

# Exploration and Exploitation of Marine Living Resources A Profile and Projections Upto the Year 2000

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## Synopsis

India, with a long maritime history of the exploitation on living resources, is one of the top ten fish producing countries of the world. As per the need based futuristic studies (the projected fish requirements of India's population) by the year 2000 A.D. are estimated to be 11.4 million tonnes. At present, 55% of the total annual catch of 2.5 million tonnes is from the harvesting of the seas.

What are the prospects and developmental avenues for achieving five-fold increase in the marine fish production within the next 20 years?

The theme paper deals with the present state, prospects, constraints and the action for exploration, exploitation, development and rational management of marine living resources in the Exclusive Economic Zone of India.

The main topics discussed here are :

1. Capture fisheries
2. Estimates of potential and exploitable yield
3. Culture fisheries
4. Fisheries technology
5. Exploratory work—R & D in Marine Biology, Fishery Sciences and Biological Oceanography
6. Action for development and rational management of marine living resources.

India, with an extensive coastline of about 5,600 km and an exclusive economic zone of above 2 million sq. km (almost 2/3 of India's onshore area) contributes about 40% of the total exploited living resources from the Indian Ocean. The present state and future prospects of the exploited living resources is as follows:

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## 1. Capture Fisheries—Present state and development

1.1 - The marine fish production is solely contributed by capture fisheries, and the most intensively harvested areas are the narrow nearshore regions. Major part of the marine catch is from the west coast of India.

1.2 - The post-independence period of 35 years (1947-1981) marked a rapid increase (in exploitation of resources, which increased) from less than 0.4 million tonnes per year in 1947 to 1.4 million tonnes per year in 1979-1980. This increase is attributed to:

- (a) mechanization of fishing boats
- (b) deployment of efficient gears like purse-seining and bottom trawling
- (c) increase in fishing efforts
- (d) ever rising export market for Indian shrimps
- (e) availability of liberal credit, subsidy and loan facility

1.3 - The development of marine fisheries during post-independence period reveals two distinct stages:

Stage 1 - Annual increase of more than 7% from 1951 to 1971.

Stage 2 - Stagnation or negative growth between 1972 and 1980.

1.4 - Some of the most important reasons for stagnation of fish production in the last decade are:

- (a) saturation of fishing efforts in the most productive inshore regions of less than 60 m depth and less than 30 km away from the shore. Result - over-exploitation of fishable stock and depletion in the rate of recruitment.
- (b) wide fluctuations in the abundance of the most prolific pelagic resources of oil sardine and mackerel.
- (c) neglect of unconventional living resources for exploitation.
- (d) lack of entrepreneurship in the case of distant water fishing.

1.5 - A significant proportion of catch increase has been of high value species like shrimps destined largely for export markets and thus, the consumption has grown more slowly than production.

1.6 - The lion's share in the increased exploitation is due to private entrepreneurship and the role of government/quasi-government organisations (fisheries corporations, federations and cooperatives) (possibly with the exception of Maharashtra state) is disappointing.

1.7 - On the basis of per capita consumption of 4.3 kg of fish/year, the projected annual requirement by the year 2000 A.D. is estimated to be 11.8 million out of which 56% or 6.4 million tonnes will have to be from the exploitation of the marine living resources.

## 2. Estimates of potential and exploitable yield

2.1 - As a result of various studies on the dynamics of marine food chain and the rate and magnitude of different biological productivity processes in the different ecosystems of the Indian Ocean, a set of generalization about the potential and harvestable yield is available.

2.2 - Estimates about the potential exploitable stock are based on :

- (a) rate of primary and secondary organic production
- (b) data on catch and effort, length and age composition of the exploited stock
- (c) exploratory fish survey including eggs and larval studies, aerial and echo sounding surveys.

2.3 - The estimates about the fish yield for the Indian Ocean vary from 7.8 to 17 million tonnes. An assessed from the present level of exploitation India's share can be about 5-6 million tonnes. Thus 4-5 times increase in the yield is possible.

