulf of Mannar, Poompuhar, Nagapattanam, Chennai and waters around Andaman and Nicobar Islands (Ayyakannu 1994). The total quantity of whelk trade during 1993 - 94 was 300 tonnes and it increased to 500-600 T during 1995 –96. This edible gastropod is an important food species and is exported in frozen condition to Japan. The export of whelk from India started in 1984 and it reached 703 T in 2001, fetching 4 crore rupees. The operculum of this species is also collected and sold for export.

Top and Turban shells

Trochus niloticus (top shell) and T*urbo marmoratus* (Turban shell/ greensnail) was exploited from Andaman and Nicobar islands till recently. There was a regular shell fishery in the islands controlled by the Government up to 2001. The average annual landing for top shell was estimated as 400-600T and for turban shell 100-150T. 9 fishing zones covering entire Andaman and Nicobar islands were leased out regularly for fishing of turbo and top shells. In recent years there was drastic decline in the total catch of both the shells due to over exploitation and they were brought under endangered species by Government of India under the schedule I of Wildlife (Protection) Act 1972 and exploitation of this resource was stopped. The shells of both the species are used by shell craft industry for making curious and there is excellent demand for both the species in the local market and for export. The shell is used for manufacture of buttons, decorative inlay works and jewellery. A large, cleaned, turbo shells now cost 300-500 rupees and top shell 100-150 rupees.

Ornamental gastropod shells

A variety of ornamental gastropod shells are caught as bycatch in the shrimp trawlers. Philip and Appukuttan (1995) recorded 29 species of ornamental gastropods from Sakthikulangara – Neendakara as bycatches in shrimp trawlers. Ramanathapuram coast in Tamilnadu is well known for ornamental shell resources and there are at least a dozen shell craft industries in Rameswaram, manufacturing a variety of shell craft products. From Lakshadweep Islands and from Andaman and Nicobar Islands many ornamental shells are collected and traded. The shells collected are graded, processed and sent to important shell craft centers in Tamilnadu, Pondicherry, Goa and Kerala. Garlands, eve chains, necklaces, earrings, studs, rings, bangles, table lamps, bath stands, ashtrays, keychains pendants and shell curtain are made out of these ornamental shells. Already there is good market for these curious items in the major tourist centers of the country and a small scale export of ornamental shell also exists.

Livelihood potential

Bulk of the cephalopod production is from trawl net operated in the 100m depth area around Indian coast. Estimates made in 2001 indicate that 51,500 mechanized crafts (mainly bottom trawlers, drift gill netters and purse seines) and 180 deep sea fishing vessels of 25m OAL are engaged in fishing in this area. All these crafts, especially trawlers offer employment opportunity for thousands of active fishermen. In addition to trawl fishing activity, cephalopod processing and marketing offer employment opportunity for fishermen and labourers. Trawl fishing beyond 100 m depth area indicates higher potential for neretic cephalpod exploitation and this will add more employment opportunity in coming years.

5000- 7000 persons are involved in clam picking around the country directly or indirectly for shell exploitation, processing and for marketing from various water bodies. At present the clam meat, except *Paphia malabarica* is not fully utilized for edible purpose. It is estimated that the clam meat percentage varies from 6-10 and if effective value addition is done the discarded meat from common species viz, *V.cyprinoides, M. casta* and *M. meretrix*

can be converted in to quality food products. This will also open up employment opportunity and additional income for rural population. Indiscriminate exploitation of juvenile clams from estuaries and backwaters is another serious problem threatening the existing stock of clams. It is suggested that scientific farming by adopting relaying method of clam seed can be prastised in all the water bodies where clams are being exploited on commercial scale. This will also provide employment opportunity for number of fishermen and also lead to resource enhancement. *Relaying of Paphia malabarica* is now being practiced in Ashtamudi , Kerala by few farmers.

The mussel and edible oyster farming techniques developed, field tested and demonstrated by the Central Marine Fisheries Research Institute, Kochi in coastal waters and estuaries of Kerala, Karnataka, Goa and Maharashtra have been easily adopted by the coastal population due to its easy and simple methodology. Right from 1996 onwards Kerala Government has approved these two methods of farming as rural livelihood programmes and gave support for popularization through BFFDA, Development of Women and Children in rural area (DWRDA). Integrated Rural Development Programme (IRDP) and ADAK. In 70's and 80's coastal aquaculture was centered around shrimp farming and right from 1991 onwards aquaculture of shrimps faced set backs due to disease problems and legal issues. At this stage only, bivalve farming witnessed phenomenal growth especially in Kerala. The farming was popularised mainly through women self help groups with the help of local self government. The women Self Help Groups (SSG's) with 11 to 15 members were given financial assistance through co-operatives or BFFDA with 30-50% subsidy. This activity was initially centered around Kasargod District in Kerala for mussel farming and in Kollam District for edible oyster farming. The most significant out come was women empowerment and additional employment opportunity for unemployed youth. In addition to that, the farming activity was taken up by more and more SSGs in Kerala and became a popular activity among coastal population of 8 coastal districts. The mussel production by culture has reached 75000T by 2006 and edible oyster production 800T. Now mussel farming is practised by SSG's in Kasargod, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha and Kollam in Kerala, Ratnagiri in Maharashtra, Mulki and Byndoor in Karnataka. Similarly oyster farming is done in Kayamkulam and Ashtamudi estuaries in Kerala by SSG's. Now Government agencies are giving importance for bivalve farming as a rural development activity and a source of livelihood improvement programme. As such, bivalve farming offers greater employment opportunity and further value addition of mussel and oyster will give additional employment in the rural sector. Another area to be promoted is seed collection of both oysters and mussel from the wild and supply to farms by farmers as a part – time avocation. Though pearl oyster farming and pearl production have not yet been commercialized, the possibilities of production of larger pearls (>6mm) in the west coast are bright. Added to that image pearl or Mabe pearl production using the technology developed by CMFRI offers greater scope for commercial production of pearls and image pearls. Pearl production can be phased out into three separate components viz (1) Seed production (2) grow out and (3) pearl production. For each component SSG's can be trained and this can be successfully implemented as a rural development programme with financial and technical support from Government agencies.

The ornamental gastropod shells, offer excellent opportunity for shell handicraft trade in India. Already number of small scale manufacturers are engaged in shell trade in Ramanathapuram, Thirunelveli, Kanyakumari, Pondicherry and Goa. The shell craft industry offers partime employment for women in making garlands, evechains, decorative table lamps, shell curtains, rings, bath stand etc.. using a variety of molluscan shells. Number of artists and labourers are also engaged in shell processing and etching of shells for exports. Thousands of small scale traders are engaged in marketing the shell products throughout India especially in the major tourist centres.