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GROWTH PROFILE OF MARINE FISHRIES IN INDIA

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ABSTRACT

An attempt is made in this paper to outline the growth and changes that have taken place in the marine fisheries of India over the past 4 decades The trends in marine fish landings, the progressive changes that have taken place in the craft and gear employed to catch the fish, the progress made by the fish-processing and marketing industry, including the phenomenal growth of the export of marine products, are reviewed.

The rapid progress achieved in important areas of marine fisheries research in the post-independence era and the areas in which more research is needed in the coming years are discussed. Education and training programmes aimed at providing the trained manpower to implement the various developmental programmes connected with the growth of the marine fishing industry are also outlined and the need for strengthening these programmes is pointed out.

The growth in the fishermen population, the mechanisation of the indigenous craft, the introduction of the mechanised fishing vessels such as trawlers, purse seiners and gill netters into the marine fishery, the advent of large trawlers on the northeast coast of India and the effect of all these developments on the traditional fishermen are discussed. The attempts at promoting joint ventures and chartering of foreign vessels are analysed with respect to advantages and disadvantages of such endeavours. The growth in the financial outlay during the successive five-year plans at the Central and State levels and its impact on the development of the marine fishing sector are briefly elucidated.

The socio-economic consequences of all these development, the new problems that have been thrown up by the progress and growth of the marine fishing sector and the strategies for solving some of these problems are discussed. For the balanced growth of the marine fisheries in India, an integrated approach is needed involving all the factors, scientific, technological, administrative and social, that have a bearing on the capture, processing and utilization of the marine fishery resources.

In the pre Independence era marine fisheries in India was a neglected subject or as we euphemistically call it a "deferred subject" as far as the British Administration was concerned. Apart from enacting the Indian Fisheries Act in 1897, which gave full powers to the provincial Governments to frame and implement regulatory measures in fisheries, little attention was paid to the development of the marine fisheries sector.

But due to the interest taken by the officers of the East India Company beginning with Russel and Hamilton Buchanan and followed by several others like Francis Day, a Veterinary Surgeon who subsequently rose to the position of the Inspector General of Fisheries the officers of the Marine Survey of India such as Seymour Sewell, Alcock and Anderson and later the stalwarts of the Zoological Survey of India, Stanley Kemp and Hora, a wealth of valuable information on the marine fauna of India was collected. In the early part of the 20th century the dedicated work done by Nicholson and James Hornell in the Madras Fisheries Department laid the foundation for the development of marine fishery in India.

The problem of supplying adequate quantities of fish to the Allied Forces stationed in India during the Second World War forcefully brought home to the British Administration the woefully backward condition of fisheries in India. In January 1945 the Fish Sub Committee of Policy Committee No 5 on Agriculture, Forestry and Fisheries under the guidance of Baini Prashad who had become the Fishery Development Adviser to the Govt. of India, recommended the establishment of a Central Fisheries Research Institute and also suggested other measures for development of fisheries in the country. This historic document brought fisheries within the orbit of concurrent subjects.

This lead to the establishment of the Central Marine Fisheries Research Institute in Madras

and the Central Inland Fisheries Research Institute at Barrackpore in 1947, the Deep Sea Fishing station at Bombay in 1948 and later the Central Institute of Fisheries Technology (1957) to catalyse the development of fisheries in India. The State Fisheries Departments were also provided with grants for some projects. The Five Year Plans initiated by the Govt. of India for the planned progress of the country set apart specified amounts for the development of Fisheries in India, for fisheries research, modernization of fishing craft and gear, development of infrastructure facilities such as fishing harbours, cold storages, ice plants, coastal roads and transport facilities, and for the social uplift of the fishermen community.

The plan outlays for fisheries development in the seven Five Year Plans are given below:

	Crores of Rupees	Share in total outlay (%)
First Plan	5	0.26
Second Plan	12	0.27
Third Plan	28	0.38
Fourth Plan	83	0.58
Fifth Plan	151	0.38
Sixth Plan	371	0.38
Seventh Plan	499	0.28

Although there has been a substantial increase in the financial outlays for fisheries in successive plan periods the percentage of funds allotted to fisheries fluctuated from a meagre 0.26% to 0.38% of the total outlay except for the 4th plan when the share of fisheries was 0.58%. Although these funds are woefully indequate to meet the needs of the fisheries sector, the planning has lead to some tangible progress in the field of fisheries over the years.

The major developmental activities that were taken up during each Five year Plan are outlined below:

1st and 2nd Five year Plans

Emphasis on mechanisation of indigenous crafts, introduction of mechanised fishing boats improvements in fishing gear, establishment of infrastructure facilities such as processing plants, cold storages and landing centres.

3rd Plan

Above programmes continued with greater emphasis on introduction of mechanised boats and adoption of synthetic materials for fishing gear. Establishment of facilities for marketing. Exploratory fishing intensified. Expansion of export trade. Programmes for manpower training intensified.

4th Plan

Beginning made in deep-sea fishing through import of trawlers as well as their indigenous construction. Export promotion intensified. Construction of mechanised boats intensified. Preinvestment survey for construction of fishing harbours taken up. Intensification of exploratory surveys.

5th Plan

EFP strengthened for deep sea exploration. Diversification of fishery products. Construction of mechanised boats. Provision of infrastructure facilities for larger vessels. Development of culture technologies for prawns, fish, molluscs and seaweeds. Development of ancillary industries such as boat building, net making etc. Development of brackishwater farms in maritime States. Socio-economic uplift of fishermen.

6th Plan

Intensification of efforts to stimulate brackishwater prawn farming in the States. Funds provided for building large trawlers in the country or for importing them. Building up of infrastructure in fishing harbours to facilitate operation of large trawlers. Export promotion intensified. Exploratory survey of deeper areas for oceanic tunas and deep sea fish. Motorisation of country craft with outboard motors. Socio-economic uplift of fishermen.

7th Plan

Promotion of prawn farming and hatcheries. Development of deep-sea fishing fleet through imports and local construction of big trawlers. Strengthening of domestic marketing of fish. Diversification of fish products. Motorisation of country craft.

This paper outlines the growth profiles in the field of marine fisheries during the past 4 decades.

MARINE FISH PRODUCTION

It was estimated that the total marine fish catch in 1947-48 was about 3.73 lakh tonnes (Anon, 1951). With the establisment of the Central Marine Fisheries Research Institute, the collection of statistics of marine fish landings on an all India basis was standardized and reliable production figures are available from 1951 onwards (Table 1). It has increased from 3.73 lakh tonnes during the Pre-Independence period to 17.23 lakh tonnes during 1986. Over all, there has been an increasing trend in the total production of marine fish as could be seen from Table 1.

