LIVING RESOURCES OF INDIAN EEZ

Dissertation submitted in partial
fulfilment of the requirements
for the Degree of

MASTER OF PHILOSOPHY

PREMINDA KUNDRA

CENTRE FOR INTERNATIONAL POLITICS AND ORGANISATION
JAWAHARAL NEHRU UNIVERSITY
NEW DELHI-110067
JULY 1984

ACKNOWLEDGEMENTS

I must gratefully acknowledge the help and guidance given by my supervisor Dr. R.C. Sharma, Centre for International Politics and Organisation, School of International Studies, Jawaharlal Nehru University.

I am indebted to Dr. P.V. Dehadrai, Commissioner Fisheries, Government of India, for making the various papers and reports accessible to me, with his help the job was made easier.

Many thanks go to my friends who have assisted me in many diverse capacities. In writing this dissertation I have benefitted directly or indirectly from numerous people, I wish to thank them all.

Thanks are also due to Mr. V. Thampy for his diligence and competence in typing the manuscript.

Premindra Kundra

(PREMINDA KUNDRA)

CONTENTS

GLOBAL EFFECT OF 200 MILE CLAIMS

SOURCE: FAO, ROME

INTRODUCTION

The 320 km exclusive zone (EEZ) presents a challenge and opens new vistas for resource exploitation. India has special interests in the Indian ocean. For the past one decade national security interests, particularly economic benefits have been predominant in the development of a policy towards the declaration of an Economic Zone. A vast area of 2 million sq. km, equal to nearly 61 percent of the total land area of India is therefore available for resource exploitation. This area includes the territorial sea (about 19.5 km) along with a 300 kms contiguous zone. India has paramount interests in this region.

The oceans are vital to the very existence of life and therefore it is clear that man must devote sizeable energies to its comprehension. The most relevant way to think of the planet as a whole and the oceans in particular is as a living, organic system and it is because of this reason that a study of this oceanic environment is important. If mankind has become capable of making or breaking this delicate organic balance, then the more that can be understood about the structure, flow and balance and details of the physical and biological forces making up the collective planetary 'body' the better. It is a challenge as to whether man can understand fully

and act responsibly, before his short-sighted and selfish exploitation of this environment spoils the system for all.

'Understand', 'predict', 'control' and 'conserve' should be the key words related to any study of the marine environment. The attitude needed is only that of a peasant farmer, an attitude of respect and understanding. Fishermen should become herders not hunters. With this attitude to the oceans we might harvest much of its potential with a new sensitivity - a sensitivity born of enlightened self-interest but heavy with the knowledge of what happens when due to indiscriminate exploitation we upset the ecological balance.

Our ever increasing population, coupled with new directions in our expanding technology, forces increased demand for most exploited resources and a constant search for new ones. In addition to increased demand, the supply of each resource varies considerably from time to time, as old sources are exhausted and new sources are found. The aim therefore should be to increase the knowledge of the marine environment with the goal of enhanced utilization of the ocean and its resources for the benefit of mankind.

Our experience shows that international conflicts, population and environmental and social problems are

all tied together. Nations with an advanced technology have a favourable balance between human populations and natural resources, or the technological means for making the resources available to their people. The trouble spots of the world, in which warfare goes on, or in which the threat of war exists are most commonly the resource deficient areas, or those lacking the technology to make use of available resources. Generally, these are the areas of over-population, in the sense that there are more people than the existing technology and the level of resource availability acceptable to the people can sustain. As world population continues to grow and as natural resources dwindle, the danger of conflict arises and multiplies. Any permanent solution to international problems must include provisions for making a healthy environment. There is little doubt that destruction of the quality of the 'human habitat' aggravates problems that are basically of psychological or sociological nature. No one can afford the luxury of isolationism, concern for human environment has become the concern of every one.

The importance of our having a knowledge of the ecological principles that control the functioning of the environment is simply that, how we treat

our environment today will determine our future. It is within our power to take such steps that guarantee a high quality of living and a wide range of human choice for future.

India is passing through a very critical period of food crisis and consequently the need for exploring various fields of natural resources to augment present production. It is believed that food supplies can be increased through research and extention but the problem is not only to increase the 'quantity' but also 'quality'. Next to the pursuit of peace, the greatest challenge for humanity is the race between food supply and population increase and it appears that this race might be lost unless immediate steps are taken. A large number of children in our country suffer from mal-nutrition resulting from protein deficiency. It is now well documented that children who suffer severe protein shortages through the age of five, often suffer permanent disability. The problem in many parts of our country is in fact, not one of under-nourishment but a problem of 'mal-nutrition' or 'hidden hunger'. Fish has long been recognised as a superior source of animal protein, a fact that has constantly been ignored, however, the situation regarding this natural resource is changing rapidly. Needs and technology

create demand for both already exploited resources as well as the search for new ones. The EEZ therefore has a special significance for a country like ours, which is short of animal protein and nutritional crisis is acute. For the first time the coastal states have had the chance to develop and manage marine fisheries in the national interest rather than compete with others for a share in resources lying off their coasts. The scene is all set for a new era in marine fishing.

The rapid increase in population leads to the emergence of various questions, for example : How can the production trends be improved by judicious management of the EEZ? How soon can We do it? What are the resources, technologies and manpower available today? What measures can be taken for conservation of renewable resources and ensure maximum sustainable yield? etc., questions which call for a comprehensive review of the present approach to the living resources of the EEZ and setting up clear and broad objectives for future. Exploitation of these opportunities pose complex biological, economic, social and political problems.

The ocean sciences are maturing to create a vertiable revolution in the way man interacts with the oceans. For man to use the oceans, he must understand

it. The problems confronting are : What stake to nations have in the sea, individually or collectively? and How will this be revealed in geopolitical dynamics? India's national goals regarding this zone of resource availability is very clear;

(1) to benefit directly from the growth of national economy;

(2) search for additional sources of food supplies to meet the demands of the growing population;

(3) to obtain information required for management and conservation of resources, for prediction, control and improvement of the marine environment and for making related social, political, legal and socio-economic decisions to provide technical basis for reduction of international conflicts in the oceans and make available technology for future ocean research and utilization.

One of the major problems associated with the oceanic environment and its use by man is to devise a fair method of distributing the wealth of the ocean and the other major problem is to use the bounty of the seas without detriment to the marine environment. In order to assess the potentialities and limits to which oceanic exploitation can be stretched, it becomes an essential to learn more about the oceanic environment, biological and physical.

New questions, new problems and new opportunities are emerging particularly with regard to the living resources from the sea. Any nation which wishes to investigate the living resources of the ocean, must consider these separate but related questions:

(1) What and where are the resources?

(2) What is their value?

(3) What is the optimum level of exploitation?

(4) To whom do they belong?

(5) For whom are these resources, and for what purpose?

Answers to these questions involves science, sociology, economics and law. The concept of the marine resources as being 'unlimited and inexhaustible' will have to be disregarded. Cheap and abundant food for the food deficient peoples of our country should be the primary objective of any study. If our chief need is the security for the future, then focus should be on understanding the complex system of interdependencies that exists in the marine environment, as well as a study of the factors responsible for the growth of the marine fisheries whose role in the development of the national economy is becoming more and more significant.

With these basic thoughts in mind the present study is being accomplished, of course, by no means an exhaustive one. It may be taken a preliminary study

of the complex marine ecosystem which promises dependable future for us. Considering the importance of the subject at least in the case of national interests, there seems a dearth of adequate information base, however, if there could be more time, one could go to the various nodal points and collect much more primary information, although the question of reliability and comparability would have complicated the whole effort. Fortunately, much information has been collected with the help of the Commissioner's Office, Department of Fisheries, Government of India (New Delhi), and its regional offices. The study being geographical in perspective, the use of statistical and cartographic techniques became necessary for a better comprehension and analysis of the intricate relationship that exists in the man-environment development syndrome.

The present study is divided into seven distinct chapters, including the introduction and the conclusion. The chapter on Marine Biological and Oceanographic aspects of the Indian Ocean and India's EEZ provides the necessary frame work to understand the environmental aspects of EEZ, which basically help in understanding the spatial pattern of distribution of our living marine

resources. The chapter on Commercially Important Species on the India's EEZ gives the wide available choice at the command of the nation. How rich are our coastal waters, should be understood for a rational utilisation and optimisation of out put and this has been the basic thrust of the chapter. Next chapter tries to Co-relate the environmental personality to the level and types of production which India's EEZ could afford presently and in future. It analyses the relationship that exists in the adjacent marine environment to our nation. The next two chapters deal with the production potentials, and trade and help in understanding the areas of future emphasis, where India's trade prospects could be brightened.

It is hoped that the present study which is being conducted under constraints of time and basic requirements of the M.Phil degree, that is, the course work and dissertation, satisfies the much needed geographic analysis to understand the marine ecosystem, the production pattern to future prospects of India's EEZ.

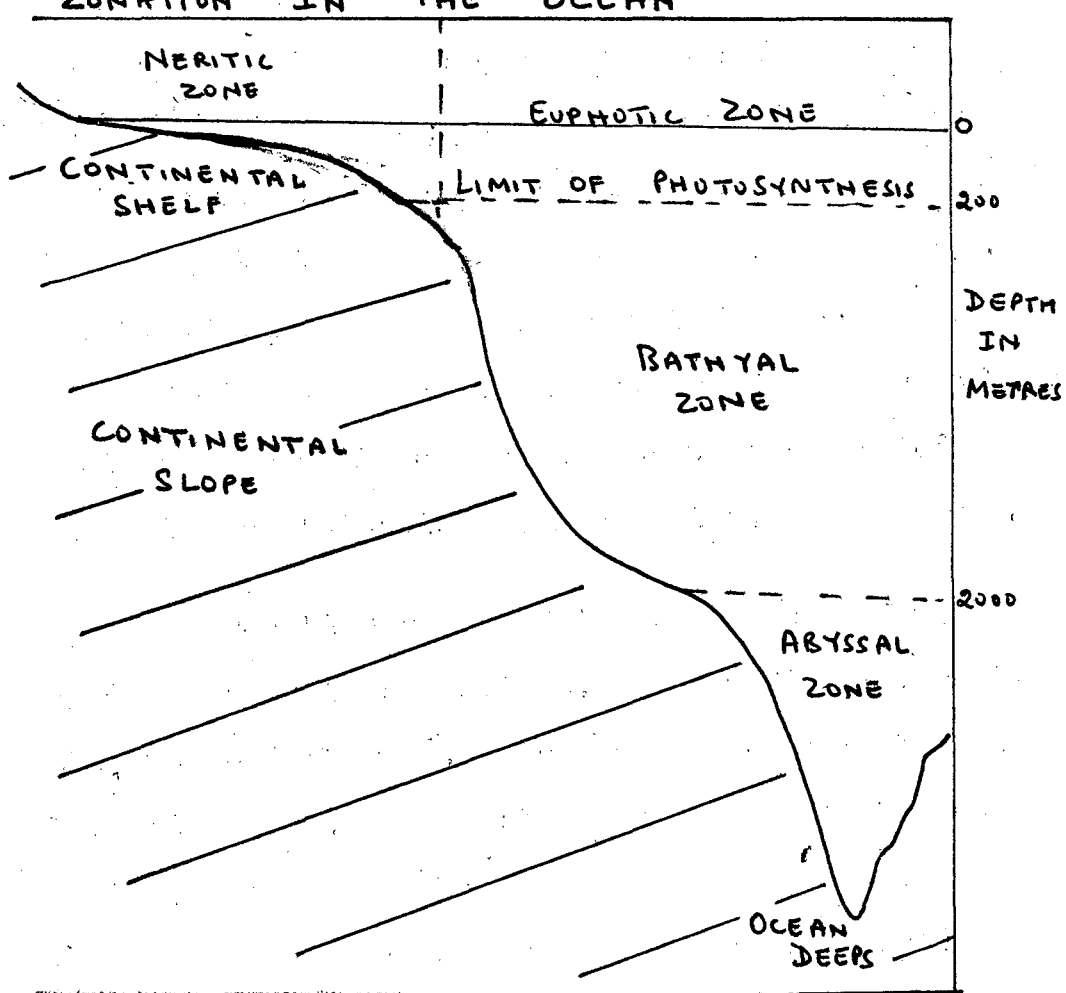
MARINE BIOLOGICAL AND OCEANOGRAPHIC FRAMEWORK

To evaluate and forecast the possible yield of the oceanic biological resources a profound knowledge is required about the physical features of the land bordering the Ocean, the periodic fluctuations in the land and the sea temperatures, the influence of winds and water currents, variations in the salinity media, upwelling and mixing of waters, intensity in the production of the standing crop, levels of oxygen saturation and light penetration etc. These together with a number of other corollary factors have a direct bearing on the scope for fisheries exploitation of any region.

The life zones of the oceans are classified by depth as well as habitat. The shallowest region is the inter-tidal zone, which ranges between the high and low water line. The shallow waters above the continental shelf (to a depth of about 200 metres) and its flora and fauna, is described as the 'neritic zone', to distinguish it from the edge of the continental shelf to the deep trenches. It is also convenient to divide

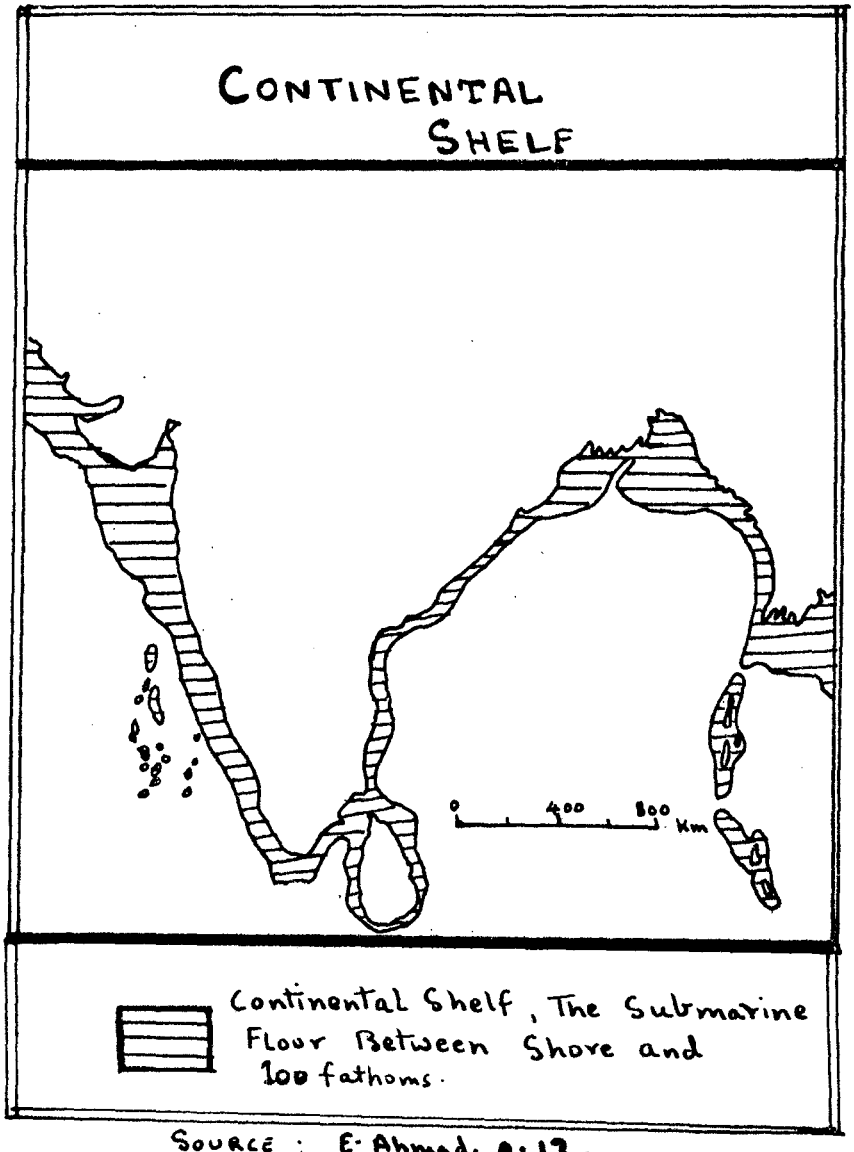
the Ocean into the region illuminated by sunlight as the 'photic zone' and the region which is in continuous darkness as the 'aphotic zone'. The depth of the photic zone depends on the clarity of the sea water and can range from 100 metres to only a few metres in certain coastal areas.[1]

FIG.1 ZONATION IN THE OCEAN



1. Peter K. Weyl, Oceanography: An Introduction to Marine Environment (New York, 1970), p.262-3

FIG. 2



SOURCE : E. Ahmad., p. 13.

Understanding of the carrying capacity of the system is essential for the rational exploitation of the available resources. Carrying capacity is simply the limit to the amount of life that can be supported by a specified habitat, it is always used to denote the 'potential', the 'actual' number of species present in an area at any one time is the 'standing crop'. Thus, in the ecological sense, carrying capacity is the ultimate constraint imposed on the biota of existing environmental limits and such factors as, water circulation, chemical constituents, salinity, temperature, light etc. have a limiting influence on the carrying capacity. It therefore, becomes obvious, that the chemistry and biochemistry of the sea water nutrient cycle is intimately linked to the productivity and fertility of the sea water by a cause and effect relationship and it is impossible to study and understand one without the other.

PHYSIOGRAPHY AND GEOLOGY

The shelf zone of the submarine margin of the continents is usually a gently sloping submerged plain of varying width and length. Proceeding from the shoreline out to the sea the depth increases as a rule, comparatively slowly and gradually down to the outer

edge of the shelf where the grade increases sharply and the gently sloping shelf plateau is replaced by a much steeper usually highly dissected slope. The maximum depth of the shelf zone is some what greater than the thickness of the productive photic zone, whose lower boundary is usually at a depth of 30 to 60 metres, occasionally dropping down to 150 metre. Hence a considerable part of the waters of the shelf are directly influenced by Solar radiation. It is a known fact that the shelf and waters occupying or contiguous to it are the most fertile regions in the oceans ensuring the highest fish productivity. Search for new fishing grounds and for planning future developmental strategies, knowledge about the coastal structure and physiography is essential.

According to Krishnan (1953, 1961), the coasts of India are relatively regular and uniform and the triangular shape of the peninsula, is controlled by the Dharwarian, Eastern Ghat and Aravalli structural trends, established during the Precambrian. Knowledge about the geology of the Indian continental margins is scarce and based on general inference and hence

highly speculative.[2] It is likely that the solid geology of the major part of the continental shelf between Ratnagiri and Kathiawar is Deccan lava.[3] The earliest marine sediments along the coast of south-east India are lower Cretaceous in age (Bhalla 1970). There is a solid biological evidence in favour of the existence of Tethys, but that in support of Drift in the Indian ocean region during the Cainozoic may be considered more tenuous. It is difficult to interpret fossil-faunal distributions due to a lack of sufficient, comparative recent studies and lack of such taxonomic problems as homeomorphy, and such biological problems as changes in the biological continuity of the study organisms. It can be said that the solid geology of the shelf is analogous to that which occurs nearest the shore on the adjoining lands. Consequently the geological formation of the shelf is expected to be Oligocene and lower Miocene Sedimentory off Kutch and Kathiawar Peninsulas. Extensive areas of the continental shelf are expected to be of Pliestocene and recent white foraminiferal

---

2. Ashok Sahni, "The Structure, Sedimentation and Evolution of Indian Continental Margins", in Alan E.M. Narin and Francis G. Stehh, eds., The Oceans, Basins and Margins: The Indian Ocean, Vol. 6 (New York, 1982), p. 354.

3. F. Ahmad, Coastal Geomorphology of India (New Delhi, 1972), p. 19.

lime stone. From Ratnagiri to Cape Comorin the marine floor on the continental shelf appears to be composed of the upper Miocene Pliocene Coralline and forminiferal lime stone. It is likely that in some places the shelf off the Malabar coast might be composed of the Archaean Crystallines which predominate in the adjoining areas. In the Gulf of Mannar and Palk strait regions, in some places of the Shelf it appears that widely extensive series ranging in age from Eocene to Pliocene consisting of loose-textured often ferruginous and gritty fossiliferous sand-stones and limestones overlie the crystalline bottom.[4] Opposite the deltas, and on the inner side of the shelf, recent coastal alluvium is the predominant geological formation. Limestones are a predominant feature in the geology of the shelves in the Andaman and Nicobar islands regions, as well as the shelves of the Laccadive and Minicoy group of islands, where in the warm tropical waters corals have had uninterrupted life during the Tertiary and Quaternary. Geological information available at at present indicates that the eastern and the western coasts of India have been formed at different times

---

4. D.N. Wadia, Geology of India (New Delhi, 1971) pp. 35-37

and have different histories.[5]

Regarding the physiography of the Indian continental margins we find that the western coastline is straight with a wide continental shelf about 150 kms near Karanchi, which widens to about 350 km off the Gulf of Cambay but narrows to only 60 km near the south-western coast. The topography of the shelf off the east coast is fairly "monotonous" all along, except for the occurrence of a number of submarine canyons; Andhra, Mahadevan and Krishna canyons (discovered in 1963), further south three other canyons, Cuddalore, Pondicherry and Palar (identified in 1968).[6] There are diverse opinions regarding the structure and origin of these canyons that apparently extend to the north-eastern coast of Sri Lanka.

A detailed submarine contour map shows that it is at about 100 fathoms that the most prominent break of slope occurs in the submarine floor around India. The 100 fm. limit gives India a continental shelf which is approximately equal in area to the Gangetic Plain.[7]

---

5. D.N. Wadia, n.4 , p.

6. Ashok Sahni, n.2, pp. 354 - 55.

7. E. Ahmad, n.3, p. 19.

The length of the total coastline of India is 7150 km. The west coast of India has a sea front of 3040 km in length running from Cape Comorin in the south to the Rann of Kutch in the north and the fishing grounds on the continental shelf of west coast upto 200 metre depth may be roughly estimated to be about 2,79,865 sq. kms. The east coast, has a total coastline of about 4110 km, while its continental shelf area upto 200 metre depth is 1,35,003 sq. km. (See TABLE 1a)

The continental shelf of India is a very narrow strip, running almost parallel to the coastline. (FIG. 2) Along the east coast it runs very close to the shore and seldom exceeds 40 km. in width except at the apex of the Bay of Bengal, on the west coast between Cape Comorin and Karanchi and Ratnagiri, with a maximum width of nearly 32 km in the region north of Bombay. There are patches of shallow areas within the 100 fathom line surrounding the small islands and atolls off the Malabar coast (Laccadive and Minicoy Is.).

The prominent banks occuring in the vicinity of the continental shelf off the Indian coasts are significant from the fisheries point of view. Off Palk strait is a shallow water plateaux called the Pedro Bank,

TABLE - Ia.

STATEWISE PARTICULARS OF COASTLINE, SHELF AREA

State/Union Territory	Length of the coast-line (Kms)	CONTINENTAL SHELF AREA	
		Upto 50 metre depth	Upto 200 metre depth
West Bengal and Orissa	680	27001	46421
Andhra Pradesh	970	16607	31044
Andamans	1900	-	16056
Tamil Nadu	960	23255	41412
Pondichery	-	N.A.	N.A.
Sub-total East Coast	4110	6683	135003
Lakshadweep	-	-	4356
Kerala	560	12569	35941
Karnataka	270	7936	23473
Goa	110	2849	9984
Maharashtra	600	25512	104758
Gujarat	1900	64810	99373
Sub-total West Coast	3040	113676	279865
Total	7150	180539	414868

Source: CMFRI 1976, Cochin - 18.

(C. 250 sq. km in area) extending upto north-east coast of Ceylon and Nagapattinam on the Indian coast. Wadge Bank (C. 10,000 sq. km in area is located off Cape Comorin. The Angria Bank having an average depth of 27 metre and forming an important fishing ground is situated beyond the limit of the continental shelf off Ratnagiri. Along the west coast, particularly near the Kerala coast off Cochin and Alleppey, occur the 'mud-banks'. The coastal stretch between Quilon and Cochin shows mud banks sometimes at definite locations, these generally appear during the south-west monsoon and continue from July through September.

The characteristics of the continental shelf around India, regarding slope and extent can be summarised as follows:

(1) The most notable break of slope in the shelf occurs at approximately 100 fm contour and this is the outer limit of the continental shelf.

(2) The average width of the shelf on the eastern coast is about 50 km and this is approximately one-third of the average width on the west. The minimum width of the shelf is opposite the delta mouths, by contrast the shelf is the widest opposite the region of large estuaries.

(3) Generally the shelf has a gentler slope nearer the shore and the gradient increases further seawards. The most frequent slope of the shelf near the shore is 5' to 7' all around the Indian coasts.

(4) The most common slope of the shelf as a whole is 21' on the eastern coast and on the west coast it varies from 10' near Cape Comorin to about 1' in the Cambay region.

(5) Most of the eastern continental shelf has an even surface with a gentle gradient, however on the west coast the shelf has a much more gentler gradient, largely unrelated to the high relief and topography of the coastal interior.[8]

The deposits on the continental shelf around the mainland are mostly supplied from the subaerial erosion of inland areas and from coastal erosion. Such deposits include gravels, sands, silts and muds. In the shelf around the Andaman and Nicobar islands and around the Laccadive and Minicoy group of islands, the deposits are marine in origin consisting of sand and mud. The western shelf is generally covered by sand but mud occurs in patches along the coast.

---

8. E. Ahmad, n.3, p. 13 - 15.

The total area of the Indian continental shelf is approximately 0.4 million sq. km. From the fishery point of view it is important to note that for most parts of the Indian ocean, the shelf is narrow and steep, with area upto 200 metre depth constituting only about 4 percent of the ocean's floor. This narrow nature of the shelf has resulted in the very low yield from demersal fisheries. The nature of the benthic communities and their secondary productivity varies with the depth of the continental shelf. Fishing of marine organisms has long been confined to the relatively narrow coastal zone, such intensive development of fisheries of the continental shelf is due to the long standing farming techniques, the relative simplicity of fishing here and the fact that the shelf and water occupying or contiguous to it are the most fertile regions in the oceans.

CURRENTS AND WATER MOVEMENTS

Currents and water movements are of supreme importance because they are fundamental in all aspects of marine investigations directed towards a better understanding of the marine living resources. Their effect is both direct as well as indirect; they directly control the distribution of temperature and other

physical and chemical properties of the sea, the distribution of the ultimate food organisms of the fishes and other forms, the dispersal of fish eggs and of the young fish prior to their acquiring motive power of their own and in the reproductive stage and must be a controlling factor in the migrations of fishes towards those places where the physical conditions exist in which alone spawning will take place.

The Indian ocean region is influenced by two systems of winds, the south-west and the north-east monsoons. The wind force on the west coast during the south-west monsoon is strong and may reach upto Beaufort 10, while during the north-east monsoon it seldom exceeds Beaufort 5.5. Similarly the wind force is higher during the south-west monsoon than during north-east monsoon on the east coast. These wind patterns influence the circulation of the waters in the Bay of Bengal and the Arabian Sea; near the coast the circulation is governed by coastal configuration. A south to south-easterly surface current occurs from February to September and a north-westerly current from November to January occurs on the west coast of India. On the east coast

between February to July the surface drift has a north-easterly direction with an occasional easterly component; this changes to south-westerly in the northern part of the coast and to southerly in the southern part about September to December. In January a weak westerly drift is also observed (Panicker and Jayaraman 1966).[9] The southerly drift from the Bay of Bengal joins the North Equatorial Current, which has a westward flow. A deviation of this flow taking a northerly direction on the western side of the sub-continent may be of much importance from the fishery point of view. Abundance of both mackerel and oil sardine fisheries is found during winter in the northern regions when this northward movement of the water along the coast is prevalent. It is possible that the fish moves along with the northward current as it produces convergence zones where the planktons accumulate.

It is important to note that during south-west monsoon, the surface currents in the Arabian sea and the Bay of Bengal move in a clockwise direction, while

---

9. K. Virabhadra Rao, "Distribution Pattern of the major exploited marine fishery resources of India", Proceedings of the Symposium on Living Resources of the Seas Around India, CMFRI (Cochin - 1973), p. 89.

during the north-east monsoon period, a reversal in the circulation pattern is observed in both these two regions.[10] The Equatorial undercurrent in the Indian ocean is well developed in the latter part of the north-east monsoon and is present till the end of May.[11] The movement of the cold Antartic bottom water into the Arabian sea and Bay of Bengal has a bearing on the organic productivity in the region. In the Arabian sea, its effect is felt by the presence of rich nutrients, low salinity and low temperature.[12]

Upwelling resulting in vertical mixing and the horizontal transfer of water in currents are of biological interest. It brings cool nutrient rich water into the euphotic zone from depths of about 200 metres or less, resulting in increased biological production. During the pre-monsoon and early south-west monsoon season strong upwelling is found along the western coast (the region of maximum intensity being from Calicut to Karwar), caused mainly by the overall divergence caused in the Arabian sea during

---

10. R. Subrahmanyam, "Hydrography and plankton as indicators of marine resources", n.9, p.210.

11. Ibid., p. 211.

12. Ibid., p. 211.

monsoon, the prevalent southward coastal drift and to a certain extent the prevailing wind systems.[13] Due to the consumption on the shelf the oxygen content of the upwelled water is further reduced and consequently the demersal fishes disappear from a rather wide belt running parallel to the coast. In connection Banse (1959) concluded that bottom trawling during this period is profitable either in very deep waters or occasionally in shallow waters.[14]

Upwelling has been noticed off the north-west coast off Bombay during October-November, as a result of which the demersal fishes from deeper waters are driven near to the shore due to shoreward uplift of the oxygen minimum layer (Carruthers et al; 1959).[15] La Fond (1958), observed that the north-easterly current flowing along the east coast during the period from January to July, causes upwelling along the coast leading to the enrichment of the waters. The development of an oxygen deficit layer, causing mass mortality of fish in the Arabian sea during winter monsoon is also attributed to strong upwelling.

---

13. R. Subrahmanyan, n. 9, pp. 211 - 212.

14. K. Virabhadra Rao, n. 9, p. 89.

15. Ibid., p. 91.

Upwelling thus brings about ideal conditions for the growth of phytoplankters, the primary synthesisers. The production cycle in many areas of the Arabian sea and Bay of Bengal closely follow a sequence of monsoon circulation and increased nutrients brought to the surface. For example it is observed that zooplankton dominates in the food of the oil sardine and hence the abundance of sardine during December on the west coast may be related to the convergence phenomenon.

OXYGEN

The oxygen regime is a major factor in controlling the volume and nature of bio-productivity of sea water. It has been observed that the waters of the Arabian sea are somewhat deficient in oxygen reaching the minimum by about 200 - 500 metres.[16] The actual oxygen minimum layer is subject to movement and it comes fairly close to the surface towards the west coast, during the south-west monsoon regime (Pannikkar and Jayaraman, 1966). The movements of the oxygen minimum layer may have the beneficial effects of concentrating populations of fish towards the coast in certain seasons, however, it is equally

---

16. N.K. Pannikar, "Fishery Resources of the Indian Ocean", Proceedings of the Symposium on Indian Ocean, National Institute of Science of India (New Delhi, 1969) Part II, p. 815.

possible that in the open ocean the high productivity of the surface areas does not reach their culmination into the profitable fisheries owing to the disastrous effects of low oxygen water. These could be the main cause of large-scale fluctuations in certain fisheries, as that of the oil sardine of the west coast and also of large-scale mortality.[17]

In some years, during the winter monsoon, freshened surface waters of the Bay of Bengal and the Andaman sea are carried by the north-east current to the Arabian sea where they form a stable layer almost completely preventing vertical convection and facilitating the rapid development of an oxygen deficit in underlying layers, resulting in the death of large masses of fish due to suffocation. The magnitude of the unexploited fish resources is indicated by the periodic mass mortalities that have occurred in this region.

LIGHT, TEMPERATURE, SALINITY

Temperature is a dominant factor in the marine environment, as it directly affects the physiological processes of the animals especially upon their rate of

---

17. N.K. Pannikar, n. 16, pp. 813-16.

metabolism and the reproduction cycle and indirectly it controls other environmental factors, such as gases in solution, viscosity of the water and density distribution with all its hydrographic implications. Temperature is undoubtedly the governing factor in spawning. Experimental and natural evidences clearly point out that the temperature limits within which spawning takes place are narrow, relatively precise and specific for each species.[18] Comparatively few organisms operate successfully at low temperatures or if the temperature varies greatly, the majority function best at relatively high and stable temperatures. The greatest biological diversity is therefore found near the surface, on the continental shelves, in the tropical waters.[19]

In coastal waters, where the euphotic zone is in direct contact with the bottom a striking correlation exists between temperature and production. Within the narrow temperature range found in the sea there are temperature barriers segregating faunas into rather well-defined geographical regions of

---

18. H.V. Sverdrup, M.W. Johnson and R.H. Fleming, The Oceans (New York, 1942), p. 643.

19. Ibid., p. 645.

submarine climatic conditions that are controlled not only by latitude but also by depth of water and general circulation. Animals are commonly divided into two large groups with reference to their tolerance to temperature range namely stenothermic and eurythermic, however there are many intergradations. Where temperature gradients are not well-defined, the faunal zones do not have strong boundaries either but merge one into the other with wide transition zones. Temperature conditions exert a marked and often decisive influence on all fishes throughout their lives.

