Management of Marine Fisheries of India

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Abstract

Marine fishing in the country is carried out by non-mechanised and mechanised boats employing wide variety of fishing gears. Over the years, a number of changes have taken place in the fishing methods, crafts and gears. The resources have also been behaving in a different manner. These changes in the patterns of fishing and resources availability and associated socio-economic problems are briefly highlighted. The intense mechanised fishing operations, especially trawling in coastal waters and to some extent purse-seining are causing alarm in some quarters for some resources. Management measures needed in such situations have been outlined.

The potential yield of fisheries resources from the Indian EEZ has been estimated to be around 4.5 million tonnes where as the annual production has been stagnant at about 1.5 million tonnes for the last one decade. While diversification of fishing activities might help to increase fish production to some extent from the traditional sector, additional production is expected mainly from the underexploited and unexploited resources offering scope for development within the presently exploited regions as well as outside. Details of such resources and the possibilities of harvesting the same are indicated.

Deep sea fishing beyond 50 m depth offers scope for fishing tunas, squids, cuttlefish, deep sea prawns and lobsters. In addition, a number of measopelagic and non-conventional resources have also been identified in the EEZ. An overall plan for fishing and utilization of such resources is discussed.

Introduction

Marine fishing is still predominantly carried out through artisanal fishing methods and mechanised fishing by small boats in the 0-50 m depth zone. Over the past 20-25 years, the efficiency and the operational range of traditional fishing have undergone revolutionary change due to the impact of mechanisation of the fishing crafts and by use of synthetic fibres for gears. This has also helped fishermen to develop their fishing practices in a steady state condition. The realisation of the export potential of marine products gave the impetus and the number of small mechanised boats in the range of 32'-33' length have increased tremendously which at the same time increased the production of other fishery resources as well. In addition, about 118 larger trawlers (20-23 m OAL) are also now operating in different parts of EEZ especially in the northern Bay of Bengal (CMFRI, 1987). The advent of purse-seiners has been a boon and at the same time, perhaps a bane with the result the indigenous gears became obsolete and less productive. This led to clashes between fishermen in Kerala, Karnataka, Goa and Maharashtra. The motorisation of indigenous crafts has also acquired momentum during the last decade. Also about 50 chartered vessels were in operations at the end of 1985.

It is a matter of concern that inspite of all these developments the marine fish production remained stagnant at 1.5 million tonnes against the estimated potential of 4.5 million tonnes from the EEZ. The intense fishing effort in a limited area over a long period to a certain extent might have contributed to the stagnation. Some of the resources have also been behaving differently with changing patterns of fishing with variations in abundance and availability over space and time. The situation is now ripe to focus attention on management procedures for evolving a national strategy for exploitation and utilization of the resources. While no further increase in effort in 0-50 m depth area is advisable, diversification of the fishing effort and mechanisation of indigenous crafts may improve the present yield to 2.0 million tonnes. An additional production could be achieved by exploiting the underexploited and unexploited resources of 51-200 m depth zone which has a potential of 1.7 million tonnes. Details of such resources and possibilities of harvesting the same are suggested.

Deep sea fishing offers great scope for fishing tunas, sharks, cephalopods, deep sea prawns and lobsters. The estimated potential is 0.5 million tonnes. A number of mesopelagic and non-conventional resources have been identified in the oceanic waters about which no realistic estimates are available. The deep sea fishing venture is in the infant stage and information on fish stocks beyond 50 m depth zone is still fragmentary. It is necessary to intensively survey the resources and consolidate the data for evolving suitable strategy for the judicious exploitation.

Planning for additional fish production should also aim to develop the infrastructure facilities and to improve the post harvest technology.

Growth Pattern and Trend in Marine Fish Production

For more than three decades the Central Marine Fisheries Research Institute has collected data on the marine living resources, in terms of quantity and quality,

following a multi-stage stratified random sampling.

The coastal fisheries limited to a depth of 0-50 m are mainly exploited by the small mechanised vessels (trawlers, purse-seiners, drift gill netters, dol netters, hooks and liners and boats with OBM) and the artisanal units accounting for nearly 98 per cent of the landings. The rest of the landings are accounted by the large vessels operated by private companies.