TABLE 1

Annual marine fish landings (in lakh tonnes) in India from 1951 to 1986

Year	Landings	Year	Landings
1951	5.34	1969	9.14
1952	5.28	1970	10.86
1953	5.81	1971	11.61
1954	5.88	1972	9.80
1955	5.96	1973	12.20
1956	7.19	1974	12.18
1957	8.76	1975	14.23
1958	7.56	1976	13.53
1959	5.85	1977	12.60
1960	8.80	1978	14 04
1961	6.84	1976	13.88
1962	6.44	1980	12.50
1963	6.55	1981	13.78
1964	8.60	1982	14.21
1965	8.33	1983	15.48
1966	8.90	1984	16.31
1967	8.63	1985	15.35
1968	9.03	1986	17.23

Source : CMFRI

The plan-wise trend in marine fish production is as follows:

Plan period	Average annual production (lakh tonnes)	Growth rate between the Five year plan periods	annual av. growth rate
First Plan	5.84		
Second Plan	7.60	30.1%	5.4%
Third Plan	7.56	-0.05%	-0.01%
Fourth Plan	11.03	45.9%	7.8%
Fifth Plan	13.48	22.2%	4.1%
Sixth Plan	14.74	9.3%	1.8%

After the initial spurt in the catches during the first two years of the Second Plan period, the marine fish production stagnated during the major part of the 2nd and 3rd Plan periods and began to increase again towards the end of the 3rd Plan period. Interestingly, the sudden increase in marine catch during the 4th Plan period coincides with the increased financial outlay for fisheries (0.58%) during the 4th five year Plan. The growth rate in production between the plan periods reached a peak during the 4th plan period and then slowed down during the 5th and 6th plan period.

The sudden increase in marine fish production during the 4th plan period is probaby due to the introduction of small mechanised boats and opening up of newly discovered fishing grounds along the Indian coast as a result of the surveys conducted by the Govt. of India vessels and the vessels belonging to the Indo-Norwegian project. The share of the total marine catch by the mechanised fishing vessels over the years is given below:

Year	Share of mechanised boats in total marine catch	Year	Share of mechanised boats in total marine catch
1969	20.0%	1978	53.0%
1970	22.0%	1979	53.7%
1971	21.0%	1980	59.6%
1972	38.0%	1981	60.9%
1973	37.0%	1982	63.9%
1974	36.0%	1983	62.4%
1975	39.0%	1984	63.9%
1976	42.0%	1985	72.9%
1977	49.9%	1985-86	75.0%

Source: CMFRI

The share of the mechanised fishing boats (Motorised indigenous crafts are also included) has increased from 20% in 1969 in 75% in 1985-86. This is closely related to another trend noticed in the composition of the marine catches in India over the same period. The pelagic fish which form the major part of the catch of indigenous craft contributed 65% of the total marine fish landings in 1969 while they formed only 51.4% of the total landings during 1985-86. In other words the contribution of the demersal fish which form the dominant component in the catch of mechanised vessels has increased from 35% in 1969 to about 49% in 1985-86. The significant impact of the mechenisation programme on the marine fish catch is evident from these trends.

MEANS OF PRODUCTION

The growth that has taken place in the fishermen population and the fishing craft and gear during the recent years is outlined here. The earliest estimate of the fishermen population of India is given for 1931 by Anon (1951). The total fishermen population (marine as well as inland) was 13,35,565 out of which 4,30,633 were active fishermen. The number of marine fishermen is not given separately. However, the Fisheries Sub-committee (1945) had noted that there was a marked decrease in the number of active fishermen particularly in the maritime areas due to the poor returns that the fishermen were getting and the consequent mass enrollment of fishermen in the fightingforces during the Second World war (Anon, 1951). The Central Marine Fisheries Research Institute has conducted frame surveys and census of fishermen villages during 1961-62, 1973-77 and 1980. The summary of the data collected during these surveys is given below:

	1961-62	1973-77	1980
No. of fishing villages	1797	1913	2408
Fishermen population	9,59,937	14,35,156	20,96,314
Active fishermen	2,29,364	3,22,532	4,74,731
No. of indigenous boats	90,424	1,06,480	1,40 833
No. of mechanised boats	nil	8,086	19,013

There has been a 118% increase in fishermen population from 1961-62 to 1980 while the increase in active fishermen was 108% during the same period and the number of indigenous crafts increased by 55.7%.

The various types of indigenous boats at the time of our independence was estimated as 69,897 (Anon, 1951). This estimate is compared with the number of indigenous craft estimated during the 1980 survey of the CMFRI below:

	1947	1980
Plank built boats	3,485	39,147
Dug-out canoes	36,317	26,442
Catamarans	23,852	73,886
Masula type boats	6,243	2,150
Total	69,897	1,40,833

While the number of indigenous boats has doubled during the period, there has been a reduction in the number of dug-out canoes (by 25.5%) and masula-type boats (by 65.6%). There has been a 10 fold increase in the number of plank built boats and a 3 fold increase in the number of catamarans. The reduction in the namber of dug-out canoes may be due to the non-availability of large trees which were traditionally used for constructing the dug-out canoes. The masula-type boats which were used for operating the large shore seines such as *Kara valai* in Tamil Nadu, *Aliv/ vala* and *Pedha vala* in Andhra Pradesh and rampani in Karnataka and which needed a large number of men to operate, have become reduced in number perhaps because it has become uneconomical to operate these labour intensive gear.

Although experimental trawling with small mechanised boats (10.97 m OAL) were carried out even during 1954-59 by the Indo-Norwegian project, along the S. W. coast in shallow waters, commercial trawlings with small mechanised vessels became popular only in the later half of the sixties.

They were mostly 9.14 m to 9.75 m in OAL. The smaller ones popularly called Pablo boats which was originally designed by Mr. Illugasson, FAO Expert to Tamil Nadu Govt. were used for operating drift gill nets and also for hand operated trawl-nets. The larger boats were fitted with trawl winches. Purse seiners were introduced in Karnataka and Goa on a commercial scale in 1976-77 and later in Kerala. One

of the earliest indigenous boats to be mechanised were the plank built boats of Maharashtra, Gujarat and Tuticorin. In recent years the dug-out canoes and catamarans of Kerala are being motorised by fixing outboard motors. According to the 1980 survey conducted by the CMFRI the number of mechanised boats under each category were as follows:

Trawlers	11,316
Gill netters	3,931
Dol netters	2,895
Purse seiners	428
Others	217
Total	18,790

According to the latest estimates there are about 23,000 mechanised boats in the country. (This includes motorised indigenous crafts).

Recently the B.O.B.P. has developed and tested beach landing crafts constructed of fibre glass for operating from the surf beaten coasts of Tamil Nadu and Andhra Pradesh. During the Seventh Five Year Plan it is proposed to introduce on an All India basis 2000 beach landing crafts and motorise 8000 indigenous crafts to increase fish production from the inshore waters.

SURVEY OF OFFSHORE AND DEEP SEA FISHING GROUNDS

Simultaneously with these developments which were taking place mainly in the inshore waters, many agencies have been trying to explore the possibility of extending the fishing operations to deeper areas not being exploited by the indigenous crafts. Even before Independence, the provincial Governments of Bengal, Madras and Bombay tried to fish upto 100 fathom depth with steam powered vessels, such as *Golden Crown* (1908) in the northern Bay of Bengal, *Lady Goschen* (1927-30) in the S. E. and S. W. coasts and William Carrick (1921-22) in the N. W. coast. Apart from indicating the presence of some potential fishing grounds these operations were not successful. It was only after the establishment of the Deep Sea Fishing Station (DSFS) by the Govt. of India (GOI) at Bombay in 1946 that exploration for new fishing grounds in Indian waters really got under way. The GOI soon established offshore fishing bases at Cochin, Mangalore and Veraval on the west coast and at Tuticorin, Madras and Visakhapatnam on the east coast and also a base at Port Blair in the Andaman Islands and the whole programme was renamed as Exploratory Fisheries Project (EFP) in 1974 and later as Fishery Survey of India (FSI) in 1983. Starting with the steam trawler *Meena* in January 1948, followed by Danish cutters M. T. Ashok and M. T. Pratap (250 H. P.) and a host of other TCM aid vessels of smaller and larger sizes upto 1969, this exploratory programme in close collaboration with the scientists of the CMFRI who participated in some of the cruises, brought out the results of these surveys in a series of publications (CMFRI, 1954; Jayaraman *et al.*, 1959; Nagabhushanam et al., 1964; Rao *et al.*, 1968; Rao and Dorairaj, 1973; Pai and Mahadevan Pillai, 1973; Sekharan *et al.*, 1973, Kuthalingam *et al.*, 1973 and Rao, 1973). Between 1970 and 1980 the EFP acquired 20 numbers of identical steel trawlers of 17.5 m OAL and organised a comprehensive survey of the demersal resources of the entire Indian coast upto a depth of 7 m from 12 bases. This well planned, round the year coverage of all the areas and depths upto 70m has yielded valuable information about the demersal resources of our coastal waters (Joseph, 1980).