2.4 - A review of various estimates of potential yield from the Indian Ocean brings out the fact that there exists wide predictability of more than 100%. Some of the possible explanations for such variations, are :

- (a) absence of comparable data due to non-uniformity in the methods of investigations
- (b) unaccounted seasonal variations in the rate and magnitude of biological productivity
- (c) varying ratios and coefficients used for computing the potential fish yield from the primary organic production
- (d) inadequate information about the magnitude of conversion efficiency from one trophic level to another in the tropical marine food chain
- (e) generalizations based on inadequate data from limited areas and from a particular season
- (f) lack of experimental information about the grazing habits of marine organisms in the tropical ecosystems

2.5 - Thus, the present state of knowledge about the potential and sustainable yield of marine living resources from the 2.02 million sq. km area of India's Exclusive Economic Zone (EEZ) is somewhat better than in 1960s. However, the available information needs to be augmented and updated by collecting relevant data on a long-term comprehensive basis.

**2.6. The following actions are needed to augment living resources :**

- (a) *realistic appraisal -- and not the assumptions of the qualitative and quantitative aspects of various biological productivity processes in the EEZ of India*
- (b) *extensive fish exploratory survey for pelagic, demersal and mesopelagic stocks in EEZ. Oceanic fisheries for Tuna and possibly for Antarctic Krill need to be developed*
- (c) *fishery biological investigations on migration, recruitment, growth, mortality and breeding grounds of major pelagic resources of Oil Sardine and Mackerel within EEZ and beyond, i.e. international waters*
- (d) *Introducing mid-water trawling for harvesting bathypelagic resources*
- (e) *strict mesh size regulation for preventing the depletion of recruitable stock*
- (f) *imposition of statutory regulations for fishing and non-fishing or closed seasons-linked with breeding periodicities, for conserving not only the fishable stock but also for preventing the indiscriminate exploitation of breeders, larval stages and the juveniles.*

**3. Culture fisheries--status and prospects**

3.1 - The whole bulk of the exploited marine living resources is from wild hunting or capture fisheries and the most important productive sector of marine culture fisheries is yet unexplored and truly unexploited.

3.2 - It is generally accepted that culture fisheries cannot replace the capture fisheries, but it is most relevant to note that *substantial increase in the production and exploitation of seafoods is only possible through aquaculture or farming of the sea.*

3.3 - Although seafarming is an industry with its traditions well rooted in the past (*bhaca-bharia* practices in West Bengal; *Pokkali* - paddy-cum-prawn culture in Kerala and *mona* fisheries of Goa). It is only recently that coastal aquaculture and mariculture have been recognised as a new industrial growth area.

3.4 - In a developed country like India, the necessity of developing sea farming on a large scale arises from the following priorities :

- (a) **to produce high quality animal proteins at a reasonable price for supplementing the protein deficient diet.**
- (b) **availability of relatively cheap and abundant unskilled manpower for utilizing extensive coastal, estuarine and backwater areas of more than 2.75 million hectares for generating substantial quantity of quality seafoods.**

- (c) production of choicest variety or quality table fish for export
- (d) less unpredictability of environmental variables, and hence, production can be forecasted well in advance
- (e) creating more employment and vocational opportunities for rural populace
- (f) efficient way of containing water pollution by using treated and untreated effluents (recycling) for accelerating the production of seafoods

3.5 - In the last few years, research on coastal aquaculture has gained impetus, primarily because of the encouraging results so far obtained.

3.6 - The organisms which are now being cultivated are shrimp, milkfish, mullets, pearl spot, eels, green mussels, oysters and seaweeds.

3.7 - The yields of all the organisms under experimental culture are consistently high and many times more than obtained by traditional fish farming practices.

3.8 - Most of the techniques of sea farming, developed so far, are low cost high yield methods having very high techno-economical feasibility.