The fluctuations in the surface temperature are very wide in the Arabian sea whereas the usual range along the Indian coast is from 23°C to 29°C. Jayaraman and Gogate (1957) noticed that a comparatively lower temperature reaching a value of 21°C occure during November-December period on the north-western coast of India.[20] In the Bay of Bengal the usual range of surface temperature is between 27°C and 29°C, in this part the fluctuation is much less than the Arabian sea. Regarding the vertical distribution of temperature, it is observed that in

---

20. K. Virabhadra Rao, n. 9, p. 89.

the Bay of Bengal off the coast the thermocline level is usually below 50 - 55 metres and at times going down to 100 - 125 metres, the shelf waters in general in the Bay of Bengal are isothermal or nearly isothermal. Off the south-west coast of India the thermocline fluctuates a great deal showing a definite seasonal trend; in winter the thermocline is found at 100 - 125 negres, while during the stable period between the monsoons the thermocline level is between 75 and 90 metres. With the progress of the south-west monsoon there is an upward movement of the thermocline level reaching 20 - 30 metres or to even still lower levels. This however is a regular feature and during this period the shelf receives cold, dense, poorly oxygenated water, which is rich in nutrients.

The isothermal layer and temperature gradient appear to play a major role in the distribution of the prawn fishery. It has been observed that the fluctuations in prawn fishery are in phase with the vertical movements of depth of the thermocline. As the depth of the thermocline varies with the vertical circulations of the waters, important for nutrient distribution and the fishes also congregate at the places of lesser

depths of thermocline.[21] During the peak south-west monsoon period (July and August), drastic decrease in temperature which amounts to nearly 6°C and 7°C, compared to other seasons combined with the oxygen poor upwelled waters could be the probable cause of decline in both demersal and pelagic fisheries. One of the main factors for high production in shallow areas is the regeneration rate of nutrient salts due to high temperature accelerating all bacterial processes at the bottom.

The average values of salinity range between 34% and 37% in the Arabian sea and 30% and 34% in the Bay of Bengal. The higher salinity of the waters of the Arabian sea is mainly due to the high saline water flowing from the Red Sea and the Persian Gulf, besides there are not many major river systems on the west coast flowing out into the sea. The Arabian sea is known to be an area of negative water balance; (evaporation exceeds precipitation and runoff) the Bay of Bengal on the other hand, has a positive water balance.

---

21. G.S. Sharma and A.V.S. Murthy, "Prawn fishery off the West Coast of India in Relation to Hydrographical Conditions of the Shelf Water", n.9, p. 422.

The direct effect of light on the chemical reactions in the sea is concerned largely with metabolism of the organisms, as in photosynthesis and pigmentation. It shows very frequent and marked fluctuations in the upper layers of the sea. Light or absence of light has been one of the most potent factors in the moulding of structural development and in the adaptations of most marine animals.[22] Light is also a significant factor in the behaviour of animals both pelagic and littoral and has a marked influence on the coloration of marine animals in different depths of the sea. There also exists a strong correlation of animal movements with light (diurnal migration). In the mouths of large rivers along the coast where the water is turbid due to silt, bringing about poor light conditions for the plankton algae, the productivity is low. On the other hand, in the shallow areas of the shelf, where the light conditions are favourable photoautotropic plants and microbenthos also significantly contribute to the primary production, which may be higher than that due to phytoplankton.[23]

---

22. Sverdrup, Johnson and Fleming, n. 18, pp. 824-30.
23. Ibid., pp. 830 - 35.

The intensity of the solar radiation and transparency of the water are factors influencing the depth of the euphotic zone (that portion of water which has sufficient light to allow photosynthesis). Studies reveal that the average radiation falling at Cochin is 250 - 550 g. cal/cm^2/day, the maximum radiation being in January - February and the minimum in June - July. (Qasim 1968).[24] The variation between the maximum and minimum amount is not very significant in the oceanic waters around India and this has a significant bearing on the primary production, for the relative photosynthesis as a function of mean radiation has no single seasonal variability. Studies on the light penetration and depth of the euphotic zone on the west coast reveal that the depth of the euphotic zone varies from 50 to 60 metres on bright days in the region outside the shelf, which shrinks to 14 - 15 metres on cloudy days and towards the coast.

---

24. Ramchandra Nair, P.V.S. Samuel, K.J. Joseph and V.K. Balachandran, "Primary Production and Potential Fishery Resources in the Seas Around India, n. , pp. 185 - 89.

NUTRIENTS: PHYTOPLANKTON: ZOOPLANKTON:

The bloom of phytoplankters is closely connected with the upwelling phenomenon. On the west coast the maximum production of phytoplankton takes place during south-west monsoon and is noticed off the Trivandrum coast from January onwards, reaching a peak in May; further north at Cochin and northwards the peak is attained in July-August, indicating the commencement of upwelling. From September onwards the phytoplankton bloom wanes which indicates the cessation of upwelling from thereon.[25] The magnitude of the south-west monsoon bloom on the west coast waters surpasses those from some of the most fertile waters of the world. Similar peaks of phytoplankton blooms are noticed on the east coast also, corresponding to the south-west and north-east monsoon seasons, although of much lesser magnitude. On the south-east coast peaks of development occur in March, May and October or February, August and November, depending on the setting in and the intensity of the monsoons.[26] For example, at Madras the bloom may be at any time between April and June, sometimes August-September,

---

25. R. Subrahmanyan, n.10, p. 202.

26. Ibid., p. 205.

a second pulse of development occurs in November or December during north-east monsoon, at Waltair the standing crop is richest from April to August. The ratio of phytoplankton production to the fish landed on the west coast of India works out at 0.029 percent which indicates that the fish landings here could be increased to at least two times or more by increasing fishing effort (Subramanyam, 1967).

Comparison between the two inshore areas on either coast show that the standing crop on the east coast does not attain even a fourth of the magnitude of that on the west coast. The magnitude of the standing crop is much higher over the shelf near-shore areas than in offshore and oceanic regions. It is significant to note that richer areas alternate with poor areas.

Regarding the zooplankton crop, in general it has been observed that the standing crop in the continental shelf area on the west coast is about 2.5 to 2.1 times greater than in the adjacent oceanic areas. The crop is particularly high between Cochin and Quilon, Karwar and Cannore and in the proximity of the Wadge Bank. Most of the areas of the Arabian sea and Bay of Bengal indicate crop of 100 to

300 mg/m^3.[27] The zooplankton crop does not show such sharp seasonal fluctuations as the phytoplankton, however most of the organisms are small during the south-west monsoon period while they are bigger during north-east monsoon. Besides they are obviously kept down due to the grazing on them by the pelagic fishes, for example the oil sardine and the mackerel (plankton feeders) whose fisheries commence in the period succeeding the south-west monsoon months. Vinogradov and Voronina (1962) showed that tuna grounds are located in areas where larger zooplankters and micronekton abound.[28]

The replenishment of nutrient salts in the productive layers is important in controlling the magnitude of the annual organic production, of which phosporous and nitrogen are the two important elements. Off the south-west coast the direct correlation between high concentration of phosphates and a rich crop of phytoplankton is observed during the monsoon months. It is significant that although upwelling is reported as seasonal phenomenon on the east coast region also, in general the nutrients in high concentrations are absent.[29]

---

27. R. Subramanyam, n. 10, p. 206.

28. Ibid., p. 217.

29. N.K. Panikkar, n. 16, p. 815.

TABLE : IV.

Private Prod. values for the different zones in $gC/m^2/day$

States	upto 50m Average	50 to 200 m Average	7200m Average
Madras (W. Coast)	1.33	0.37	0.18
Kerala	1.22	0.25	0.17
Karnataka	1.08	0.19	0.28
Maharashtra	—	0.12	-
	1.19	0.43	0.18

Productivity

	Arabian Sea	Bay of Bengal
Phosphate mg/m^2	75-153	40-48
Primary Prod. $MgC/M^3/day$	50.120	10-30 (Average for I. Ocean)
Chlorophyll Mg/sq.metre	100-320	N.A.
Phytoplankton	High Concentration	Low concentration
Zoo Plankton	" "	" "
Benthos	Rich	4 to 6 times lower than Arabian Sea.

Productivity Studies

Region	Cg m^2/day 0-50 metres	50-200 metrs	Potential Catch (thousand four
Maha-Gujarat	1.21	0.12	1062
Mysore-Goa	1.08	0.19	140
Madras (W. Coast)	1.33	0.37	32
Kerala	1.22	0.25	183
E. Coast)	1.21	0.48	871
		Total	2288

In the region between Alleppey and Cochin, there is a vertical acceleration resulting in the lifting up of the silt laden botton waters, kept in a state of suspension extending over wide regions know as 'Mud banks'. Such 'mud banks' are the store-houses of rich nutrients like the phosphates promoting rich plankton production. The abundance of planktonic organisms attract a large number of fish and crustacean groups. The waters in the regions of the 'mud banks' are calm and therefore afford shelter to the organisms during the monsoons when the adjacent areas are subjected to severe turbulent conditions. This phenomenon peculiar to the south-west coast occurring with cyclic regularity during the south-west monsoon period is associated with fisheries of some magnitude, especially those related to prawns, sardines, mackerel, soles etc.

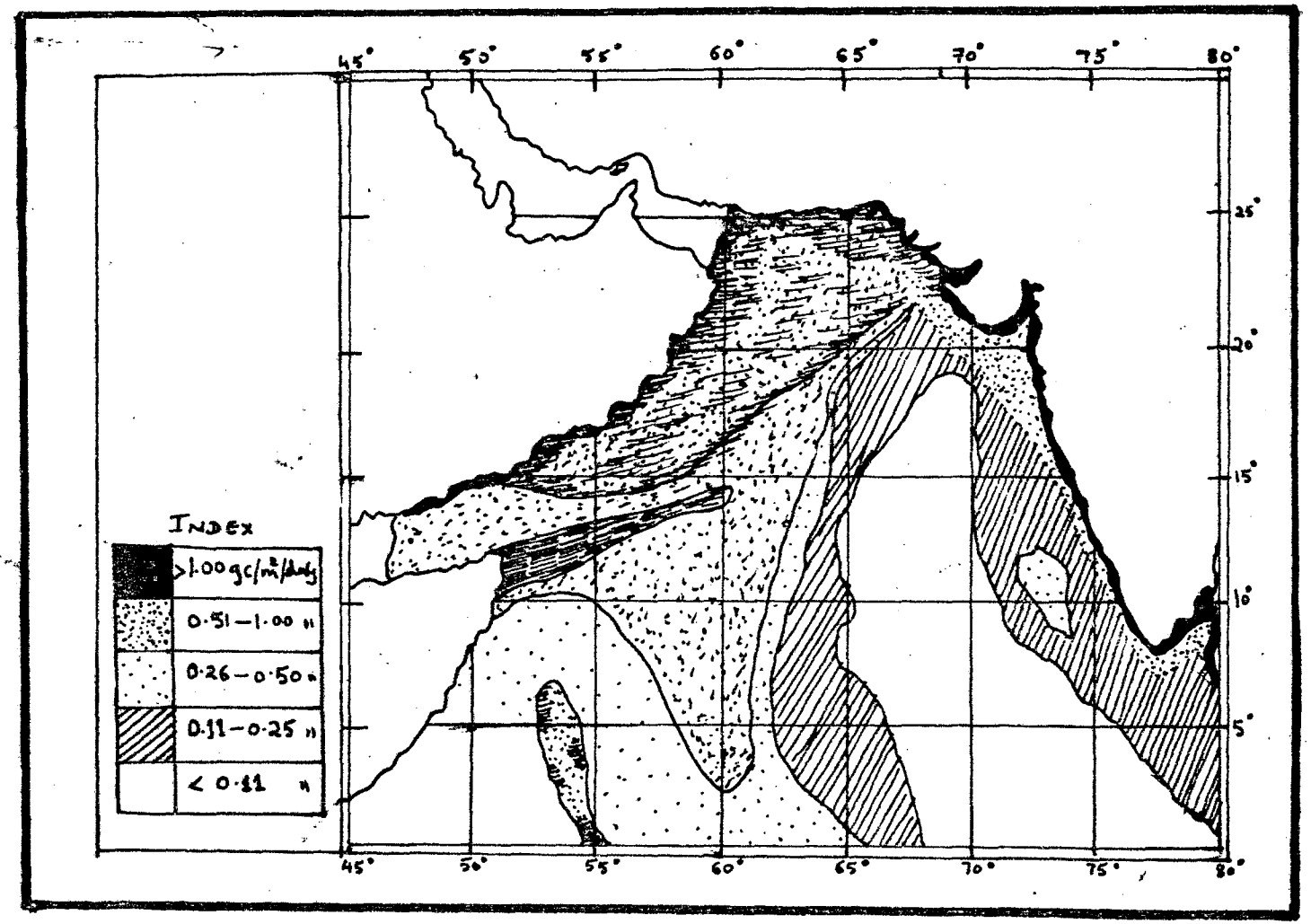
PRODUCTIVITY:

Due to nutrient enhancement of the coastal seas, the productivities over the continental shelves are on an average more than three times higher than in the open ocean and even higher in areas of upwelling on an average it may be about 625 mg Cm^{-2} day^{-1}.

All along the west coast of India the rate of production is high, over 1.0 g C/m^2 day especially at the time of upwelling i.e. during the south-west

FIG. POTENTIAL RESOURCES

FIG. 3.



SOURCE: P.V. Ramachandran, et al. p. 193.

monsoon. The fact that over 2/3 of the total annual production of sea fish in the country is obtained from the west coast, obviously indicates a higher productivity of the Arabian sea waters as compared to the Bay of Bengal. On the East coast the rate of production is of a lower order excepting in the shallow regions of the Gulf of Mannar and Palk Bay, where the average rate is over 2.0 g C/m^2 day (Prasad and Nair 1963). In the Bay of Bengal the rate of production on the shelf is 0.63 g C/m^2/day and outside the shelf 0.19 g C/m^2/day. Observations made by Indian Ocean Expedition:[30]

(a) Productivity of the Arabian Sea: It is found that the level of organic production is high towards the coast and becomes less towards the edge of the continental shelf and least outside the shelf. Values over 2.0 g C/m^2/day are obtained within 50 metres depth. Over the Wadge Bank at a station 38 metres deep the production rate during the upwelling season was 2.09 g C/m^2/day; just below the surface the rate per unit volume was 12 mg C/m^3/hour suggesting a constant replenishment of nutrients.[31] The highest

---

30. S. Jones and S.K. Banerjee, "A review of the Living Resources of the Central Indian Ocean", n.9, p.5.

31. Ramachandran, Samuel, Joshep and Balachandran, n. 10, p. 189.

value recorded for the west coast was from the Wadge Bank area for a station 90 metres depth, the production being 4.55 g C/m^2/day in September. The annual gross production of the region is 434 g C/m^2/year; assuming that 40% of this is being utilised for respiration the net production would amount to 200 g C/m^2/year.[32] Based on this, the gross organic production on the shelf within 50 metres depth for an area of 114520 sq. km where there is active fishing, would amount to 50,000,000 tonnes of carbon and the net production available to the environment would be 30,000,000 tonnes of carbon, so the maximum yield from the west coast would be 1,200,000 tonnes of fish (0.4% of organic production in terms of carbon), but we find that the present production is only a little over half of a potentially exploitable yield, even if our efforts are confined to the area within the 50 metres line. Extending the fishing limit to the edge of the continental shelf, nearly 169,000 sq. kms. of additional area would be available where the organic production is of the order of 0.43 g C/m^2/day, which is moderately high. The annual gross production of carbon would amount to 157 g C/m^2/year and the net production

---

32. Ramanthandran, Samuel, Joshep and Balachandran, n.10, pp. 189-90.

94 g C/m^2/year. If we take 0.3% as the percentage yield in terms of carbon, as the waters here are deeper and the fish population more diffuse, the additional quantity of fish that could be harvested is 500,000 tonnes, thus considerably raising the total production from the shelf area.[33]

Outside the shelf the level of organic production falls to <0.2 g C/m^2/day, but since this rate persists throughout the year an annual net production of about 50 g C/m^2 can be expected. Higher rates of production are found in the shallow waters in the coastal regions of the Laccadive and Minicoy Islands. The Arabian sea, taken as a whole presents vast contrasts (as observed during the IIOE). High productivity was observed in the northern and western Arabian sea, however a large area of low productivity with rates of <0.26 g C/m^2/day was observed between 60° to 70°E.[34] The reason for the high productivity in certain regions of the Arabian sea, lies in the presence of unusually high levels of inorganic nutrients at shallow depths often within or close proximity to the euphotic zone. Large mass mortalities of fish reported in the Arabian

---

33. Ramachandran, Samuel, Joshep and Balachandran, n. 10, p. 190.

34. Ibid., pp. 191 - 94.

Plankton Distribution In The Indian Ocean And Adjacent Seas

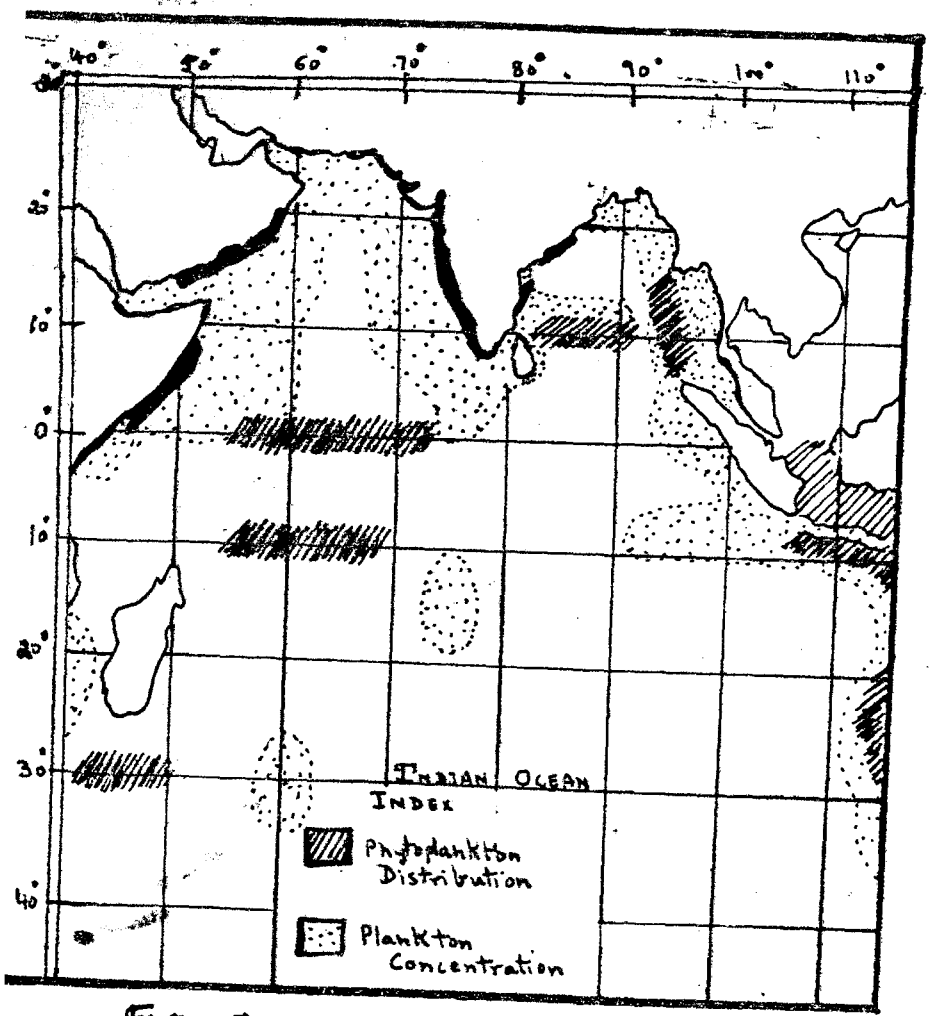


Fig. 5

Source : R. Subrahmanyam, p. 209.

Productivity In The Bay Of Bengal

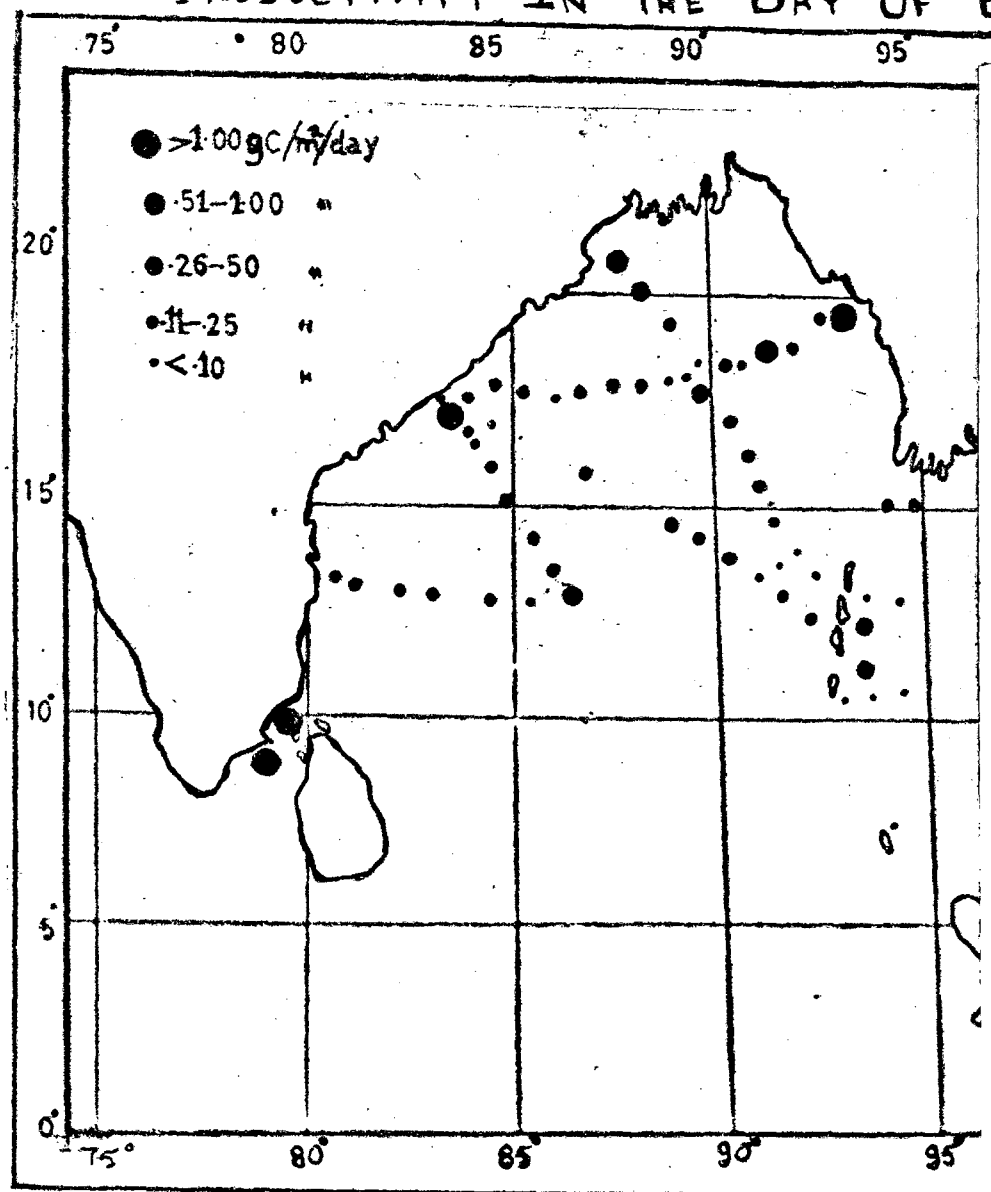


Fig. 4. Source : P. V. Ramchandran, et al. P. 195.

sea is now considered an adverse effect of high productivity (due to depletion of oxygen). (Fig. 3)

(b) Productivity of the East Coast : Observations show that in the surface waters of the Gulf of Mannar towards the coast organic production rates range between 250 to 300 mg $C/m^3/day$. For the entire euphotic zone of 10 - 15 metres near the shores the gross production would thus amount to 2 - 3 g $C/m^2/day$ and the annual gross production would total to 700 - 1000 g C/m^2. Such high productivity is characteristic of shallow tropical seas where there is constant replenishment of nutrient by bacterial regeneration aided by high temperature. Off Tuticorin within 50 metre depth the surface waters possessed a rate of 237 mg $C/m^3/day$ and at 10 metres 255 mg $C/m^3/day$.[35] The column production for this area amounted to a very high value of 5 g $C/m^2/day$. The level of production in the Palk Bay is of a higher value. In June-July the surface waters possessed values ranging from 455 mg $C/m^3/day$ to 2340 mg $C/m^3/day$. The column production amounted to 0.3 g $C/m^2/day$ in March to 6.0 g $C/m^2/day$ during June-July.

---

35. Ramachandran, Samuel, Joshep and Balachandran, n. 10, pp. 194 - 95.

The salinity is relatively low in the Bay of Bengal, due to the supply of freshwater. The depth of the euphotic zone as observed during the GALATHEA Expedition was 45 - 66 metres at the western region and 84 - 99 metres in the eastern region indicating low productivity. The production rate on an average was 0.19 g $C/m^2/day$ in the deeper part, while the shelf stations were all characterized by a high rate of production, an average of 0.63 g $C/m^2/day$.[36]

The average value for the entire shelf is 0.63 g $C/m^2/day$ which is moderately high, but is only about one-half of the productivity of the west coast within 50 metre depth but slightly more than the average value for the region outside. Taking this average value, the net organic production of the East coast would be over 15,000,000 tonnes of carbon and the maximum exploitable yield would amount to a little over 6 lakh tonnes thus the production could be easily increased by three times on the eastern coast. (Fig. 4)

Evaluation of the primary production is essential for determining the biological productivity of any water body, which helps us in the evaluation of the

---

36. Ramachandran, Samuel, Josyhop and Balachandran, n.10, pp. 195-96.

potential for increase in the marine fish production in any region. Productivity reflects the geographical approach. It has been suggested that transplantation and acclimatization of commercial items and food organisms among oceans may have a significant role in increasing high productivity. The knowledge and available data regarding the productivity of our waters is inadequate, making the evaluation of our marine fish resources a difficult job.

The main objective of marine resources studies is to identify the factors which affect the fluctuations in harvest and to identify areas where fishing may be profitably conducted. We see that the productivity and the fertility of the sea-water is closely related to the chemistry and biochemistry of the sea water, hence a knowledge of the physical oceanography of an area is the prerequisite to any food-chain study as they all are intimately tied together by a cause and effect relationship and it is impossible to study one in isolation to another. This would lead to an evaluation of the present available resources and forecasting of the possible yields in future.

It therefore becomes clear that there exists a system of interdependencies which have to be explored

and understood. Better understanding of these factors and their various effects on the marine living resources of our EEZ, would serve the marine fishing industry beneficially and would help in evolving a policy for India's maritime security.

COMMERCIALLY IMPORTANT SPECIES

The location distribution and potential catch regions for the living marine resources are guided by physiographic, hydrographic and biological conditions of the seas, as outlined in the proceeding chapter. The part of the Indian Ocean, significant for our country from the fisheries point of view, is composed of a Tropical Northern two-thirds of the Indian Ocean which is continuous in faunal character and is a distinct marine zoo-geographical division; and includes the Arabian Sea and Bay of Bengal among others.[1] Sea water fish falls in two categories : (a) Demersal (living in or near the sea-bed) (b) and Pelagic (living in the intermediate waters or near the surface.

The warmth of the tropical waters appears to favour the growth of a large variety of fish, not all of which are commercially important. The principal feature of the Indian marine fisheries is that the pelagic and mid-pelagic species dominate the commercial catches. Most commercial species are characterised by having comparatively large breeding seasons and one

---

1. V.G. Jhingran, Fish and Fisheries of India (New Delhi, 1975), p. 650.

of the major peculiarities of the fish stocks is the predominance of the younger age groups in the commercial catches, nearly three-fourths of the entire catches on the Indian coasts, are taken up by fish not more than three years old and even among this the zero-year class makes a major contribution. Another feature of the marine fish fauna in relation to the coastal fisheries is that there are important species which are primarily found in the sea these breed in the sea and coastal waters, but ascend estuaries and coastal lagoons when they are young. Annual migrations of young fish of this type take place throughout our coastline and the yield from their harvest in the adjoining areas of the coastline is considerable; to this category belong the Hilsa, species of mullets and of penacid prawns, milk-fish, the well known chanos chanos, threadfins etc. There exists a virtual absence of gadoids (Cods) and poor dominance of the pleuronectiformes (flat fishes) in the Indian marine catch.[2]

The catch in any season is usually composed of several races and several age-classes, depending on the race and age composition of the stock on the

---

2. N.K. Panikkar, "Fishery Resources of the Indian Ocean", Current Science, No.18, (1966),pp. 58-59.

grounds fished, and these in turn vary according to the life cycle of various species and the factors governing the survival and growth of particular races and age classes. There are two main schools of thought with respect to factors governing the abundance of marine species; one school bases its theories on the principles developed by Liebig and Malthus and maintains that the main factor is the amount of food available to the species and the other holds that the abundance of marine species is governed by the hydrographic and biological conditions, in an early critical stage of life of various year-classes of the species.

The problems of interdependence of food supplies marine population density rates of growth and the influence of the intensity of fishing on the abundance of stock of a particular marine species are extremely complex. However, by the help of the various studies carried on in different parts of the world reveals that :

(1) there exists a strong relationship between the fluctuations on the numerical value of the stock of fish and the yield of the great fisheries;

(2) and that unlike land species, marine species renew their stock in a highly irregular manner, making prediction a difficult task.

However we can generally conclude that the abundance of the year classes is influenced at all stages by the general hydrographic and biological conditions prevailing in the seas, but an adequate supply of food for the young fish at the critical stage is most essential lest they die of hunger. By following the abundance of young fish of various year-classes as they appear in experimental catches and as they are incidentally caught with fish of commercial size, it is possible to predit to a certain extent, the probable future abundance of particular 'classes'.

Owing to the varied conditions under which various marine species renew their stock, no theory can, with success claim a general validity and serve equally well for the explanation of the abundance of all species or races. Only with full knowledge of various races of particular species and their associated problems, for example, factors influencing reproduction and mortality, rate of growth, feeding grounds and habits, migrations, influence of fishing on the depletion of fish etc., can the relative abundance of races and the possible need for conservation measures be established, the progress of rehabilitation followed and the suitable management policies devised. A detailed and thorough study of these problems is basic to any progress and development in this field.

Tables

S.No.	SPECIES	MAJOR AREAS OF PRODUCTION	PEAK FISHING SEASON	CRAFT AND GEAR USED	UTILIZ (Mak
1..	Oil Sardine	Kerala, Karnataka & Maharashtra	Kerala - Oct-Dec. Karnataka - Oct-Dec. Maharashtra-Oct-Dec. (Fishing all the year round)	Boat Seines & Shore seines Gill nets, cast nets	Fresh Fish Fish
2.	Other clupeiformes	Kerala, Tamil Nadu, Andhra Pradesh	Oct to Dec. (Season: Sept.-Feb)	Shore seines and purse seines cast nets, gill nets	Manur
3.	Anchovies	Tamil Nadu, Kerala, Andhra Pradesh	(Season: June to Jan)	Shore & Boat seines gill nets	Sun d
4.	Mackerel	Kerala & Maharashtra	Oct. to Dec.		Salt c cured. Pickl Manur
5.	Pomfret Dusk	Gujarat, Maharashtra	Sept. to March		Fresh.
6.	Perches	Tamil Nadu, Kerala, Maharashtra		Gill nets drag nets long lines, hand lines	
7.	Polynemids	Maharashtra, Gujarat	East coast-Feb-May, West coast-Sept-Nov.		Salted, dried

S.No.	SPECIES	MAJOR AREAS OF PRODUCTION	PEAK FISHING SEASON	CRAFT AND GEAR USED	UTILIZATION (main)
8.	Cat Fishes	Kerala, Maharashtra and Tamil Nadu	Kerala-April-June Maharashtra-Oct-Dec. (All the year round) TamilNadu-July-Sept.		
9.	Ribbon Fishes	Tamil Nadu, Andhra Pradesh	July-March	Shore & Boat Seines Trawls Gill nets, hook & line	Fresh cured, sun dried, salted.
10.	Silver Bellies	TamilNadu, Kerala, and Andhra Pradesh	West coast-July-Nov. East coast-Aug-April		Salted, sundried (for export) Manure
11.	Sear Fishes	Tamil Nadu, Andhra Pradesh, Kerala		Gillnets, hook & line	Fresh, salted cured.
12.	Tunas	Laccadive & Minicoy	Sept-May	Shore Seines pole & line, whiffing line Drift nets	
13.	Elasmobranchs	Tamil Nadu, Andhra Pradesh		Chain hooks	Fresh, salted, dried, fish meal, oil meal, leather (shark)

An analysis of the commercially important fisheries has been attempted in terms of species, their distribution over space, their special characteristics (size, periods of abundance etc) and peculiarities and their uses etc. which will give us a better understanding of the kind and structure of the Indian marine fisheries and the related problems.

