

Fishery resources in the Indian EEZ: Recommendations for deep-sea fisheries development

V.S. Somvanshi

Fishery Survey of India, Botawala Chambers, Sir P.M.Road, Fort, Bombay-400 001, India

The marine fishery resources potential is estimated to be 3.92×10^6 tonnes. The data collected through the exploratory surveys conducted by the Fishery Survey of India (FSI) have not only been the basis of this estimated potential but the source of knowledge on the types of resources and their distribution in time and space. Considering the current level of annual marine fish production, 2.69×10^6 tonnes, the potential entails additional harvestable yield of about 1.3×10^6 tonnes. This additional yield will be mainly from the deep-sea and oceanic sectors. For further development of fisheries in the Indian EEZ, application of a number of fishing techniques viz. bottom trawling for deep-sea fin-fishes, cephalopods, deep-sea shrimps and deep-sea lobsters; mid-water trawling for columnar species and tuna longlining for oceanic stocks of tuna and allied species should be considered. These techniques used in exploratory surveys were proved to be effective. The effectiveness of these techniques and the availability of the resources were further confirmed by the deep-sea fisheries vessels operated under various deep-sea fishing schemes. However, some of the commercial techniques such as mid-water trawling for columnar resources and purse-seining for oceanic tunas need to be experimented for recommending its commercial scale application in the Indian seas. In the present scenario of fisheries development, there is need for adapting suitable strategies for rational development aimed at sustainable exploitation and conservation of the fish stocks in the Indian EEZ.

The marine fishing industry in India has made significant contribution towards increased fish production over the past several years enabling India to secure seventh position among the leading fish landing nations of the world. Since the declaration of the Indian EEZ in 1976, emphasis was given on exploitation of the resources available in the deep-sea areas by operating sophisticated vessels adopting modern fishing technology. The exploratory surveys conducted by the FSI have enabled us to understand the availability and distribution of a variety of fish resources in the Indian EEZ encompassing a total area of 2.02×10^6 km² and offering immense scope for production from these resources^{1,2}. Since the coastal fishery in India has been subjected to near optimum level of exploitation mostly by the traditional and mechanised fishing vessels, further focus should be placed on exploiting the hitherto unexploited resources by adopting eco-friendly fishing methods aimed at sustainable development of deep-sea fishing industry. In the context of the recent guidelines issued by the world bodies,

coastal states have great challenges wherein it is essential to adopt to resource specific fishing methods, technological upgradation of the existing vessels to venture into deep-sea and acquire training and expertise in the respective fishing techniques.

Gear, methodology and surveys

For the demersal resources sampling standardised demersal trawls were used. The methodology followed is the "Swept area" with 40% of the headrope of the trawl as effective horizontal mouth opening and the catchability coefficient of 0.4-0.5. Considering demersal stocks up to 50 m depth along the coastline are exploited to the near MSY (maximum sustainable yield) level the Cadima's modified formula, $MSY = 0.5 (Y + MB)$ was used to estimate the potential in the region³. The resources beyond this contour up to 500 m depth remaining unexploited were estimated using the formula of Gulland⁴, $MSY = 0.5 MB_v$ where M is natural mortality rate of the stock, B is the biomass, B_v is virgin biomass and Y is the

current yield. In the case of coastal pelagics sampling was attempted following systematic surveys with the principle of tracking the fish shoals using sonar followed by sampling with pelagic trawls or purse-seines. The abundance and composition indices were worked out based on this data. The assessment of potential of pelagic stocks within 50 m depth is made considering the then current production representing 80% of the potential and the areas up to 200 m depth by assuming 50% of the potential per unit from within the 50 m depth.

The oceanic tuna and allied species were explored following systematic survey using tuna long-line gear. The number of specimens caught were expressed as percentage (hooking rate) in the number of hooks operated. Considering 24.8% of the total production of yellowfin tuna is from longline fishery and rest 75.2% by surface fishing methods in the Indian Ocean, the same is made applicable to the Indian EEZ. Based on the estimate of oceanic pelagics as 27,400 tonnes deep swimming tunas, the surface swimming component has been worked out.