3.9 - Some of the important constraints in the rapid development of sea farming in India, are :

- (a) lack of proper extension network for the efficient transfer of technology to user community
- (b) need for evolving realistic land-use policy for maximum use of backwaters, mangrove swamps and coastal zone for aquaculture
- (c) non-recognition of aquaculture as an activity under the agricultural fisheries credit sphere
- (d) total absence of technical manpower needed for infield involvement in the aquaculture industry
- (e) lack of hatcheries and nurseries for supplying quality seeds/spots/post larvae/fish larvae for stocking
- (f) necessity for formulating cheap but high caloric feeds for organisms under aquaculture
- (g) need to have R & D in aquatic pathobiology for diagnosis and treatment of various diseases of captivated organisms grown under aquaculture.

3.10 - It is estimated that world aquaculture production which was 6 million tonnes in 1977-78 will rise to 70 million tonnes by the year 2000 A.D.

3.11 - India being one of the leading fish producing countries, can aim at an annual aquaculture production of 4 million tonnes with break-up of 1.5 from freshwater and 2.5 from coastal aquaculture.

#### 4. Fishery Technology--Processing and marketing

4.1 - Exploitation of marine living resources, as an industry, has a special place in the socio-economic sphere of Indian society as it has the following significant features :

- (a) total marine fishermen population is over 1 million with more than 0.3 million actively engaged in fishing
- (b) there are about 1,800 fishing villages and more than 3,000 fish landing centres
- (c) number of fishing boats is more than 1 lakh, out of which 85,000 are country crafts and 15,000 mechanized
- (d) total annual revenue from exploited marine living resources is about Rs. 3,500 million and the investment involved is more than Rs. 15,000 million.

4.2 - At present, the disposal of marine fish catch is 81% fresh, 9% processed, 7% sundried and 3% curing.

4.3 - Less than 9% (about 70,000 tonnes/year) of the total catch is exported and it fetches about Rs. 2,250 million of foreign exchange earnings annually. Important exported products are frozen shrimps, lobster tails, squids, beachde-mer and assorted dried fish.

4.4 - Due to high cost of tin and edible oils, canned fish products are less popular.

4.5 - As a result of extensive R & D efforts in the post-independence era, a number of new improvised fish products have been developed. However, due to wide fluctuations in the availability of raw materials, the fish processing industry, except the shrimp processing, has not adequately developed.

#### Crafts and Gear

4.6 - As per the topographic characteristics, the evolution of country crafts, along the east and the west coast of India has progressed along different lines. Accordingly,

- (a) along the heavy surf beaten and open type of coastline of the east coast, the traditional boats like catamarans, masula, etc. are of disjointed and flexible type.
- (b) More compact and sturdy boats, like dug-out canoes, plank-built canoe and out-rigger boats are commonly used along the west coast, which is less surf-beaten and more sheltered.

4.7 - Mechanized boats which made their entry around 1955 are mostly small-sized (less than 40 ft in length and powered with less than 85 h.p. engine). Accordingly, such mechanized boats are only suitable for operations in the nearshore region within 40-60 m in depth and not beyond 30 km from the shore. Their sustenance is of 1 day or less at sea.

4.8 - Medium (above 45 ft in length) and big (above 80 ft in length) vessels are few (less than 100 or so) in number and have a longer sustenance of 3 to 7 days at sea.

4.9 - Traditional gears like seine nets, wall nets, cast nets and gill nets are more selective and hence chances of depletion of fishable stock are less.

4.10 - The mechanized fishing gear like purse-seining and bottom trawl, as per the basic design are supposed to be selective, however, due to indigenous fabrication and handling methods, they turn out to be non-selective. Thus, giving rise to over-exploitation.

4.11 - Due to operational limitations, both the mechanized and non-mechanized fishing activities are restricted to the most productive inshore fishing grounds. Hence, unless the operational range of the existing fishing fleet is increased, no substantial rise in the exploitation can be expected.