With the declaration of EEZ in 1976 the Government of India keenly felt the need for collecting data on deep sea resources beyond the 70 m depth and, therefore, chartered a 69 m Polish factory trawler M. T. MURAENA which surveyed the north-west coast between latitude 15°-23° upto a depth of 200 fathom. This vesael used both bottom trawls and pelagic trawls and discovered the existence of vast shoals of horse mackerel, ribbon fish, cat fish, pomfrets and carangids in the region. In fact the pelagic trawling by M. T. MURAENA yielded better results than bottom trawling (Anon, 1979; Bapat *et al.*, 1982). From 1979 to 1986 the FSI has been acquiring larger survey vessels (31.5 m to 42.5 m) for conducting bottom trawling, pelagic trawling and long-lining in the deeper areas (70-500 m) of our EEZ on the east and west coast. A wealth of information on the availability of deep sea

demersal fishes and tunas has been collected by these surveys. (Philip *et al*, 1984; Joseph and John, 1986; Joseph, 1986; Sivaprakhasam, 1987 and FSI Bulletin No. 13). It was observed that the northern latitudes of Gujarat, Maharashtra, West Bengal, Orissa and Andhra Pradesh, where the continental shelf is relatively wide, are the most productive. In Gujarat the major resources between 70-100 m were pomfrets, elasmobranchs, perches and cephalopods and between 100-200 m horse mackerel and threadfin breams are the major resources. In Maharashtra the ribbon fishes, pomfrets, and perches are the major groups in the 100-200 m zone. In Karnataka threadfin breams, bull's eye, drift fish and lizard fish are the important resources in the 70-200 m depth zone while on the continental slope (200-500m) black ruff and drift fishes are abundant. In Kerala cat fish and threadfin breams are the dominant resources in 70-100 m while the bull's eye becomes important in 100-200 m and green eye, black ruff and deep sea lobsters and prawns occur on the slope (200-500 m). The Wadge Bank is dominated by perches and balistids in the 70-100 m zone and threadfin breams and scads in the 100-200 m region, while deep sea sharks are found on the continental slope. In the Gulf of Mannar barracudas and crabs are abundant in 100-200 m while bull's eye, scads and threadfin breams are found on the slope (200-500 m). The Coromandal coast has cat fishes, scads and perches in 70-100 m, bull's eye, drift fish, scads and threadfin breams in 100-200 m and green eye, drift fish and cephalopods, on the slope region. Along the Andhra coast scads and cat fishes are dominant in 70-100 m, threadfin breams, bull's eye and scads in 100-200 m and black ruff in 200-500 m. A remarkable finding is that in the shelf region off the coasts of West Bengal and Orissa mackerel formed 22%-36% of the demersal catch from the 50-100 m zone and 8%-62% in 100-200 m; the slope region is dominated by bull's eye and cephalopods.

Concurrent with the above efforts of the FSI, the Indo-Norwegian Project (INP) which was established in 1952 at Neendakara and which was shifted to Cochin in 1963 started using small mechanised vessels (10.97 m) to explore the shrimp resources in the shallower regions of the continental shelf between Goa and Mandapam Camp along the S. W. and S. E. coast and identified productive shrimp grounds off Karwar (9-33 m), Mangalore (16-29 m), Cannanore (9-25 m), Cochin (9-37 m) and between Alleppey and Quilon (9-37 m). The INP which was later taken over by the Govt. of India in 1972 and renamed as Integrated Fisheries Project also surveyed the deeper regions of the S. W. coast of India upto the continental slope with larger vessels. Apart from bottom trawling these vessels also experimented with pair trawling, single boat pelagic trawling, purse seining, hand lining and trapping and squid jigging. These operations in which the CMFRI also participated actively, revealed the existence of deep sea lobster resources between 180 and 270 m off Quilon and Mandapam, and deep sea prawn and fish resources on the Quilon Bank (300-450 m) (Tholasilingam *et al.*, 1964; Tholasilingam and Nair, 1968; Silas, 1969; Rao and George, 1973; Suseelan, 1974; Mohamed and Suseelan, 1973; Oomen, 1980, 1985; and Pillai and Sathiarajan, 1986). The existence of rocky grounds rich in rock-cods and other large perches between 8°N and 14°N latitudes on the west coast of India in 75-115 m depth was also brought to light (Silas, 1969).

The Pelagic Fisheries Project (PFP) at Cochin which was established with UNDP/FAO assistance in 1971 carried out extensive acoustic surveys with research vessels *Sardinella* and *Rastrelliger*, coupled with aerial surveys, for pelagic fish on the S. W. coast. During these surveys fishing with pelagic trawls was also done. Dense concentrations of white baits, horse mackerel, scads, ribbon fish and cat fishes were located along the S. W. coast and estimates made of their standing stocks (Menon and George, 1975; Rao *et al.*, 1977; Anon, 1976 a and b). The existence of mackerel and oil sardine shoals outside the presently fished inshore zone was also brought to light.

The tuna long-liner of the Central Institute of Fisheries Nautical and Engineering Training (CIFINET) has been conducting long-line fishing for tunas since 1981 in the Arabian Sea, Indian Ocean upto 6°S latitude, Bay of Bengal and the Andaman Seas. Very high hooking rates (upto 38.6%) for yellow fin tunas have been obtained off the the Karnataka-Konkan coast

between lat. 12°N and 15°N and long. 71°E to 73°E These fishing grounds are hardly 120 nautical miles due west of Honavar (Swaminath *et al.*, 1987).

COMMERCIAL "DEEP SEA" FISHING VENTURES

There have been a few very successful commercial "deep sea" fishing ventures in the private sector. The New India Fisheries Company, Bombay had a very successful spell of bull-trawling during 1956-63 in the N. W. region between Bombay and Kutch. The two pairs of bull-trawlers (250 H. P. each) landed 26,304 metric tons of fish which was sold for 1.6 crores during this period. However the fishing operations were confined to less than 70 m depth (Rao, 1973).

The other success story was on the N. E. coast. The Union Carbide Company operated Mexican type outrigger trawlers with facilities for onboard freezing and packing. With Visakhapatnam as base these vessels were fishing along the Andhara, Orissa and West Bengal coasts mainly for shrimps. They started with 2 vessels in 1970 and because of their spectacular success introduced 2 more in 1975. However, their fortunes started declining in 1976 due to poor management and eventually collapsed in 1983. The catch details of these fishing operations of the Union Carbide vessels are not available but it is said that they got 7.2 tonnes of prawns per day (head-on weight) during the peak season and 1.7 tonnes per day during the lean season.