Marine fish production increased from 0.6 million tonnes in the fifties to 1.7 million tonnes in 1986 (Fig.1). Estimated landings (in tonnes) of major exploited marine fish resources in India during 1961-85 are given in Table 1. The average rate of growth recognised during the different stages in 1961-65, 1966-70, 1971-75, 1976-80 and 1981-85 was 26.6, 28.9, 10.9 and 12.9 per cent respectively. While the landings increased there was decline in growth rate. The maximum growth rate (28.9%) between 1966-70 and 1971-75 may be attributed to intensification of mechanisation. But this growth rate declined in later years inspite of introduction of purse-seines, motorisation of indigenous craft and with over all increase in the effort. The reason may be that despite the technological progress in capture techniques, no efforts were made to diversify the fishing effort in the 0-50 m depth zone as well as to tap the vast potential resources of the EEZ.

The average fish production in the four major regions, viz., north west, south west, north east and south east were 35, 34, 17 and 14 per cent respectively. Analysis of the data over the years indicated that the relative contribution of north east and north west regions have increased. Though the south west region was the major contributor, the relative contribution showed declining trends, whereas it remained more or less constant in the south east region (Fig.2).

The oil sardine accounted for 11.0 per cent followed by penaeid prawns (7.9%), *Stolephorus* (4.7%), lesser sardines (4.4%), silver bellies (4.3%), perches (4.2%), non-penaeid prawns (3.8%), elasmobranchs (3.7%), cat fishes (3.5%), carangids (3.5%), ribbon fishes (3.4%), soles (2.1%), cephalopods (1.5%) and tunnies (1.4%) (Fig.3). Contributions by the mechanised and non-mechanised sectors in the different maritime states are given in Fig.4.

The resource pattern of fin fishes over the years has considerably changed. Groups which were important in earlier years do not appear to be that important during the present day. The oil sardine and mackerel indicated a declining trend. A salient feature during 1986-87 was the very high landings of 23,841 tonnes of mackerel in Andhra Pradesh thus enabling this state to exceed the production from Kerala (21,205 tonnes) and Karnataka (21,175 tonnes). The contribution from demersal resources has increased from about 35% to almost 50% in the total landings. Groups like croakers and the carangids have been yielding over one lakh tonnes per annum. Some of the resources, especially shrimp, though exhibited wide fluctuations, later reached a plateau creating apprehensions of over fishing.

Potential Fishery Resources

Jones and Banerji (1973) estimated the potential yield at 2.5 million tonnes. Revised estimates of potential yield have been made with the declaration of EEZ. The annual yield has been calculated as 4.0 million tonnes (Silas *et al.* 1976) and 4.47 million tonnes (George *et al.* 1977). Alagaraja (1987) based on relative response model and maximum contribution approach (MCA) estimated potential yield from 0.50 m depth area as 2.2 and 2.0 million tonnes respectively. Nair and Gopinathan (1987) estimated the present exploitable yield of living resources of EEZ to be 5.5 million tonnes based on productivity studies. The estimated potential of the 51-200 m depth zone is 1.7 million tonnes out of which nearly 1.0 million could be exploited. The oceanic waters beyond 200 m have a potential of 0.5 million tonnes. Estimated annual potential yield of marine fish in the EEZ of India is given in Table 2.

The following are the important resources and their estimated potential (George *et al.* 1977 and James *et al.* 1987).

Potential Pelagic Resources

The estimated potential is 1.85 million tonnes as against the yield of 0.8 million tonnes (Fig.5). The white baits (anchovies) with a potential of 2.4 lakhs tonnes can contribute significantly, especially from Gulf of Mannar during July-September and from the south west coast during October-December. The current yield is only 73,000 t. Additional yield of 150,000 t could be expected within 20-50 m depth by operating purse seines and mid water trawlers.

The carangids have a potential yield of 2.65 lakh tonnes against the current production of 54,000 t. The magnitude of additional yield will be about 200,000 t especially from south west, off Gujarat and upper east coast and could be exploited by mid water trawling, drift gill netting and purse seining.

The current yield of ribbon fishes is 59,000 t only, though the potential works out to 270,000 t. Considerable increase in production could be expected by employing boat seines, trawl nets in 20-80 m depth zones of north west, south west and south east regions.