The commercially important marine fisheries include:

1. CLUPEOIDS :

Clupeoid fishes are of great economic significance as a source of food and oil and as a group constitute about one-third of marine fish landings in India. These are represented in Indian waters by sardines, anchovies, white bait etc. Sardines form the most important group among clupeoids and are represented by nine species of comercial importance in the Indian seas. Clupeoids are shoaling fishes, which move in groups of thousands along the west and south-east coasts of India, resulting in higher per hour catch per unit of man power which makes it profitable. The important species contributing to the Indian sardine fishery are : Sardinella longiceps (Oil sardine), Sardinella fimbriata and S. gibbosa

(all of which occur in large shoals) besides Dussumieria (rainbow sardine) and Kowala (white sardine) also feature in this fishery.

(a) OIL SARDINE : S. longiceps rank as a very valuable commersial fish owing to its food value and industrial uses. This fishery is largely confined to the west coast, though during certain years stray catches are made along the coasts of Tamil Nadu and Andhra Pradesh. Along the west coast, large shoals occur from Ratnagiri in the north to Quilon in the south, the zone of maximum abundance being the Malabar region. This fishery starts immediately after the commencement of the south-west monsoon and lasts from August to March. Shoals appear first in the Calicut region and then show-up gradually in succession towards the north, disappearing towards the end of the season in the reverse order. The spawning season of oil sardine extends from June to October or even later, but there appears to be two spawning peaks, one early in the season and another towards the end of the season. The commercial landings are always of fish above 10 cm; the species attain sexual maturity at about 15 cm. Big sized fishes in advanced stages of maturity along with many small-sized sardines appear in August-October. In the peak season of September to January, the catches are

made up chiefly of juveniles ranging from 12 to 15 cm, after which the fishery dwindles and comes to a close by about April-May.[3] This fishery continues to be restricted to a narrow coastal belt within 50 metres depth.

One of the interesting features of the oil sardine fishery is its fluctuations or periods of abundance alternating with scarcity. Sardines were abundant in 1941-42; during 1942-49, they were on the decline, from 1949 , catches have gone up; indicating a cyclic period of glut and scarcity.[4]

Such wide annual and long-term fluctuations appear mainly due to fishery independent factors, in spite of considerable scientific work done, the exact reason for large variations in landings and the unpredictable nature of this fishery has yet remains an unsolved problem. Environmental studies have indicated that the intensity of south-west monsoon may have a positive correlation with sardine abundance. Some of the causes attributed to the scarcity of oil sardines are; indiscriminate capture of immature fish during years when the fishery is abundant, capture of

---

3. V.G. Jhingran, n. 1, p. 852 - 55.

4. K. Chandy, Fishes (New Delhi, National Book Trust, 1983), pp. 133 - 14.

spawners in the breeding season, unfavourable surface temperature and poor availability of Fragilaria Oceanic (which forms the choice food organism of oil sardines).[5] Overfishing could also be one of the main causes of the failure of this fishery. However none of these factors can explain the unrecognizable revival of this fishery in certain years (ex. 1964-70) or group of years. It is most likely that the causes of fluctuations in abundance lie in the relative year to year strengths of the year class of the population involved, determined basically by the extent of spawning and rate of survival, which in turn are controlled by oceanographic factors.[5] Little is known at present about, where the oil sardines spawn, where from they arrive in the inshore waters to support fisheries and to where they go after the fishing season.

Oil sardines are used as food as well as for extracting oil (the body oil content is very high) which is used in jute, leather and soap industries. The fish manure prepared is used as a fertilizer in coconut, coffee and tea plantations, and the oil extracted by crude methods is applied to the fishing crafts for seasoning the wood and acts as a repellent

---

5. Jhingran, n.1, p. 869.

for protection of wood against marine borers. Since oil sardine is easily perishable fish, proper cold storage facilities are essential at the landing centres.

(b) LESSER SARDINES : This group is made-up primarily of S. fimbriata, S. albella, S. gibbosa and S. sirm and constitute significant coastal fisheries in several regions. The individual fisheries are largely seasonal and inshore and the group on an average contributes about five percent of the annual marine fish production in the country. The fishery of S. sirm is restricted to the extreme southern part of peninsular India, but the fisheries of the other three species often overlap one another in their areas of abundance. S. fimbriata is the most abundant of the lesser sardines on all coasts and the length of the fish in the commercial catches is 10 to 15 cm. The lesser sardine fisheries are purely coastal fisheries and depend entirely on 0-year classes and now here in India is this fishery made-up of adults and spawners.

The lesser sardine fishery commences in Maharashtra waters immediately after the south-west monsoon is over. In Goa and Karnataka, S. gibbosa and S. fimbriata constitute this fishery of which the season starts from September and lasts till February.

In the northern part of the Tamil Nadu coast this fishery depends on S. fimbriata and S. sirm, with a duration from December to April. In Andhra Pradesh and Orissa the fishery commences from October and lasts till January and is supported by the two species S. gibbosa and S. fimbriata. The fishery is active from April to October in the Palk Bay and from November to March in the Gulf of Mannar and consists of the species S. gibbosa and S. albella.

The 'chaodai' fishery of the Tamil Nadu coast is based on the thin-bodied sardines (S. albella, S. gibbosa, S. jussieu, S. sirm, S. clupeoids etc.) the fishing season of which lasts from March - April to October - November. Fishing is limited to inshore waters and fishing operations are conducted during the night and a larger part of the catch is dried on the beach.

(c) WHITE BAIT AND ANCHOVIES : The Anchovielle belonging to family Engraulidae rank next in importance to the sardines, the commercially important species of which include Anchovialla commersoni, A. indica, A. heterolobus, all of which are of considerable importance along Tamil Nadu, Kerala and Andhra Coasts. Family Engraulidae also includes the species Thrissocles malabaricus,

T. mystax, T. setirostris and T. dussumieri, which occur in large quantities along the coasts of Tamil Nadu, Kerala and Andhra Pradesh, which together account for about ninety percent of the total anchovy catches.

The fishing season for white bait fishery varies with locality and species but generally the season extends from June to January. As in the case of white baits, the fishing season for anchovy fisheries extends from June to January.

(d) OTHER CLUPEIFORM FISHES: This is a broad group comprising of various species of the following genera; Hilsa, Clupea, Nematolosa, Ilisha, Dussumieria, Albula, Chanos Megalops, Elops etc.

Hilsa ilisha is a migratory fish ascending all the major river systems, where it is caught in considerable quantities. In coastal waters it occurs in the vicinities of the river mouths especially Narmada, Tapti, Cauvery, Pennar, Godavari, Krishna and Mahanadi. In the estuaries of West Bengal, Hilsa forms a lucrative fishery as with large landings.

The wolf herring, Chirocentrus dorab is a carnivorous fish is of special importance along the Tamil Nadu coast. Although distributed on all the

coasts, it is comparatively more abundant on the east coast. Its reported maximum length is 3.5 metres, but fish measuring about one metre are not uncommon in the commercial catches. This fish appears to breed in the off-shore waters and the major catches are landed by shore-seines and gill nets. The highest landings are made in the fourth quarter of the year.

The milk fish Chanos chanos is solely a plankton feeder obtaining a maximum size of nearly 1.8 metres and occurs both in inshore as well as off shore waters, its minute fry enter the shallow coastal lagoons and creeks in summer months in large numbers.

2. MACKEREL

Amongst the marine bony fishes in India mackerels rank the highest as a commercial group contributing high tonnage per year. The Indian mackerel, Rastrelliger kanagurta, is the only species of the genus found in the seas around the sub-continent, in the inshore waters. The species of mackerel occuring around the Andaman Islands is believed by some to be different from the Indian mackerel viz. R. brachysoma. Although the Indian mackerel occurs on both the coasts of the country, more than ninety five percent of the total landings comes from the west coast, where the area between Ratnagiri

in Maharashtra and Quilon in Kerala state is important. On the East coast the catch appears sporadically near Nandapam, Nagapattinam, Madras, Kakinada, Vishakapatnam and some parts of Orissa. From the point of view of mackerel fisheries the west coast of India can be divided into three regions, according to the intensity of fishing, the fishing practices, gears used and the seasons of the fishery:

(1) Cape Comorin to Ponnani River Mouth: The fishery here is poor or moderate and shoals of mackerel are caught at irregular intervals during August to February for which generally boat-seines and dug-out canoes are used.

(2) Ponnani River Mouth to Mangalore: This region is most important, where fishing season starts in August/September and lasts till March/April. The craft used are dug-out canoes with boat-seines or gill nets, both of local design and hand made.

(3) Mangalore to Ratnagiri : This area is also a busy centre for mackerel fishery. The fishing season starts here a little later, i.e. from October to November and lasts till February/March; the peak period being October - November. The gears used generally consist of gill nets and specialised shore seines.[6] Mackerel landings on the west coast

---

6. Jhingran, n.1, pp. 871-72.

are highest in the 4th quarter of the year, moderate in the first quarter and poor in the second and the third. On the East coast in Tamil Nadu, the catches taken in the third quarter of the year are the highest and those in the fourth quarter lowest. In Andhra coast, the catches are uniformly moderate in all the quarters of the year except in the third when they are poor. In West Bengal and Orissa the catches are poor throughout the year. This fishery is supported mostly by juveniles of the length range 16 - 18 cms.

Mackerel fishery is subject to wide fluctuations and as such present problems similar to those of the oil sardine fishery. It has been suggested that delay in the onset of monsoon of the Indian coasts are often followed by delays in the fishing season. The mackerel is a plankton feeder, and the landings show their peak and coincide with or follow the abundance of plankton Possibly the shore ward movement of the mackerel shoals in fishing seasons is determined by the abundance of planktonic food items in any particular region. There appears to be some relationship between the rainfall in a region and the landings of mackerel, it has been noticed that good fisheries have resulted when the wind force had mean values.[7]

---

7. K. Virbhadra Rao, "Distribution Pattern of the major exploited marine fishery resources of India", Proceedings of the Symposium on living Resources of the Seas Around India, CMFRI (Cochin 1973), p. 45.

An inverse relationship has been observed between the mackerel and oil sardine fisheries; though this relationship does not appear to be consistent on year to year basis, it appears to hold good over long-term basis. Since both the species are planktophagus and occupy the same neritic-pelagic habitat, there seems to be competition among them for food and space thus the effect of one species on the abundance and availability of the other in a given area. It has also been observed that sudden outbursts of planktonic blooms producing the 'red tide' adversely affects the prospects of a good fishery.

Mackerel is pelagic in habit and moves in massive shoals which are easily visible from a distance. During day time, the shoals appear as dark patches and at night the fishes are visible by the emission of light from their phosphorescent bodies. It is important to note that a small number is occasionally obtained from trawl catches from Bombay and Gujarat coasts as well as from deeper waters of the Bay of Bengal.

Mackerel is an excellent food fish, particularly when fresh. About forty percent of the catch is preserved in ice and despatched to various inland markets, the rest is either salt-cured or

pickled and also canned of which a part is consumed within the country and the rest exported. When the catch is very abundant, the surplus is converted into manure and fish meal.

3. RIBBON FISHES

Ribbon fishes contribute a fairly large percentage of the total catch per year. Ribbon fishes or hair tails of the family Trichiuridae are represented in the Indian waters by six species viz, Trichiurus lepturus, Lepturacanthus Savala, Eupleurogrammus intermedius, E. muticus, T. gangeticus and T. pantulio, these are important low-priced food fishes widely distributed along the Indian coast and are particularly abundant along the coasts of Andhra Pradesh, Tamil Nadu and Kerala. Nearly fifty percent of the ribbon fish landings of India is contributed by Tamil Nadu.

Hair tails are essentially a shoaling fish, large schools of ribbon fish often enter the inshore fishing grounds coming very close to the shore. Each species moves in a separate shoal and at a different time of the year. The breeding grounds of ribbon fishes appear to be in the far-off deeper waters; the entry of shoals into the inshore waters seems to

be immediately after spawning. Fishing season lasts from July to March, the catches have been found to vary from year to year. Ribbon fishes are all predacious, carnivorous and sometimes cannibalistic.

T. lepturus is the most important species of our coasts, the commercial size of which ranges from 16 to 80 cm, individuals of over one metre length are not uncommon. T. lepturus, moves in great shoals and appears to migrate from east to west around the Cape during August to October, when it is caught in large quantities. The commercial size of E. intermedius is from 14 to 35 cm, and of L. savala and E. muticus from 25 to 75 cm.

The ribbon fish fishery in Tamil Nadu commences in the month of September normally, the catches increasing steadily and reaching a peak in December, Juveniles occur almost throughout the year along the Tamil Nadu coast, indicating that the breeding grounds are not very far. In the northern area of the Andhra coast, ribbon-fish are caught abundantly between July and December. Time of peak landings varies from year to year, but usually there is a peak in summer; and during the peak period these fishes contribute as much as fifty to sixty percent of total fish catch

in this area. Along the Gujarat and Maharastra coasts the fishery extends from September to December, and the landings here are highest in the fourth quarter (October - December). The fish is marked fresh (consumed mostly by the poorer sections along the coast) or in cured condition.

4. SEER FISHES

Seer fishes of the family Scombridae are represented in the Indian waters by the species Scomberomorus commerson, S. guttatus, S. kuhli and S. interruptus. Seer fishes are caught all along the coasts on lines baited with piece of sardines, anchovies or prawns and are in general high-priced quality fishes. These are related to the mackerel and like mackerel, have a reddish flesh with high fat content. Some of the species grow to over a metre in length and are hence large in size. The major portion of the catch comes from Tamil Nadu, Andhra Pradesh and Kerala and is also important in Maharashtra and Karnataka, in the other states it is not of much significance. In Tamil Nadu, the fishing starts in March and terminates in October; in Andhra Pradesh the fishing generally lasts from February to May and on the west coast, the fishing season is from October to May with peak during November-December.

Nothing definite is known about the migratory movements of the fish, they seem to move to the inshore waters when there is abundance of small fishes and crustaceans there. In a recent study by K. Srinivasa Rao (1973), it has been pointed out that S. guttatus which moves along the Tamil Nadu coast in large shoals is most likely subjected to the influence of coastal currents. Depending on the penetration and speed of the current, the magnitude of the fishery may vary from year to year (K. Srinivasa Rao 1973) at the different localities. The effect of the circulation pattern of the water masses in the Bay of Bengal, explains the scarcity of the fish north of Andhra coast; the dwindling of the fishery in the northern regions is due to an off shore deflection of the water masses during the June - July period.[8]

9. BOMBAY DUCK

Bombay duck is the popular name of Harpodon nehereus belongs to family Synodiate, is a well known commercial fish in India. The fishery shows a discontinuous distribution occuring abundantly along Gujarat

---

8. K. Srinivasa Rao, "Migration of Seer fish in Relation to the Circulation Pattern in the Bay of Bengal", Paper presented at the National Symposium on 'The Oceans : Realities and Prospects', I.I.C., New Delhi March 26-29, 1984. (under publication).

and Maharastra (it is very important from Ratnagiri to Broach ranking next to the mackerel in total annual tonnage) region of West coast and the West Bengal region on the East coast, is found in small numbers along the Coromandel coast.

Bombay ducks are migratory fishes and the most likely factor to have a bearing on the distribution of the species is surface temperature. The surface temperature values are reported to be generally lower in the areas of distribution of this species during the fishing season on both the east and west coasts; the regional differences being more marked on the west coast, where the catches are larger.[9]

The fishing season for Bombay duck lasts from the end of September to January - March; the annual fluctuations in the catch seem independent of the fishing pressure. Although individual fishes appear to breed only once a year, the species as a whole breed throughout the year. The morphometric studies have revealed that, though the fisheries on the Maharastra coast are supported by a single stock, those of Andhra and Gujarat coasts are supported by independent stocks. The migrations of this species, seem to be

---

9. Jhingran, n.1, p. 874.

influenced by two main factors; the availability of the food and the favourable salinity medium of the waters.[10] About eighty percent of the individuals in catches are juveniles. Commercial catches of the fish are constituted by size ranging from 60 to 270 mm in total length. The fish attains sexual maturity at 210 mm length.

Bombay duck accounts for nearly ten percent of the marine fish landings in the country of which about ninety seven percent comes from the west coast. A portion of the catch is used fresh, but over eighty percent is sun-dried. Being very soft it is very easily spoiled in case of delays and then has to be converted into manure. The gear used for catching this species are dol-nets operated from boats plying within a distance of 5 to 8 kms off-shore.

6. TUNA FISHERY

Tunas are well known pelagic fishes and the commercial tuna fishery in India consists of three species of Katsuwonus pelamis (skip-jack), Euthynnus affinis (mackerel tuna) and Neothunnus macropterus (yellowfin tuna). The skipjack is the most predominant species. Tunnas are oceanic fish, the shoals approach the coast of the Laccadive and Minicoy Islands from the southern side at the beginning of

---

10. K.V. Rao, n. 7, p. 39.

fishing season and move northwards probably to the feeding grounds, indicating that the real increase in the production can come only by exploiting the deeper waters. Similarly schools of skipjack occasionally enter the coastal waters in pursuit of small shoaling fishes, and it is these schools which are caught in the inshore waters.

The fishing season is generally from September to May their size range is very wide; the mackerel tuna grow to about 60 cm, and the yellowfin tuna to over 1.8 metres. Excepting in the Minicoy and Laccadive Archipelago, where the oceanic fishjack is fished in considerable quantities, there is no organised fishery for these species on the Indian coasts. The species obtained from the inshore waters are commercially less important than those from the high seas. Among the coastal states Kerala ranks first followed by Tamil Nadu in annual landings, where these fishes are obtained as incidental catches in types of gear operated for other fishes. The tuna fishing boats are sturdier and stronger than the types of boats usually employed in the inshore fishing operations for other fishes. Tunas are large fishes and are economically important for the canning industry; tuna meat is also boiled in brine, smoked or sundried

and its cured product known as 'nasmin' forms an important item of export.

7. CARANGIDS AND ALLIED FISHES

This is a very broad grouping including the species Decapterus russelli, Megalaspis cordyla, Selaroides leptolepis, Caranx kalla and Chorinemus spp. etc. The travallies, the horse mackerels, the queen-fishes and the Queenfishes etc. belonging to the family Coryphaenidae and the kingfishes of family Rachycentridae together from a fairly high proportion of the catches both on the east and west coasts of India; the most predominant species is Decapterus russelli. The average size of the Carangids caught do not generally exceed 30 cm in length, though individuals grow over to 60 cm. The fishing season varies considerably from region to region and the landings are marked by considerable annual fluctuations. In Gujarat and Karnataka the highest yields are in the fourth quarter, in Kerala and Tamil Nadu in the third and in Andhra in the second quarter of the year. In the states of Maharastra, West Bengal and Orissa the catches are poor. In general these fishes occur all round the year. Studies reveal that in all the states the present fishing intensity is exerting pressure on the coastal stock of Carangids. The flesh of Carangids is generally coarse and hence mostly sun-dried and salted

8. FLYING FISHES

Flying fishes belonging to the family Exocetidae are represented in India by Parexocoetus brachypterus, Exocoetus volitans, Cypselurus bahiensis, C. poecilopterus, C. altipennis and C. coromandalensis and are obtained with other fish catches in small quantities all along the coast, but is particularly important along the Coromandal coast from point Calimere to Madras. This fishery commences by about May and lasts till July or August. These fish inhabit off-shore waters 30 to 40 kms away from the shore and have the habit of depositing their eggs on floating weeds. The fish are lured to bundles of 'pandanus' leaves or twigs of 'tephrosia' tied to long ropes and suspended in the sea by the fishermen. As they get attracted by these lures to deposit their eggs, they are scooped by nets and which are emptied into specially built, large-sized sail catamarans called 'Kolla marams'. The bulk of the landings are made in the second quarter of the year. Almost the entire catch is salted and sun-dried.

9. PERCHES

Perches belong to a large number of families with a large number of species under them, these include the genera Lates and Psammoperca

Ambassis; Holocentrus, Serranus, Epinephelus; Priacanthus; Apogon; Sillago; Aprion, Lutianus; Etelis Pristes; Kurtus etc., which together form the commercially important fisheries of the inshore and offshore waters all along the east and west coasts. Perches are abundant in coastal waters, particularly around the coral reefs and on the rocky bottoms of the sea even at considerable depths. The size varies much, for some species like Epinephelus tauvina grow to about 2.5 metres while a few of the Apogon species do not exceed 8 to 10 cm in length.

Lates calcarifer called 'Bekti' is a coastal fish which enters and survives well in estuaries, back waters and also fresh water (lends itself to culture in ponds and tanks). The maximum size known is 152 cm but the usual size in the commercial landings of perches in Maharashtra and Karnataka are made in the fourth quarter, in Kerala and Tamil Nadu in the third and in Andhra in the second quarter of the year.

10. SCIAENIDS

The members of the family Sciaenidae are well represented by a large number of species popularly known as Jew fishes, occuring in abundance on all the

coasts; but constitute important fishery of Maharastra and Kathiawar coasts. Some of the larger species, Pseudosciaena diacanthus (ghol) and Otolithoides brunneus (koth) support important fisheries and are highly priced, and Dhoma, comprising all smaller Sciaenids. The large ghol commonly captured in the trawl off Bombay weight between 5 to 11 kgs. In Gujarat and Andhra the peak catches are obtained in the first quarter, in Maharastra and West Bengal and Orissa in the fourth quarter and in Karnataka, Kerala and Tamil Nadu in the third quarter of the year.

Ghol and Koth grow to a large size of 60 to 120 cm and the smaller Sciaenids grow to 20 to 30 cm in length. Sciaenids besides being a valuable source of food, are noted for their large air bladders (when sundried yield isinglass) which have a trade name of 'maws', the bulk of better quality maws is exported.

11. POLYNEMIDS

The commercially important Polynemids include nine species; Eleutheronema tetradactylum (Rawas), Polydactylus indicus (Dara), Polynemus heptadactylus (Shende), P. sexfilum, P. plebeius, P. sexifilis, P. paradiseus, P. xanthonemus and P. microstoma. These mostly occur in all coastal waters on the continental

shelf but some are known to frequent the estuaries and lagoons as well as even ascend up the rivers a few miles from their mouths, indicating their tolerance to great fluctuations in salinity. Commonly known as thread-fins these occur all along the Indian coasts and due to their seasonal migratory movements these support fisheries in the offshore, inshore and estuarine environments.

In the Gulf of Kutch and Cambay the dominant size group is 91 to 100 cm caught by gill nets during the season. Such adult members are very rare in the trawl catches. In the offshore fishery more juveniles are caught, while from the inshore waters adult fish in the ripe stage of maturity are collected, where they come for spawning. Spawning is more than once a year and each time the liberation of the eggs is in batches. Shoals in the inshore catches is made up mostly of juveniles. Spawning takes place all the year round and its intensity appears to be more in the offshore waters. Rawas grow to 18 cm, Dara to 140 cm and the rest are usually small not exceeding 30 cm in length. Polynemids are Carnivorous and predate on small prawns crabs and young teleosts.

In Gujarat and Maharastra the catches are high in the first two quarters; in Tamil Nadu the landings are more or less equal although low in all quarters of the year. Dara are mostly obtained in the inshore fishery though individuals at time appear in the trawl landings also. The best yields of Dara is from November to March though catches of some magnitude continue to be obtained till May during the rest of the year the catches are poor, it is known to prefer waters below 45 metres depth and temperatures below 24°C. Shende, has no well-defined season and good catches are obtained all the year round. It prefers deeper waters upto 70 metres.

Polynemids are fished by different types of gears, however seines and drag nets are employed in shallow inshore waters and estuaries and long lines and handlines baited with small fish are in use in the deeper coastal waters, all operated by the country crafts.

12. CAT FISHES

Commercially important marine Cat fishes belong to the families Plotosidae and Tachysuridae. Under the family Plotosidae are included such common species as Plotosus Canius and P. anguillaris which

grow to 75 cm in length and occur in coastal waters. Family Tachysuridae includes species like, Osteogeneiosus militaris, Tachysurus sona, T. maculatus, T. caelatus T. thalassinus, T. dussumieri, and T. jella, a few of them attain a large size for example T. sona grows to about one metre in length. Although all the species are found on all coasts in this country, T. thalassinus and T. dussumieri are best obtained from Kerala. T. jella is comparatively more abundant on the east coast. Since they are predacious and carniverous, the cat fishes are very destructive to other fishes. In Kerala the catches are the highest in the second quarter with little variation from quarter to quarter. In Gujarat, Maharastra, Karnataka and West Bengal and Orissa the highest seasonal catches are in the fourth quarter and in Tamil Nadu and Andhra in the third and first quarters of the year respectively.

The commercial cat fishes are confined to grounds upto 50 metres depth, most of the fishing is done in waters 40 m. deep, especially during the rough season from April to November. The fishery has three peaks in a year, in March, May-June and September-October. The bulk of the catches are made by the indegenous gear, though in recent years mechanised boats have come into operation.

13. SOLES AND ALLIED FISHERY

This group falls into several distinct genera, represented in the Indian waters by Psettodes, Poecilopsetta, Bothus, Pseudorhombus, Solea, Pareplagusia and Cynoglossus. Psettodes erumei known as the Indian halibut, occurs in some quantities in Bombay-Gujarat waters and the south-eastern coasts. Most of the flat fish species occur in small numbers in the miscellaneous catches all along the coast, except Cynoglossus Semifasciatus Day, the Malabar sole which forms the bulk of the catch from Quilon in Kerala to Mooliki in South Kanara; the heaviest landings are in the region between Mukad and Kadapuram on the Malabar coast; known locally as 'Nangu' in the north and as 'Manthal' in the south.

It is known that the south-west monsoon turbulence affects the shoaling of this species directly and causes in-shore and off-shore migrations. The maximum size of C. semifasciatus is about 18 cm, the peak fishery is supported by the one year old fish when they are mostly between 10 - 12 cm. The bulk of the catch is obtained at the commencement of the season i.e. in September, the sudden appearance of the soles in the surface or subsurface waters of

the inshore region is phenomenal, and are caught in huge quantities in boat seines, Cast-nets and shore seines which are operated from canoes. After the peak fishery (when the fish are fully mature potential spawners) the soles begin to disappear as suddenly as they have appeared spawning seems to take place in the deeper waters and for a protracted period from October to January. They feed at the bottom on polychaetes, amphipods and molluscus; the migration of the soles appears to be for the purpose of feeding and breeding. In all the three states of Karnataka, Tamil Nadu and Kerala catches are highest in the third quarter.

14. ELASMOBRANCHS

This fishery makes fish production of the country and include sharks, skates and rays. The most important sharks of commerce are species of Rhinocodon, Galeocerdo, Carcharhinus, Scoliodon, Sphryna and Stegostoma. Among the rays, Dasyatis, Aetobatus, Aetomylus, Rhinoptera, Pristis, Rhinobatos, Rhynchabatus are important. Sharks are mostly found along Kathiawar, Bombay, Kerala, Coasts of Tamil Nadu and West Bengal.

Sharks are found throughout the year, but the peak season is from July to March on the west coast, usually found in waters 250 - 300 fathoms deep. These are caught by long lines and hooks baited with fish or beef pieces usually employed from small boats on the east coast or dug out canoes on the Malabar coast and on the Bombay coast, large plank-built boats.

The flat-bodied rays, are found in shallow waters 10 - 15 fathoms. Elasmobranchs are most abundant along Tamil Nadu coast, where the landings are highest in the third quarter and lowest in the fourth; in other states on the east coast the same trend is found. However, along the west coast the fourth quarters catch is the highest. Some of the elasmobranches attain gigantic sizes, for example the whale shark grows to over 15 metres in length, among the rays Aetobatus flagellum attains 3.3 metres; all the saw fishes also grow to very large size over 4.5 to 7 metres in length.

Although not very good for eating on account of their 'urea' flavour these are widely used as food either in fresh or cured condition. The chief value of sharks and rays lies in their liver oil

rich in Vitamin A. Huge quantities of oil which is not utilised for medicinal purpose is used in the leather industry for taning etc. Dried shark fins form an item of export, and is also used for making fish meal and fish manure.

15. SILVER BELLIES

Silver bellies or pony fishes of the family Leiognathidae occuring all along the coasts are laterally much compressed, slimy fishes with minute scales. These are represented in the Indian waters by three genera, Secutor, Leiognathus and Gazza of which S. ruconius, S. insidator, L. daussumieri, L. fasciatus, L. bindus, L. lineolatus and G. minuta are fairly common and L. equulus and L. splendens most abundant. The bulk of silver bellies landings come from Tamil Nadu, Kerala and Andhra coasts; heavy landings are obtained on the south-eastern coast in the vicinities of Mandapam, Rameswaram, Pamban and Thangechimadam and on the south-western coast in the vicinities of Kerala backwaters; off Vishakapatnam and Kalingapatnam the landings are fair.

Fishing season lasts from July to November on the west coast and from August to April on the east

coast. In Tamil Nadu the fishery is fairly good in the second, third and fourth quarters and reaches a peak in the third; in Kerala the fishery commences in the second quarter and reaches a peak in the third and dwindles by the fourth quarter. In Andhra, West Bengal and Orissa good catches are obtained in the first and second quarters of the year.

Most of the fishery constitute of small fish, about 10 to 15 cm in length , while a few like L. equulus grow upto 30 cm. As most of the species are small and appear to be short-lived and since the present method of exploitation leaves enough brood for replenishing the stocks, it is desirable to catch fish of all sizes for the best utilisation of the stock.

Silver bellies are low priced as these are mostly small and scanty of flesh and a very insignificant quantity is consumed in fresh condition.

16. LACTARIUS

Lactarius lactarius of the family Lactariidae commonly known as white fish is a small-sized carnivorous fish growing upto 29 cm in length. The size range in commercial catches is between 15 and 25 cm. Lactarius moves in shoals in inshore waters

and is more abundant on the east coast than the west. In Kerala, the landings are extremely good in the second and third quarters; third and fourth quarters in Tamil Nadu and in Andhra Pradesh the landings are largest in the second and fourth quarters of the year. Tamil Nadu is the largest producer followed by Andhra Pradesh and Kerala. White fish is consumed either fresh or in cured state.

17. EELS

Eels which occur in large numbers in our coastal and offshore waters belong to the families Anguillidae and Muraenesocidae of which the common species are A. bengalensis and M. talabonoides and M. cinereus. A. bengalensis is fairly abundant on the east coast while the other two species are found in the north-western coast of India. M. talaboncides grow to a large size upto about 2 metres in length. All eels are predacious and carnivorous. These make up a good portion of the trawler landings from the Bombay and Gujarat waters.

18. GAR FISHES AND HALF BEAKS

Commercially important marine Gar fishes belonging to the family Belonidae are Strongylura, Crocodilus and S. strongylura. Half beaks belonging

to the family Hemirhamphidae are represented by Zenarchopterus dispar, H. quoyi, H. unifasciatus, H. georgii and H. marginatus. The half beaks grow to about 15 to 30 cm, while the gar fishes grow to bigger size, for example T. crocodilus is over a metre in length when full grown. In Tamil Nadu these are in greater abundance where the catches are the highest in the second quarter of the year.

19. BARRACUDAS AND GREY MULLETS

The barracudas belonging to family Sphyraenidae, the grey mullets of the family Mugilidae and the hardy-heads of family Atherinidae comprise a large group which inhabit mostly the inshore waters, often entering the estuaries and backwaters. The barracudas are represented in the Indian waters by several species under the genus sphyraena of which the common ones are S. commersoni, S. obtusata, S. jello and are active predatory fishes. S. commersoni and S. jello grow to over 1.5 metres. Landings are not very significant in most states except in Tamil Nadu where the catches are the highest in the third quarter. Barracudas are among the prized game fishes and are caught by hook and line and trolling artificial lures.