The early success of the Union Carbide vessels stimulated a number of private entrepreneurs and the State Fisheries Development Corporations to go in for large trawlers (23 m) mainly for shrimps. At present (1987) there are about 96 large trawlers (23 m and above) and 30 smaller trawlers (17 m) operating from Visakhapatnam fishing harbour. They are fishing between 15 and 100 m along the N. E. coast from Visakhapatnam to the Sandheads. These vessels discard most of the fish catch and bring back only the prawns in the headless condition. On an average each large trawler landed 43 tonnes of headless prawns during 1983-84, 47 tonnes during 1984-85, 40 tonnes during 1985-86 and only 31 tonnes during 1986-87. The catches are clearly declining (Sudhakara Rao, M S). The value of the 3077 tonnes of headless prawns landed by the big trawlers at Visakhapatnam during 1986-87 is valued at Rs. 37.5 crores.

CHARTERING OF DEEP-SEA VESSELS AND JOINT VENTURES WITH FOREIGN COLLABORATION

The Government of India in a bid to stimulate interest in deep sea fishing introduced the charter and joint venture schemes in 1976. Under certain stipulated conditions companies could charter foreign vessels or enter joint ventures with foreign companies for deep sea fishing, boat building, processing and marketing of marine products. The purpose of these schemes was to import technical know-how in deep sea trawling, purseseining, long-lining and squid jigging, modern fishing craft designs, boat building and to train Indian counterparts in all these activities. It was also felt that these operations would open up new fishing areas for deep sea fishing and lead to the building up of a sound indigenous deep sea fishing sector. However, these ventures did not work out very well due to various reasons. The chartered vessels have not given us any additional information on the resources. In fact the analysis of the catch of six confiscated poaching Taiwanese vessels (Joseph' 1981) has given us more information about the composition of the resources. At one time there were 108 chartered vessels fishing in our waters (Gokale, 1986). It was well known that they were fishing only between 30 and 40 fathoms. So when fishing of these vessels within the 40 fathom line was banned the chartered vessels quickly withdrew, obviously because it was not economical for them to fish beyond the 40 fathom line. However, the Govt. of India has again revived the charter and joint venture schemes in January 1987 after revising the terms and conditions.

MARINE FISHERIES RESEARCH

Marine fisheries research in India really started during the early part of this century with

James Hornell of the Fisheries Department of the Madras Province, who conducted a survey of the fishing methods of the Madras Presidency (Hornell, 1924, 1934) and initiated studies to understand the fluctuations in the oil sardine fishery on the west coast (Hornell, 1910; Hornell and Naidu, 1923) and the pearl fishery in the Gulf of Mannar (Hornell, 1905, 1916, 1922). He also tried to understand the factors responsible for the spawning of edible oysters (Hornell, 1910). However, after Hornell marine fisheries research languished and was revived again by Hora and his associates (Hora, 1934; Hora and Nair, 1940; Prashad *et al.*, 1940). The tradition has lingered in Madras (Devanesan. 1943.)

However it was only after the establishment of the Central Marine Fisheries Research Institute in 1947 that Marine Fisheries Research came into its own. The main objectives of the Institute are to estimate and monitor the catches of the various types of marine fishes landed by the different types of fishing gears all along the Indian coast throughout the year, to conduct research on marine fisheries resources in order to step up their production to the maximum sustainable level, to locate new fishing grounds, to conduct environmental studies in relation to fisheries and to develop indigenous technologies for culture of marine organisms with a view to generating additional resources for human consumption and to recommend measures for the rational exploitation of the various fishery resources.

The Institute has come a long way from its humble beginnings in 1947 and has become a premier centre for marine fisheries research in the S. E. Asian region. An update on the achievements of the Institute has been published recently (James, 1986) and the numerous publications of the Institute right from its inception have been listed in a bibliography published recently (CMFRI Special Publication No. 27).

The Central Institute of Fisheries Technology (CIFT) was set up in 1957 to undertake research on fishing craft and gear, post harvest handling, processing and packaging of fish, and quality control of fishery products. The achievements of the Institute are highlighted in a recent publication by Nair (1986).

The National Institute of Oceanography (NIO) was set up in 1966 at Goa. The major objectives of the Institute are, advancement of knowledge about the Indian Ocean, development of mariculture technology, survey and exploitation of mineral resources, oil pipeline surveys, pollution monitoring and control, coastal development, development of marine instrumentation, establishment of an oceanographic data and information centre and participation in international oceanographic programmes and the Antarctic programme of the Govt. of India

Apart from these three national Institutes, the maritime Universities such as Andhra University, Madras University, Annamalai University, Kerala University, Cochin University Bombay University and the Fisheries Colleges attached to the Agricultural Universities of Tamil Nadu, Kerala, Karnataka and Maharashtra have made valuable contributions to the field of fishery science. The State Fisheries Departments of West Bengal. Tamil Nadu, Kerala, Maharashtra and Gujarat also have active research wings for tackling problems of local fishery importance.

The tremendous amount of research work done by the national Institutes and Universities during the 4-decades is commendable. These researches have brought to light the great scope for strengthening marine fisheries research in the following areas:

1. Monitoring and assessment of marine fishery resources and their response to fishing pressures.
2. The influence of environment parameters on the recruitment, availability and movement of fish stocks.
3. Estimating the population parameters of under-exploited fishery resources to assess their potential for further exploitation.
4. Further development of technologies for mariculture of marine organisms.
5. Improving the fuel efficiency of the fishing vessels and fishing efficiency of the gear.

DOMESTIC MARKET FOR MARINE PRODUCTS

Prior to 1947 the major part (51%) of the fish caught were sun-dried or salted and only 42.7% were consumed in the fresh condition. This was mainly because the landing places were not properly connected to the main roads for quick transportation of fish, nor were cold storage facilities available at most of the landing centres. Since 1966 however, the pattern of consumption of fish in the domestic market has undergone a sea change. About 70% of the fish are marketed fresh. Cold storages, ice plants, processing facilities and transportation systems have been developed and fresh fish are transported to far off interior places to be sold in good condition. The rising standard of living of the people and the consequent change in their food habits have also resulted in the heavy demand for fresh fish. The changing pattern of fish utilization in the country can be seen from Table 2. For comparison the world figures for fish utilization are also given.

TABLE 2

Utilisation of fish in India and the world

	India				world
	1945	1961	1966	1979	1982
Marketed fresh	42.7%	47.9%	70.4%	65.1%	19.8%
Frozen	—	—	1.9%	5.6%	22.1%
Cured	41.0%	43.7%	21.9%	22.2%	14.4%
Canned	—	—	0.6%	0.2%	13.0%
Reduced	7.0%	8.4%	3.9%	5.4%	29.7%
Miscellaneous	—	—	1.3%	5.4%	1.0%

It is immediately apparent that the pattern of utilization of fish in India is entirely different from the average pattern observed in the other countries of the world, where only 20% is marketed fresh while the major part is processed into frozen, canned or reduced products.

In India fish which were once considered as "trash" have now become acceptable and have even become delicacies or costly exportable varieties. The domestic market for fish has been largly neglected since the export boom started in the early sixties. However the State Fisheries Departments have been trying their best to develop a good marketing system.