The technique-wise effort expended in different regions during 1971-1988 is furnished in Table 1. In all, twenty survey vessels of 17.5 m OAL were deployed for coastal demersal resources survey during 1971-80 and twelve larger survey vessels during 1979-1988 for demersal, pelagic and oceanic resources surveys. The annual current fish production was taken as an average production figure of 1981-1990. The aggregate potential estimate is compared with latest annual yield (1994-95) of 2.69 million tonnes.

Potential of fish-stocks in the Indian EEZ

Several estimates are available on the marine fishery resources potential of the Indian EEZ based on various studies. The most direct among the estimates are those based on exploratory surveys in case of demersal resources and acoustic surveys coupled with test fishing in the case of small pelagics and long lining for larger oceanic pelagics. The potential yield estimate of the demersal, pelagic and oceanic fish resources of the Indian EEZ is 3.92×10^6 tonnes while the current production is only 2.69×10^6 tonnes^{2,5} (Table 2). Region-wise potentials of the different categories of stocks are shown in Table 3.

However, the estimates based on the lower trophic level productivity studies have shown that the potential of marine fishery resources from the EEZ is in the range of 3.66 - 3.79×10^6 tonnes^{6,7}. The planners have since then been using the potential figure that has been worked out based on the results of directed exploratory surveys i.e. 3.92×10^6 tonnes.

Demersal fish stocks

Of the total 3.92×10^6 tonnes of the potential yield, 1.93×10^6 tonnes is constituted by demersal stocks (Table 2). The depth-wise distribution indicates that the areas up to 50m depth support a stock of 1.28×10^6 tonnes while areas beyond this depth zone support a stock of 0.65×10^6 tonnes (Table 3). The important demersal stocks identified for future exploitation are threadfin breams, catfishes, horse mackerel, elasmobranchs, bulls eye, perches, mackerels, ribbon fishes, scads, sciaenids, lizard fishes, carangids, pomfrets, black

Table 1—Survey techniques and sampling effort

Type of survey	Region-wise effort (hours)			
	West coast	Wadge Bank & Gulf of Mannar	A & N islands	East coast
Demersal survey				
(i) 17.5 m vessels	38455	9116	1116	24071
(ii) Larger vessels	12745	5483	-	9862
	51200	14599	1116	33933
Coastal pelagic survey				
(i) Pelagic trawling	177.09			419.00
(ii) Purse seining	36.00*			125.00
Oceanic tuna survey	440000**	39000**	58000**	234000**

* No. of sets

** No. of hooks operated

ruff, Indian drift fish, clupeids, barracuda and silver bellies. Among the potential stocks of the crustaceans, deep-sea shrimps and deep-sea lobsters are important while cephalopods are represented by squids and cuttle fishes in significant quantities (Fig. 1).

Coastal pelagic and oceanic stocks

Potential yield estimate of pelagic stocks is 1.74×10^6 tonnes (0-200 m) along the Indian coast. The major resources identified are mackerels, oil sardine, anchovies, coastal tunas, carangids, seerfishes and ribbon fishes (Fig. 2). The resources in the offshore region beyond 50 m depth are mainly comprised of coastal tunas, ribbon fishes, horse mackerel and sharks. Among the oceanic cephalopod stocks, oceanic squids offer scope for development. The potential yield estimates⁸ of the oceanic resources (Fig. 3) comprising large pelagics of tunas, bill fishes, sharks and others is 246000 tonnes.

Current fish production and sustainable growth of the deep-sea fishing

The coastal fishing belt is already experiencing the pressure of fishing effort leaving little scope for further enhanced production^{2,5}. It is therefore felt that there is an urgent need for implementing appropriate management measures in this sector. The additional yield is to be achieved from the deep-sea and the oceanic sectors, which are virtually unexploited. The operation by chartered/joint venture vessels in the Indian EEZ have confirmed the economic viability and sustainability of the deep-sea and oceanic resources.

The current global approach to fisheries development is oriented to resource specific fishing methods linked with environmental issues for exploitation of the resources, giving due importance to development of new resource specific gears, exclusion devices for non-target

Table 2—Potential of fish stocks in the Indian EEZ

(Source: Sudarsan *et al.*⁸) (values are in $\times 10^6$ tonnes)

Region/Fish stocks	West coast	East coast	Lakshadweep	Andaman & Nicobar	Total
Demersal	1.251	0.656	—	0.022	1.929
	0.004				0.004*
Pelagic	1.106	0.434	0.063	0.139	1.742
Oceanic	←----- 0.246 -----→				0.246**
Total	2.357	1.090	0.063	0.161	3.921

*Demersal resources from 300-500 depth zone in lat. 8-10°N along west coast.