The common species of the grey mullets fall under the genera Mugil, Liza and Valamugil, the important

ones being M. cephalus, L. macrolepis, L. parsia, L. tade, V. seheli and V. buchanani. They are active but non-predatory fishes feeding on detritus and the smaller components of the phytoplankton and zooplankton and are more abundant on the east coast than the west, most of them grow to a maximum size of 25 to 45 cm., caught in the lagoons and the adjoining brackish-water lakes and in the estuaries. As they are caught almost throughout the year, they form a valuable source of food-fish during the off season of the other commercial fisheries. In India nets specially meant for catching mullets are devised with regard to their peculiar habits. They are known to ascend in schools to the shallow littoral areas and connected creeks and channels with the high tide for feeding purposes. Besides serving as a delicious table fish, the grey mullets are important in that they are hardy and one of the best suited for fish farming.

The hardy heads are small fishes, congregating in dense shoals in shallow water lagoons, the most common species is Atherina forskali, having a prominent silvery lateral stripe

20. <u>POMFRETS</u>

Pomfrets or butter fish are among the best of the table fishes, having ovate, compressed bodies, securing

in shoals usually away from the shore comparatively in deeper waters. Belonging to the family Stromateidae. The commercial fishery in Indian waters are assigned to three different genera; Stromateus (grey) Chondroplites (white) and genus Parmio (black; probably not a member of this family). These constitute an important seasonal trawl fishery, particularly in the Gujarat waters. Gujarat is the largest producer followed by Maharastra and Andhra Pradesh, though pomfrets are landed on all the coasts. Pomfrets are best obtained in the fourth quarter in Gujarat, Maharastra and Kerala. In Andhra Pradesh there is a gradual decline of the catch from the first to last quarters of the year, while in West Bengal and Orissa the variation in catches is not marked from year to year. The two species that mainly support the fisheries are Pampus argentius and Parastromateus niger.

21. CRUSTACEANS

Among the most important constituents of the country's commercial landings are the crustaceans comprising the prawns, lobsters and crabs. Among these the penaeid prawns form the major component followed by non-penaeid prawns and the other crustaceans about three percent. Maharastra leads in the landings of crustaceans followed by Kerala and Gujarat. As regards

seasonal trends in Gujarat and Maharastra crustacean catches are the highest in the second quarter and lowest in the third quarter, in the first and the fourth the landings are fairly high. In West Bengal and Orissa the catches are highest in the fourth quarter while in the rest of the states highest landings are made in the third quarter of the year.

(a) PRAWNS: The major portion of the marine prawn catch is contributed by penaeid prawns viz. Penaeus indicus, P. monodon, Metapenaeus dobsoni, M. affinis, M. monoceros, M. brevicornis, Parapenaeopsis stylifera, P. sculptilis, P. hardwickii and Solenocera indicus. The main species of non-penaeid prawns are Palaemon tenuipes, P. styliferus, Hippolysmata ensirostris and Acetes. The commercial fisheries of M. dobsoni are on the south-west and east coasts, of M. brevicornis in West Bengal, Andhra Pradesh, Maharashtra and Gujarat, of P. stylifera only on the west coast, of P. sculptilis, P. hardwickii and H. ensirostis in Gujarat, Maharastra and Andhra, of S. indicus in Maharashtra and Andhra; of P. tenuipes in Gujarat, Maharastra, West Bengal and Orissa of P. styliferus in Maharastra and West Bengal. The rest of the species are met with in some quantities in the commercial catches all along the east and west coasts. From depths of 275 to 700 metres off the

south-Western coast. Some deep water species of prawns have been recorded, some of these species seem to occur in such densities as to support fisheries. Acetes spp. constitute good fisheries on both east and west coasts and comprises of three species, all of which occur in larger shoals in the inshore waters.

Most of the penaeid prawns breed in the sea and their young ones enter the estuaries and back waters. P. stylifera completes its entire life cycle in the sea. The larvae and post-larvae of the species, entering the brackish water environments, feed and grow to juveniles of fair size in some mouths and then return to the sea for attaining sexual maturity to breed. Some of the species like M. monoceros, P. indicus, M. affinis seem to enter fairly deeper waters of over 50 metres for breeding.

The fishing season for prawns extends from November to May in the west coast and from December to August in the east coast, with interruptions during the monsoons. Prawns are fished in good quantities in June-July in close vicinity of the mud-banks in Kerala and in the Gulf of Kutch there exists a monsoon fishery of prawns of significant magnitude. Prawn fishery

flourishes when the colder and denser waters prevail along the coast during the monsoon months.[11]

(b) OTHER CRUSTACEANS : The spiny lobsters are represented by Panulirus polyphagus, P. ornatus and P. homarus. These inhabit rocky bottoms along both the coasts and grow to over 30 cm in length. P. homarus, supports a freezing industry in the export trade of 'lobster tails' in the south-western coast of India between Trivandrum and Cape Comorin. The fishing season in the southern part of the south-west coast commences by November-December and lasts for about 4 months ending in March-April; while in the northern part the fishing season last only from July to October. On the South-east coast the peak seasons are January to March and July to September. The species is mainly carnevorous feeding on fishes and crustaceans available on the ground. The craft and gear used are wall-seines, gill-nets, anchor hooks and baited traps.

Of the crabs, Scylla Serrata, Portunus pelagicus and P. sanguinolentus are common and are caught in the shore seines, trawl nets and specialised crab-nets.

---

11. H.K. Mohamed, "Penaeid Prawn resources of India", n.7, p. 550.

The important areas of production are the Gulf of Mannar and Palk Bay, along the other coasts the landings are comparatively less. The fishing ground is generally characterized by muddy bottom. Although caught throughout the year, on the west coast this fishery is generally active in the fourth quarter of the year, in the east coast the peak season is observed in April-June and October - December.

22. CEPHALOPODS

The edible Cephalopods fall under three groups; the cuttle fish Sepia aculeata, S. rostrata, Sepiella inermis; the squids sepioteuthi arctipinnis, Loligo indica, L. hardwickii, L. affinis and Octopi, Octopus rugosus, O. octopodes, O. favonia, O. herdmanii and O. hongkongensis. On the south-east coast of India there is a regular squid fishery of Sepioteuthis arctipinnis in the summer months in the Gulf of Mannar and Palk Bay around Mandapam and Rameswaram. Along other coasts these squids and cuttle fish are not very important and are caught with other fishes in all types of seine-nets.

The Octopi are caught from the Palk Bay lagoons in traps made locally.

The Cephalopods, besides being utilized as food, are also used as bait in hook and line fishing.

23. MOLLUSCANS

The molluscan fishery is of considerable economic importance as a source of protein, as well as a raw material in making lime, mortar and cement and also for ornaments and curios. Clams and oysters, besides mussels are of prime importance among the edible molluscs of India. The chank and pearl oyster fisheries of the Gulf of Mannar and the edible oyster fisheries of the estuaries and backwaters of the east coast and the mussels of the west coast contribute significantly to this fishery as a whole.

Two species of sea-mussels occur in Indian waters; the green mussel (Mytilus viridis Linnaeus) and the brown mussel (Mytilus sp.). The green mussel has a wider distribution occuring all along the Indian coasts, wherever submarine or intertidal rock stretches are present, but on the south-west coast of Kerala the brown mussel is more important. Among the clams, those belonging to the family Veneridae is the most important species in the Indian waters and the major landing areas of the clams are the Maharashtra, Goa and North Kannara coasts, though it occurs all along the Indian coasts.

The sacred chank xancus pyrum, is a commercially important gastropod fished in large numbers along both the east and west coasts, though more abundant on the south-eastern coasts of India. Fishing is carried out mainly by skin diving, although hand picking and net fishing are also prevalent. Being gregarious it forms distinct beds and the most important beds lie in the Gulf of Mannar in the depths of 10 to 20 metres with sandy bottom. In the Palk Bay to the north of Adams bridge chank occurs at lesser depths upto 12 metres in sand mixed with mud. Along the Gujarat coast they are found on or in the vicinities of the coral reefs.

Valuable sources of edible oysters are located in the backwaters of bays and estuaries of Kerala, Tamil Nadu, Andhra and Orissa. The most abundant is the rock oyster Crassostrea cucullata, occuring along both the coasts of India. The window-pane oyster, placenta placenta, known for the seed pearls to produces, occurs in abundance in the Gulf of Kutch, Malabar coast. In the Kakinada Bay, window-pane oyster are fished from a depth of about 4 fathoms fishing is carried out by the plank-built boats. Fishing in the Bay is conducted throughout the year with a peak season in March to May and a secondary peak from October to November during certain years. Pearl oyster occurring

in the Gulf of Mannar and Palk Bay and the Gulf of Kutch, are also edible species besides yielding pearls. In the Gulf of Mannar, oysters settle, and grow on the hard rocky substrate called 'Paars'. Within 10 - 20 metre depth, in the Gulf of Kutch the pearl oysters grow attatched to reefs known as 'Khaddas'. Apart from the traditional grounds, new fishing grounds for chanks and oysters have been discovered which are gaining in importance.

Availability of comprehensive and reliable fishery statistics on regular basis for the country as a whole as well as for each state is an essential prerequisite for planning and development and exploitation of the fisheries. Another equally important field is fisheries statistics research which is lagging behind; this aspect involves application of scientific method of statistics to experimentation and survey in fisheries work which will result in data deviating from expectation by chance. The one item of biological data for which high priority should be given is length data, which can be used to provide an early index of the health of the stock, more detailed assessments and measures of other biological parameters

ex. growth, mortality etc.. Progress in this direction will lead to the over all growth and development of the industry as it will provide, the policy makers with more information on opportunities for increasing catches from under-exploited stocks and on the needs for management of heavily fished stocks and at the operational level assist the fishermen and scientists in locating good grounds and making predictions on the likely magnitude of the future catches.

REQUIREMENTS OF GROWTH

The Ocean research over the last decade has indicated the existence of large under-utilised resources in the Indian waters. However, the present marine fisheries are intensively carried on within 10 fm depth only, there are large gaps in the resource utilisation between 25 and 40 fm depth range and the greater depths beyond 40 fm remain completely unexploited. The developping countries have both advantages as well as disadvantages for immediate utilisation of the living resources of the EEZ. The advantages are mainly in the proximity of the resources making the operation comparatively more economical besides the semi-skilled and unskilled manpower readily available in the coastal states, will also significantly add to the economies of operationsin the gainful employment of the people.

A fishery resource is a self renewable living natural resource in a dynamic habitat. When fishing exploits a resource it changes the mortality and therefore the behaviour of the system, due to environmental changes. The aim of fundamental research therefore is to have a full knowledge of all characteristics of a resource and their interactions with the dynamic changes in the environment in response to changes generated by

fishing, to assess the 'optimum' quantity to be taken from a given fishery resource. The fishing industry in India as in most developed countries is passing through an initial phase of changing over from the traditional to the modern methods of exploitation from the use of indigenous craft and gear to large powered vessels, operating the more efficient type of fishing gear and other auxiliary equipments such as the radars, fish finders etc. Limitations due to climate, absence of suitable harbours and the inadequate refrigeration, transport and marketing facilities are serious handicaps in the way of the development of the marine fishery in India. The fishing season for marine fisheries actually lasts for about five months from September to June, creating problems of seasonal employment, poverty and other related socio-economic problems hindering the growth of this industry. Fishery development is largely determined by demand and market structure, both domestic and foreign. Demand is not altogether an economic problem but also governed by sociological, psychological and political factors.

The marine fishing industry in India is not organised in any way, nor is it localised in any particular area. The industry suffers from lack of judicious management at different stages and systematic planning at various levels. The development of marine

fisheries is thus governed by a large number of factors, obvious and obscure. All planning and management efforts would prove futile unless due importance is awarded to all these determinants, hence the need to study, rationally analyse and understand them.

RESEARCH AND DATA BASE

Resource information is vital to the industry. Policy makers need information on opportunities for increasing catches from under exploited stocks and also on the needs for management of heavily fished stocks and at the operational level fishermen and others need assistance in locating good grounds and prediction of the likely magnitude of future catches. Survey of the fish landings, estimation of resources with a view to determining sustainable levels of the fisheries continue to be an important area of work. It is the rule rather than exception for each kind of fish to have both good and bad 'survival years'. Knowledge of the exact combination of conditions necessary to bring about a good survival would make it possible to predict when another large influx into the fisheries would occur and hence obviate unnecessary glut on the market in the event of a coming good year or direct attention to some more profitable fish before the lean year comes. No rational utilisation of marine living resources is possible without detailed oceanographic studies; knowledge about the hydrographic and biological conditions of the seas

is essential.[1]

The importance of fishery statistics has been recognised only recently in our country and very little action has been taken for strengthening the data base in marine fisheries. The data required to be collected can be broadly classified into five categories:

Resource Statistics:

This category includes:

(1) Catch data: which is essential and is usually collected by sampling; wherever discarded fisheries are important, this data needs to be collected.

(2) Species data : It should be tied to the type of gear used.

(3) Depth-wise and region/state-wise estimates of fishery resources off the Indian coasts and their present pattern of exploitation.

(4) Effort data : Number of crafts and gears, number of landings etc., collection of effort data should be matched with records of the catch taken by that effort, otherwise later interpretation is difficult or meaningless.

(5) Information about shore-base construction facilities.

(6) Human resources like fishermen population, family-side, literacy etc.

---

1. J.A. Gulland, "The Management of Marine Fisheries", (Seattle, 1974), pp. 106 - 110.

(7) Financial resources and their availability etc.

Production Statistics:

(1) Consists of state-wise/district-wise fish landings in terms of quantity and value.

(2) Manufactured fish products.

Infra-structure Facilities Statistics; regarding the number and capacity of :

(1) Ice plants.

(2) Cold storages.

(3) Freezing and canning plants.

(4) Fish meal plants.

(5) Fish pulverisers.

(6) Dry and curing facilities.

(7) Retail and wholesale markets.

Trade Statistics: This category includes information on :

(1) Prices (both in producing and consuming centres) fluctuations, trends.

(2) Flows according to uses and locations.

(3) Price spreads and number of different types of market intermediaries.

Information Collected for Regulatory Purposes :
This encompasses all the three segments - production, marketing and consumption.

Statistics for utilisation demand and supply throw light on the manner in which the available production is utilized. Statistics on manufactured fish products are necessary for estimating the contribution of fisheries to available food supply and for measuring the trends therein besides providing a fair knowledge of about the regional distribution of available production in relation to demand in different areas. For making assessments about the potential resources it is necessary to have statistics on new and under-utilised stocks and their distribution and densities, correlation of these features with environmental factors, behaviour of different stocks to various types of catching methods, fishing pressure and changes in the environment etc. Collection of meteorological data would contribute much to fishery operations through both long-range forecasting and better short-term forecasting about the interaction of the atmosphere and the ocean.

Scientific studies should lead to the preparation of periodic, comprehensive reports on the health of the ocean, in order to assist the government and individuals to collectively take required steps to counteract its effects. Statistics on resource exploitation would help in formulating required conservation policies. Information on demand and trends in the markets will lead to a better information on which to base an improved assessment not only of the natural resources,

but also of the likely demands on them and their societal implications, thus help in making future projections and give direction to the marine sea food industry.

Deep-sea fishing is a risky venture and at present level of information it is not convincing enough to induce private capital in this area. It is essential to take-up a time-bound programme of intensive and extensive survey of the entire Indian EEZ and to prepare fishery charts indicating productive fishing grounds based on these surveys. In India, mostly more than two organisations are involved in collecting data which leads to a lot of duplication of effort, resulting not only in increased cost of data collection but also make acceptance of such data doubtful due to the non-comparability of the data from different sources.[2]

The data collected is not compiled systematically and there are considerable gaps in the information, for; data on fish production is non-existent at the district and centre level; census of fishermen population at village level is not available; although 57 percent of the marine fish is consumed after processing, however information on capacity utilization of fish plants is

---

2. M. Dharma Reddy, V.R. Bharathi and Amerjeent Singh, "Data Base in Marine Fisheries: An Overview" (Paper presented at the National Seminar on Fisheries Development in India, Ahmedabad, IIM, April 9 - 11, 1982), pp. 2 - 8.

FIG:5

STATE WISE DISTRIBUTION OF FISHING CRAFT - 1981

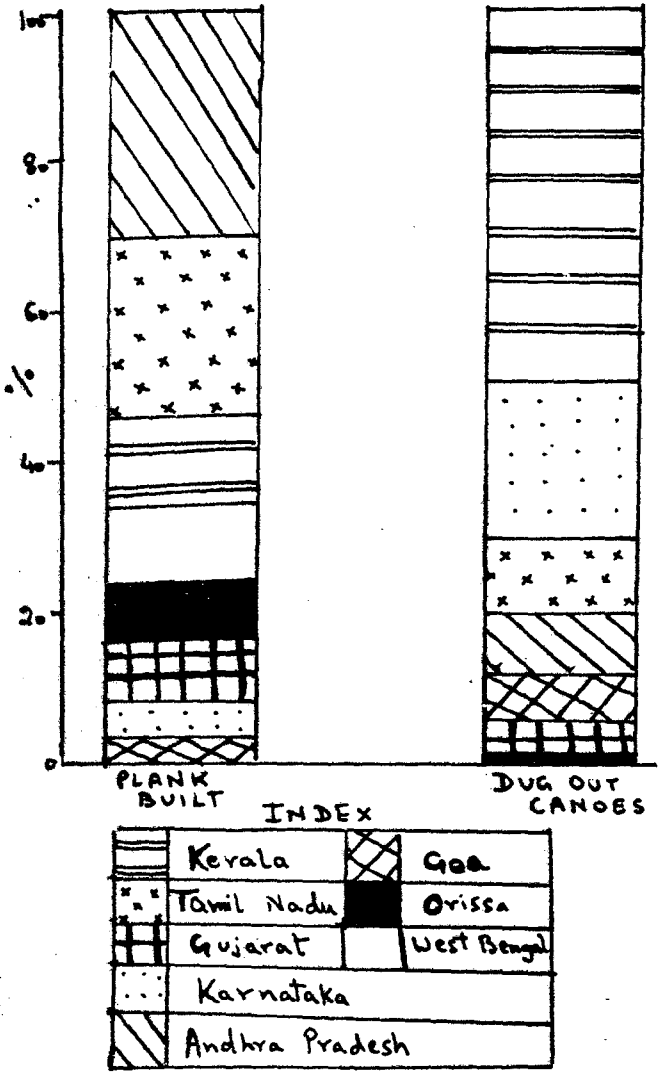


FIG:

STATE WISE DISTRIBUTION OF MECHANISED BOATS - 1979-80

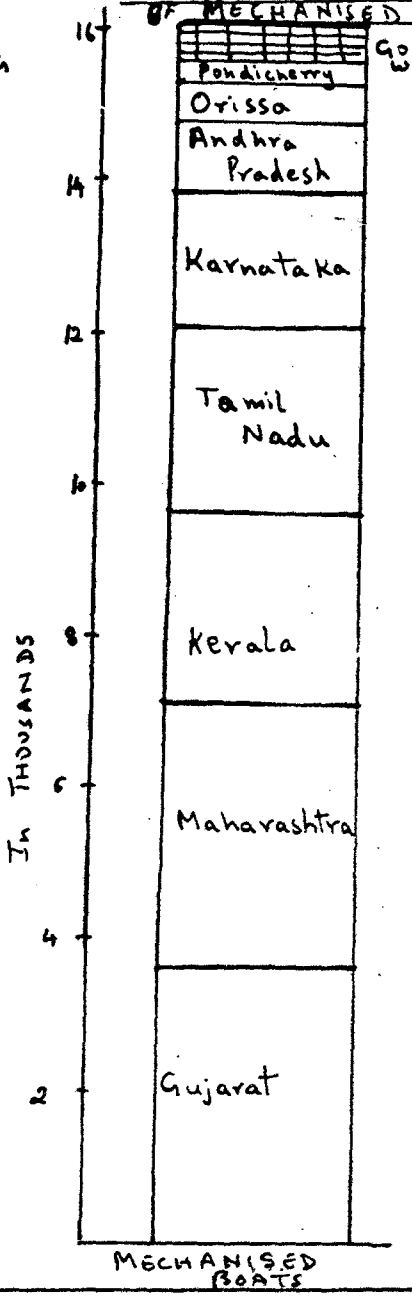


TABLE : III a

States	1980 No. of Mechanised Boats
A. Pradesh	850
Gujarat	3646
Karnataka	1750
Maharastra	3525
Orissa	500
Tamil Nadu	2429
W. Bengal	107
Andamans	8
Goa	245
Lakshadweep	214
Pondicherry	286
Total	16100

TABLE : III b. FISHING CRAFT - 1980

Items	Total
a. Mechanised Trawlers	6288
Total	9289
b. Non-Mechanised	
Plank-Built	37904
Dug-Out Canoes	21684
Catamarans	73431
Others	1722
Total	134741

not available in most of the states; fish distribution system is mostly in the hands of the private sector which has led to an improper and inadequate data-base system; the estimates of resource potential of each maritime state/region is very scanty. As such the concerned research sections will have to be strengthened and refinements in methodology and techniques attempted to obtain more information on a continuing basis.

Appropriate budgetary provisions commensurate with the needs for the establishment of a proper statistical system for obtaining reliable fishery statistics will have to be made for fishery research is a national responsibility in the context of the EEZ and the extended national jurisdiction, for example in the present situation it becomes increasingly important to know about the health of the oceans and the migration of fish across the new man-made boundaries, a factor which could in the near future become the cause of international and regional conflicts.

FISHING CRAFT, GEAR AND FISHING METHOD

According to a study conducted by the IIM Ahmedabad, 70% of the total marine landings and 30% of the shrimp landings at present are effected by indigenous country craft. Many fishermen still depend

on their traditional dug-out canoes, catamarans and "machwas" to fish in shallow seas with their primitive nets. With these primitive methods of fishing, the catch is neither better in quality nor adequate in quantity, besides they are always exposed to the problems of vagaries of nature, heavy sea-conditions, seasonal catching and migratory nature of fishes. They are unable to pursue the migratory shoals as their crafts and gear are unfit for this purposes, and hence Indian fishermen obviously cannot fish in the deeper waters and such resources for example, shipjack, seer-fish etc. cannot be optimally utilized. The advent of out-board engines since last 3 - 4 years has helped the small fishermen operating such country craft to increase the production of fish by enabling them to reach the fishing grounds faster and operate for longer periods, thus gaining in actual fishing time. Boats fitted with out-board engines are able to land 1000kgs of fish as compared to the 700 kgs landed by boats manually operated. Since there is no indigenous manufacturer of these out-board engines and all have to be imported so the ultimate price paid by the fishermen is substantially high. Considering that the operators of country craft belong to the economically weaker sections and that the increasing use of out-board engines will improve their productivity which will lead to an increase in the production, complete exemption of

import duty on out-board engines should be granted.

Our fishing vessels are mainly built of Indian timber, subject to severe damage due to attack of wood boring and fouling organisms. Due to the increase in demand for timber, the cost of timber has risen sharply and will continue to rise. To deal with this problem fibre-glass boats, canoes and catamarans could be introduced; which as several advantages like -

(a) facility for mass production,

(b) light weight and high strength,

(c) protection from corrosion,

(d) very low incidence of borer-attacks,

(e) increased pay load capacity,

(f) low maintenance cost etc.

One of the major areas of development of marine fisheries has been the introduction of mechanised boats where the engine power is used for shooting and hauling nets. Today most of our mechanised boats are trawlers mainly concentrating on shrimps, at present we have nearly 300 small purse-seiners, some of which catch 1000 tonnes in the course of three months, as against 5 tonnes or so by an ordinary unmechanised boat.

The state-wise data on the distribution of mechanised boats shows that there is heavy concentration of mechanised boats on the west coast compared to the east. (FIG: 5 , TABLE III a)

For bringing the catches quickly from the fishing grounds to the shore, a mechanised boat is the obvious solution. To get better economic returns it is necessary that the fishing boats should be well designed and diesel powered.

With a view to exploiting the potential in off-shore regions, the Government of India has from time to time introduced schemes for import of trawlers. As per the 1980 estimates, there were 141 deep-sea fishing vessels; out of which 28 were small (14 to 18 m. length), 109 were medium (18 to 30 m. length) and 4 were large (30 to 40 m. length); however at the time of the revision of the 6th plan, the number of large vessels was only. 57.

The unsatisfactory progress in introducing deep-sea vessels has seriously stood in the way of achieving the required growth in the industry.

For the optimal utilisation of our EEZ the fleet should be so adjusted that their annual fishing effort and the annual stock available for exploitation more or less equalise. By the year 1980, the Indian fishing fleet consisted of about 152000 mechanised fishing boats and 100 large fishing vessels.[3] The

---

3. N.P. Bhakta, "Development of Infra-structure Facilities for the Optimal Utilisation of EEZ" (Paper presented at the National Seminar on Fisheries Development in India, Ahmedabad, April 9 - 11, 1982), p. 5.

Government of India had planned to increase the total fleet to 19,000 small and medium boats and 350 large vessels during the 6th plan. Mechanised boats cut down the costs considerably and increase fish yields. TABLE shows the estimates of total fleet required for the optimal utilisation of our EEZ.

Keeping the problems in view, charter arrangements will have to be the immediate practical means of bringing deep-sea area under levels of exploitation commensurate with the achievement of the targets. Currently about 80 mechanised foreign vessels, are operating in the Indian seas. Strict norms have, however been laid down by the Union Government regarding the operation of these ships in order to effectively safeguard the interests of the common fishermen who generally confine their activities to the near shore waters. The foreign vessels chartered by Indian companies are allowed to fish in the EEZ but only beyond 23 kms of the coast line.

The appliances used in fishing in the seas are mostly nets of various sizes and designs, besides lines and hooks are employed for catching large fishes off-shore. The traditional fishing gear like gill nets and entangling nets, shore seines beach-seines etc. continue to be in operation in different parts of India. Modernisation of fishing gear is essential for the development of the fishing industry.

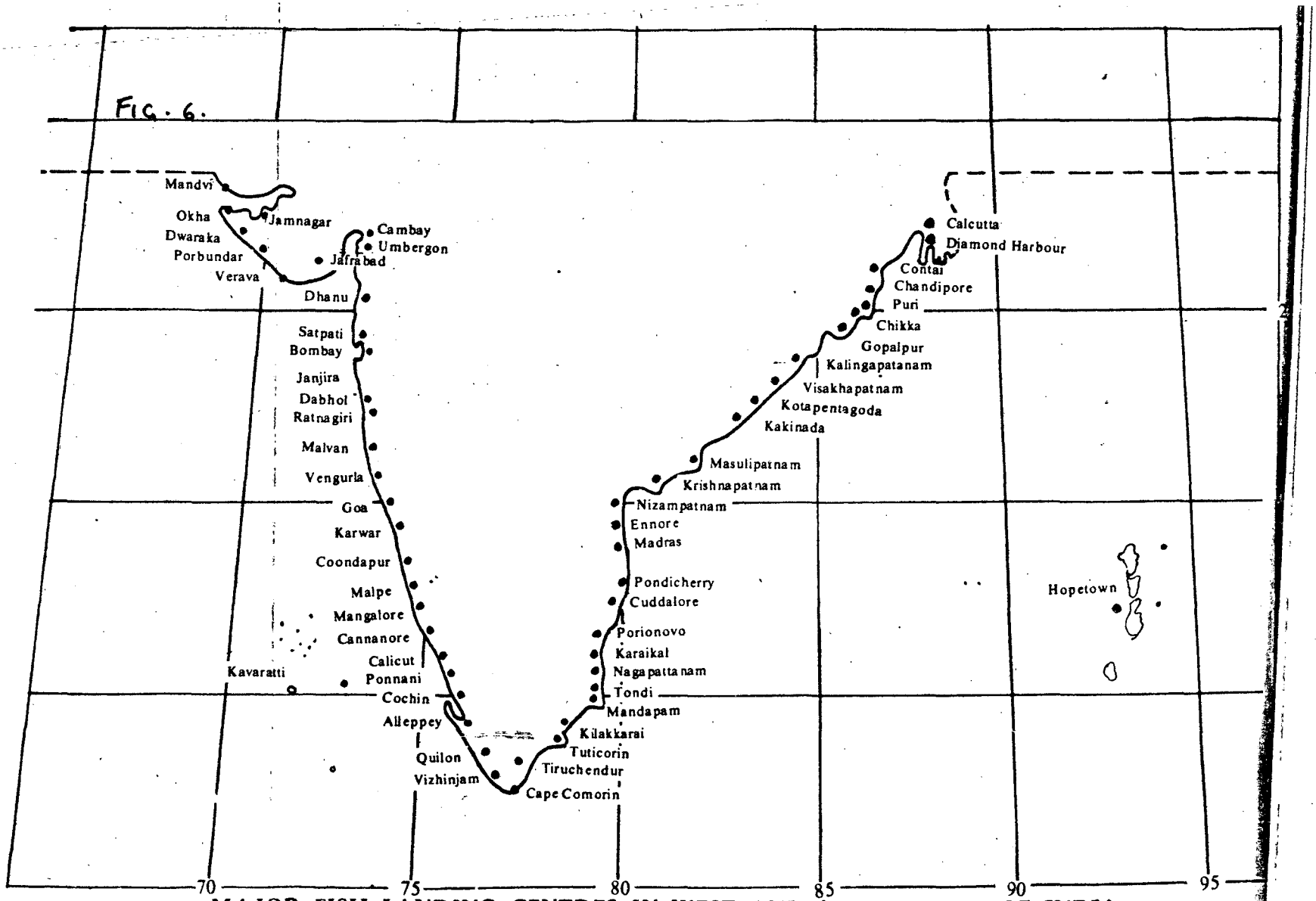
TABLE III a,b,c, FIGURE 5. gives an account of the state-wise distribution of fishing craft.

Technological research for designing and testing craft and gear has to take rapid strides in improving efficiency and economising expenditure as non-powered indigenous craft using traditional types of fishing gear continue their operations to the limited but over-exploited narrow about 11 km shallow region bordering the coastline with meagre yields per unit of effort expended.

Diversification of fishing effort is yet another important area. Apart from trawling and purse-seining, methods of fishing such as two boats bottom trawling, single and two boat mid-water trawling, mechanised gill-netting, long lining, trap fishing, floating raft-attracted and light attracted fishing are potentially viable lines of diversification, for which preferential subsidy, and training should be given.

There is a need to diversify the deep sea fishing techniques from the conventional demersal trawling. The new fishing techniques which would be promoted are mid-water trawling, purse seining and squid jigging. Considerable improvement can be achieved even on existing gill-net fishing by improving the hanging co-efficient and selection of appropriate mesh and twine size. Hard lining can be extended to

FIG. 6.



MAJOR FISH LANDING CENTRES IN WEST AND EAST COASTS OF INDIA

the distant waters by using mother vessels equipped with echo-sounders. Introduction of accoustic equipments is yet another line of modernising the fishing industry. The powerful echo-sounders can send echoes upto a depth range of 4000 metres. These echo sounders can sense the presence of fish in the path of its sound-pulses between transducer and the bottom.

Fishermen will be able to predict the productivity of these grounds by utilizing such echo-sounders fishing will have to take a change from "blind fishing" to a targetted fishing in many areas. More sophisticated accoustic equipments like the sonars, netsonde, trawling presently in vogue in many countries have yet to be introduced in our waters on a large scale.

INFRA-STRUCTURE

1. Harbours and Jetties:

In the context of the rapid expansion of the fishing fleet, envisaged, the provision of adequate fishing harbours and landing jetties assumes importance. Without a sheltered harbour, boats cannot be safely anchored during the stormy monsoon months when high waves and lashing surf creates extremely dangerous conditions for the small boats. Fishing harbours should contain, the following facilities:

(a) Landing quays for quick and hygenic unloading of fish with sufficient sheltered back-space for landing, cleaning, sorting, weighing and display of fish sations.

(b) Berthing jetties for idle berthing of boats and to replenish provisions and fishing gear required for the next voyage.

(c) An outfitting quay for quick replenishment of diesel oil, potable water and crushed ice.

(d) Repaid quay and service facilities for conducting necessary routine maintenance and repairs to the engine and boat.

(e) The depth required alongside the quays and jetties should be ensured for the vessels for whose operation the harbours are designed.

(f) Slip ways or sloping yards for hauling up boats with workshop facilities for conducting major repairs and annual maintenance.

(g) Fish auction hall close to the landing quay for cleaning, sorting, weighing, display and auctioning of fish.