For small tunas, the estimated potential is 1,00,000 t in the Andaman waters, 50,000 t in Lakshadweep and 90,000 t along the mainland. The potential yield of tunas in the oceanic region of our EEZ is around 500,000 t and mainly consists of yellowfin, big eye and skipjack tunas. Sailfish, marlin and oceanic pelagic sharks also constitute an extra component. Recent longlining operations have indicated commercial fishing grounds for tunas in our EEZ (Joseph and John 1986, Swaminath *et al.* 1986). Organised fishery by

pole and line exists only in Lakshadweep at present. Operation of larger pole and line vessels, purse seining and long lining can yield better catches (Silas and Pillai 1986; James and Pillai 1987).

Potential Demersal Resources

Though the estimated potential of demersal fin fish resources of our EEZ is around 1.1 million tonnes, the current yield is barely one third of the potential (Fig.5). Some of the resources like catfishes, carangids, sciaenids, perches, nemipterids, lizard fish and barracudas are under-exploited. The catch rates of these resources have been worked out by Joseph and John (1986). The estimated potential of resources such as catfishes, sciaenids and perches is 310,000 t. The upper east coast, north west coast and south west coast between 20 and 100 m depth range are productive fishing grounds. The present production of perches forms only 26% of the estimated potential of 2.5 lakh tonnes. Joseph and John (1986) have worked out the catch per hour of nemipterids in the various depth zones of the four major areas. The good fishing grounds for perches are in the 75-225 m depth range along the south west and upper east coast.

Resources like croakers and leiognathids have potential yields of 210,000 t and 100,000 respectively. The current yield of the former is more than 50% and the latter 67%.

Crustacean Resources

There have been apprehensions of over exploitation of the shrimp resources and very little scope exists for additional production of penaeid prawns (The current yield is 123,000 t against the potential yield of 180,000 t) from the traditional grounds (Fig. 5). But the non-penaeids with a current yield of 59,000 t and a potential yield of 105,000 t show scope for additional exploitation. The deep water shrimps and lobsters having a potential of 12,000 t are exploited only partially. They are particularly abundant in 300-400 m depth in the south west coast and Gulf of Mannar and could be exploited by larger trawlers.

Cephalopod Resources

One of the important resources which is still under-exploited is the cephalopods. The increase in the current yield of cephalopods to the tune of 40,000 tonnes in 1986-87 is not due to any specific development programme but a natural increase in the by-catches of trawlers and other artisanal gear. The zone between 50-200 m seems to be good potential grounds (130,000 t) for cephalopods. An additional resource of about 50,000 t or even more could be exploited by squid jigging. The data available on oceanic squid resources around India are qualitative and indicative of a vast potential. Significant collections of the ommastrephid squid *Symplectoteuthis oualaniensis* were made from a depth range of 40 to 250 m off Bombay-Okha.

Unexploited Deep Sea Non-conventional Resources

The potential of unexploited deep sea non-conventional resources have an estimated potential of 18,146 t (Oommen, 1985) and their importance has been highlighted by Joseph (1986). The FORV *Sagar Sampada* cruises have indicated potential resources of myctophids and other deep sea fishes in our oceanic waters. The studies conducted in USSR do not preclude the use of such resources for human consumption.

A variety of edible and unfamiliar species of the deep shelf waters include the 'bulls eye' *(Priacanthus* spp.), 'Indian drift fish' *(Psenes indicus),* the 'black ruff' *(Centrolophus niger),* the 'green eye' *(Chlorophthalmus* spp.), and the 'Rat tail' *(Bathygadus* spp.) offer scope for exploitation and utilization.

Scope for Increasing Production

The traditional sector, the small mechanised sector, and the large ocean going sector have to play their roles in further fisheries developmental activities. Introduction of additional small mechanised craft in the 0-50 m zone is not advisable. However, the production could be increased by another 0.5 million tonnes from the present 1.5 m tonnes through diversification of fishing activities. The drift gillnets are popular among fishermen. Motorisation of the indigenous crafts for operating gillnets and hook and line may enhance production. Installation of suitable mechanical net hauler and energy saving devices and use of sails are some of the new approaches to be made. The seasonal conversion of mechanised boats (shrimp boats) for gill netting with mechanised hauling could be tried. It will be worthwhile to try drift gillnetting in the offshore waters as a diversification of fishing effort.