4.12 - Distant water fishing, vessels for deep sea exploration and exploitation are few and have been introduced in the last 5 years or so. Their performance is still to be evaluated.

4.13 - Mechanized fishing, at present is mainly confined to the exploitation of pelagic and demersal populations. Limited attempts have been made for the commercial exploitation of meso-pelagic and bathy-pelagic stocks by using midwater trawling.

4.14 - Oceanic fisheries like tuna, having good potentials are being poached by foreign countries like Taiwan, Thailand, South Korea and Japan, and no efforts are made to develop and exploit these resources.

4.15 - Substantial resources of unconventional organisms like horse mackerel, myctophid fishes, euphasids and stomatopods are available but due to the absence of appropriate technologies for harvesting and processing these resources are not properly used.

4.16 - Inadequate shore facilities are resulting in the wastage of fish and thus affects marketing prospects. To small scale fishermen who form the majority, deterioration of prime quality of fish, results in low returns and give little incentives to fishermen to increase their catches.

4.17 - Requirements for improving the shore facilities, include:

- (a) facilities to handle and dispose of the catch with least or no deterioration
- (b) facilities for the repair and maintenance of small fishing crafts

## **5. Exploratory work**

Development of Indian marine fisheries, in the recent years, is an outcome of the exhaustive R & D work in the field of marine biology, fisheries sciences and biological oceanography.

5.1 - Marine biological investigations inspite of a long tradition, are without any special stress on the quantification of marine living resources.

5.2 - Researches in marine fishery sciences, have added much information to the knowledge of various aspects of fishery biology of most of the exploited species. However, vital information pertaining to the migration and breeding grounds of important resources like Oil Sardine and Mackerels, is still not available. No information is available on the important aspects of ecology of commercial fishing grounds.

5.3 - Exploratory fish resource surveys, conducted for the last 25 years have given some valuable data on the fishing efforts. However, no reliable information is available about the sustainable yield that can be harvested from the potential resources.

5.4 - Biological oceanographic research, encompassing the qualitative and quantitative aspects of the organic production has started in the last two decades, and so far the results have helped to certain extent, in elucidating some of the basic and applied aspects of the tropical marine food chain. However, much needs to be done for arriving at reliable long term estimates of potential living resources.

5.5 - The following data for the EEZ of India need to be collected and/or augmented:

- (a) quantitative and qualitative aspects of marine food chain with particular emphasis on rate, quantum and magnitude of organic production, grazing rate, generation time, growth dynamics, mortality rate and ecological efficiency of conversion at different trophic levels
- (b) role of microbes in the formation and fate of organic matter, nutrient salts and pollutants in the marine environment
- (c) dynamics of phytoplankton, macrophytes, zooplankton, benthos and nekton in the marine ecosystems
- (d) environmental impact on the marine biota—assessment, recycling and monitoring

5.6 - Exploration of the living resources of the South Indian Ocean and Antarctica for the possible exploitation of food wealth.



## **6. Action for development and rational management of marine living resources of India**

6.1 - The most likely trend in supply and demand of marine products of commerce, at the end of the 20th century, indicates the growing shortage of concerned commodities. Appropriate action to meet the challenge can broadly be identified as :

- (a) efforts to increase production, either of those unconventional species or through coastal aquaculture and mariculture
- (b) improved utilization of fish now caught, i.e. reduction of post-harvest losses
- (c) exploration and exploitation of meso-pelagic / bathypelagic resources
- (d) attention to the problems of management to ensure that already exploited resources continue to provide the desired economic and social benefits

6.2 - Efforts to increase production—possibilities and problems of increasing the catch of conventional species can be augmented by increasing the fishing efforts in the non-traditional fishing grounds.

6.3 - Some form of governmental assistance will be required, e.g. incentive schemes, or from international agencies, e.g. grants, loans or technical assistance.