(h) Ice plants, chilled rooms and cold storages for supply of ice and storing chilled and frozen fish close to the landing and outfitting berths.

(i) Sufficient area for establishing processing plants, auxiliary industries and fishing hardware stores, with proper roads connecting to these industries and other facilities.

(j) Uninterrupted power supply.

Though there are 50 ports dotted along the eastern and western coasts, many are still under various stages of construction, others do not have necessary facilities. There are no more than 3 all weather adequately equipped fishing ports; Bombay (Sassoon Dock), Cochin and Vishakapatnam.[4] The only fishing harbour capable of handling deep-sea fishing vessels in India for the present is Vishakapatnam which is accomodating the entire fleet of deep sea fishing vessels [illegible]. For any worth while fisheries development programme, the primary need is to have sufficient number of fishing harbours with full facilities, and for expansion of deep-sea fishing fleet, it is essential that priority is given to the completion of as many harbours as possible. (Fig. 6)

Although mechanised boats of varying sizes have been launched in large numbers during the last few years, yet adequate workshop facilities like dry docks and slip-ways for the maintenance of the fishing fleet are not in existence. Owing to the absence of such facilities many vessels remain

---

4. Times of India (Delhi), 4 January, 1982.

stranded and idle for several days and weeks; it is therefore imperative that adequate work-shop and repair facilities should be provided in all the major landing centre. As compared to the existing facilities available the requirements for different categories of ports is large (TABLE III c).

2. Handling and Marketing Facilities

Traditional fishermen are engaged in fishing only, for the disposal of their catches, they are dependent upon their household members or the fish merchants. Even though the country has increased its fish landing considerably, good wholesale or retail markets are very few, sometimes just a vacant plot of land near or away from the landing centres. Facility for marketing of all catches - exportable as well as non-exportable, alone can render fishing operations economically viable. At every fishing port auction and packing halls should be provided to enable the landed catch to be cleaned, sorted, weighed, iced and dispersed for auction under shelter, soon after the fish has landed to ensure minimum deterioration due to exposure to the sun. After auction a part of the catch can be packed in the packing hall for sending to distant markets.

Many fishing villages are situated in remote rural areas and due to lack of handling facilities, these fishermen are forced to land only sufficient fish which they can dispose off immediately. Provisions of ice plants and cold storages have to be made for fish is a highly perishable commodity and besides the climate too is sub-tropical. Ice is needed by (1) the fishermen for being used in the boats, (2) the distributors and carriers to be used in lorries, for transport to the processing plants and (3) the processors and packers for use in their peeling sheds and plants. Although there are a number of ice plants in different parts of the country, ice is still not available in adequate quantity and at reasonable prices in all the landing centres; particularly during the peak seasons. In some strategic centres ice storages should be put up, where ice could be stored in advance and released during peak landings, besides the fishermen should be educated about the benefits of usage of ice. (TABLE VIf.)

Refrigerated transport and freezing facilities for movement of fish in good conditions to consuming areas will ensure a balanced relationship between demand and price. For the transport of frozen cargo over long distance it is necessary to use refrigerated transport. At present insulated transport is being used which is not sufficient to maintain quality of the product.

There are large sections of the Indian population to whom fish simply is not available, or at least only rarely available, because satisfactory arrangements do not exist for the treatment, storage and distribution of fish. In India about 50 percent of the fish supplies are consumed fresh, which means a very limited area of distribution mainly among coastal communities. Well connected transport system (feeder roads) and linking of the markets with the landing centres is essential, leading to both accessibility and availability.

Cold storages and freezing plants should be put up in all important ports of sea food export as well as in centres catering to home markets, which will reduce wastage through spoilage for example frozen fish on board can be immediately put in the frozen storage. Overseas warehousing is yet another step which would lead to the growth of the fishing industry. Overseas warehouses have the following advantages:

(1) facilitate realisation of better prices;

(2) ready regular and quick supplies at short notice from the stocks available in the warehouse;

(3) due to larger stocks being available in the warehouse, it will lead to the reduction of prices;

(4) the ware-houses would serve as focal points for publicity in foreign markets for Indian marine products.

TABLE give an account of the present infra-structural facilities available and the state-wise requirements and clearly indicate the need for expansion in this direction.

3. Processing, Packing and Quality Control

One of the most obvious and most practical way of increasing our food supplies from the fisheries is by improvements in preparation and utilisation. Diversification of products is the urgent need of the hour in the current situation. This is a very difficult task as it involves the identification of the right product for the right market at the right price. Fish landed in a condition unsuited for human consumption is often discarded, during the processing of fish, low quality fish which do not fetch a good price in market, shells of prawns and other shell fishes, sea weeds etc. form important raw materials for a fishery by-product industry. At present the by-products are divided into three categories: (1) protein products (2) fat products (3) miscellaneous products. (TABLE III g.h.)

Sun drying and salt curing have been the traditional processes of preservation of fish, and the bulk of the miscellaneous fish landed is still being utilised by these processes. India has very few commercial dryers, and only a negligible portion of fish is being processed

in artificial driers. Compared to other products (frozen and canned) dehydrated fish is more concentrated in protein. However, traditionally cured products vary widely in quality especially in the moisture and salt levels; infection by fungus, bacteria and maggots and insects is very common. Salt or salt mixture used by the curers also vary in composition. Technologies should be made available to the fishermen for the production of even non-traditional dried fish products which have better scope for export for example, Bombay duck and squids.

In the early stages, sufficient technical know-how and transportation were not available to the sea food industry, with the result that several complaints were reported from foreign buyers regarding quality of our fishery products. Since the markets for sea food are very competetive and becomes foreign buyers demand high standards, it therefore becomes imperative to have quality control in the sea food industry. The complaints mainly relate to lack of freshness, under-grading and short weight, therefore, samples should be taken at various stages and get analysed, besides tightening the present inspection system.

A few years back when the shrimp trade was lucrative, a large number of processing units were set-up all over the country, making use of the liberal credit facilities from banks and without taking into

account the availability of raw material for the industry. This haphazard expansion in the processing capacity has resulted in many of the units now idling due to lack of raw materials. Of the existing freezing capacity only around 15 percent is being utilised. As regards canning, there are hardly 6 units actually working in the whole of India, which has resulted in intense competition for procurement of raw shrimps, even at exorbitantly high prices; which has further led to the emergence of certain malpractices viz. mixing the grades and counts, processing sub-standard quality material, resorting to underweight etc. It would be in the interest of the healthy growth of the industry not to permit the establishment of additional shrimp processing units; shifting of the existing units which are under utilised to areas adjacent to major landing centres should also be encouraged.

Most of the quality problems in marine products arise due to the inadequate standards of hygiene at the primary levels of catching, handling and processing of which our fishermen and workers are not aware. Ultimately the quality of our marine products are dependent on the infra-structure facilities.

At present most of the processing plants do not have any laboratory facilities for checking the

quality of raw materials or the finished products which is one of the minimum requirements in any modern processing plant handling perishable food products and it should there be made compulsory for the processing units to have attached laboratories. If a single processing unit finds it difficult to set up laboratory facility, a group of processors can join together and set up a common facility laboratory.

Quality problems are also related to packaging because due to the lack of facilities for mechanical handling and loading (into the ships) the cartons get damaged because of rough handling. Thus Indian products generally have a poor appearance and presentation, when unloaded at their destinations, as against this the packages received from other countries, are in master cartons made out of excellent card boards and show very little trace of damage in transit. Poor packaging thus becomes one of the reasons why Indian products fetch relatively lower prices in the export markets, there is thus a need to develop packaging standards not only for foreign markets but even domestic markets.

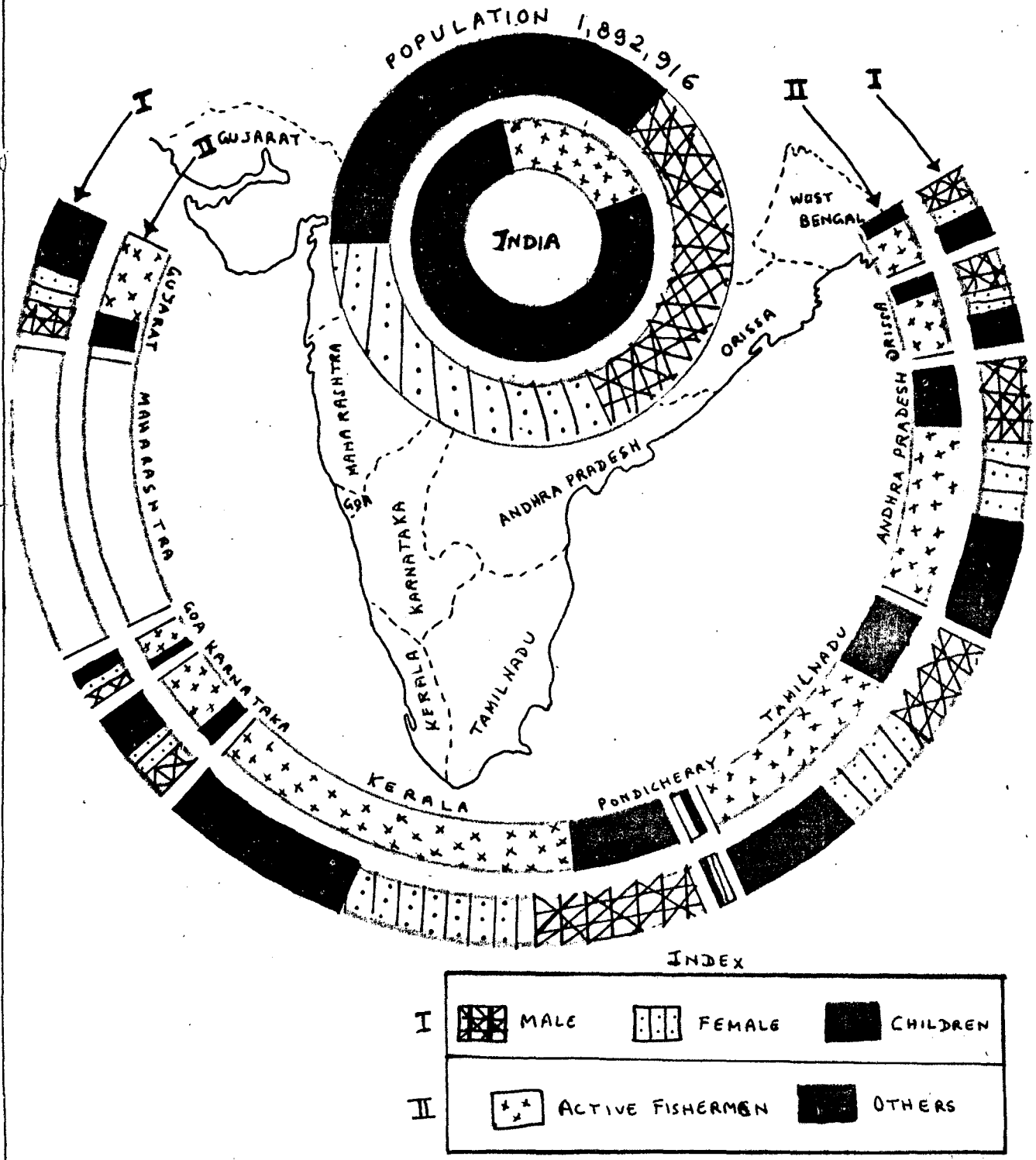
SOCIO-ECONOMIC CONDITION OF THE FISHERMEN

It is estimated that over a million fishermen derive their sustenance from fishing while many more keep themselves engaged in auxiliary vocations, like

net-making, fish processing, transportation and trade etc. Though fishermen are engaged in this profession for more than 2000 years, until recently no adequate attention has been paid to improve their economic conditions and they form economically among the weakest sections of the Indian population. Despite their incessant efforts, dexterity and skill, their earnings on the whole are still at a lower level when compared with other industrial workers and professional groups. Their opportunity earnings are very low, most probably due to their immobility to other occupations and also do not get a good share of the consumer price.

Since they come from weaker sections of population, they lack the necessary monetary resources and organisational capacity required for better organisation of fish production. Besides they always maintain the deficit budgets due to lower incomes therefore they borrow money from money lenders or fish merchants at high rates of interest; thus getting involved in the vicious circle of indebtedness and poverty, fostering exploitation, which in turn makes the fishermen continuously depend on money lenders cum traders.

Fig. STATEWISE DISTRIBUTION OF MARINE FISHERMEN POPULATION IN INDIA - 1980



The plight of the Indian fishermen who earn Rs.1 crore a day as foreign exchange for the nation, but themselves continue to exist in abysmal poverty, is pathetic. According to a study by the FAO, 12 crore fishermen contributing well-over Rs. 361 crores as foreign exchange earnings through their toil, risking their lives in the open sea, hauling 70 percent of the total marine fish landing by their traditional craft have become bonded labourers to petty traders, multi-national companies and monopoly houses. In the absence of a separate agency to separate specific funds fishermen who are exploited by the middlemen, still remain disorganised, educationally very poor and socially backward.

For the 12 crore fishermen, the average per capita income is Rs. 40 per month. For every Rs. 100 worth of fish bought the traditional fishermen get Rs. 39, whereas the middlemen get Rs. 61. The fishermen have been classified by all states in the Indian Union as living below the poverty line. The participation of women in their traditional occupation is 100 percent.[5]

TABLE gives the fishermen population of India and their educational status. The number of persons per family works out to be 5.7 for the whole

---

5. Renu Mittal, "Fishing in Troubled Waters", Surya, February 15, 1984.

India. In Karnataka it records the maximum (7.2 persons per family). Most of the fishermen are illeterate and therefore unexposed to modern technology and techniques. They live in very unhygenic conditions and poor surrounding have very inadequate health facilities, all of which together act as a major handicap in the development of the fishing industry.

Due to lack of education, improper management and neglect the fishermen suffer from a high degree of exploitation which has become highly institutionalised, mainly by the middlemen who get away with 50 - 60 percent of the gross income generated in this sector.

A report prepared by the Task Force on the marine products, appointed by the Commerce Ministry in September 1983 has observed that 75 percent of the landings were from the traditional fishing crafts, while those from mechanised crafts was just 25 percent of the total exports of marine products the share of the big houses, including multi-national companies in 1980 - 81 was 10.84 percent. From this it is evident that the backbone of the marine products industry is the small scale sector, which has continued to exist in spite of having been outside the main thrust of planned fisheries development. Competition between the

traditional fishermen and multinational has lead to various conflicts. Small-scale fishermen have little understanding of the need for management but depend on their participation in the fishery for their sparse livelihood. Considering that fishing is often a part time occupation, the need to consider fisheries in the content of an integrated rural development plan gains particular importance. The development of acquaculture and mari-culture will not only provide an additional source of income, employment and cheap animal protein but also help to ease the pressure on over-exploited coastal fisheries. The present situation demands the integration of small-scale fisheries into an overall plan for rural development, which might help in breaking the isolation of the small-scale fishermen. Besides it is likely to foster greater participation of the community, women in particular and help in reducing regional inequalities.

There is now a wider acceptance that fishery management does not deal with fish or with fish and money but with fish, money and people. This wider prospect is particularly applicable to inshore fishing. The coastal communities which these fisheries support seem particularly exposed to social and economic problems. Mostly the interests of the small-scale fishermen are ignored, and it is the small scale

fishermen and their families who suffer most from the present governmental policies. Policy makers are not always aware of the social and economic complications of promoting the development of fisheries in the coastal zone. These social and economic impediments often prevent development plans from being successful, the main cause being that the human resource base is not adequately understood. Compounding these difficulties is that we do not adequately understand how local communities percieve their coastal zone, perceptions which can either strengthen or weaken a development programme.

It is necessary to establish better mechanisms by which the interests of the small fishermen are looked after. One of the aspect of marine fisheries development in India is the formation and running of fisheries cooperatives for preventing exploitation by middlemen, for the middlemen who provide the prequisites take as much as 50 percent of the net sale proceeds as charge on hire. Creation of Welfare Funds for fishermen and a national fishery bank, which could lend adequate finances to the fishermen at low rates of interests, would be yet another step in this direction.

EDUCATION AND TRAINING

Education in fisheries should be encouraged so that the trained will be able to implement modern

fishing techniques. This will enable the fishermen to a great extent to increase fish production in particular and development of the industry in general. The fishermen have kept a rich heritage and customs of fishing profession, and have remained as a distinct class of professionals. Their vast experience on the sea will prove very useful in conversion of their skills to modern techniques of fishing and they can easily take to deep-sea fishing and advanced fishing methods provided they get a short term training in those techniques. Besides, they should be taught simple techniques in the processing technology such as handling and preservation, which will result in less wastage and spoilage and quality improvement.

Trained personnel is required at three levels:

(1) for planning, designing and organising statistical data collection programmes;
(2) for collection of data in field;
(3) for processing and analysing data.

Fisheries colleges like the one in Mangalore should be set-up, with facilities for practical training in the manufacture and maintenance of fishing equipment, processing, freezing and canning. Training of fishermen to increase their skills is necessary.

Efforts should be directed towards educating the masses about the calories and nutritional values

of fish at relatively cheaper price, media and publicity campaigns would prove useful. It is essential to elaborate a public education plan that will provide a functional means of bringing about public consciousness of problems and concern for the resources and its future related to the public welfare. Such a programme would create and foster the public support to assure its adoption and implementation and teach that any change in fishing or management or allocation is closely related with the ecological balance. Education would also help in involving both the masses and the fishermen in the areas of conservation and reveal the drastic repurcussions of marine pollution.

POLLUTION

It is perfectly clear that man through his numbers and his actions, is having increasingly pronounced effects on organism populations and the entire ecosystems. The process of entrophication often happens rapidly enough to make every one aware that an ecological catastrophe has occurred. It is a contradiction in terms to speak of throwing away 'something', it must go somewhere, if it cannot be broken down it will naturally be returned to us in some form or the other. The marine environment is particularly susceptible to pollution because most avenues of disposal

terminate in the oceans. Water has a great capacity to purify itself, but when an acquatic system becomes too heavily loaded the results can be disastrous. Pollution is an insidious process which may continue for years with an apparent effects until the rate of discharge exceeds the capacity of the system to recover. Different pollutants have different effects on the living acquatic organisms and on fisheries, for some stimulate the growth of plants and could have been beneficial if properly controlled, while some are toxic and can kill acquatic organisms or make them unfit for human consumption. Pollution can result in the reduction of stocks by spectacular mass mortalities, gradual decline or change in the composition of populations or whole ecosystems as a result of interference with fundamental life processes, increased competitiveness of individuals and increase occurrence of diseases. Effects of pollution on the acquatic ecosystem are the most difficult to establish, as each environment (coastal, estuarine etc.) is somewhat different and each species inhabiting any given environment have evolved over long periods of time and each species have their own role to play.

Any additional stress, whether natural or man-made will tend to eliminate some species leaving only the more resistant and tolerant forms to survive; the effect may be direct on the species involved or indirect by the elimination of a food supply.

Fishing gear and operations may be adversely affected by various kinds of pollutants. Over-fertilisation may cause fouling and clogging of nets, traps and other fishing gear by masses of macro-algae or other plants and animals drifting in the water or using the material as substratum.

The following table gives details about the present status of marine pollution in India.[6]

1. Coastal Population	:	155 million (approximately 25 percent of the total)
2. Land Area	:	3.276×10^6 km^2
3. River run-off (annual)	:	1645 km^2
4. Rate of Sewage production per person per day.	:	(1) Metropolitan Areas - 120 litres (2) Non-metropolitan Areas - 60 litres
5. Total Additional Sewage Waste to the Coastal water	:	35 km^3
6. Industrial waste added by Coastal industries. (10 percent of the total domestic sewage)	:	3.5 km^3
7. Solid Waste added by Coastal Population (1.7 kg. per person per day)	:	96 million tonnes per year

6. B. Patel, ed., Management of Environment (New Delhi, 1980), pp. 510 - 11.

8. Total industrial Wastes of Inland Origin added to the sea, via., the Indian rivers.	:	0.1 km^3
9. Total addition of Pesticides to the sea (25 percent of the total production)	:	62500 tonnes per year
10. Total addition of detergents to the sea (25 percent of the total production)	:	27500 tonnes per year

---

Nearly 60 percent of the world's crude oil and its products are shipped along the oil tanker routes across the Indian ocean and the fact cannot be ignored that these must be definitely contributing to the pollution of the marine environment through spillage, leakage, dumping etc. Such enormous quantities of pollutants when added to the seas around India will undoubtedly have some effect on the water quality of marine environment.

The growing population and establishment of new industries both these trends will obviously lead to pollution problems in the near future, unless adequate management measures are initiated at once. The ideal solution to aquatic problems is to develop means whereby wastes can be recovered and to do so in a way that will improve the aquatic resources and environment. Waste products such as toxic heavy metals cannot be used for

enrichment of the environment and these must be removed from affluents at the source. It should however be possible to use non-toxic domestic sewage and waste heat for this purpose under favourable conditions, for example, aoqua-cultural production can be substantially increased by the controlled use of organic pollutants as fertilisers.

All kinds of environmental contamination whether accidental or deliberate need watching. In case of ocean pollution what we need is a good deal of information about the consequences of the contaminants that are being discharged into the sea; and can be prevented by rational policies based on research and monitoring. At no cost should the environmental effects be over looked, as has been the practice by the planning authorities in the developing countries with pressing needs for housing for the growing urban populations and the establishment of industries, because it could lead to irreparable damages and repurcussions and adversely affect the growth of the marine sea food industry.

CONSERVATION

Man's concepts of the ocean are so illusive, that there is a tendency to consider marine resources as being unlimited and inexhaustible which is very inaccurate, with respect to living resources there are

already signs of depletion in some fisheries. Fishery resources in our country are open for commercial exploitation by any fishing vessel and this situation in the absence of regulatory measures leads to over exploitation. Conservation implies the rational use of the environment so that it provides a high quality of living for mankind. It is the planning and control of man's environment with a consideration of the long range future. The major problem of conservation and the major threat to the human environment is from the 'continued increase' in human populations. In view of the rapidly multiplying Indian population, we can infer from the present performance that increased fishing effort is inevitable and even over-exploitation unless checked.

Over-fishing results in the reduction of the stocks to such a low level that their annual increment or yield is not worth fishing. The concept of "over-fished" stocks follows that there is some level of fishing effort which will maintain the stock and its yield at an "optimum level". It is the object of such fishing regulation and of fishing treaties to reduce effort to this level by means of quota or closed season. It is important to govern closely the intensity of fishing each year. Heavy fishing by reducing the stock of many of the most valuable fishes can actually reduce the catch in all subsequent years, unless by abstention the fishermen allow the stock to grow to its "optimum" size.

It is significant to note that the degree to which a stock is exhausted depends upon economic considerations. When the stock is reduced, fishing becomes more expensive per tonne; since fish are harder to find and their density in the water is reduced. The pressure of fishing then tends to decrease, although the smaller catches may fetch a higher price; this works in the opposite direction causing the fleet to redouble its effort, as a result fish that are cheap to catch or those that have a high value per fish may soon be over-fished below their "optimum" level. But less valuable fish may be kept by the industry at an "optimum" biological level without any regulation being necessary. In every ecological system there are natural limits to the total amount of living resources exploited. Conservation of an existing stock is much easier than building a new one.

The two main aims of fish conservation are :

(1) To secure to mankind a continued supply of fish sufficiently large to meet the demand.

(2) And to maintain a paying fishing industry of which the second aim should be given first priority not only for its own sake, but also for the sake of achieving the supply needed.

In India, the marine fish landings have shown a declining trend and the total landings are not in proportion to the increase in effort. In the case of shrimp, the total

landings have virtually remained stagnant over the last four years. At present there are no strict conservation measures and all the maritime states have been adopting an open-entry policy for marine fishing. Regulation of fishing in the inland and territorial waters is vested with the state governments, different states pursue different policies and a united national policy in this regard is yet to be implemented. The stagnant shrimp landings might be indicative of the realisation of the maximum sustainable yield in this species in certain areas; further increase in effort in this case would result in only lesser economic returns, the reduction in effort could be achieved by limiting the number of boats in operation. An area which requires urgent conservation measures is the fishing in the backwaters and estuaries, where the stake-nets are in operation. These catch early juveniles of all prawns entering into the estuaries and backwaters. An indirect measure of conservation which can be thought of from the export angle, is a blanket ban on the export of 'broken' grades of shrimps from which large size "moulded" shrimps are made. India is a main supplier of this grade, which however has a depressing effect on our export prices, if the 'broken' grades are banned from exports it will have a healthy effect both upon the foreign exchange earnings and exploitation.

Conservation of natural resources is not the responsibility of a few, but every individual or organisation must share in the task of preserving the resource base upon which a particular economy has been based. It is the major responsibility of education and media to involve the masses in this process.

Environmental management should become a tool for development for the solution to the environmental problems would lead to higher living standards in the long run. Physical planning should be a part of an integrated approach to environment management. Comprehensive environmental analysis should precede decisions concerning the location of any major industry or activity. As far as possible legislation should be based on sound scientific knowledge.[7]

DEMAND

The rapid increase in demand for fish is due to the fact that the per capita increase in fish consumption is expected to be greatest where population increase is fastest and where consumption at present very low. In such circumstances even small increase in per capita income can have very large effects on

---

7. Raymond F. Dasmann; Environmental Conservation (Canada, 1959), 3 edn., pp. 210 - 35.

the demand for fish. Much fish consumption depends on the price and the price on technology and supply. If fish were to become more expensive related to other food, it would become even more difficult for people who are in need of more fish, to obtain this essential component of their diet.

However, increased production is not needed to solve the food problem alone, particularly with regard to marine fisheries, for protein supplies are on an average far in excess of the needs for this particular type of food. Food consumption and particularly protein consumption is not restricted to a nutrient motivation in man, but there are a number of underlying factors. Why people eat; what they eat and how much they eat are controlled by sociological economic and political factors.

For the development of the marine sea-food industry it is necessary to create demand both domestic and foreign. In order to increase consumption of fish as processed fish product it is necessary to introduce low-cost processes compatible with traditional food preparations and habits. The technical and economic problems that prevent the use of this valuable protein as human food are serious but not insurmountable but the major obstacle is the acceptance by potential consumers. Acceptance of marine food products is conditioned not because of its beneficial properties, however, the main determinants of consumer attitude

towards particular food are : availability, acceptability/ avoidance and economic status. The particular importance of these determinants for the consumer's decision depends on : (1) Environment; (2) physical capacity; (3) culture; (4) social pattern; (5) and economy. For example, a considerable fraction of people in India avoid fish for religious reasons. Panniker (1962), assumes that, about 68 - 73 percent only of the total population in India eats fish. According to Simons (1974) 15 - 35 percent of the Hindu population avoid fish.[8]

As regards the foreign markets, we have already seen that the scope for expansion is great and that the foreign markets for Indian marine products are undergoing change. More and more new countries are joining the list of importers, but to create a steady demand for the Indian marine food products in markets abroad the measures for quality control would have to be tightened and product diversification encouraged. The modernization and expansion of fish processing industry is also necessary. There is a great demand for convenience food in the foreign markets and hence a bright future for such products as fish keema, fish sauce, fish wafers etc.

---

8. Report of the FAO Round Table Discussion on "Fishery Products and the Consumer in Developing Countries", Fisheries Report No. 271, Rome, 1982.

Market surveys and consumer campaigns would indeed prove helpful. Too many product development efforts in the past have failed because these considerations were not appreciated and also because the attributes of potentially successful products were not investigated first. Overall expansion can continue only if dietary habits change to accommodate marine animals other than those traditionally caught. Consumer demand projections show that the per capita consumption of fish is going to improve in the country as a whole as well as for the individual states, this increase in the demand for marine fish would be both for human consumption as well as other uses, for example, fish manure. At present there is great disparity in the consumption pattern (TABLE V i). for it is observed that the per capita human consumption of marine fish much higher in the coastal states, than in the non-coastal states. Efforts ought to be therefore made to make the fish available to more and more people by improved infrastructural facilities.

MANAGEMENT

Planning and management form the necessary components of marine fisheries development. Fisheries planning entails, definition of objectives; the setting of priorities; the selection of strategies and the

allocation of resources. The new developments in the regime of the oceans provides for a basis for effective stewardship and in most cases places the responsibility for management solely on the coastal states. The coastal states have therefore two major responsibilities:

(1) to ensure that the most effective use is made of the existing stocks,

(2) and that the resources are managed in such a manner so as to ensure sustainable yields.

There are two ways to increase our present harvest from the EEZ waters, keeping long-term gains in mind;

(1) to restrict the harvest from presently over-fished stocks, these include the bottom-dwelling molluscs and crustaceans,

(2) to increase the production by encouraging the harvest from presently underfished stocks.

The problem facing marine fishery management is how to maximise the amount of fish that can be harvested year after year (MSY). Conservation could be improved if a system of tax or licensing were introduced to reduce the profits and hence discourage new participants in the inshore waters. The concept of the sea as a common property has led to the creation of many

undesirable situations. The marginal social product of labour and capital is less in fishing than in other industries, besides no one has the required incentive to maintain or conserve the stocks. However improved management system would not only help the over-fished stocks but also the unexploited ones, in the deeper waters.

It is evident that our artisanal fisheries are basically more economically viable and socially desirable, while the industrial fisheries are particularly important for harvesting of certain types of mobile, monospecies in the offshore waters, as such strategies should be evolved which give required weightage to the development of both the sectors. Policy makers are not always aware of the social and economic complications in the coastal zone which often prevent developmental plans from being successful. Conflicts reflecting different social and economic interests, have to be accomodated through appropriate policies and strategies.

There is a wide array of management tools, each with its even advantages and disadvantages, the choice of the tool must be matched to the local conditions.

Objectives and strategies of fisheries management for the EEZ.

(1) Maximisation of food production, to meet minimum protein requirement through fish.

(2) Social order for fishermen welfare.

(3) Area development, to stop migration to the cities and increase in the incomes of local people.

(4) Conservation; security for the future.

(5) Maximisation of net economic returns.

(6) Optimum yield.

(7) Better utilisation of fish for human consumption and development of domestic markets.

(8) Creation of fisheries estates in bays, back-waters and mangroves; aquaculture mariculture.

(9) Protection of coastal environment and migratory species.

(10) Sport fishery; for recreation and to generate employment and wealth in coastal areas.

(11) Maximum utilisation of the fishery for employment purposes.

(12) Equitable allocation of fishery resources.

(13) Development of knowledge and technology.

(14) Minimisation of conflicts (domestic and international) between different users of the ocean space.

(15) Political acceptability.

(16) Minimisation of wastage at all stages of production and consumption.

(17) Emphasis on small-scale and artisanal fisheries.

(18) Reduction of past harvest losses and wastage at different stages.

(19) Increased emphasis on small scale processing and preparation units, could provide employment for women.

(20) Use of more labour intensive techniques.

Development should be gradual and over expansion of the industry should be avoided. A need therefore arises for an integrated, multidisciplinary and coordinated approach to planning.

Besides the factors already mentioned, the government plays a very significant role in the development of this industry. Since the inception of planning in India, special attention is being given to the development of fishing and allied industry, however though the various steps taken both at the central and state levels have helped in increasing the production and stepped up the marine products exports, yet the efforts are not adequate. It is obvious that the development of the marine fish industry thus depends on the integration and coordination of all these factors.

[redacted] DETAILS OF PRESENT INFRASTRUCTURAL FACILITIES / REQUIREMENTS

(FISHING FLEET) (HARBOURS)

S.	STATES / U.T.S	TOTAL NUMBER OF MECHANISED BOATS REQUIRED TO EXPLOIT THE AREA AT OPTIMUM LEVEL				Existing No. of Mechanised Vessels (1977)	No. of Mechanised Vessels Required	No. of Ports Required To Cater To the Fleet			
		Small	Medium	Large	Total			Small	Medium	Large	Total
1.	Gujarat	2860	2235	206	5301	1734	3567	15	1	2	18
2.	Maharashtra	1107	1066	120	2293	2034	259	8	1	2	11
3.	Goa	438	225	49	712	192	520	2	–	1	3
4.	Karnataka	1845	192	153	2190	1044	1146	5	2	1	8
5.	Kerala	3618	995	125	4738	1026	3712	10	3	1	14
6.	Tamil Nadu	2657	811	222	3699	1533	2166	16	1	2	19
7.	Andhra P.	2633	507	164	3304	418	2886	12	4	1	17
8.	Orissa	1157	324	132	1613	253	1360	9	1	1	11
9.	West Bengal	232	150	46	428	58	370	2	–	1	3
10.	Pondicherry	401	–	–	401	47	354	2	–	–	2
11.	Andaman & Nicobar Is.	464	1486	350	2302	7	2295	–	–	3	3

Statewise figures of marine fishing vilages and fishermen pop.in some states of India.