**The estimate pertains to the oceanic stocks within the EEZ encompassing all the regions.

Table 3—Region-wise and depth-wise potential yield of demersal resources

(values in $\times 10^3$ tonnes)

Region	Depth zone (m)		Total
	0-50 m	50-300/500 m	
North west coast	535.7	379.0	914.7
South west coast	223.5	112.3	335.8
		4.0*	
Lower east coast	188.3	39.9	228.2
Upper east coast	309.7	118.2	427.9
Andaman Sea	22.5	—	22.5
Total	1279.7	653.4	1933.1

*300-500 m depth zone in latitude 8°-10°N along west coast.

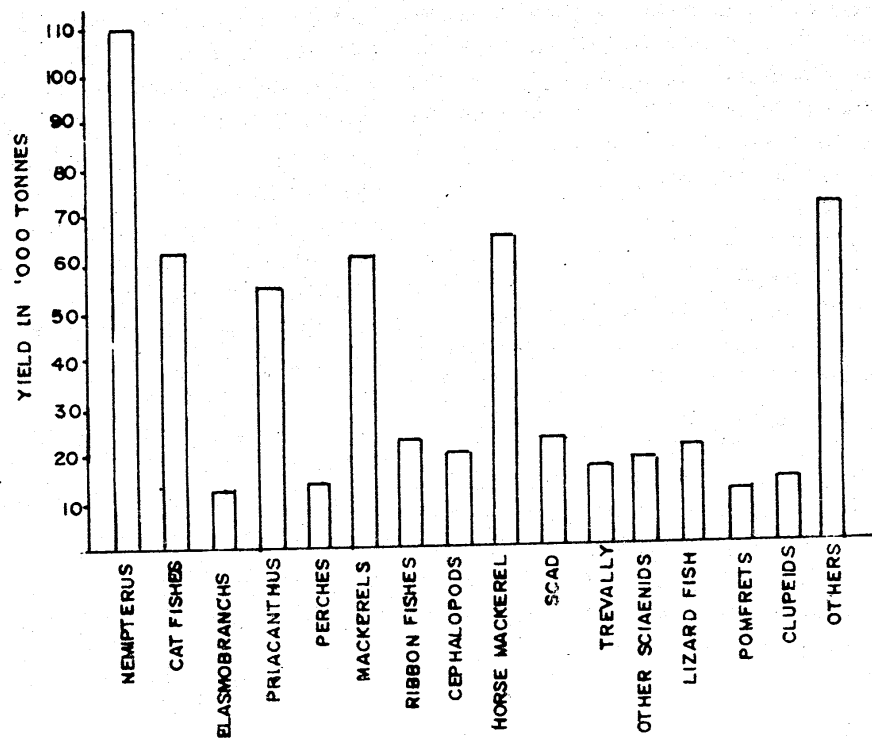


Fig. 1—Potential yield of important demersal resources in 50-300/500 m depth in Indian EEZ