The IFP has done some pioneering work in this field by introducing diversified fishery products to promote domestic consumption of fish. The State Fisheries Marketing/Development Federations/Corporations in Tamil Nadu, Kerala and Maharashtra have also devoted much attention to promote the domestic consumption of fish through the fish stalls and canteens which they have opened in the larger cities. It should also be remembered that there is still a great demand for dried and cured fish products in the interior places which should be properly exploited for the benefit of the fishermen and the consumers.

EXPORT OF MARINE PRODUCTS

Till early 1950s India was mainly exporting dried and cured fishery products to Hong Kong Singapore, Burmah and Sri Lanka (Table 3).

TABLE 3

Export pattern of fish products in 1945 (Average for 1941-45)

Fish products	Quantity (tonnes)
Fish (including prawns) sun dried	12,512
Fish, dry salted	7,822
Fish, wet salted	1,743
Fish, maws & shark fins	225
Fish manure	4,038
	26,340

About 84.7% of the exports were dried or salted. Canned or frozen fish or prawns were unheard of.

But during the late fifties the demand for frozen prawns in the international market was increasing and some enterprising men in Kerala started freezing the prawns and exporting them mainly to the U. S. A. Because of the high unit price realised by frozen prawns in the international market it attained the number one position among the expoit marine products in the early sixties. Soon prawns were also canned and exported. Dried prawns continued to be exported but in declining quantities. The trend in marine products export from 1965 to 1985 is given in Table 4. The canned prawns and dried prawns steadily decreased in importance as export items over the years (Table 4). There has been a gradual increase in the export of lobster tails. It is encouraging to note that the fresh/frozen fish export has picked up after 1975; the export of dried fish has been steadily declining but there are signs of it picking again in 1985 (Table 4). There has been a steady market for shark fins and fish maws from 1965 to 1985. Another encouraging trend is the steady increase in the export of frozen cuttle fish and squids from 1975 onwards.

TABLE 4.

Pattern of marine products export from India (Q-quantity in tonnes: V-value in thousands of Rs; figures in parenthesis are percentages)

		1965	1970	1975	1980	1985
1. Frozen prawns	Q	7028(45.47)	22135(59.51)	46831(87.68)	47762(64.07)	49540(61.47)
	V	41422(59.83)	242515(68.21)	943386(89.93)	1833661(83.78)	3143837(83.69)
2. Canned prawns	Q	1148(7.43)	2578(6.93)	261(0.49)	365(0.49)	15(0.02)
	V	9506(13.73)	39541(11.13)	5999(0.57)	15794(0.72)	765(0.02)
3. Dried prawns	Q	1702(11.01)	1486(4.00)	99(0.18)	124(0.17)	117(0.15)
	V	5447(7.87)	9361(2.35)	1132(0.11)	1349(0.06)	1800(0.04)
4. Frozen lobster tail	Q	112(0.72)	382(1.03)	402(0.75)	501(0.67)	1465(1.82)
	V	1274(1.84)	6021(1.69)	15760(1.27)	27889(1.27)	120953(3.21)
6. Fresh and frozen fish	Q	8	6	134(0.25)	11195(15.02)	9557(11.86)
	V	30	42	1884(0.18)	111939(5.11)	162137(4.31)
6. Frozen cuttle fish & fillets	Q	nil	nil	1017(1.90)	1603(2.15)	4139(5.13)
	V			29071(2.77)	30326(1.39)	91657(2.44)
7. Frozen squid	Q	nil	nil	46(0.09)	2179(2.92)	3485(4.34)
	V			305(0.03)	25084(1.16)	43945(1.17)
8. Dried fish	Q	4431(28.67)	7269(19.55)	2295(4.30)	4340(5.82)	9022(11.20)
	V	6522(9.42)	18368(5.17)	9061(0.86)	20802(0.95)	79525(2.12)
9. Shark fins & fish maws	Q	244(1.58)	282(0.76)	307(0.57)	332(0.45)	242(0.30)
	V	2032(2.93)	5998(1.69)	9822(0 94)	32526(1.49)	31780(0.86)
10. Frozen frog legs	Q	443(2.87)	2545(6 85)	1317(2.47)	3095(4.15)	1785(2.21)
	V	2694(3 89)	32899(9.26)	27083(2.67)	73200(3.34)	63653(1.69)
11. Other items	Q	341(2.26)	480(1.34)	703(1.15)	3046(4.09)	1221(1.52)
	V	310(0.49)	1543 (0.47)	6460 (0.44)	16186(0.74)	10847(0 45)
Total	Q	15467	37175	53412	74542	80488
	V	69237	355359	1049063	2188756	3756699

Source: MPEDA Statistics of Marine Products Exports 1985.

The marine products exports from India have increased from 15,457 tonnes in 1965 to 80,588 tonnes in 1985, the value increasing from Rs. 6.92 crores to 375.67 crores in the same period. The quantity of frozen prawns rose from 2238 tonnes (19.3%) in 1962 to 49540 tonnes (61.47%) in 1985 and has become the mainstay of the marine products export industry, fetching a foreign exchange of Rs. 314.38 crores in 1985. This accounts for 83 7% of the total export earnings from all marine products. The major share (81.3%) of exported frozen prawns went to U. S, A. market in 1965, with Japan coming second (10%) and Australia third (7.8%). But over the years the trend as far as U. S. A. and Japan are concerned has been reversed, Japan absorbing 67.6% of the frozen prawns in 1985. The share of Australia has also gone down while the exports to U. K. have picked up slightly (8.5%) in 1985 (Table 5).

To look after the fast developing export trade in marine products the Marine Products Export Promotion Council was formed in 1961. This body was renamed Marine Products Export Development Authority (MPEDA) in 1972. The MPEDA's specific functions include registration of fishing vessels, processing plants and infrastructure facilities, laying down standards and specifications for marine products, improvement of marketing of marine products overseas by providing market intelligence, promotional activities, rendering financial and other assistance to exporters, regulation of export of marine products and arranging for training in different aspects connected with export. In recent years the MPEDA has gone in a big way to help promote brackishwater prawn culture in the country. Apart from giving subsidies to prawn farmers and prawn seed banks, the MPEDA is also establishing large prawn hatcheries with foreign collaboration in various States.

DEVELOPMENT OF INFRASTRUCTURE FOR THE FISHING INDUSTRY

The major portion of the five year plan outlays have been spent on the development facilities for developing marine fishing industry. Fish are landed in 1414 landing centres along the long coastline of India and the fishermen who are bringing this catch live in 2408 fishing villages. If the fish landed at these sprawling centres are to be utilised efficiently by the country a vast amount of infrastructure facilities in the form of landing bases, connecting roads, transport vehicles, adequate water supply system, gear sheds, hard ground for drying of fish, ice plants, etc. have to be provided. Towards this end the centrally sponsored financial assistance schemes are operated by the State Fisheries Departments of all the maritime States to provide these basic amenities to as many fishermen villages as possible.

To accommodate the rapidly developing fleet of small mechanised boats the Government of India set up a Pre-investment Survey of Fishing Harbours project in 1968 with UNDP assistance. As a result of these surveys the Government have taken up the construction of 5 major fishing harbours and 83 minor fishing ports which are at various stages of completion. One more major fishing harbour

TABLE 5.