There is need to restrict further increase of small mechanised boats along the coasts of different maritime states. There have been apprehensions of over fishing of shrimps in some areas. There is need to review the mesh size of shrimp trawls all over the country and take effective steps to see that trawls with cod end mesh below 30 mm are not used in any part of the country. From 50-200 m depth zone about 1.7 million tonnes of potential stocks of under exploited and unexploited resources have been estimated. Oceanic tunas, marlins, sharks and cephalopods have a potential of 0.5-0.8 million tonnes. Efforts are now needed to exploit such resources through suitable crafts and gears.

Target Oriented Exploitation

Although the country has been seriously thinking of implementing the deep sea fishing activities in the Indian EEZ by introducing upto 500 vessels during the VII Five Year Plan period, the programme has not taken off. The capital has shied away from the fishing industry for fear of day to day changes in the implementation of the rules and

regulations. Moreover, the deep sea fishing can be economical provided the industry gets good price for the fish or the product which presently is not the case. Whereas foreign fleets operating in our waters find it economical because they get ready markets in foreign countries at fairly high prices and hence their ventures are profitable. Some of the countries bordering Indian Ocean have achieved tremendous growth in fish production to the tune of 400-1000 times after the declaration of EEZ. The time has come to take effective steps to lead or follow. We should at this stage frame a target oriented and time bound programme for additional exploitation.

In the oceanic waters the resources like tunas, sharks and cephalopods are the least exploited. To exploit the tunas in our EEZ about 150 long-liners each with a capacity to produce around 450 tonnes of tunas annually are required to achieve a production target of 60,000-75,000 by 2000 AD (Silas and Pillai, 1986). Under large scale commercial fishery sector augmentation of production of tunas can be achieved by proper deployment and management of oceanic purse seiners and improvement in expansion of longline fishery. As opined by Silas and Pillai (1986) successful surface fishery for tunas can be achieved by large scale purse seine operations through joint venture/ownership agreement. About 110,000 tonnes of tunas per annum from EEZ and contiguous high seas could be produced by employing two categories of large purse seiners (1) 10-12 purse seines each of annual production capacity of 6000 tonnes and (2) 20 purse seines each of 4000 tonnes production capacity. The surface fishery for tunas carried out presently by 272 pole and line units (7.9 to 9.1 m) in Lakshadweep could further be developed by introducing larger boats of 15-20 m OAL. Each boat may require 0.5 to 0.8 tonnes of live bait per annum for operation. Operation of 100 such units can produce 20,000 tonnes on an average annually.

The potential resources of cephalopods in oceanic areas could be harvested if directed methods like squid jigging are introduced. Here also joint venture with countries having expertise and experience in high sea fishing appears to be ideal.

Development of Infrastructure Facilities

Planning for fisheries development should also give prior attention to develop the infrastructural facilities. During the last decade, though several fishing harbours have been constructed, most of them do not have even proper berthing facilities. They are to be made operational to accommodate about 500 deep sea/offshore fishing vessels. These harbours should be able to provide fish storage, loading and unloading equipments, supply of ship stores, fuel, oil, freshwater, ice etc. Moreover, vessel maintenance facilities, workshops, slipways, suitable space for repairing of nets and better transportation of the fresh or processed fish also are to be provided. Other basic requirements include the creation of good processing and marketing systems.

Presently we have 272 freezing plants and 308 cold storages with a total storage capacity of 34,351 t of fish. But most of them are not functioning due to lack of demand for fish storage. At present about 20% of the total marine fish catch goes for curing and drying. A chain of curing and drying yards are required to meet the additional production of fish. The present production capacity of 474,000 t. of fish meal plants and pulverisers will be adequate to handle any increase in additional production. Product diversification also should get priority attention. Products like *masmin* produced from tuna in Lakshadweep have no organised marketing system. Technology for improving the quality of *masmin* and new products from coastal tunas will have to be attempted.