TABLE : III d.

Items	West Bengal	Orissa	A.P.	T.Nadu	Pondi-chari Kar. Ma-he& Yeha-	Kerala	Karnai tak-	Goa	Daman & Div.	Gujarat	Total
No.of Fish-ing villages	303	236	453	422	27	304	147	61		179	2132
No.of land-ing Country	47	56	379	375	27	222	105	54		173	1438
No.of fisher-men house-holders	14169	20329	72862	75721	4625	99894	15638	6725		23075	333038
Fishermen pop.Total	83561	117144	326304	395903	25312	639872	112893	39912		152015	1892916
Statewise Distribution of Marine Fishermen Population %											
Male	33%	32%	30	32	-	33	29	31	28		31
Female	28%	29%	30	32	-	33	31	31	28		31
Children	39%	39%	40	36	-	34	40	38	44		38
Acti fisher-men	24%	26%	26	24	-	20	22	22	24		23
Others	76%	74	74	76	-	80	78	78	76		77

Source: Marine Fisheing Information Service (FMRI) Cochin India No300 Aug.1981
Technical & Exten Serviees.

[redacted]SITION OF [redacted]931 IN PERCENT

Year	Fresh	Frozen	Cured	Canned	Reduced	Miscellaneous purpose	Total for the reduction	All groups
1977	65.64	6.91	21.50	0.21	3.96	1.36	0.42	100.00
1978	65.25	6.36	21.56	0.20	4.37	1.40	0.86	100.00
1979	64.57	6.48	21.92	0.18	5.13	1.42	0.30	100.00
1980	65.17	5.92	21.01	0.21	5.14	1.93	0.57	100.00
1981	67.47	5.57	16.98	0.23	6.34	2.64	0.77	100.00

TABLE III h. STATEWISE UTILIZATION OF MARINE FISH IN 1979 (Quantity in '000 tonnes)

	UTILIZATION FORMS	W. Bengal and Orissa	%	Andhra-Pradesh	%	Tamil-Nadu + Pondicherry	%	Kerala	%	Karnataka	%	Maharashtra + Goa	%	Gujarat	%	Total	%
1.	Fresh Domestic	28	45	38	42	123	50	182	55	52	41	124	39	50	26	597	43·7
2.	Dry Edible	25	39	35	38	90	37	76	23	35	28	108	34	57	30	426	31·2
3.	Dry Fishmeal	8	12	8	9	17	7	16	5	30	24	45	14	73	38	197	14·4
4.	Exportable	2	4	10	11	15	6	56	17	9	7	42	15	11	6	145	10·7
	TOTAL	63	100	91	100·00	245	100·00	330	100·00	126	100·00	319	100·00	191	100·00	1365	100·00

SOURCE : M. Raghavachari, pg. 36.

TABLE: IIe. SPATIAL DISTRIBUTION OF SUPPLY INFRASTRUCTURE FACILITIES IN INDIA 1978 (Unit in tonnes)

	STATES	ICE PLANTS Cap / day	Cold storage Cap / day	Freezing Plant Cap / day	Frozen storage cap / day	Fish Meal plant Cap. in tonnes / day	Fish Pulveriser cap. in tonnes / day
1.	Gujarat	416	3573	66	–	112	65
2.	Maharashtra	1399.5	9641.5	61.75	1390	–	93
3.	Goa	172	420	18	–	–	–
4.	Karnataka	724	762	94	2020	200	60
5.	Kerala	2560.45	916	419.35	5507	12	6
6.	Tamil Nadu	709.5	5347.5	23	–	50	7
7.	Pondicherry	6	7	–	–	–	–
8.	Andhra P.	446.50	386	29	1055	–	–
9.	Orissa	236.5	1927	27.5	–	–	–
10.	W. Bengal	45*	2678	40.0	–	–	–
	ALL INDIA TOTAL	6715.45	25658.0	778.6	9972	372	231

* Excluding the plants in Calcutta
– indicates nil.

Source: U.K. Srivastava and M. Dharma Reddy, Pg: 27

TABLE: IIf. STATEWISE ANNUAL AVAILABILITY OF ICE FOR FISHERISES USE – 1978

	STATES / U.Ts)	Tonnes
1.	Gujarat	70605.6
2.	Maharashtra	168569.78
3.	Goa	4350.65
4.	Karnataka	75551.93
5.	Kerala	302738.07
6.	Tamil Nadu	81253.6
7.	Pondicherry	521.63
8.	Andhra Pradesh	40872.70
9.	Orissa	31248.75
10	West Bengal	5015.4
	ALL INDIA	780728.25

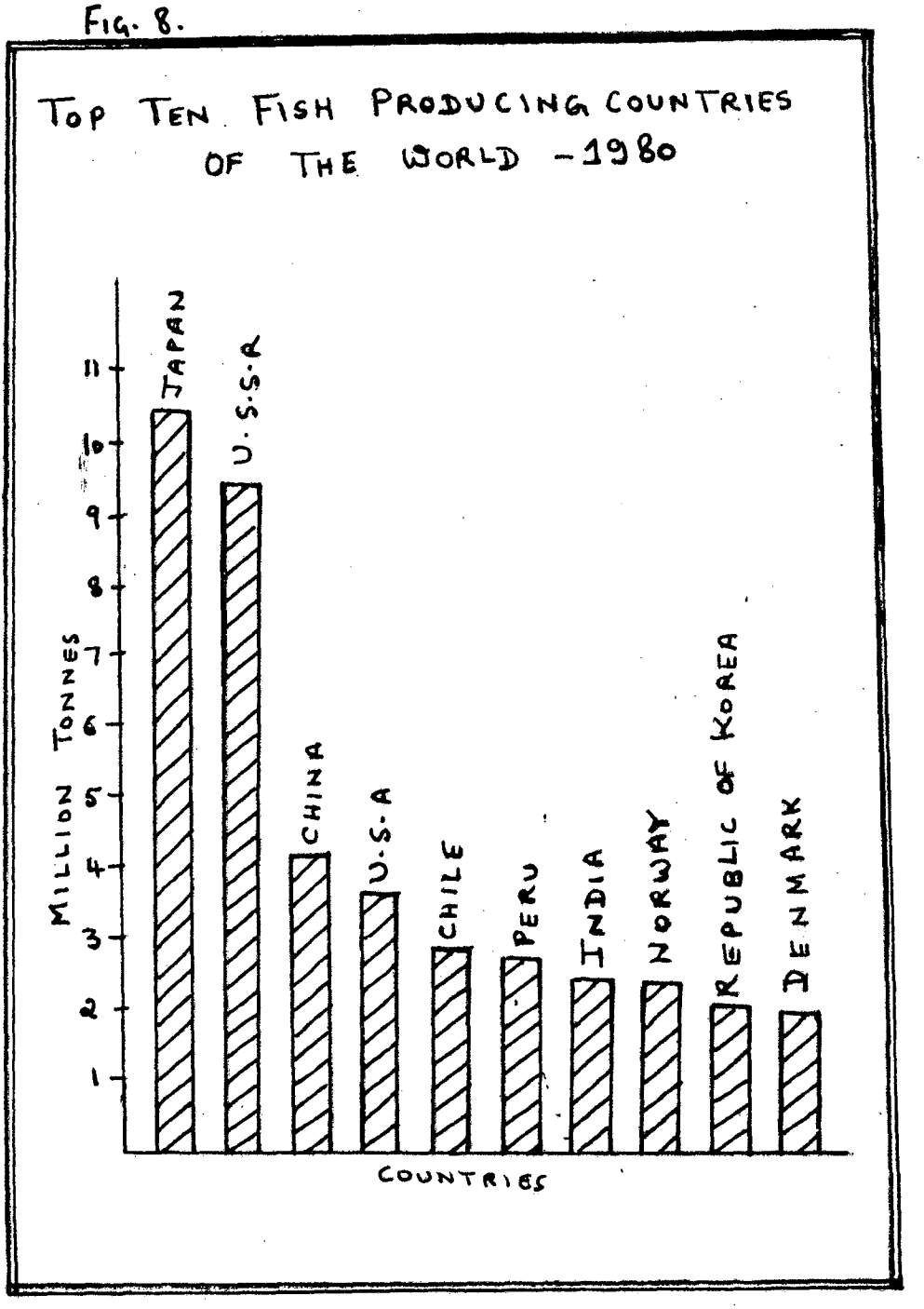
SOURCE: U.K. Srivastava and M. Dharma Reddy Pg. 31

At present of all the countries bordering the Indian Ocean, the largest fish producing country is India, accounting for about 40 percent to the total landings from this region. Ten countries which have more than one million tonnes of landings on an average account for more than 50 percent of the total world catch. (TABLE IV a., Figure 8). In 1980 the total world fish production was 72.19 million tonnes, India's (ranking as the seventh largest producer) share was a bare 3.4 percent, with a total production of 2.42 million tonnes.

The marine fisheries can be classified into: coastal or inshore fisheries and offshore or deep sea fisheries. The species composition and the resource potential of the two regions differs greatly.

Expressed in area the EEZ waters comprise about 2.02 million sq. km, such a vast area which is equivalent to about 61 percent of the total land area of India is therefore available for exploration and utilization of various resources. Out of this area roughly 0.4 million sq. km comprises the inshore region (upto 50 metre depth) and consequently there is a remaining area of 1.6 million sq. km for offshore

FIG. 8.


TOP TEN FISH PRODUCING COUNTRIES OF THE WORLD - 1980
MILLION TONNES
1
2
3
4
5
6
7
8
9
10
11
JAPAN
U.S.S.R
CHINA
U.S.A
CHILE
PERU
INDIA
NORWAY
REPUBLIC OF KOREA
DENMARK
COUNTRIES

fisheries (between 80 and 200 metres depth range).

Distribution of EEZ waters[1]

Region	Million Sq. Km.
West Coast (including Lakshdweep)	0.86
East Coast	0.56
Andamans and Nicobar	0.60
Total	2.02

Over 90 percent of marine life is concentrated in the 10 percent of the waters above the continental shelf, the sea bed and the sub-soil of the submarine area adjacent to the coast and extending to the depth of 200 metres. Nearly three fourths of the total catch in India is obtained from the sea, the rest comes from the coastal and inland waters.

The marine fishery resources of India comprise chiefly of :

(1) major pelagic resources, such as oil sardines, mackerel, seer fish, tuna and other pelagic resources of regional importance such as lesser sardines anchovies and ribbon fishes;

1. "Development of the Indian off-shore fisheries and a suggestion for priorities", (Hardinxveld, 28th January 1983).

(2) demersal fishery resources, including perches, cat fishes, polynemids, flat fishes, pomfrets, eels, sharks and rays;

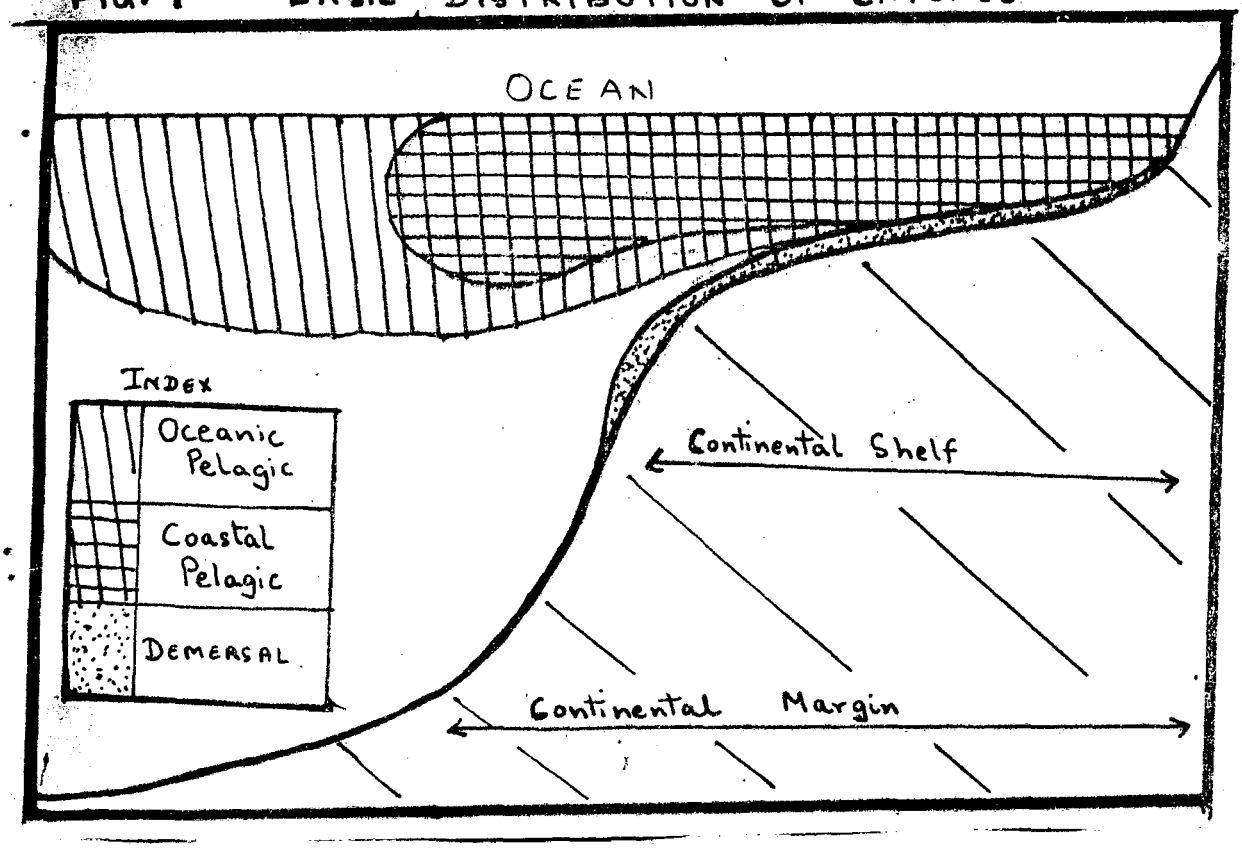
(3) mid-water fishery resources, made up by Bombay duck, silver bellies and horse mackerel;

(4) Crustacean fishery resources consisting of shrimps, lobsters and crabs;

(5) Molluscan fishery resources such as chank, oysters, mussels, clams, squids and cuttle fish; and

(6) Sea-weed resources.

FIG. 9 BASIC DISTRIBUTION OF CATCHES



CURRENT PRODUCTION :

The marine fish production of India which is characterised by wide annual fluctuations increased at an annual growth rate of 4.5 percent during 1954 to 1978. In 1978, the total marine fish production was 1.4 million tonnes and the states on the west coast contributed nearly 74 percent to the total. The demersal fisheries contributed nearly 30 percent to the total, followed by mid-water fisheries 28 percent, pelagic fisheries 27 percent Crustacean fisheries 14 percent and Cephalopod fishery only 1 percent to the total catch. In the same year Kerala ranked first in production followed by Maharashtra etc. (see TABLE IV b. Figure 18, 13). The demersal fish catch was highest in the states of Gujarat, Maharashtra, Kerala and Tamil Nadu. Crustacean catch was highest in Maharashtra, Cephalopod catch in Goa, Maharashtra and Kerala and the Pelagic fish catch was largest in Kerala followed by Karnataka. Gujarat, Maharashtra, Kerala and Tamil Nadu showed the minimum production of mid-water fish (see TABLES IV c) Figures

The Indian EEZ can be sub-divided into four regions:

1. North-West Coast Region (NWCR); comprising the states of Gujarat and Maharashtra;

FIG. 10

STATE-WISE PENAEID AND NON-PENAEID PRAWN LANDINGS (%) - 1980

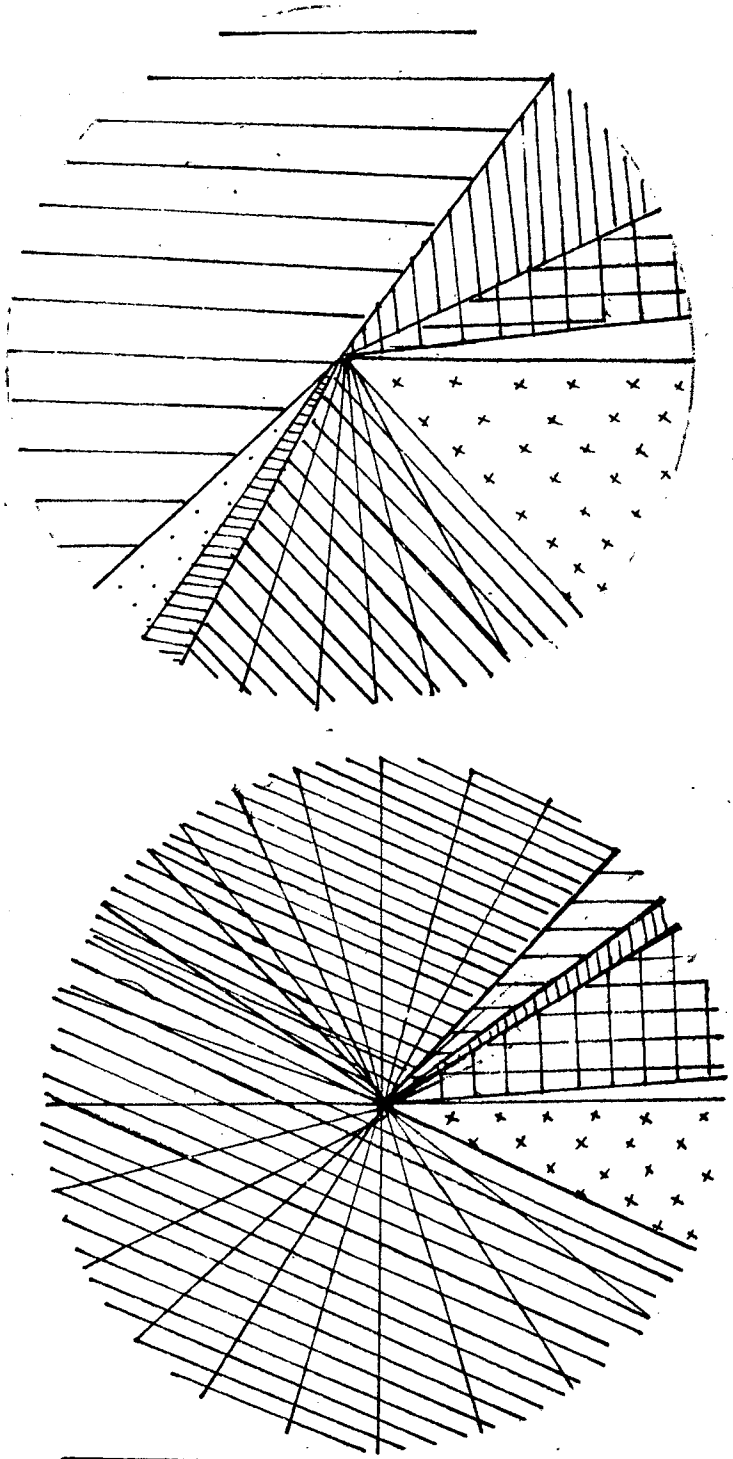


TABLE : 1980

STATES	PENAEID %	NON-PENAEID %
Gujarat	12.9	7.0
Maharashtra	20.9	80.6
Goa	1.7	—
Karnat Ka	2.8	0.2
Kerala	47.0	3.0
Tamil Nadu	8.1	1.6
Pondicherry	0.4	0.1
Andhra-Pradesh	5.1	7.4
Orissa	1.0	—
West Bengal	0.1	0.1
Andamans	—	—
Private Trawlers	—	—
Total	100.00 % (112037)	100.00 % (58900)

SOURCE : CMFRI

	Gujarat		Goa		Kerala		Andhra Pradesh
	Maharashtra		Karnat Ka		Tamil Nadu		Others

2. South-West Coast Region (SWCR), comprising Goa, Karnataka, and Kerala;
3. Lower-East Coast Region (LECR), comprising Tamil Nadu, Pondicherry and Andhra Pradesh; and
4. Upper-East Coast Region (UECR) comprising Orissa and West Bengal.

The region-wise production figures for 1978 reveal the fact that the SWCR is the largest producer, followed by NWCR etc. (see TABLE IV d) Figures). Regarding the percent share of current production (1978) in the resource potential upto 50 metres depth, we find that it was as high as 87.14 percent in the SWCR; 78.83 percent in NWCR, 72.57 percent in the LECR and only 9 percent in the UECR.[2]

The average production per sq. km was 3.38 tonnes for the country as a whole in 1978. The states of Kerala, Karnataka and Tamil Nadu and Pondicherry recorded averages higher than the country's average, that is 10.39, 6.0 and 5.30 tonnes per sq. km. respectively (TABLE IV c.). The contribution of the landings along the west coast to the total was 74.6 percent in 1978.

---

2. M. Raghavacheri; "Marine Fish Supplies: Trends and Projections" (paper presented at the National Seminar on Fisheries Development in India, Ahmedabad IIM, April 9 - 11, 1982), p. 5.

GROWTH OF ANNUAL PRODUCTION OF MARINE FISH – 1958 – 1978 TOTAL LANDINGS

FIG: 11

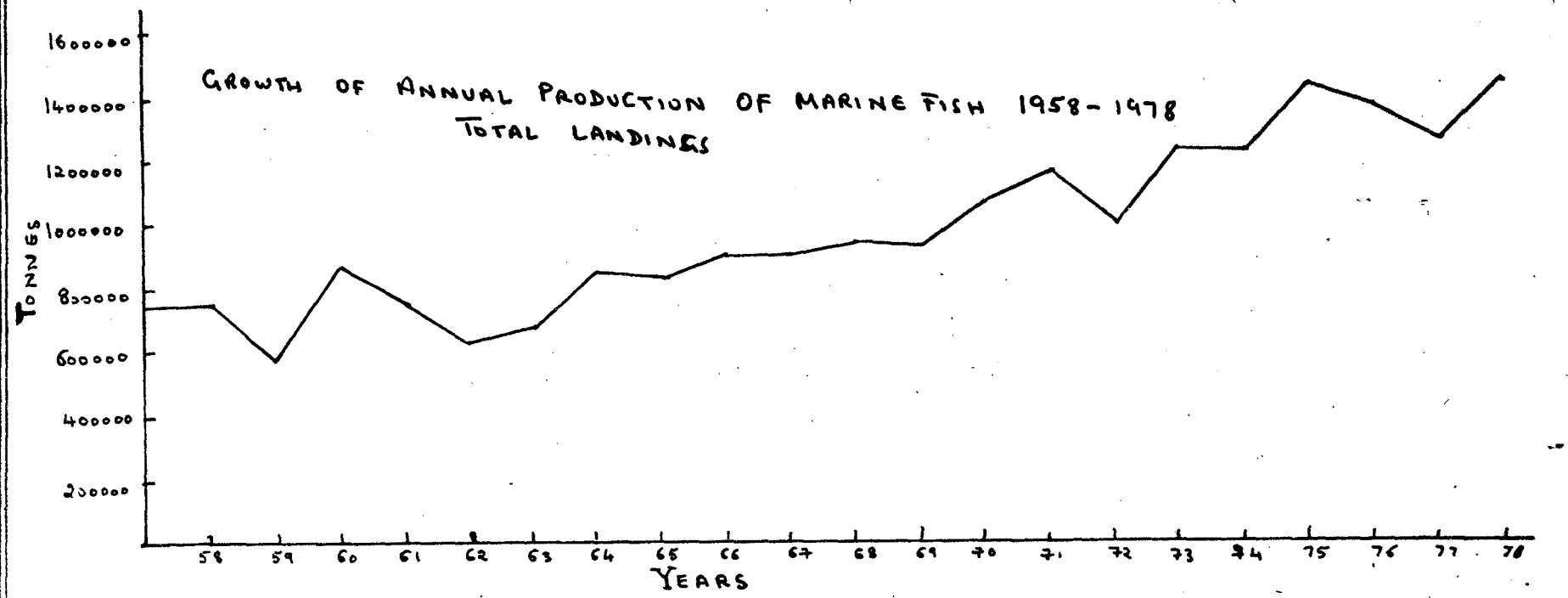
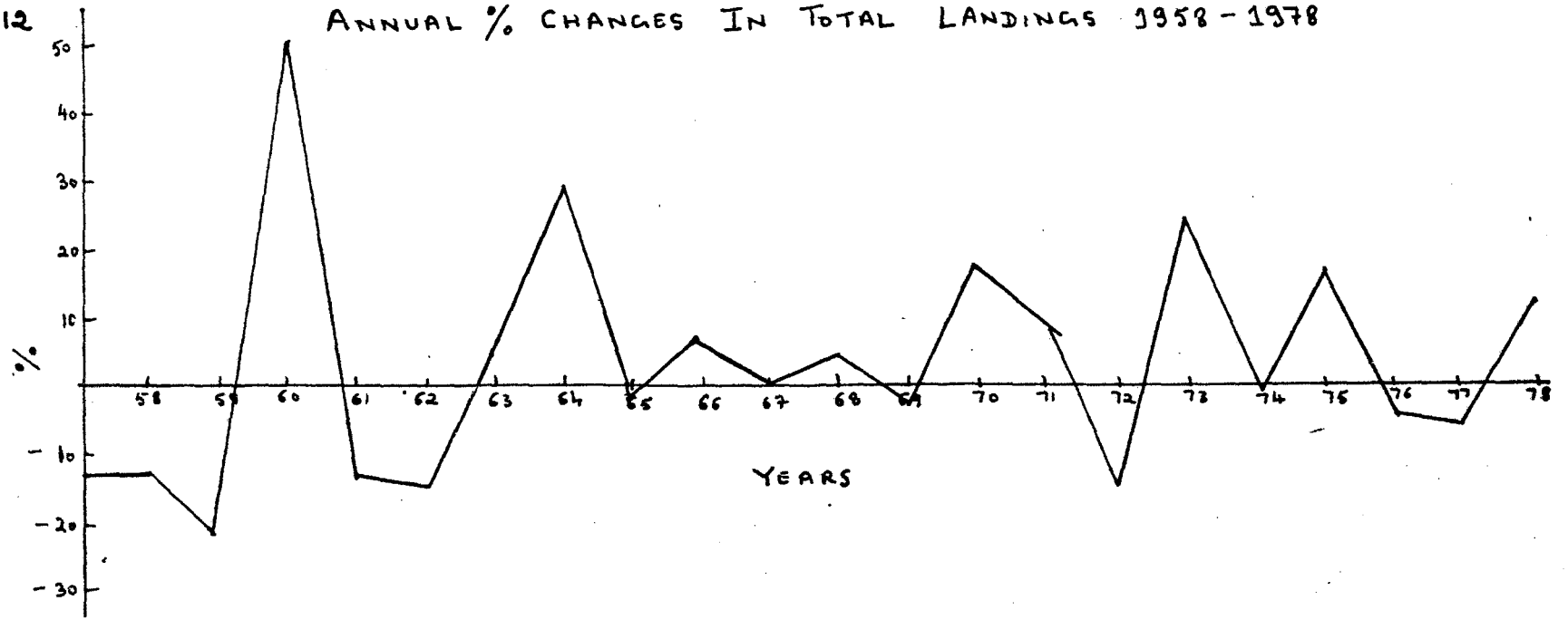


FIG: 12



TRENDS : (1958-1978)

Over a period of twenty years from 1958 to 1978, the total marine fish landings have shown a trend marked by fluctuations, though the overall production has gone up from 756100 tonnes in 1958 to 934611 tonnes in 1968, while in 1978 the total landings of marine fish amounted to 1403607 tonnes (TABLE Ⅳe). During this time span, the peak production of 1.42 million tonnes was recorded in the year 1975 after which the production fell down in the years 1976 and 1977, however in 1978 the situation improved considerably (Figure 11)(TABLE Ⅳe)

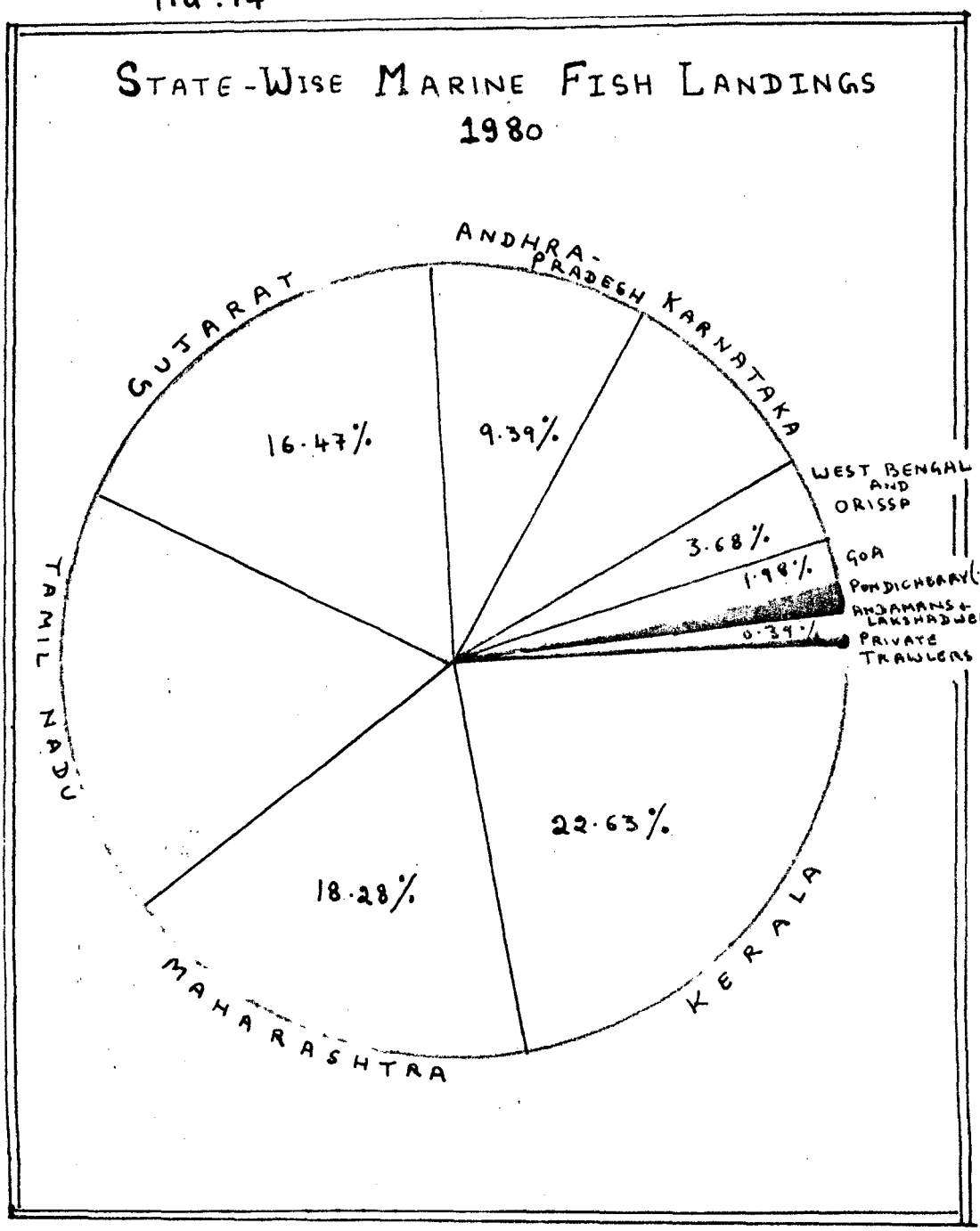
Statistics regarding the annual percentage change in the total landings also show a similar trend of large scale fluctuations, the fluctuations between the years 1959 - 1965 are very pronounced followed by a period of comparably more or less stagnant production between the years 1966 - 1969, but from then onwards the annual percentage changes in the total landings was considerable (TABLE Ⅳe , Figure 12).

STATE/REGION WISE TRENDS:

State wise total marine fish landings do not appear to have undergone much changes over the period from 1966 - 1978, taken under study (TABLE IV b, Figure 13). Over the period the percentage share of Kerala to the total was highest 32.75 percent, followed by Maharashtra 18.67 percent, Tamil Nadu 17.51 percent etc., the contribution of Andamans, Pondicherry and Lakshadweep taken together amounted to only 1.11 percent to the average landings.