The share of major markets for frozen prawns in % (on the basis of quantity exported from India)

	1965	1970	1975	1980	1985
U. S. A.	81.27	63.18	29.07	13.85	18.59
Japan	10.40	29.93	64.54	76.28	67.62
Australia	7.82	3.25	2.60	0.87	0.37
U. K.	—	negligible	0.26	2.81	8.54
Others	0.51	3.64	3.53	6.24	4.88

and 15 minor ports are being provided in the Seventh Plan. It is expected that when these harbours are completed they will be able to accommodate about 16,000 small mechanised boats and 317 deep sea fishing vessels. This will still not be able to meet the requirements of the 31,000 small mechanised boats and 350 trawlers that are expected to be in operation by the end of the 7th Plan period.

On the processing and marketing side, apart from the lead given by the State Fisheries Departements in the construction of cold storages, ice plants, freezing plants, fish meal plants and canning plants, the private sector contributed a good deal in the construction of these infrastructure facilities. According to the survey conducted by the CMFRI in 1973-77 there are 264 freezing plants, 64 canning plants 131 ice making plants, 83 peeling sheds 31 fish meal plants and 319 cold storages in the country. The updated figures upto December 1980 are given in Table 6.

DEVELOPMENTAL ACTIVITIES OF THE STATE FISHERIES DEPARTMENTS

The State Fisheries Departments of all the maritime States have been actively engaged in various developmental activities to better the lot of the fishermen. They have played a key role in the mechanisation programmes by providing subsidies and arranging bank loans for the purchase of marine diesel engines, fishing nets and craft for fishermen through fishermen co-operative societies. Housing schemes for the fishermen are also managed by them. They have also formed co-operative marketing societies for marketing the catch of the fishermen in some places. They have established boat building yards for construction of mechanised fishing vessels, nylon net factories, and fishermen training centres for training them in operating the mechanised craft and gear and in maintaining the equipment etc. and have opened fishermen schools in many places. On the basis of Fish Farmers Development Agencies the Orissa State Departmet has formed

TABLE 6

Details of freezing plants, canning planning plants etc. upto 1st December 1980 (Capacity in tonnes/day)

State	Freezing		Canning		Ice making		Fish meal		Cold storage	
	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity
Kerala	117	534	42	156.5	56	644	3	62.5	141	11548
Karnataka	29	113	9	38.0	15	212	5	150.0	31	2612
Tamil Nadu	46	180	3	4.5	36	335	6	62.0	60	5424
Andhra Pradeseh	21	86	1	0.3	23	254	—	—	25	2096
Pondicherry	—	—	1	3.0	—	—	—	—	1	6
Lakshadweep	—	—	1	3.0	—	—	—	—	—	—
Maharashtra	41	288	3	5.5	5	218	6	95.0	46	7336
Gujarat	11	92	1	6.4	9	97	12	194.0	23	3283
Goa	12	45	7	33.5	2	19	1	12.0	9	560
Oriss	14	52	1	1.0	5	48	—	—	15	1150
West Bengal	31	96	—	—	5	90	1	14.0	27	1929
Total	322	1486	66	249.7	156	1917	34	589.5	379	35943

Source: Girija and Ravinath (1987)

Brackishwater Fish Farmers Development Agencies which have done a great deal to stimulate interest in prawn culture in the Chilka lake area. Other States are planning to start BFDAs on the Orissa model. The co-operative movement among fishermen was sponsored mainly by the State Fisheries Departments and it is estimated by CMFRI that there were 2759 Fishermen Co-operatives in the coastal regions of the county in 1973-77. Out of these only 748 were running successfully.

ANCILLARY INDUSTRIES

As a result of rapid mechanisation of the fishing industry a number of ancillary industries that supply the needs of the fishing community have sprung up in the private sector. The 1977 estimates are given here (Indian Fisheries, 1977).

Boat building yards: There were 69 registered wooden boat building yards for constructing mechanised boats, 16 shipyards for building trawlers and 3 yards for FRP boats. Recently a number ship building yards for building large trawlers utilizing the know-how from foreign boat building yards are functioning in the country. The country has adequate material, expertise and designs for construction of wooden and steel vessels upto 30m.

Marine diesel engines: There were 9 private firms manufacturing marine diesel engines in the country, the popular brands being "Kirloskar", "Meadows", "Leyland" and "Ruston".

Net factories: There were 4 net making plants in the public sector and 4 small ones in the private sector. 4 firms also produce nylon yarn for the fishing industry.

Others: Fishing floats, life saving equipment, trawl winches, reduction gear, stern gear, power take off clutches, auxillary engines, radio telephones, refrigeration equipment etc. are also manufactured in India.

MARINE FISHERIES EDUCATION AND TRAINING

In 1945 the Government of India sponsored the All India Fisheries Training Course at Madras for training district level officers in marine fisheries. As part of the scheme for development of deep sea fishing in the country an *ad hoc* scheme for training of deck and engine side officers was initiated in 1948, under which the Deep Sea Fishing Station of the Government of India took apprentices on board their fishing vessels for providing training and sea time to persons who could subsequently appear for the MMD examinations for skippers and mates of fishing vessels. These marked the beginning of organised programmes for education and training in fisheries in India. With the introduction of mechanised fishing the need arose to train the fishermen in the operation of these boats. The fishermen Training Centre at Satpati established in 1954 with FAO assistance was the forerunner of similar centres which were soon established in all the maritime States.

It soon become clear that if the marine fisheries were to develop in India it is necessary to train four levels of personnel:

1. Operatives for small mechanised fisheries (Base level)
2. Parsonnel for manning ocean going vessels and shorebased personnel for handling, processing and marketing fish as well as for maintenance of vessel and fabrication of fishing gear (under graduate level):
3. Managerial personnel to plan and execute developmental programmes (graduate and post-graduate level).
4. Scientific and technical personnel for research in various areas of fisheries, exploration, development of new technologies etc. (post-graduate level).

1. *Base level training*: The Indo Norwegian Project established at Neendakara in 1952 as an area development project did pioneering work in this field. Subsequently the fishermen training centres on the Satpati pattern have been established in all maritime States by the State Fisheries Departments, for training the artisanal fishermen in the operation and maintenance of mechanised boats. The courses have teaching and practical components and extend over a period of 6 to 10 months. There were 31 such

training centres in the country in 1977 with a total intake capacity of 900 candidates. The requirements for this course is only basic education upto 5th standard and 5 years fishing experience. This course is meant for enterprising fishermen youth. The Krishi Vigyan Kendra of the CMFRI established in 1977 has been conducting short term training courses in prawn/fish culture in brackishwaters.

2. *Under-graduate level training:*

a. *Personnel for manning of ocean going fishing vessels*

All fishing vessels exceeding 25 tonnes gross tonnage should be commanded by duly certified deck officers and engineers as per the provisions of the Indian Merchant Shipping Act. Initially the programme for training these personnel through actual sea and engine room service was implemented by taking them as apprentices on board the vessels of the Deep-Sea fishing Organisation, IFP and West Bengal Government vessels. Regular institutional training was organised only after the establishment of the CIFNET at Cochin in 1963. A unit of CIFNET was started in Madras in 1968 and a third unit at Visakhapatnam recently. Candidates who wish to qualify as skippers (fishing vessels), Fishing Secondhands, Engineers (fishing vessels) and Engine Drivers, undergo institutional training for 15 months, followed by the requisite qualifying sea/workshop service before appearing for the Certificates of Competency examinations conducted by the Ministry of Transport and Shipping. The Institute also offers refresher courses for Fishing Secondhands and Engine Drivers appearing for higher Certificates of Competency. It also conducts refresher courses for Skippers in acoustic methods used in modern fishing, fishing fleet management and in diversified modern fishing methods. Matriculates are eligible for these courses. The syllabus for these courses is being revised according to the new Merchant Shipping Examination Rules, 1985.