Good marketing systems have to be evolved with proper management strategies establishing fishermen's co-operatives in all major landing centres all along the coast. The need for penetrating into export market is vital for development of oceanic fishery. Domestic price for fish is too low. Large scale commercial ventures have to bank on the lucrative export market to make the ventures economical. This is proved by the foreign fleets operating in our waters. Though we have also got the same catch and catch rates as foreign fleets, because of low price value for the fish, our ventures have turned to be uneconomical. Indian traders are one of the most skilled and talented in the world and the international market will respond to Indian exporters provided we make a thrust in these markets by product diversification to suit the taste preferences in foreign countries. Proper market survey, steady supply of the products and above all strict quality control measures are necessary to compete with other countries.

Need for Conservation of Marine Resources

There is urgent need to protect the inshore environment from further deterioration from possible effects of industrial, agricultural and other effluents. The breeding periods of fin fishes are to be critically studied to suggest regulatory measures for their exploitation in space and time. Some of the groups (like shrimps) though exhibited wide fluctuations, later reached a plateau causing fears of overfishing. According to Pauly (1979) "over fishing is indeed the primordial sin, the bankruptcy of fishery management. It is in fact, the worst epithet a fishery biologist can hurl at the fishing community". Though the mechanised fishing is effective in the inshore area it has been creating difficulties for artisanal fishermen. This economic overfishing has arisen in some parts of the country leading to clashes between fishermen in artisanal and mechanised sector in Tamil Nadu, Kerala. Karnataka,

Goa and Maharashtra. It is necessary to demarcate the coastal zone very close to the shore exclusively for such fishermen who are unable to go in for motorised or mechanised fishing. These clashes could be averted promptly by scheduling the fishing operations (Jacob *et al.* 1979; Alagaraja *et al.* 1982 and Balakrishnan *et al.* 1984). The different regulations now existing in the coastal areas of different states also have to be reviewed to examine the possibility of achieving uniformity with regard to resources exploited by adjacent states.

The 'size over fishing' due to reduction in the mesh size leading to reduction in size at first capture has been noticed in prawns (Sudhakara Rao *et al.* 1980). Capturing young fish in large quantities before they spawn will lead to 'recruitment overfishing'. The stock may not be able to withstand the loss due to natural and fishing mortalities, leading finally to their disappearance from fishing ground. Such a situation may happen due to fishery dependent factors as in the case of catfishes in Karnataka (Silas *et al.* 1980). The results of the studies by CMFRI indicate that in many cases, there is need to reduce the intensity of fishing while in other cases there is need to increase the mesh size to relate it to the size at capture. Selective fishing methods can also be adopted to exploit some of the resources like the tuna (by long-lining and purse-seining), seerfishes and other related fishes by gill nets, and hooks and lines. Perches, carangids and other varieties could be exploited by a number of gears including gill nets, hooks and lines and crafts.

In order to safeguard the marine prawn fishery it is necessary to control mechanised fishing in the sea as well as fishing for juvenile prawns in the brackish water systems of the country. The resources of the northern Bay of Bengal can supprot above 105 trawlers of the Mexican type (23 m) operating from Visakhapatnam. The number reached 118 during 1986-87. Any further increase will lead to overfishing and depletion. The catch/hour from a maximum of 20 kg/hr has started declining to 16 or 15 kg/hr from 1985 onwards. This indicates there is need to restrict the number of boats at the 1985 level and at the same time watch the situation for one or two years before deciding to add further units to the fleet.

Planning for introduction of larger pole and line boats for tuna fishing should at the same time ensure easy and enough availability of live-bait fishes. These resources need a thorough survey. Trials with alternate candidate species and culture of live baits are of paramount importance. Some damage to the ecosystem has already been done in Minicoy though not in other islands. It is all the more important to protect the environment in the islands to ensure nature's balance as well.

The marine fishery resources of the country are constituted by multispecies and exploited by multi-gear which create problems for estimating the stock of various groups. There is need to standardise the effort in terms of the most dominant gear for a resource under study. Overall estimates of MSY of commercially important species on all India basis is the need of the time to postulate management measures. It is necessary to intensify and constantly monitor the various resources and watch the resource response to the management measures as well. Periodic processing and critical evaluation of the enormous data from all sources to arrive at concrete information which would form the basis for future exploitation of the resources is essential for further development and management of marine fisheries of the country.