If taken individually the States/Union Territories (UTs) reveal trends which are very dissimilar and give an indication to the existing situation (Figure 13). Taken as a whole we notice that West Bengal and Orissa, Tamil Nadu, Maharashtra, Lakshadweep, Andamans and Gujarat have shown a gradually upward rising trend; Goa and Pondicherry have not shown much variation in the total landings over the period, while Andhra Pradesh and Karnataka reveal a very undesirable trend whereby exceptionally high production in one particular year is followed by a sharp fall in the corresponding year. Andhra Pradesh recorded a peak production in the year 1974, while in the state of Karnataka recorded a peak in the year 1970. A very interesting feature appears in these two state and we

Fig : 14


STATE-WISE MARINE FISH LANDINGS
1980
ANDHRA-PRADESH
KARNATAKA
WEST BENGAL AND ORISSA
GOA
PONDICHERRY (.76%)
ANDAMANS & LAKSHADWEEP
PRIVATE TRAWLERS
KERALA
TAMIL NADU
GUJARAT
MAHARASHTRA
9.39%
3.68%
1.98%
0.39%
22.63%
18.28%
16.47%

find that while 1978 was a year of very high production for the state of Andhra Pradesh, the production was very low in Karnataka in the same year. However it can be concluded that the pattern of production in the states/UTs more or less follows the same trend as that of the country as whole.

The trend in the composition of fish based on the averages for 1960 - 1964 and 1974 - 1978 reveals some interesting changes over the period (TABLE ⅣF). We notice that pelagic and mid-water category contributed substantially less, while the share of demersal and crustaceans increased considerably. Use of mechanised boats and gears after 1972 appears to have contributed to this change

TABLE ⅣF.

Percent Composition of Fish and its Change[3]

Category	Percentage Composition 1960-64	1974-78	Change from 1960-64 to 1974-78
Demersal	18.67	26.86	8.19
Pelagic	37.81	27.89	- 9.92
Mid water	32.05	28.07	- 4.02
Crustacean	10.85	16.40	5.57

3. M. Raghavacharl, n.2, p.7.

In the 1960s pelagic and mid-water fisheries accounted for more than 70 to 75 percent of the total catch. The share of these two groups of fisheries came down to 50 to 55 percent in late 1970, the decline being more pronounced for pelagic category than the mid-water category. There was a steady increase in the demersal and crustaceans landings and they increased at the annual rate of 8.85 percent and 9.60 percent respectively. The pelagic and mid-water categories grew at the annual rate of 1.82 percent and 3.20 percent during 1960 - 1978.[4]

TABLE IV.9.

Annual rate of Increase of Fish Production Category wise and coast-wise. 5
1960, 1975, 1978

Category	Annual rate of increase (%)	
	West Coast	East Coast
Demersal	10.17	8.93
Pelagic	0.94	7.91
Mid water	3.49	2.66
Crustaceans	8.89	14.01

4. M. Raghavachari, n. 2, p. 7.

5. Ibid., p. 8.

TABLE IV h.

Change in the Composition of Categories in the Total Catch. 6
1960 - 64 and 1974 - 78

Category	West Coast	East Coast
Demersal	+ 9.28	+ 3.95
Pelagic	-14.17	+ 3.62
Mid water	- 1.51	-11.96
Crustacean	+ 6.37	+ 4.34

The above two tables reveal some interesting facts and throw light on the East and West coast trends regarding the annual rate of increase and the changes in the percentage composition of the four categories in the total catch. We find that while on the west coast demersal fisheries showed the highest annual rate of increase (10.17 percent) on the other hand crustaceans recorded the highest increase on the East coast (14.01 percent) during the period under study. However on both the coasts the mid-water fisheries under went a moderate rate of increase. It is significant to note that although the rate of increase for the pelagic fisheries was less than

6. Ibid., p. 8.

FIG: 13

STATE-WISE ANNUAL MARINE FISH LANDINGS

1966 - 1980

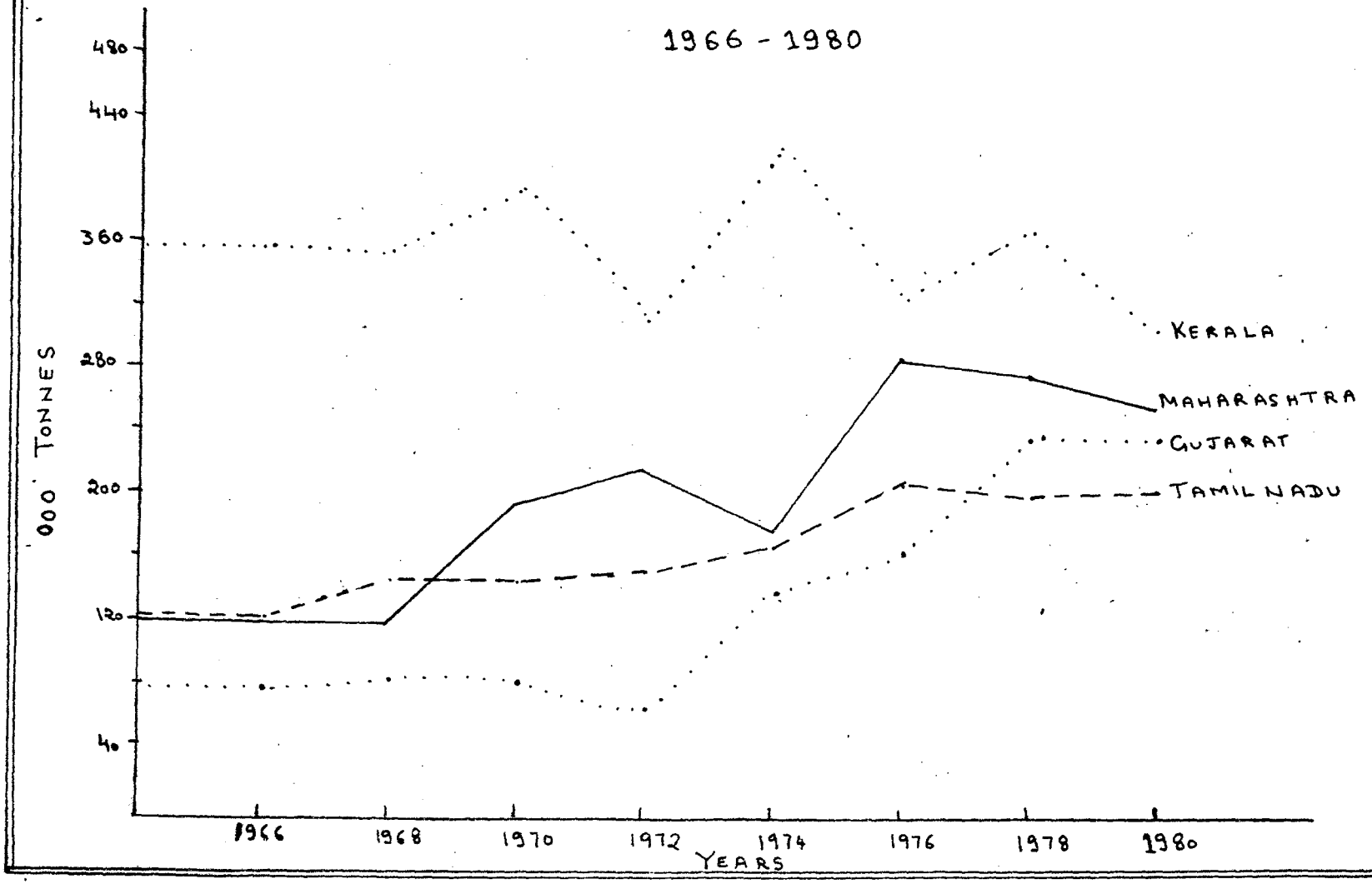


FIG: 13

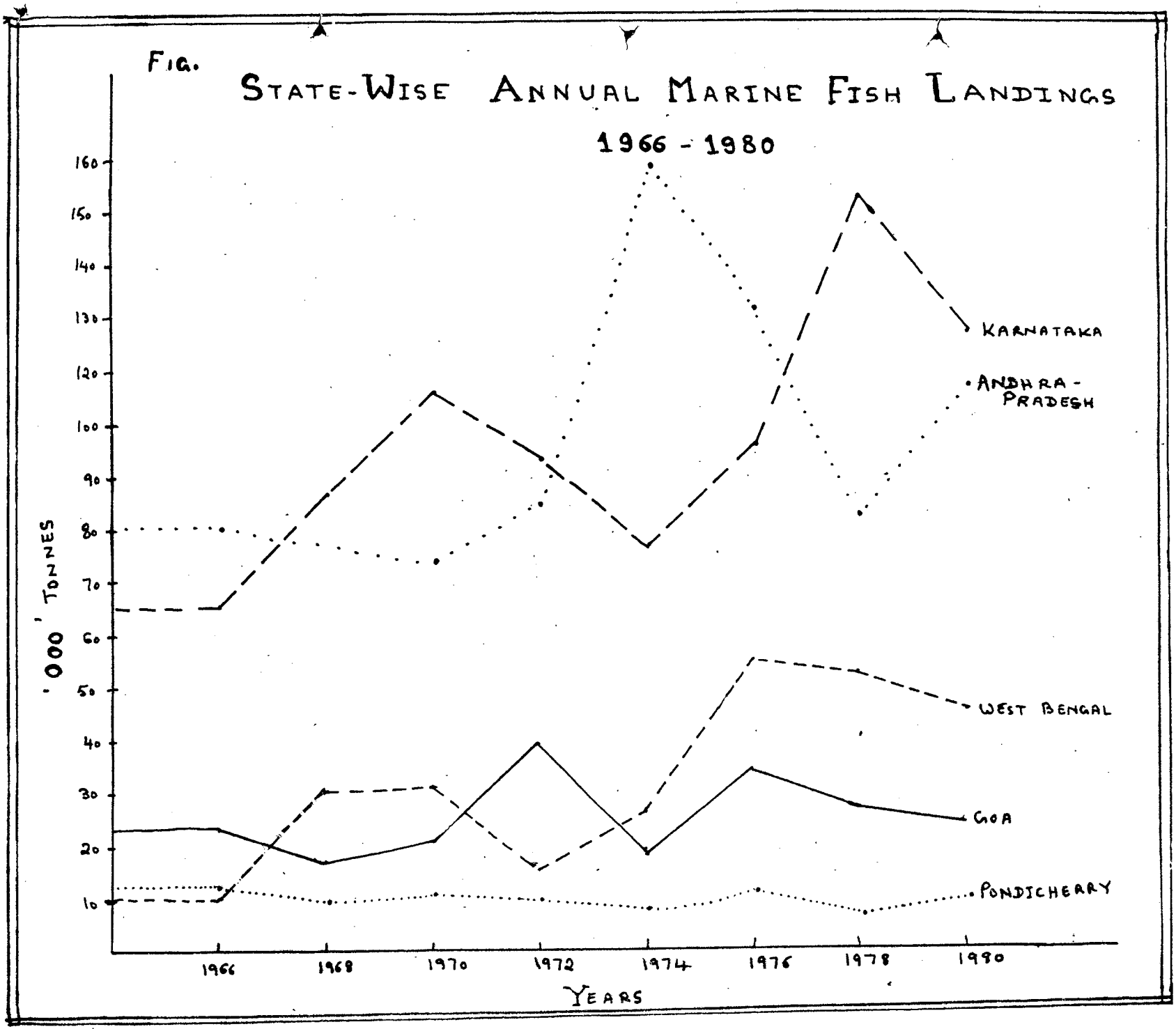


FIG.
STATE-WISE ANNUAL MARINE FISH LANDINGS
1966 - 1980
'000' TONNES
160
150
140
130
120
100
90
80
70
60
50
40
30
20
10
1966
1968
1970
1972
1974
1976
1978
1980
YEARS
KARNATAKA
ANDHRA-PRADESH
WEST BENGAL
GOA
PONDICHERRY

t percent on the East coast it comparatively recorded a high rate on the West coast. The change in the composition of these categories in the total catch, exhibits a definite pattern.

The contribution of the West coast to the total landings all along has been over 70 percent. In 1960 the West coast contributed over 80 percent of the total marine catch; since 1965 its contribution has been declining and in 1978 it was as low as 74.6 percent. The following TABLE shows the trends in the percentage contribution of West coast to the total marine fish landings.

TABLE

1960	1965	1970	1975	1978
80.6	76.01	74.8	69.7	74.6

REGION WISE DISTRIBUTION

The Arabian Sea coast of India produces about 75 percent of the country's total marine fish catch. While the higher fish productivity is related to the physical conditions prevailing in the different sections there exists a high correlation between high productivities and the varying extent to which

modern commercial methods of exploitation have been adapted. The nature and composition of fisheries in different coastal zones vary considerably.

The major fisheries of India like the sardines, the anchovies, clupeoids and the prawns (shrimp) are almost solely confined to the West Coast. The fisheries of the eastern coast is mostly made up of less valuable clupeoids, horse mackerels and silver bellies. Over 1800 varieties of fish are found in the Indian Ocean of which over 300 are edible species.[7]

The Gujarat coast is famous for its Bombay duck and pomfret fisheries. Shrimps are also abundant here, the Gulf of Kutch area holding prospects for higher yields. The coastline between Bombay and Kathiawar has proved quite productive for ghol, koth and dosa also eels and perches. The Gulf of Cambay and the coastal region north of Bombay are rich in Bombay duck. The Maharashtra coast has wide resources of shrimp, pomfrets, Bombay duck, rawas and dara. The Konkan coast is known for its large shoals of Indian mackerel, Karnataka and Kerala

---

7. R.M. Thirumarsan, "Indian Fisheries", The Geography Teacher (Madras), Vol.IX, no.3, May-June, 1974.

coasts also make large landings of Indian mackerel oil sardine and related species along with anchovies. Along the Malabar coast of Kerala several Carangids, Cat fishes, small Sciaenids pomfrets and a large number of miscellaneous fish contribute to the total landings which is the highest in the country. Adjoining the coast of Kerala extensive beds of sea prawns also occur. In the region between Cochin and Quilon, a regular fishery for the Pseudosciaena spp. exists. In the Cape Comorin area especially the Wadge Bank, demersal and littoral perches such as Lethrinus spp. and Epinephelus spp. etc., occur in great abundance. The white fish, silver bellies, smaller sardines and anchovies are obtained in large quantities are obtained in large quantities in the Cape Comorin areas. With the advent of mechanised boats, new fisheries for Kolava have been opened in the Wadge Bank area.

The most productive section of the entire east coast of the peninsula is the Palk Bay and Gulf of Mannar region, stretching from Devipatnam to Cape Comorin. Further south and around Cape Comorin and also on the Coromandal coast of Tamil Nadu, the seer fish and miscellaneous fisheries formed of various

percoids and trichiurids occur in considerable abundance. Fisheries in the Gulf of Mannar are composed of white fish, silver bellies and some smaller clupeoids besides sharks and rays also contribute significantly to the landings. The Palk Bay is one of the best fishing grounds for smaller sardines, silver bellies, white fish and half beaks. Around Madras the most significant is the seer fish, while in the region lying between Devipatnam and Cuddalore catfishes, silver bellies, sciaenids, sharks and rays make up the main landings. The clupeoids are predominant on the Andhra and Orissa coast. Flying fishes and ribbon fishes are found in the coast off Nagapattinam and Pulicat lake. The coastal fisheries of the two states of Andhra Pradesh and Orissa consist of miscellaneous groups of sardines, percoids, sharks and many other species.

The Bombay and Gujarat waters are the richest areas for polynemids and these together contribute to about 80 percent of the polynemid landings in this country. The main areas where sharks exist are

Kathiawar, Bombay, Kerala and coasts of Tamil Nadu and West Bengal. In India one of the most important fishery is that of oil sardine, mainly confined to the west coast. Usually catches vary between 90,000 and 180,000 tonnes per annum. The shrimp fishing grounds off the coasts of India are amongst the richest in the world and yield an average of nearly 80,000 tonnes and Kerala contributes about 60 percent to the total. Sardine fishery is most predominant in Malabar, South Kannara, Kerala and Bombay zones.

Indian mackerel is chiefly fished in the area between Ratnagiri and Quilon, on the east coast it appears sporadically near Mandapam, Madras, Kakinada, Vishakapatnam and parts of Orissa. The most important zone for ribbon fishes is that of Kerala, Madras and Andhra coasts. Jew fishes contribute a sizeable proportion to the marine fishery, particularly on the Bombay and Kathiawar coasts. The important centres of pomfret fishing on the west coast are South Kannara, Malabar and on the east coast in the Vishakapatnam and Nellore districts, these are also caught in the northern parts of the Bay of Bengal. Indian salmon occur most abundantly along the Gopalpur and Ganjam on the east coast and Bombay and Gujarat on the west coast. The main centre for tuna fishery is Lakshadweep area.

Regarding demersal fish resources within 40 fathom (fm) depth, the highest average catch per hour was recorded along the Upper East Coat, particularly off Paradeep (191 kg.). The catch rates in respect of other areas as recorded in 1981-82 are as follows: Cochin 144 kg, Goa 137 kg, Madras 122 kg, Mangalore 100 kg and Vishakapatnam 79 kg.[8] Cat fish appears to be the most dominant group along the West Coast and the East Coast, except lower east coast.[9] Elasmobranchs were the most dominant group in all regions and its incidence in Tuticorin region was 26 percent. The highest percentage of Dhoma was recorded along the north-western coast (21 percent), followed by Upper East coast. The shrimps recorded the highest percentage from Paradeep. The survey vessels (1970 to 1980) observed that, by and large, the demersal fishery consists of several species of low value fish.[10] Quality fishes, consisting of perches, pomfret, ghol, warm and carangids account only for about 10 percent of the total catch. It has been found that the depth range 20 fm to 35 fm. was

---

8. Report of the Task Force on Marine Products, Ministry of Commerce, Government of India (New Delhi, September 1982), p. 36.

9. Report of the Task Force on Marine Products, no.8, p. 36.

10. Ibid.

most productive along the west coast, while the depth zone of 10 fm to 25 fm yielded the highest catch rate along the east coast. The present landing of demersal fish is about 0.64 million tonnes, the bulk of which is from within 40 fm.

The demersal trawlers surveying (1970-78) the waters beyond the 40 fm depth gave invaluable information regarding deep sea fish resources. The most important group of fish which is found beyond the 40 fm depth is perches, popularly known as rock cod or Kalava; available in large quantities from Cape Comorin to Mangalore. Recent observations made by "Matsya Nireekshani" along the north-west coast reveal the fact that "Sweet lips" (group of fish), species of nemipterus, perches and elasmobranchs are the main varieties of fish which can be caught from beyond 40 fm depth along the Gujarat Coast.[11] Deep sea lobster and deep sea shrimp occur all along the south-east coast from south of latitude 12° North (N), from the Gulf of Mannar and from the lower east coast, especially off Point Calimere beyond 100 fm depth. On the east coast deep-sea lobsters are found from 100 fm to 200 fm in the Gulf of Mannar

---

11. Report of the Task Force on Marine Product, n.8, p. 36.

and off Point Calimere, due to inadequate surveys in deeper waters in this region not much recent information is available.[12]

The mid-water trawling operations of M.T. "Matsya" and "Matsya Nireekshani" along the north-west coast have indicated the rich potential for pelagic and mid-water species, mostly found between 30 and 60 fm depth the main area of concentration appeares to be between 25 fm to 50 fm depth belt. Purse-seine operations along the Gujarat coast have indicated the existence of little tuna and frigate mackerel in sizeable quantities from September to June, between 20 fm to 40 fm depth.[13] This group of fish was also available in sizeable quantities from Cape Comorin to Mangalore from 20 to 40 fm depth. Catch rate upto 20 tonnes of sardines have been recorded between Vengurla and Goa along the north-west coast. A hooking rate upto the 40 percent for large sized sharks along the south-west coast between latitude 7°N and 8°N has been indicated by recent observations made by "Matsya Sugandhini".[14]

---

12. Report of the Task Force on Marine Products, n.5, p.36.
13. Ibid., p. 37.
14. Ibid., p. 38.

No appreciable pelagic and mid-water fish resources have been located along the east coast, except for some stray catches.

A detailed study conducted by Indian Institute of Management reported that, the major share of over 85 percent of the total landings at all India level and in individual states was from inshore region. A comparative analysis of marine fishery resources and current level of exploitation indicated that the in-shore region in the WCR and SWCR were well fished about 70 percent of the potential in the ECR was fairly fished about 58 percent and in the UECR was poorly fished about 8 percent.[15] the deeper shelf or off-shore region was poorly exploited, about 20 percent or less of the total resources, in majority of the maritime states and Union Territories (TABLE V l,m). Figure).

GROWING POPULATION : FOOD FROM THE SEA

Continued increase of population in relation to the limited food resources available is one of the major problems confronting over country. The gap between food production and the requirement is

---

15. Report of the Task Force on Marine Products, n.8, p. 38.

substantial and will widen if necessary and immediate steps are not taken thus creating an urgent need to tap all sources for food and protein.

Statistics throw considerable light on this problem and we find that while the total population in 1971 was 54.81 crores in 1981 it had increased to 68.5 crores, thus recording a net increase of about 25 percent. The average density of population per sq. km. rose from 177 in 1971 to 221 in 1981. The population of India has been steadily rising from 1901 to 1981, but from 1951 onwards the growth rate has been very high, consequently it has been observed that nearly 50 percent of our population has been living below the poverty line (less than 2400 calories per person in rural and 2100 calories per person in urban areas) continuously over a long period of time, some recent reports have stated that the percentage of population below the poverty line has increased in the recent years instead of decreasing.

Population projections show that the population of India may reach 1000 million or more by the turn of this century. It is an established fact that the per capita net sown area has substantially come down from 14.8 million hectares in 1964-65 to 13.0 million

hectares in 1969-70 and more and more area is being put under non-agricultural uses, such as roads, industries and housing etc., it has increased from 1.12 million hectares in 1950-51 to 1.38 million hectares in 1969-70.[16] In the United States an area of 9000 sq. metres is utilised for sustenance of a single person, whereas in India it is only 2300 sq. metres at present and the size will obviously further reduce in the future; may be not more than 1200 sq. metres per capita by the end of this century according to estimates.[17]

The rapidly expanding population poses problems not only of quantity but also of quality, for the problem in many regions of our country is really not of 'under-nourishment' but that of 'malnutrition' or the 'hidden hunger'. At present the per capita food consumption consists mainly of cereals which do not contain amino acids, essential for the growth and healthy development of the human body. Not only the total protein supply is deficient in our country the quality of dietary protein available in general is inferior to that consumed in the developed

---

16. Report of the Food and Agricultural Organisation (FAO), Nored Round Table Discussion on Fishery Products and the Consumer in Developing Countries, Fish Report 271 (Rome, 1982), p. 7.

17. Ibid., p. 8.

countries. The problem of "protein gap" at present is acute in our country and we are facing a steadily worsening state of nutritional crisis.

An average Indian needs about 2300 calories per day to keep his body in healthy condition, but he gets only 1950 calories. About 70% of people get on an average less than 1700 calories, about 40 percent get between 1700 and 2300 calories, which shows that at least one third of the people in India are under-nourished.[18] According to the Diet Atlas of India (1971) the calorie intake perday per adult in India between 1960 - 69 was 1985 calories while the recommended allowances are 2400 calories.

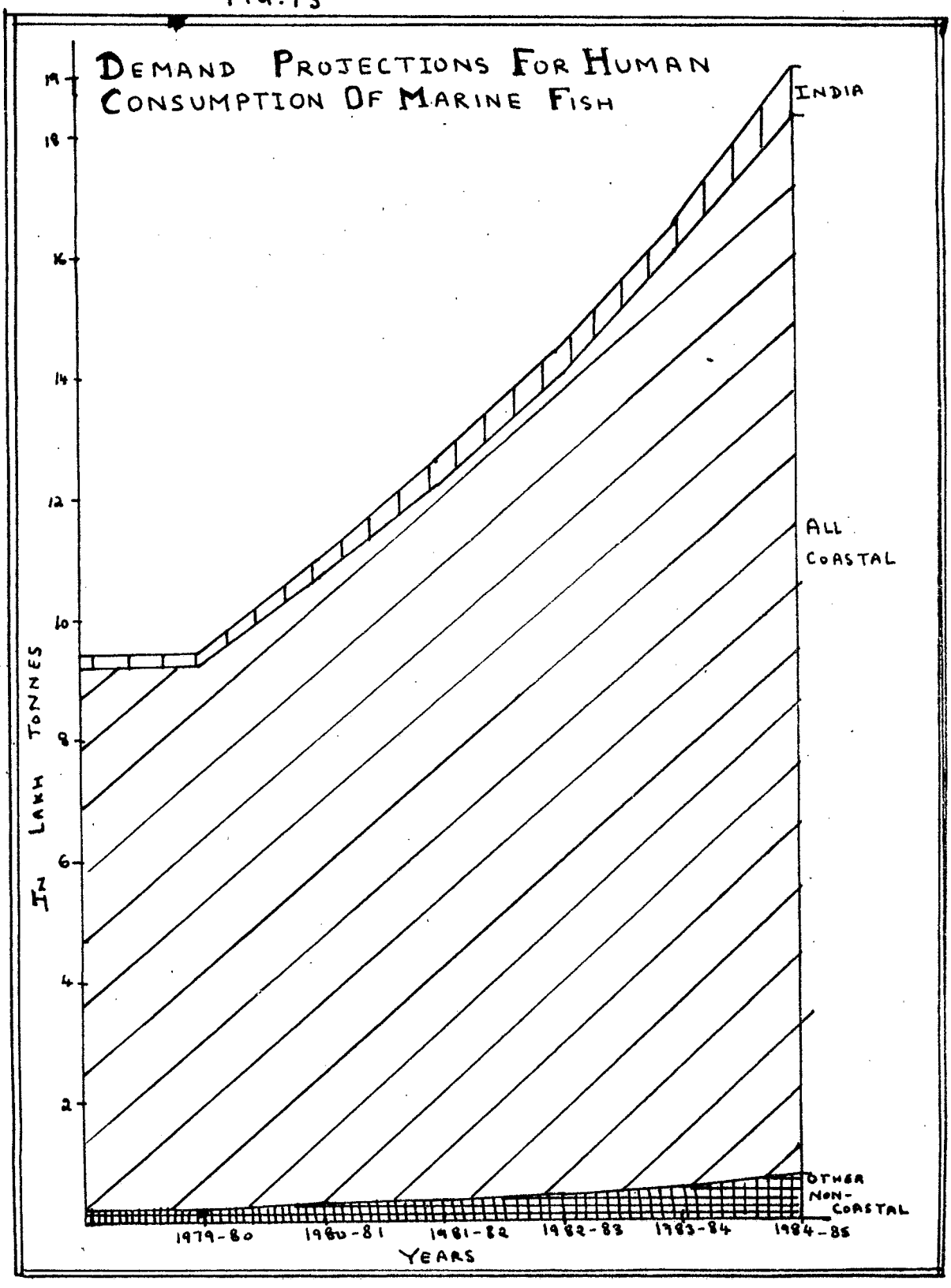
The nutritional level in India is very low as compared to other countries of the world. According to the UN estimates the total calories per capita in India was 1940 in 1968 - 69 and 1990 in 1967 - 70. Out of the total 1990 calories, 1354 calories came from cereals and only about 6 percent was of animal origin (meat, fish, eggs and milk). Whereas in United States of America (USA) out of the total 3300 calories per capita, available in 1970, only 652 calories were obtained from cereals and about 40 percent was of animal origin.[19]

---

18. R.C. Sharma, Population Trends Resources and Environment: Hand book on Population Education (New Delhi, 1975) p. 135.

19. Ibid., p. 136.

FIG: 15


DEMAND PROJECTIONS FOR HUMAN CONSUMPTION OF MARINE FISH
INDIA
ALL COASTAL
OTHER NON-COASTAL
IN LAKH TONNES
16
18
K
14
12
10
8
6
4
2
1979-80
1980-81
1981-82
1982-83
1983-84
1984-85
YEARS

The total protein intake per capita in India was 48 grams (gms) per day during 1968 - 69 and 49.4 gms in 1969 - 70. Out of this only 5.6 gms was of animal origin and 31.6 gms came from cereals. In the USA the total protein intake per capita per day was 97 gms in 1969 and 98.6 gms in 1970. Out of 98.6 gms, 71.5 gms was of animal origin and only 15.4 obtained from cereals.[20] In view of the high consumption of cereals the protein requirement might appear to be met on an average, which however is not a true indicator of the problem and does not reflect a healthy, desirable situation.

In the developing world the predominant problem is one of producing additional animal proteins which may be so scarce there, that any meat unless excessively cheap, is a luxury commodity available only to a wealthy few. It has become a cliche that the people of India need protein. Even the most socially unaware persons have some grasp of the magnitude of the problem being faced. It is clear that the solution, will not come as any single panacea, but from the effective population control coupled with increased and more efficient

---

20. R.C. Sharma, n. 16, p. 139.

Per Capital Human Consumption of Marine Fish Kgs.

TABLE : IV i

	Annual Growth rate %	1980-81	1981-82	1982-83	1983-84	1984-85
All Coastal	10.63	3.12	3.80	3.93	4.37	4.86
All Non Coastal	23.10	0.30	0.37	0.46	0.57	0.70
All India	10.27	1.61	1.80	2.03	2.26	2.53

All India Aggregate Demand Projection

TABLE : IV j

Year	Human Consumption	Pop. ('0'0)	Per capita total Demand Kgs.
1979-80	95,70,57	65,51,59	2.2
1980-81	11,03,025	68,38,10	2.35 (10.8)
1981-82	12,65,311	70,02,98	2.66 (13.2)
1982-83	14,46,791	71,71,95	2.98 (12.4)
1983-84	16,58,528	73,45,13	3.39 (13.4)
1984-85	19,02,889	75,22,57	3.84 (13.3)

Average Daily Per capita Intake of Colonies-1971

TABLE : IV n

Countries	Consumption
USA	3200
UK	3150
Japan	2460
Sri Lanka	2170
Pakistan	2230
China	2050
Thailand	2140
India	1943

Numbers in( ) indicate growth rates % over the respective years.

protein production by many means. The necessity of exploring the various fields of natural resources to augment present production weighs heavily on the minds of our planners. Keeping the present situation in mind and following the demand projections for food, it will not be wrong to conclude that man will turn increasingly to the oceans for sustenance and security. According to the nutritional experts, the diet in developing countries should consist of 70 gms of protein per day of which at least 20 gms should be from animal source. Fish has been recognised as a superior source of animal protein and as a source of food fisheries stand next only to agriculture. Marine products, not only supply protein, but also support proper growth and health of the human body. Taking the favourable amino-acids pattern into account it has been estimated that 80 to 85 percent of the raw weight of fish can be utilised for human consumption.

The average Indian diet includes cereals and pulses accounting for three-fourths of the nutrients; 85 percent of the total proteins come from the cereals and pulses. The average per-capita consumption of animal protein per day in India as a whole in 1975 was only 14 gms which is far below the recommended allowances of 35 gms.[21]

---

21. Diet Atlas of India, National Institute of Nutrition (Hyderabad, 1971).

A comparision between the average daily per capita intake of animal proteins and fish in India with other countries, clearly shows that it is amongst the lowest in the world. Most of the people belonging tothe low income groups are mostly vegetarians most probably due to economic necessity. Fish being a cheaper supply of protein could be easily introduced to the diets of a vast majority of the people.

TABLE

Comparison of International Diets
Per Capita Daily Intake (gms) 1970[22]

Countries	Total Protein	Animal Protein	Fish
USA	96	69	17
UK	88	54	26
Japan	75	28	84
Sri Lanka	48	8	16
Pakistan	52	11	5
China	57	-	10
Thailand	47	10	19
India	49	6	7

22. Diet Atlas of India, p.19.

The above figures throw light on the current state of nutritional crisis in our country and it becomes increasingly important to divert our attention to the marine fishery resources, which has great potentials for exploitation. For this reason it is most important to have a clear picture of the process of biological production in the ocean and to attempt a quantitative evaluation especially for the highest stages which are most important for man, which requires a scientific evaluation of the marine fish productivity.

The nutritional value of fish is primarily in direct consumption as protein, whether fresh, frozen or otherwise preserved and indirect protein consumption through conversion to fish meal which is then used as feed supplements for live stocks. It cannot be denied that a well nourished nation paves the way for economic development and general well-being. The aim therefore should be to increase self sufficiency and self reliance in food and nutritional matters and the contribution of marine fish in this direction can be considerable in fact its development can be an answer to all these problems.

The prospects of the Indian marine fisheries can be easily predicted to be very bright if properly managed and optimally exploited. A number of factors give the marine fisheries an advantage over the other sources of food, these include:

(1) One of the chief attraction of fish is that it doesnot compete for land resources with other food or agricultural products.

(2) Sea resources as compared to the agricultural resources are renewable and replenishable year after year, provided the maximum sustainable (MSY) yield limit is not exceeded.