With the introduction of more large trawlers for deep sea fishing the need for certificated hands is bound to increase and the required manpower needs will have to be assessed and provisions made for training them expeditiously. Strategies have already been drawn up to meet these new demands (Swaminath, 1987).

b. *Technicians for shore-based work:*

The CIFNET offers courses for training (1) Boat Building Foreman (2) Shore Mechanics (3) Fishing Gear Technicians and (4) Fishing Vessel Electronic Technicians. The IFP conducts courses for refrigeration technicians, fish processing technicians, purse-seine operators, fishing boat designers and servicing of electronic equipment and engines.

The Central Food Technological Research Institute, Mysore offers a short term course in refrigeration techniques involved in food preservation, including fish and meat.

The College of Fisheries, Mangalore conducts a 3-month course for fish processing technicians already employed in processing establishments.

3. *Managerial level training:* The College of Fisheries, Mangalore attached to the University of Agricultural Sciences, Bangalore is the first professional fisheries college in the country, established in 1969, it has a regular 4 year degree course in Fishery Science leading to the B.F.Sc. degree. Subsequently four more Agricultural Universites have established Fisheries Colleges offering B.F.Sc. degrees in Fishery Science - Tamil Nadu in 1977, Kerala in 1979 and both Maharashtra and Orissa in 1981.

The Central Institute of Fisheries Education, Bombay, estabilised in 1961 offers a 2 year post-graduate diploma course in Fishery Science mainly to district level officers deputed by the State Fisheries Departments. Private candidates are also admitted and the diploma is treated as equivalent to an M.Sc. degree for all practical purposes. From 1986 the Institute has started offering a Masters degree programme in Fisheries Management.

The Central Fisheries Extension Training Centre of the CIFE which has recently been shifted from Hyderabad to Kakinada conducts a 10 month course in extension techniques related to fish culture for in-service personnel.

The State Fisheries Staff Training centres in the maritime States conduct 1-12 months training for their in-service junior level personnel like Inspectors and Research Assistants.

The Trainers' Training Centre of the CMFRI has been conducting short term training courses in prawn farming, hatchery production of prawn seed, oyster culture, seaweed culture, SCUBA diving and assessment of marine fish stocks to officers of the State Fisheries Departments since 1985.

4. *Training of scientific and technical personnel:* The Fisheries College, Mangalore has M. F. Sc. programmes in Industrial Fishery Technology and in Fish Production and Management. It also offers Ph.D. programmes in Fishery Biology, Aquaculture, Fishery Oceanography, Aquatic Biology and Fish Processing Technology.

The CMFRI is conducting post-graduate and doctoral programmes in Mariculture for which the Cochin University of Science and Technology is awarding M.Sc. and Ph.D. degrees. This programme was started in 1979 with UNDP/FAO assistance as a Centre of Advanced Study in Mariculture at the CMFRI. After 1986 the project has become an integral part of the Institute as the Post-Graduate Programme in Mariculture.

The Fisheries College, Tuticorin has also started a M.F. Sc. course in Fisheries Science. The College of Fisheries, Panangad attached to the Kerala Agricultural University is also offering a M F Sc. course in Fisheries since 1986. The Cochin University of Science and Technology is offering M.Sc. degree course in Industrial Fisheries since 1976. The Kerala University offers a 2 year M.Sc. course in Aquatic Biology and Fisheries, while a two year M.Sc. course in Marine Biology is offered by Karnataka, Annamalai, Andhra and Cochin Universities.

SOCIO-ECONOMIC CONSEQUENCES OF PROGRESS ACHIEVED IN MARINE FISHERIES

The various developmental methods that have been adopted during the past 4 decades for developing the marine fisheries sector have no doubt improved the socio-economic status of the marine fishermen. However, it is the segment of their population that has opted for mechanisation that has benefited much from these developments. The fishermen who have stuck to indigenous methods of fishing have also profited to some extent from the introduction of synthetic materials for net making, which has made their gears more efficient. But compared to the fishermen in the mechanised sector, the traditional fishermen are definitely poorer. Whether this is due to the adverse effect of mechanisation or due to the lesser efficiency of the traditional gear has to be looked into. The very fact that the mechanised sector (19,000 boats) has accounted for 61% of the total marine catch in India in 1981 clearly shows that the traditional sector (1,40,800 boats) which encompasses the majority of the fishermen is experiencing a set back

An analysis of the problem carried out by the CMFRI shows that there are three types of interaction between the mechanised and the traditional sector:(1)The mechanised sector competes with the traditional sector leading to clashes between them as in the case of the purse seiners and rampani operators in Karnataka. Jacob *et al.* (1979) have shown that the rampani operators were adversely affected by the introduction of purse seiners from the point of view of income and employment. The Karnataka Government took prompt action to encourage rampani operators to purchase purse-seiners by offering subsidies and loans and consequently the intensity of the problem is reduced. In other places where the small mechanised trawlers were fishing for prawns close to the shore where the traditional fishermen normally fish, clashes have been frequent. The State Fisheries Departments have intervened and demarcated the deeper areas for mechanised fishing and reserved the inshore areas for the traditional sector.

(2) The second type of interaction is complementary. Panikkar and Alagaraja (1981) and Sathiadas and Venkataraman (1981) who studied the socio-economic condition of fishermen in Puthiappa-Puthiangadi area and Sakthikulangara respectively found that mechanisation has benefited the entire fishermen population of the village. However the poorer section of the fishermen are left behind.

(3) Lastly the traditional fishermen themselves go in for motorisation of their indigenous craft. This has happened in Gujarat and Maharashtra on a large scale and is now catching up in Kerala also when they suddenly discovered that outboard motors could be easily fitted to their dug out canoes. This has increased their range of operation, reduced physical strain and increased the quality and quantity of their catches (Gopakumar et al., 1986).

Apart from these social problems, mechanisation can also affect the fish populations in some regions. The mass destruction of tonnes of cat fish carrying incubating eggs in the mouth by the purse-seiners on the Karnataka coast is a very dangerous practice indeed and could affect the recruitment of cat fish very adversely (Silas *et al.*, 1980). It is also a well-known fact that wherever there is a dense concentration of mechanised boats all operating for prawns, the prawn catch rate has drastically come down. Although this is attributed to economic over-fishing it could easily lead to biological over-fishing unless the fishing pressure is reduced in time.

GENERAL REMARKS

It is evident from this review that India has made creditable progress in the marine fisheries sector in the past four decades. In spite of it the per capita availability of marine fish in the country is said to be only 4.57 kg (Silas *et. al.*, 1986). The gap between the supply of and demand for marine fish in the domestic market in 1985 was about 0.79 million tonnes (Silas *et. al.*, 1986).

The average growth rate of marine fish production has been about 3.5%. Unless the growth rate is increased considerably, the supply will continue to be far short of the demand. So there is an urgent need to accelerate the pace of fish production in the country. But this has to be done in a pragmatic manner.

A critical and calm appraisal of the marine fishery scenario outlined above brings to light some significant strengths and weaknesses in our approach to the problems.