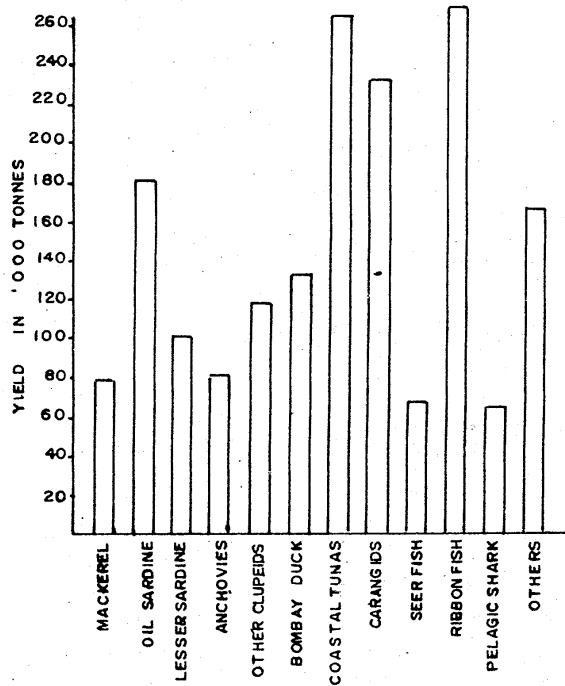


Fig. 2—Potential yield of important pelagic resources in the Indian EEZ

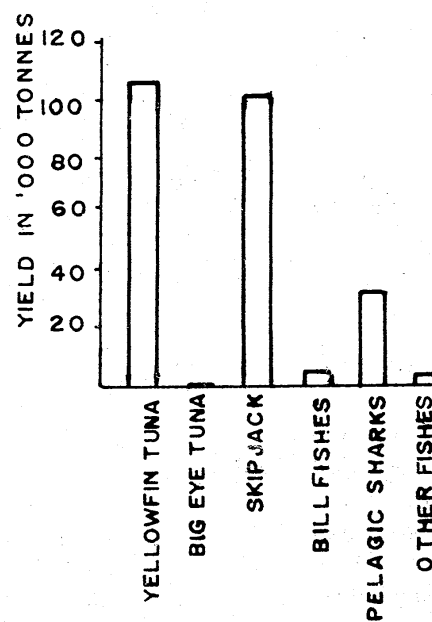


Fig. 3—Potential yield of important oceanic resources in the Indian EEZ

species, study of environmental impact of fishing gear, etc.

The United Nations under the provisions of Law of the Sea has been promoting optimum utilisation of the resources at sustainable level through conservation and management approaches. The UN Convention on Conservation and Management of straddling fish stocks and highly migratory fish stocks are also relevant in this context, with regard to development of resources and due consideration for ecosystem and biodiversity. India is therefore required to gear up to meet the growing challenges posed by the domestic fishery as well as the guidelines specified by the world bodies to meet the ultimate objective of optimum utilisation of fishery resources at a sustainable level and their conservation and management on scientific basis.

Oceanic resources offer new avenues for fishery development all over the world. The coastal nations are already exploiting these highly migratory fish stocks either by building up their own fleets or under licencing arrangements with distant water fishing nations. In Indian Ocean, tuna production has increased manifold since 1983, mainly because of development of purse seine fishery especially for surface-swimming tunas. Whereas in the Indian EEZ, there was no substantial increase in the tuna production due to non-availability of suitable vessels and technology. This is an area where India should take sustainable action for acquiring the skills, expertise and vessels. Mid-water trawling can be profitably introduced for harvesting the small pelagics/coastal pelagics in the Indian waters at a sustainable level. In order to avoid non-target species and to reduce the by-catch problem, resource specific methods are recommended. This can promote a healthy atmosphere to preserve the ecosystems especially in the context of the global approach on environmental issues relevant to marine bio-diversity. Some of the resource specific fishing methods are mid-water trawl fishing for cephalopods, columnar fin-fishes; jigging for squids; trap fishing for selected species, bottom dwelling species and purse seining and long lining for oceanic tuna and allied species.

Another promising resource offering scope for exploitation especially when the conventional resources are reaching the optimum level is the

krill and other fishery resources in the Southern Ocean. The countries currently exploiting this high protein rich crustacean resource are Chile, Japan, Korea, Poland, Ukraine and Russia. In view of the present level of exploitation of the coastal resources in the EEZ and that the prospects for development of deep-sea/oceanic fisheries are also known, India is required to consider utilisation of Antarctic stocks as a major resource base in the 21st Century. It should undertake survey of fishery resources in Antarctic waters with krill as the target resource in order to obtain information on distribution, density, seasonality, harvestable biomass and biology of the stocks. The preliminary survey of Antarctic krill resources recently carried out by India in the Indian Ocean sector of Southern Ocean, has shown encouraging results in this direction⁹. Technical and economical viability of exploitation of the krill is yet to be ascertained. In Indian market this may not become popular, like that in Japan and Korea as the food habits of Indians are entirely different. Probably if succeeded, this may become an important export item.

A perspective plan envisaging introduction of fishing methods like demersal trawling, midwater trawling, squid jigging, hook and line fishing, hand lining, long lining should be drawn up and implemented for exploiting the un-exploited and under-exploited resources in the deep-sea and oceanic regimes. The plan should *inter alia* include judicious mix of modernisation, modifications and redeployment of existing fishing fleet and induction of requisite types of large fishing vessels.

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