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Table 1. Estimated Landings (in tonnes) of Major Exploited Marine Fish Resources in India during 1961-85

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Oil Sardine	159240	169262	150130	168078	153971	115744	220126	205294	183706	188832	120587
Mackerel	45947	65497	62136	85233	71514	55279	18660	28007	31227	42648	61860
Bombayduck	99614	87075	85236	125481	126044	95505	137790	86476	100950	117742	112454
Anchovies	30744	30069	34033	39054	26588	33684	33383	41824	89257	94951	54514
Other Sardine	112117	10000	65724	52838	68351	67053	61980	55496	77010	67594	60773
Seerfishes	18897	20159	21119	20779	29547	25986	27553	33197	35615	36615	34078
Tunnies	11285	19322	13005	13893	26595	20371	17803	20597	16959	20354	31261
Carangids	24238	31318	35739	21476	33935	30113	37345	40025	53082	58813	54704
Ribbonfishes	57330	64542	42407	77785	71349	62690	41569	48875	39071	53085	84403
Silver bellies	39813	42445	34504	41777	55255	54400	69449	72668	91733	57122	52725
Pomfrets	24987	37701	35127	41434	40427	38231	48728	49968	54290	49979	32974
Croakers	114535	87581	99887	96379	93018	89360	82686	87247	100755	109852	101078
Perches	35232	18162	31799	49312	35657	38541	31325	45026	56141	71241	71813
Catfishes	68689	43540	53504	39231	48817	43745	59390	67664	60764	57415	44500
Elasmobranchs	65230	54605	62216	61621	52843	57862	56009	64316	70046	57757	52804
Penaeid prawns	141713	114640	96472	129204	113665	112037	68539	110797	118203	130051	121958
N. Penaeid prawns	79038	76787	73992	50652	63917	58700	61430	51148	48750	61961	67084
Cephalopods	7889	10826	10005	15931	15032	11335	9548	15799	19748	20954	31586
Total	1422693	1352855	1259782	1403607	1388380	1249837	1378457	1420624	1548475	1630678	1534726

Table 2. Estimated annual potential yield of marine fish in the EEZ of India (in thousand tonnes)

Region	India's present production (1986)	Annual potential yield			
		Depth: 0-50 m	50-200 m	beyond 200 m	Total
North-west	571.6	540	340		880
South-west	626.6	700	720		1420
South-east	408.5	480	200		680
North-east	70.5	540	200		740
Lakshadweep	5.5	—	90		90
Andaman & Nicobar	10.6	—	160		160
Oceanic of all regions	—	—	—	500	500
	1693.3	2260	1710	500	4470

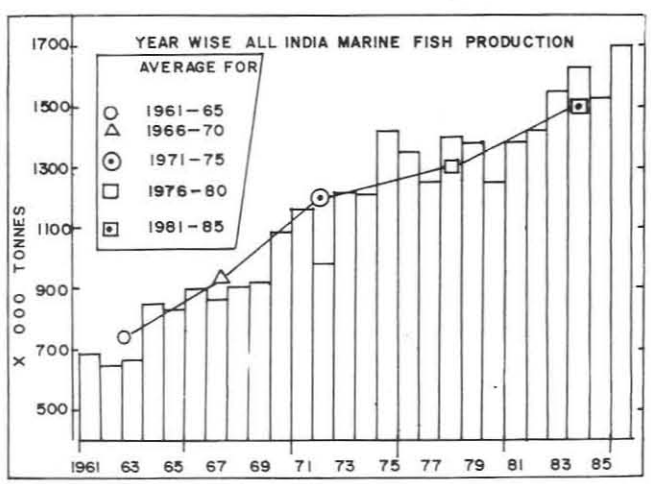

Fig. 1. Year-wise all India marine fish production and average production during various stages.

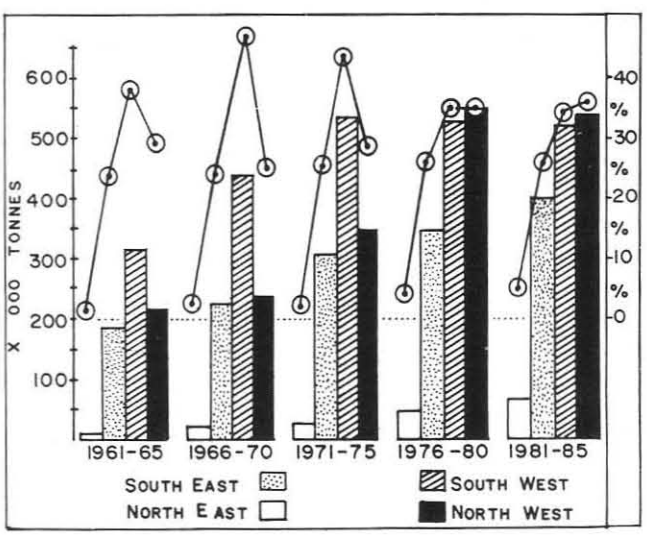

Fig. 2. Average production and percentage contribution in the four major regions during various stages.