There is no gainsaying the fact that the majority of our fishermen are still following indigenous methods of fishing and by and large are still financially backward. This traditional fisheries sector cannot be neglected for two reasons, one is the social obligation to uplift the traditional fishermen. Secondly, in view of the rising cost of fuel we cannot afford to forget our traditional skills in fishing which depend more on muscle power and wind power. The efficiency of the traditional crafts and gear should be improved by directing research efforts in this direction also.

It is also fairly clear that the small mechanised boats should be made more fuel efficient by improving their design by scientific research and by introducing modern technological improvements like Kort nozzle for the propellers, etc. Since a good amount of power (40%) is consumed by the dragged gear like trawls, there is vast scope for improving the design of the otter boards and nets to reuuce the drag and improve the efficiency. Bull trawling is also considered to be more fuel efficient as no energy is spent for keeping the trawl net open. All the trials conducted with bull trawlers of various sizes have invariably proved that the catch rate of a pair of bull trawlers is vastly greater than the combined catch rate of the two tawlers if they had operated along. This is also the lesson that the foreign poaching vessels (mainly Taiwanese) in our waters are trying to teach us. They are mostly bull trawlers.

Exploratory surveys conducted by the IFP along the south-west coast have brought to light the existence of rich "Kalava" grounds in 70-100m depth between 8°N and 13°N latitudes. These are rocky out crops abounding in large sized (average 1.75 kg) perches which have a ready domestic market and which also do not spoil easily. Nature has provided us with natural FADs in these rocky outcrops within easy reach of our shores. It is upto us to exploit them.

As far as demersal fishery resources are concerned the exploratory survey vessels of the FSI and IFP, the foreign chartered trawlers and poaching vessels have clearly shown us that the commercially exploitable demersal resources of horse mackerel, perches, threadfin-breams, bull's eye, cephalopods, shrimps,

barracuda, lizard fish and ribbon fish are confined to the continental shelf region mainly upto a depth of 100 m. There are also some resources upto the 200m line but the distance between the 100 m line and the 200 m line is so narrow in most of the regions that the 100-200 m zone forms a very minor percentage of the area of our EEZ. For all practical purposes we should realize that our "deep sea" as far as the demersal resources are concerned is confined within the 100 m line and this is an area which is well within the range of operation and fishing capacity of the medium trawlers 17 m in OAL. The cost of these trawlers (Rs. 35 lakhs) is only 1/3 the cost of the 23 m trawlers (Rs. one crore) which are now proposed to be introduced on a large scale. The 17 m vessels can also be used to exploit the "Kalava" grounds. With these vessels we can greatly and definitely improve the marine fish production. And they will be bringing in fish which are already familiar to our domestic consumers. However, since the operational range of these vessels is limited we may have to develop berthing and bunkering facilities for them in the minor fishing ports that are being constructed.

The so-called continental slope (200-500m) is a very steep and narrow zone where trawling is difficult and possible only in a few places like the "Quilon Bank" where the slope is less steep and more wide. The demersal fishes available on this slope are also small in size and may not be easy to market. For the present we need not devote much time and financial resources in catching these presently uneconomical fishery resources.

Regarding pelagic resources the surveys have clearly shown that vast under exploited resources of white baits are available even within the 50 m line on the south west and south east coasts. Between 50 and 200 m the existence of vast resources of horse mackerel, scads and ribbon fishes have been discovered. But these resources should be caught by pelagic/midwater trawl nets operated from paired vessels or single vessels and expertise in this field is still limited in our country. But these techniques have been used by the IFP, PFP and the FSI and it should not be difficult to popularise them. But more research work is needed in this field to standardize the size and type of vessels and the gear.

The "Deep Sea" and the larger vessels become important only when we think of the oceanic tuna and squid resources for which there is a ready export market. The long-liners of the CIFNET and FSI have clearly proved the existence of very rich tuna grounds (probably the richest in the world) relatively close to the shore (100-150 nautical miles) between Mangalore and Goa. The existence of large oceanic squids in the deeper areas of the EEZ has been proved by these surveys. The tuna long-liners which are large vessels are needed to exploit these resources. The long-liners can also be equipped for squid jigging for catching the oceanic squids during night. This is the area in which we should really think of joint ventures with foreign countries. In this connection it is necessary to develop Goa and Mangalore into major fishing harbours which could handle these large vessels.

We should accept the fact that our chartering scheme has been a failure. It has not fulfilled the purposes for which it was started. It has not given us one bit more information about the location and magnitude of the fishery resources than what we already know about them through our own survey programmes. The confiscated poaching vessels have given us more information. This is because the chartered vessels have not provided correct information about the location and composition of the catch to the concerned authorities. Nor have they helped in training our men in modern fishing methods. The technology transfer through chartering is practically nil and it has not lead to the establishment of Indian deep sea fishing ventures. If at all we have to go in for chartering the Government should charter the vessels and not the private companies. This has been the practice in other countries. The chartering of M.T. MURAENA by the Goernment of India has given a lot of reliable information on our fishery resources.

When we restrict Joint Ventures with foreign countries to the exploitation of oceanic tuna and squid resources, the much discussed problem of protecting our shrimp resources from the operations of these large foreign

vessels can also be solved. Regarding our prawn resources it is now abundantly clear that the inshore prawn resources upto the 50 m depth are being exploited at the maximum level and any further increase in catch is not possible even if the fishing effort is increased. It is also evident that the productive offshore prawn resources upto the 100 m line are restricted to the north east region and are at present being exploited by more than 100 large trawlers (23m).

Our studies clearly show that these resources also cannot withstand increased fishing pressure. So, for increasing prawn production in the country we have necessarily to resort to prawn culture in a big way. The efforts that are already afoot in this direction should be strengthened.

It is apparent that except for tapping the oceanic tunas and squids we may not need to go in for joint ventures. The other resources can be tapped by the 17 m vessels and the existing types of smaller vessels with suitable improvements and modifications and development of required infrastructure to facilitate the smooth functioning of these vessels.

We have been too much pre-occupied with the export market which consumes only about 10% of the marine fish production. The good work that has been done by the MPEDA and the EIC have brought our export earnings to Rs. 400 crores per year. It is planned to increase the earnings to Rs. 700 crores by the end of the seventh five year plan. We should realise the limitations of the resource potential as far as the shrimps are concerned. There is an urgent need to diversify the export basket. There are already good signs of the exports of frozen fish, frozen cuttle fish and squids and dried fish picking up. These items are backed up by good resource potential and should be promoted.

But unless the domestic market for fish is stimulated the marine fishing industry cannot prosper. This is an area which needs immediate attention. Unless the fish caught are marketed efficiently the fishermen will not get proper returns on their catches and will not have the incentive to catch more fish. Facilities in the form of cold storages etc. to build up a buffer stock during glut periods will help stabilize the fish prices. Market surveys to assess the demand for the various types of fish products, development of diversified fish products packed in attractive consumer packs to suit the market demand, consumer education to popularise the new types of products, aggressive sales promotion drives, establishment of cold chains, provision of quick transport facilities and construction of hygienic fish markets should be undertaken urgently. The CIFT and IFP have already developed a number of diversified fishery products which should be taken up for marketing by the State Fish Marketing Federations/ Corporations.

Lastly manpower planning and training of personnel for all the developmental activities should be given due importance to provide for the smooth functioning of the schemes envisaged to increase fish production in the country.