6.4 - From multilateral sources, in terms of cost, at least the most important projects to be financed will be those concerned with infrastructural investments like :

- (a) marine works including new and improved harbour and port facilities
- (b) investment in this field (port and harbour development) which has traditionally been the most important area for regional and international bank financing, could further be boosted by the rising cost of fuel and the desirability of establishing fishery bases near to the fishing grounds
- (c) the pattern of investment in new vessels is complex but additional vessels seem to be required to exploit opportunities in the recently established EEZ
- (d) the main brake on the growth and development of fisheries is usually the management and entrepreneurial abilities. Attempts to force the pace of development where these skills have been lacking have met with limited success.

6.5 - More immediate prospects to increase the production are offered by aquaculture, which while increasing the food supplies can make a significant contribution to rural development through raising the income of small farmers.

6.6 - Apart from developing specific aquaculture schemes, these objectives can be achieved through introducing fish as an additional crop or by introducing the rearing of other animals to fish farmers--in both cases recycling waste.

6.7 - The pre-requisites for achieving an increase in production, from aquaculture, are:

- (a) an organisation (governmental, parastatal or private) to convince farmers the benefits of aquaculture
- (b) to organise the supply of inputs, particularly fish seed/development of seed banks
- (c) to assist in marketing
- (d) extension services for substantial training programmes
- (e) creation of credit facilities and channeling the funds to actual users

6.8 - Planned efforts are needed to explore the extensive seaboard of India not only for food resources but also for exploiting living resources for multiple use in drug, pharmaceutical and chemical industries.

6.9 - Management of resources for maintaining high and sustained yield from the exploited stocks.

6.10 - Effective management will require satisfactory institutional arrangements including appropriate legislature, adequate research capabilities and the necessary means of surveillance and enforcements.

6.11 - Management of resources which are exploited or potentially exploitable in more than one EEZ will need agreement among the sharing countries for determining the total allowable catch and the relative share of the total catch.

6.12 - Foreign poaching should be controlled and prevented.

6.13 - While exploration and exploitation of self generating and renewable marine living resources for the benefit of mankind should be one of the major objectives of the Ocean Development, the most relevant aspects of protection of marine life by conservation and monitoring of the environment deserves high priority. Anthropogenic perturbations deteriorating the marine biota, needs as strict vigil.

**ANNEXURE-II**  
**TRIENNIAL AVERAGE OF WORLD'S FISH FOOD CONSUMPTION & PROJECTED DEMAND**  
**FOR 1985 TO 2000 A.D.**

Fish consumption 1972/74	1985		Projected demand		2000 KG per capita
	Million Tonnes	KG per capital	Million Tonnes	Million Tonnes	
Developed countries	19.2	25.7	23.1	27.9	30.9
Developing countries	14.0	7.6	22.4	39.0	11.0
Centrally planned economies	10.7	13.8	25.3	41.9	39
World	43.9	13.1	70.8	107.8	100

(Source: F.A.O. Commodity projections, 1971)

**ANNEXURE-III**  
**SUPPLY AND DEMAND PROJECTIONS OF FISH FOOD IN INDIA**

(Source: Report of the National Commission on Agriculture, Part VIII: Fisheries, 1976)

Year	Popula- tion in millions	Non-Veg. population (70% of Cat.2)	Supply in million tonnes inland Marine Total	Export (in million tonnes)	Used in fishmeal & other industrial products (m.tonnes)	Balance of fish food for consump- tion (in m.tonnes)	Per capita avail- ability (in KG)	Demand as per nutritional standards 11 KG per capita, per annum (in million tonnes)
1971	647.0	382.80	0.70	0.04	0.15	1.81	4.2	4.21
1985	724.5	507.43	2.22	0.10	0.40	3.78	7.4	5.58
2000	935.4	654.78	4.50	1.00	1.00	6.75	10.3	7.20