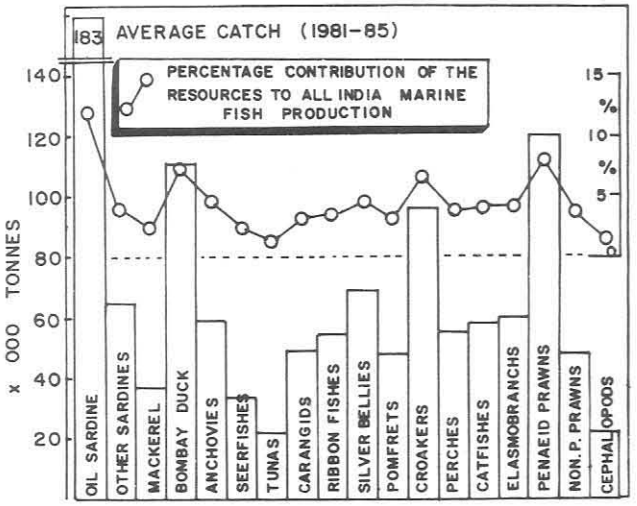

Fig. 3. Production of major exploited marine fishery resources and their percentage contribution. (Av. 1981 – 85).

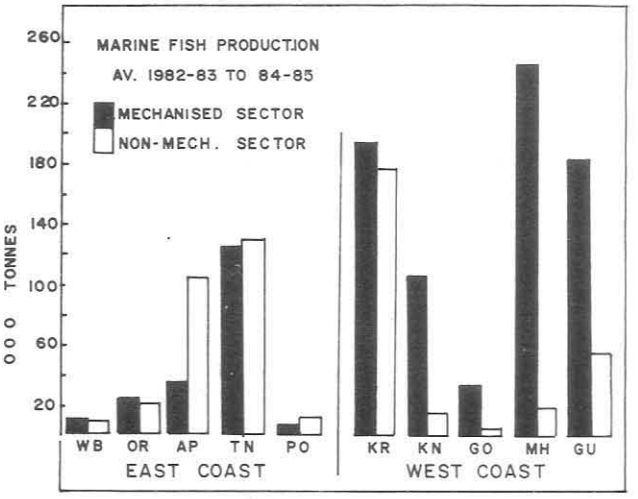

Fig. 4. Contribution by the mechanised and non-mechanised sector in the different maritime states of India.

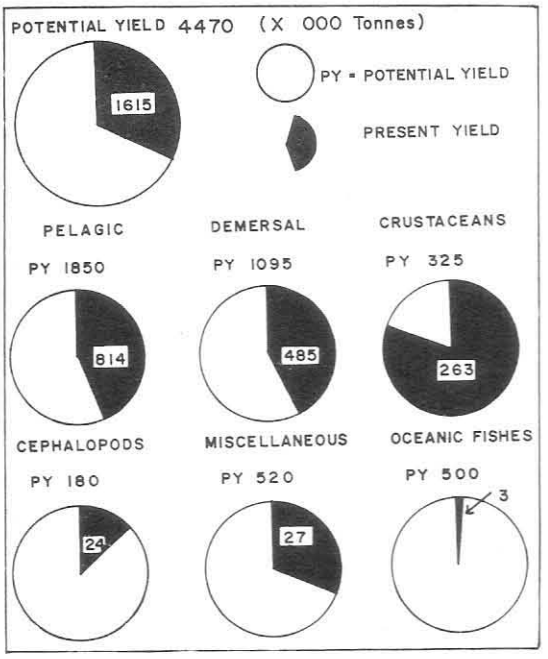

Fig. 5. Potential yield and present yield of major fishery resources.