(3) It is cheaper to produce fish as compared to the cost of production in raising any other protein from land animals. Although the comparative economics regarding the cost of production has not been worked out in India, there are indications which show that it is more economical to produce fish. For example 1 kg of wheat produced in our country had cost about 0.95 paise whereas the average cost of fish for 1 kg was 0.44 paise in Bombay and 0.69 paise at Mangalore.[23] Besides it is established that in terms of nutritional value fish is a far superior

---

23. P.S. Rao, Fishery Economics and Management in India, (Bombay, 1983), edn. 1, pp. 10 - 12.

commodity to that of wheat or any other cereal.

(4) Recently a Russian Scientist S.V. Mikhailov, pointed out that fish can be supplied by fewer manhours and less capital investment than in agriculture, the reason being that the sea fish are free resources requiring no inputs for production except in investment on modern boats and manpower utilisation.[24]

(5) Growing population will also create the problem of unemployment and by developing this resource we would be creating more employment opportunities.

(6) Expansion of the marine sea food industry would both directly and indirectly lead to the improvement in the socio-economic conditions of the fishing communities.

Fisheries development is for the benefit of populations in their two-fold role as producers or consumers and these basic human needs of the people involved should guide every action in every phase of the development. Increased production is not the only solution to the problem, because unless there is a required demand for marine fish the problem will be

---

24. Ibid., pp. 14 - 15.

left half solved. It is an accepted fact that food consumption and particularly protein consumption is not governed by any nutrient motivation in man, but is a combined effect of accessibility, availability and economic status. Before making any future predictions it therefore becomes necessary to study, understand and analyse the consumer behaviour in respect to marine fish.

In 1979 - 80, the per capita consumption of marine fish at all India levels stood at 1.46 kg and it varied between zero in all non-coastal rural locations and 25.14 kg in Goa.[25] The figure for all coastal states stood at 2.82 kg and that for all non-coastal locations 0.07 kg. Urban areas have a higher per capita consumption. The most popular varieties consumed were pomfrets, followed by seers, Indian mackerel, sardines, prawns etc. Studies reveal that the per capita consumption also varies over seasons. In our country marine fish consumption generally varies significantly over the various income levels. An analysis of the consumer behaviour reveals that religion is the most dominant factor, followed by economic status, taste, non-availability. A large part of the

---

25. G.S. Gupta and P.S. George, Marine Fish : Consumer Behaviour and Demand Forecasts, (Paper presented at the National Seminar on Fisheries Development in India, April 9 - 11, 1982, at Indian Institute of Management (IIM), Ahmedabad), p. 18.

Indian population avoids fish for religious reasons. The proportion of fish consuming population in 1979 was about 50 percent in the urban and 55 percent in rural areas.[26]

The low-level of marine fish consumption in the non-coastal and rural areas shows throws light on the problem of availability. 50 percent of the fish in our country is consumed fresh. Due to inadequate infra-structural and transportation facilities, the marine fish catch has very limited distribution and there are large sections of the population to whom fish is either not available or only rarely available. In order to increase consumption of marine fish as processed fish product, it is necessary to introduce low-cost processes compatible with traditional food preparations and habits particularly important in a low income country like ours both due to lack of purchasing power and the prevalence of conservative food habits. The major obstacle that prevents the use of this valuable protein as human food is the acceptance by the potential consumers.

---

26. Ibid., p. 39.

By using the Box-Jenkins Methodology, N. Raghavachari (1982) has made certain forecasts regarding all India marine fish production in the coming year. The forecasts indicate that the total production in India would grow at a linear rate of 2.14 percent per annum.[27] The production on the west coast will be 70 percent of the total catch. The share of west coast in the crustacean catches is very high 83 percent, and in the other categories it is expected to be about 70 percent. (TABLE FIGURE

G.S. Gupta and P.S. George (1982) carried out an extensive study on the consumer behaviour and the future demand for marine fish; the the period 1979 - 80 to 1984 - 85.[28] The per capita human consumption of marine fish was estimated to increase from 1.46 kg in 1979 - 80 to 2.53 kg in 1984 - 85 in the country as a whole (TABLE V i , FIGURE 15). The per capita marine fish consumption was projected to grow at an annual rate of 10.27 percent over the period under study; the maximum, per capita consumption was expected to be at Goa, 47.18 kg. It shows a steadily rising

---

27. N. Raghavachari, Marine Fish Supplies; n.2, p. 53.
28. G.S. Gupta and P.S. George, n.23, pp. 1 - 30.

trend for the country as well as for the various regions separately. The aggregate human consumption of marine fish was forecasted to increase from 9.58 lakh tonnes in 1979 - 80 to 19.03 lakh tonnes in 1984 - 85; giving an annual exponential growth rate of about 15 percent (TABLE V i , FIGURE 15). An increase in aggregate demand at the rate of 10 percent per annum is expected. To ensure a balance between demand and costs would rise by 3.10 percent and 1.78 percent per annum respectively. This low rate of increase was based on the declining or low rate of growth in several states during the last few years. The forecasts clearly indicated that unless new shores and different depth levels were explored, the marine fish production would not grow at a sufficiently rapid ratio to meet the growing demand both at home and abroad.

The time series forecasts also indicated the likely composition of the total catch, keeping in mind the current trends. Accordingly in 1985, the largest contribution would be from Demersal (30.6 percent) fisheries followed by pelagic, mid-water and crustacean. (TABLE). The east and west coasts also would have a similar composition for pelagic

and mid-water species. For crustaceans the west coast would have a 21 percent share in the total while the corresponding figure for the east coast would be 10 percent. Demersal category would contribute 36.5 percent on the east coast and 30.6 percent on the west coast.

To ensure a balance between demand and supply, production of marine fish should increase at an annual rate of 16 percent, during the period under study, reaching to a production level of 2.9 lakh tonnes in 1984 - 85, as against its current production (1979 - 80) level of 13.4 lakh tonnes (TABLE IV 3,f). FIGURE)x All these parameters taken together the trend is a healthy one. The rate of increase in aggregate demand worked out to 10 percent per annum. Efforts should be made to step-up the total production of marine fish thereby meeting the demand requirements, and to provide better storage and marketing facilities so that quality fish can be supplied to needy people. Such efforts bring some non-consumers (40 percent) into the group of fish consumers.

Some studies reveal the fact that demand for fish has outstripped supply. The per capita requirement of fish for the non-vegetarian population in the country, as worked out by the National Commission on Agriculture is 10 kg.[29] To meet the

29. Times of India, (Delhi), 4 January, 1982.

growing demand, all that are labelled as 'marine food resources' must be turned into nutritious and attractive food products, acceptable to the consumers in order to gain profitable markets. For the vegetarians the sea weeds could have potential markets, with required technological break through the taste of this potential food resource. Lack of education and awareness restricts many potential consumers from accepting this food. Education, media and publicity campaigns would bring about an awareness of its food value. Aequaculture, through transfer and technological enhancement would be a required step in decreasing the protein gap. One of the most obvious and practical ways of increasing food supplies from marine fisheries is by improvements in the preparation and utilisation;

(1) by making use of less popular or rejected species as also of those parts of the fish that are at present wasted; and

(2) by preventing spoilage of fish between landing and consumption.

The demand for marine fish would increase not only for human consumption directly but also indirectly through fish meal. Projections indicate that the

poultry feed demand would experience an annual growth rate of 20 percent, between 1979 to 1984 - 85. (TABLE Vf.)

We thus see that an eventual carrying capacity of the earth in terms of food supplies is not the major area of concern at the moment, what mankind is more interested in is striking a reasonable balance between food demand and supply and also that economic development comes upto the requisite level not only to ensure better income distribution, but also to reduce malnutrition and provide a better standard of living. However, if our chief need is the security for future, then we ought to assess the potentialities and limits to which oceanic exploitation can be stretched; and use this resource rationally. Growing population will add up to the problems of pollution and environmental deterioration and these environmental effects should not be over looked as it can do considerable damage to the resources and have serious repurcussions.

It is apparent that the case of food supplies in relation to population growth is a complex one involving inter-acting social, demographic, economic and technical factors. The hope that our EEZ can provide substantial contribution to the food supplies is fully backed by research and growing knowledge in

TABLE : IV K.

STATEWISE PRESENT LEVEL OF EXPLOITABLE AND EXPLOITED RESOURCES

	STATES/ U.T.S	Area of Economic Zone in Sq. Km.	Yield Estimated in ton per km^2 in different zones from shore upto			Total Exploitable Potential (tonnes)	Present (1979) Production (tonnes)	Balance Available for Future Exploitation (tonnes)
			Upto 40 Km.	40 to 160 Km.	160 to 320 Km.			
1.	Gujarat	214060	5	4	2	650150	203436	446714
2.	Maharashtra	131680	5.2	4.3	2	488068	310589	177479
3.	Goa	43500	5.2	4.3	2	128544	38683	89861
4.	Karnataka	87080	8.4	4.2	3	425140	202813	222327
5.	Kerala	147740	9	4.4	2	656368	330450	325918
6.	Tamil Nadu	197120	4	4	2	598224	206956	391268
7.	Andhra.P.	139580	4.2	4.2	2	447268	91182	356086
8.	Orissa	97720	5	5	2.5	285100	32000	253100
9.	W. Bengal	32320	5	5	2.5	115100	60000	55100
10.	Pondicherry	1440	4	—	—	20040	13179	6861
11.	Andaman + Nicobar Is.	519590	2.8	2.8	1	811108	1721	819387
12.	Lakshwadeep.	178666	9	4.4	2	620511	3846	616665

SOURCE : N.P. Bhakta, pp. 3-4

the field of oceanography. The gravity of the situation, however calls for adoption of new attitudes, management systems and technologies.

POTENTIAL

Currently accepted marine fish resources estimates for the Indian EEZ, place the annual sustainable yield at 4.5 million metric tonnes of fish per annum. More than half of this resource 50.6 percent lies in the in-shore zone, the deep sea zone contains 38.3 percent of the total marine potential, while 11.2 percent of the total potential is in the depth beyond 200 metres.[30] The area between 50 - 200 metre depth and beyond 200 metre depth are 11.6 percent and 79.4 percent respectively of the EEZ. This implies that nearly 50 percent of the potential yield is found in the in-shore zone (9 percent of the total area of the EEZ), and the other half of the potential yield is found in 91 percent of the total area of the EEZ (beyond 50 metre depth). The kilogram per hectare yield of the waters beyond the 50 metre depth thus accounts for only one-tenth of the in-shore zone.[31]

---

30. Manjula R. Shyam, "Strategies for Developing Off-shore Fisheries in the Exclusive Economic Zone" (Paper presented at the National Seminar on Fisheries Development in India, April 9 - 11, 1982), p. 2.

31. Ibid.

In view of the above estimated 3 million tonnes of potential unexploited until today, it seems high time to shift our priorities to those waters (TABLE IV K,Lm) ~~XXXXXX~~)x The yield potentials and present level of loadings indicate the level of unexploited potential today. The exploitation of potential yield in India differs spatially in the different coastal states, but it is evident that the present level of exploitation as compared to the potential available is very low. The over all catch in 1976, worked out to be only 49.77 percent of the potential yield on the East Coast and 58.93 percent on the West Coast.[32] Data regarding the region-wise unexploited marine fisheries potential clearly shows that considerable part of the potential remains unutilised at the different depth zones (TABLE IV K,L) ~~XXXXXX~~). TABLE IV m. ~~XXXXXX~~ throwslight on the unexploited potential yield of various species group in different depth zones in different regions.

Regarding the types of fisheries potential the demersal fisheries upto 50 metre depth are rich in all states with Orissa and West Bengal

---

32. R. Raghavacharl, n.2, pp. 4 - 6.

REGIONWISE UNEXPLOITED MARINE FISHERIES POTENTIAL (Quantity: Lakh Tonn

	REGIONS	CURRENT PRODUCTION		ESTIMATED POTENTIAL		% OF POTENTIAL EXPLOITED		% OF POTENTIAL UNEXPLOITED	
		upto 50 mts	50-200 mts and beyond	0-50 mts	50-200 mts and beyond	0-50 mts	50-200 mts and beyond	0-50 mts.	50-200 mts and beyond
1.	NWCR	3.89	0.97	5.42	3.41	72	28	28	72
2.	SWCR	4.43	1.11	7.01	7.21	63	15	37	85
3.	LECR	2.41	0.60	4.78	1.96	50	31	50	69
4.	UECR	0.42	0.10	5.40	1.95	8	1	92	99
5.	Andamans and Lakshadweep	—	0.10	—	7.50	—	1	—	99
	TOTAL	11.15	2.88	22.61	22.03				

SOURCE: M. Raghavachari, p. 45.

TABLE: IVm. UNEXPLOITED POTENTIAL YIELD OF INDIAN EEZ (in '000 tonnes) Depth-Zones

SPECIES GROUP	NWCR mts. 0-50	NWCR mts. 50-200	SWCR mts. 0-50	SWCR mts. 50-200	LECR mts. 0-50	LECR mts. 50-200	UECR mts 0-50	UECR mts 50-200	TOTAL (Species) 0-50	TOTAL (Species) 50-200	Total
1. Exportable Species	4	30	4	150	18	125	68	75	88	380	
2. Panaeid Prawns	2	—		15		5	28	5	30	25	
3. Other Crustaceans	2	—	1		9	—	—	5	12	10	
4. Cephelopods		30	3	30	3	15	40	60	46	135	
5. Tuna & Allied Fishes	—	10	—	100	—	105	—	5	—	220	
6. High Priced Species	17	160	61	180	24	75	110	25	212	380	
7. Low-Priced Species	105	210	103	480	94	160	329	100	631	950	
TOTAL	126	340	168	810	130	360	507	200	931	1710	3141

SOURCE: Manjula. R. Sharma. p. 3.

ranking first, the potential between 50 to 200 metre of depth for demersal fishes is highest in Goa, Karnataka and Kerala.[33] The potential yield of demersal fish resource from within 40 metre depth zone is estimated at about 1.7 million tonnes, of which the present landing is about 0.64 million tonnes only, hence there appears to be considerable scope for increasing the catch even from within 40 metre depth.

The cephalod fishery has greater potential upto 50 metre depth and between 200 metre depth in Goa, Karnataka, Kerala, Orissa and West Bengal. An increase in the crustacean fisheries would be possible by bringing many new areas under exploitation, in regions where prawns are already fished at present though with a greater concentration on the location of areas of deep water prawns in the further waters of the shelf. Mackerel catches can be significantly increased. According to Suda (1973) an additional yield of 5,00,000 tonnes of mackerel can be obtained from the Indian Ocean.[33] A fishery which is now of

---

33. N. Krishnan Kutty, "Some Thoughts on the Exploitation and Scientific Management of the Fishery Resources in the Seas Around India" (Paper presented at the National Seminar on Oceans : Realities and Prospects, New Delhi, March 26 - 29), p. 30.

low magnitude but which offers great scope in the future relates to the Mollusca which are capable of giving very high yields per acre from the shallow coastal area. Increase in pelagic fisheries is possible in areas which have been diagnosed as areas of divergence and up welling higher dissolved nutrients, higher plankton biomas and higher benthic fauna. Apart from the known pelagic fisheries and the shoaling species of sardines and scombroids the indications are that the actual fish stocks with reference to an individual species is not of a large magnitude. A large number of smaller fisheries composed of various species with a wide range of distribution will figure more significantly as commercial fisheries in the future.

As regards increased capacity of trawler yields the scope really lies in fishing beyong the marginal seas on the shelf and on the scope of the shelf.[34] From trawler fishing the increase may not be much in terms of total yield, but substantial in terms of value. Productive trawling grounds for deep-sea fishing have been located west of the Kathiawar region. Other equally rich areas have been located between Alleppey and Quilon and at the head of the

---

34. R. Raghavachari, n.2, pp - 4 - 5.

Bay of Bengal, off the mouths of the Prachi and Baitarni and the Mahanadi rivers.

Regarding region-wise potential, certain areas have been identified which offer a large under exploited or unexploited marine fishery resource. Amongst grounds important for future activity are the Pedro Bank extending over a 100 sq. miles mostly at 20 to 30 fathoms and the Wadge Bank south of Cape Comorin roughly 4000 sq. miles in extent. In certain productive regions like the Andaman sea, and along the west coast of India, are areas where substantial increase in production is possible from stocks already known and partially exploited. The seas around Lakshadweep in the Arabian Sea are known to abound in many valuable varieties. Commercially very valuable fishing consists of pearl fishing, window-pane oysters found in the open sea off the Coromondal Coast, Madras and Cochin have a promising future. The waters of the Gulf, near the edge of Kathiawar Peninsula as well as the Gulf of Kutch are rich in oyster beds, yielding highly valuable pearls are as yet under exploited.

The Exploratory Fisheries Project's vessels have located grounds for perches and groupers within the 30 - 100 fathom region. Along the south-west coast alone, their potential is estimated at 7000

tonnes each per annum. As these fish have white meat, therefore do not only have a high domestic demand but has good prospects in the foreign markets as well. Along the north-west coast there are large resources of mackerels, ribbon fish and carangids within the 20 to 60 fathom range. These can be harvested by purse seining and mid-water trawling off the Maharashtra and Gujarat coasts there are reserves of pomfrets which are essentially confined to the depths of 40 fms to 90 fms. After 90 fms the catch declines though pomfret has been found in areas upto 150 fms. In this region there are also considerable quantities of squids and cuttle fish, the major concentration of these fish is between 50 fms - 150 fms, with the maximum concentration at a depth of 50 to 80 fms. These can be found upto a depth of 200 fms.

Marine algal resources of India, estimated to be about 70,000 tonnes fresh weight and are likely to be increased considerably after surveying the unexploited potential areas of Andaman and Nicobar Islands.[35] The imbalance between the exploitable resources and the current level of production, hence there is a need to ensure that a balance is maintained between exploitation and the growth optimum.

---

35. Arvind C. Untawale, "Status of Marine Algal Resources of the Indian Coast for Research and Development", n.30, pp. 2 - 4.

The potential for growth and the present exploitation pattern of marine fish resources indicate that additional marine fish production could come from two sources:[36]

(1) Deeper shelf waters of all the states/regions in general and particularly from deeper waters off Orissa, West Bengal, Andamans and Lakshadweep.

(2) In-shore regions of the WRCR, ERCR, SWCR and NWCR in decreasing order of their contribution.

However, the overall additional production should come from the deeper waters which are practically untapped, than the inshore regions which are being over fished and might soon show signs of depletion. The current yield is very small in India mainly due to lack of information and low level of exploitation. The catch per fisherman per annum is among the lowest in the world. In comparison with the farming on land the resources of the sea for food are very inefficiently used.

Though fishery development depends on many factors the catch and development trends of the fishery can be considered to reflect the actual realisation of the fishery potential of Indian EEZ. Obtaining useable information about the resource and the fishery is the most immediate requirement in the EEZ.

---

36. Report of the Task Force on Marine Products, n.8, pp. 37 - 38.

In terms of needs of animal protein and the potentialities of the resource the present yield is very small. The catch per annum is the lowest in the world. The present level of exploitation is less than 16 percent of the harvestable resource and therefore an increase of 2 to 3 times will not be a difficult task. For the entire Indian continental shelf, the demersal catch will be around 7 million tonnes and the pelagic yield 3 million tonnes, however if intensive the region may provide more than 11 million tonnes. Though the estimates of the Indian Ocean potential very considerably. According to Qasim 25 million tonnes and J.A. Gulland 14.5 million tonnes) yet this fact is obvious that the Indian Ocean can produce at least an average of 16 million tonnes. At present the total production is only 3.7 million tonnes. It is estimated that the west coast would yield an estimated potential of 8 million tonnes as against the present yield of 9 lakh tonnes. Similarly the east coast would yield 3.8 million tonnes as against 4 lakh tonnes at present. At the present over all growth rate the potential for most of the fisheries would be reached between the year 1990 and 2000, hence the next decade will

herald the development of the fisheries of the Indian EEZ[37] to its fullest potential depending on the determination and enthusiasm with which we approach the problem and the practicability of the programmes adopted.

---

37. Arun Pavulekar, "Benthic Explorations and Potential Demersal Fishery Resources of the Indian Ocean", n.30, pp. 13 - 14.

Table - IV a.

Top Ten Fish Producing Countries of the World*

(Million Tonnes)

Country	1973	1974	1975	1976	1977	1978	1979	1980
1. Japan	10.09	10.10	9.90	9.99	10.12	10.18	9.97	10.41
2. USSR	8.61	9.26	9.97	10.13	9.35	8.91	9.11	9.41
3. China	3.79	4.13	4.25	4.32	4.46	4.39	4.05	4.24
4. USA	2.80	2.85	2.84	3.05	2.98	3.42	3.51	3.63
5. Chile	0.66	1.13	0.90	1.38	1.32	1.93	2.63	2.82
6. Peru	2.33	4.14	3.45	4.34	2.54	3.37	3.68	2.73
7. India	1.96	2.26	2.27	2.17	2.31	2.31	2.34	2.42
8. Norway	2.91	2.58	2.48	3.36	3.40	2.59	2.65	2.40
9. Rep. of Korea	1.46	1.69	1.89	2.12	2.09	2.09	2.16	2.09
10. Denmark	1.46	1.84	1.77	1.91	1.81	1.74	1.74	2.03
World Landings	62.70	66.47	66.38	69.75	68.91	70.44	71.27	72.19

* Arranged on the basis of 1980 landings.

Source : FAO Year Book of Catch Statistics.

GROWTH OF ANNUAL PRODUCTION OF MARINE FISH (1957-78)

TABLE : IV e

Year	Total Landings (Tonnes)	Anual % Changes in total Landings
1958	756100	-13.68
1959	584500	-22-70
1960	879800	50.52
1961	753700	-14.33
1962	634400	-15.82
1963	664900	4.81
1964	859500	29.27
1965	832777	-3.11
1966	890111	6.91
1967	891838	0.71
1968	934611	4.79
1969	913630	-2.24
1970	1077466	17.93
1971	1161389	7.98
1972	980049	-15.61
1973	1220240	24.50
1974	1217797	-0.20
1975	1422693	16.82
1976	1352855	-4.90
1977	1259782	-6.08
1978	1403607	11.42

Source: MPEDA

TABLE IV C.
~~Exhibit II~~

MARINE FISH PRODUCTION - 1978 - STATEWISE (TONNES)

States	Demersal Fisheries			Pelagic Fisheries	Midwater Fisheries	Total	Production per sq.km. (Tonnes)
	Fish	Crustaceans	Cephalopods				
Gujarat	81,612 (40%)	11,957 (6%)	1,959 (1%)	19,485 (10%)	86,916 (43%)	201,929	2.03
Maharashtra	60,220 (21%)	86,101 (30%)	4,557 (2%)	19,231 (7%)	114,135 (40%)	284,244	2.71
Goa	7,588 (30%)	2,217 (7%)	124 (4%)	10,872 (41%)	6,310 (18%)	27,111	2.72
Karnataka	31,885 (20%)	9,220 (6%)	1,346 (1%)	101,508 (67%)	8,901 (6%)	152,860	6.00
Kerala	82,449 (22%)	47,642 (13%)	6,516 (2%)	165,339 (45%)	71,393 (19%)	373,339	10.39
Tamil Nadu	95,436 (45%)	23,451 (11%)	1,042 (-)	32,170 (15%)	60,800 (29%)	212,899	5.30
Pondicherry	2,421 (37%)	569 (9%)	36 -	2,235 (31%)	1,567 (23%)	6,828	
Andhra Pradesh	29,258 (36%)	10,060 (12%)	297 -	13,743 (17%)	28,758 (35%)	82,116	2.65
Orissa	11,276 (28%)	2,615 (8%)	4 -	13,238 (32%)	12,537 (32%)	39,670	1.68
West Bengal	6,458 (50%)	1,268 (9%)	30 -	1,410 (11%)	3,588 (30%)	12,754	0.56
Andamans	5,911 (85%)	265 (3%)	- -	309 (4%)	592 (8%)	7,077	0.44
Lakshadweep	589 (21%)	- -	20 -	1,908 (68%)	263 (11%)	2,780	0.64
Total	415,103	195,365	15,931	381,448	395,760	14,03,607	3.38

Demersal Fish - Sharks, Rays, Eels, Perches, Polynemids, Sciaenids, Misc. small fish, Soles, etc.
Crustaceans - Shrimps, Lobsters, Crabs, etc.
Cephalopods - Cuttle fish and Squids
Pelagic fish - Oil Sardines, Other Sardines, Mackerel, Other Clupeids, Tuna, etc.
Midwater Fish - Cat fish, Ribbon fish, Horse Mackerel, Pomfrets, Seer fish, Anchoviella, Bombay Duck, etc.

Table1 17. State-Wise Annual Marine Fish Landings in India

(1966-1980) (Figures in Tonnes)

States	(3) 1970	(4) 1971	(5) 1972	(6) 1973	(7) 1974	(8) 1975	(9) 1976	(10) 1977	(11) 1978	(12) 1979	(13) 1980
West Bengal & Orissa	31,403	18,032	15,330	22,736	26,092	45,761	55,234	21,761	52,426	62,552	45,472
	(2.92%)	(1.55%)	(1.56%)	(1.86%)	(2.14%)	(3.22%)	(4.08%)	(1.73%)	(3.73%)	(4.51%)	(3.68%)
Andhra Pradesh	74,459	84,910	84,480	99,544	1,58,818	1,55,638	1,31,321	1,00,756	82,116	91,426	1,16,013
	(6.91%)	(7.23%)	(8.62%)	(8.16%)	(13.04%)	(10.94%)	(9.11%)	(8.00%)	(5.85%)	(6.59%)	(9.39%)
Tamil Nadu	1,49,106	1,60,619	1,55,153	1,82,419	1,75,713	2,21,215	2,26,078	2,06,046	2,12 899	2,35,008	2,17,394
	(13.84%)	(13.83%)	(15.83%)	(14.95%)	(14.43%)	(15.55%)	(16.71%)	(16.36%)	(15.17%)	(16.93%)	(17.60%)
Pondicherry	10,624	10,454	8,980	8,682	7,698	8,150	10,123	6,462	6,828	10,068	9,390
	(0.99%)	(0.90%)	(0.92%)	(0.71%)	(0.63%)	(0.57%)	(0.75%)	(0 51%)	(0.49%)	(0.73%)	(0.76%)
Kerala	3,92,880	4,45,347	2,95,618	4,48,269	4,20,257	4,20,836	3,31,047	3,45,037	3,73,339	3,30,509	2,79,543
	(36.46%)	(38.35%)	(30 16%)	(36.74%)	(34.51%)	(29.58%)	(24.47%)	(27.37%)	(26.60%)	(23.80%)	(22.63%)
Karnataka	1,15,205	1,03,724	92,676	91,489	76,263	87,494	95,283	97,152	1,52,860	1,26,384	1,06,737
	(10.69%)	(8 93%)	(9.46%)	(7.50%)	(6.26%)	(6.15%)	(7.04%)	(7.71%)	(10 89%)	(9.10%)	(8.64%)
Maharashtra	1,92,361	2,15,305	2,20,002	2,26,696	1,84,961	2,56,619	2,93,601	2,64,452	2,84,244	2,93,326	2,25,853
	(17.85%)	(18.54%)	(22.45%)	(18.58%)	(15.19%)	(18.04%)	(21.70%)	(20.99%)	(20 25%)	(21.12%)	(18.28%)
Gujarat	89,027	82,159	75,846	1,21,963	1,45,309	1,93,775	1,71,294	1,89,638	2,01,929	1,91,312	20,3,494
	(8.26%)	(7.08%)	(7.74%)	(9.99%)	(11.93%)	(13.62%)	(12.66%)	(15.05%)	(14.39%)	(13.78%)	(16.47%)
Andamans	500	569	780	854	920	1,104	1.334	1,532	7,077	1,721	1,803
	(0.05%)	(0.05%)	(0.08%)	(0.07%)	(0.08%)	(0.08%)	(0 10%)	(0.12%)	(0.50%)	(0.12%)	(0.15%)
Lakshadeep	1,165	1,190	1,080	1,853	2,232	2,931	2,572	2,215	2,780	3,846	2,909
	(0.11%)	(0.10%)	(0.11%)	(0.15%)	(0.18%)	(0 20%)	(0.19%)	(0.18%)	(0.20%)	(0.28%)	(0.24%)
Goa	20,736	39,980	39,104	15,740	19,534	29,170	34 968	24 731	27,111	25,388	24,490
	(1.92%)	(3.44%)	(3.07%)	(1.29%)	(1.61%)	(2.05%)	(2.59%)	(1.96%)	(1 93%)	(1.83%)	(1.98%)
Private Travels	—	—	—	—	—	—	—	—	—	16,840	2,244
	—	—	—	—	—	—	—	—	—	(1.21%)	(0.18%)
Total	10,77,466	11,61,389	9,80,049	12,20,240	12,17,797	14,22,693	13,52,855	12,59,782	14,03,607	13,88,380	12,35 342
	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)

Source : MPEDA

~~Exhibit I~~ TABLE: IV d.

REGIONWISE MARINE FISHERIES RESOURCES OF INDIA AND CURRENT LEVEL OF EXPLOITATION (1978)

(Quantity in Lakh tonnes)

	Demersal Fisheries				Crustaceans				Cephalophods				Pelagic Fish				Midwater Fish				Total			
	Resources			Current Production	Resources				Resources				Resources				Resources				Resources			
	0-50 mts (a)	50-200 mts. (b)	Total (c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
1. NWCR	1.30	1.10	2.90	1.42 (78.88)	1.15	0.10	1.25	0.98 (85.21)	-	0.20	0.20	0.07 (35.00)	0.65	0.15	0.80	0.39 (60.00)	1.80	1.85	3.65	2.01 (55.06)*	5.40	3.40	8.30	4.86 (?0.00)
2. SWCR	1.40	2.60	4.00	1.22 (87.14)	0.85	0.20	1.05	0.59 (69.41)	0.05	0.30	0.35	0.08 (26.66)	3.20	0.50	3.70	2.78 (36.61)	1.50	3.60	5.10	0.87 (53.00)	7.00	7.20	14.20	5.53 (76.14)
3. LECR	1.75	1.00	2.75	1.27 (72.57)	0.40	0.05	0.45	0.34 (85.00)	0.05	0.15	0.20	0.01 (6.66)	1.30	0.05	1.35	0.48 (36.92)	1.30	0.75	2.05	0.91 (70.00)	4.00	2.00	6.80	3.02 (62.91)
4. UECR	2.00	0.80	2.80	0.13 (9.00)	0.35	0.15	0.50	0.04 (11.42)	0.40	0.60	1.00	-	0.75	0.05	0.80	0.15 (20.00)	1.00	0.40	2.30	0.16 (40.00)	5.40	2.00	7.40	0.53 (9.62)
5. Andamans	-	0.30	0.60	0.06	-	-	-	(6)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.60	0.07
7. Lakshadweep	-	0.30	0.30	0.01	-	-	-	-	-	0.05	0.05	-	-	0.55	0.55	0.02	-	-	-	(b)	-	0.90	0.90	0.03
Total	6.95	6.10	13.05	4.16 (59.85)	2.75	0.50	3.25	1.95 (70.90)	0.50	1.30	1.80	0.16 (32.00)	5.90	2.35	8.45	3.80 (64.40)	6.50	6.05	13.15	3.96 (60.92)	22.66	17.13	9.70	14.04 (61.95)

Sources: 1. Resources potential has been compiled from George P.C., et. al. (1977) Op.cit.
2. Current Exploitation from CMFRI, Cochin, Published data.

Notes:
1. - indicates nil or negligible.
2. (b) indicates less than 500 but more than 100 tonnes.
3. Figures in the parentheses of current production columns are the percent share of current production in the resources potential upto 50 mts. depth range.
4. * indicates the per cent share in total resources upto 200 mts. depth. We have computed the share of current production in total resources as the current production is more than the resources potential upto 50 mts. depth range.

Table 4.f: Per Capita Human Consumption of Marine Fish

State/Union Territory	Annual growth rate %	Per Capita Consumption in 1980-81 (Kg)	1981-82 (Kg)	1982-83 (Kg)	1983-84 (Kg)	1984-85 (Kg)
Andhra Pradesh	14.81	1.54	1.77	2.03	2.33	2.68
Goa	12.53	29.42	33.11	37.26	41.93	47.18
Gujarat	10.29	1.21	1.33	1.47	1.62	1.79
Karnataka	12.92	3.90	4.40	4.97	5.61	6.34
Kerala	10.65	17.90	19.81	21.92	24.25	26.83
Maharashtra	14.05	1.81	2.06	2.35	2.68	3.06
Orissa	16.03	1.51	1.75	2.03	2.36	2.74
Tamil Nadu	12.80	2.29	2.58	2.91	3.28	3.70
West Bengal	6.51	0.94	1.00	1.07	1.14	1.21
Other coastal UT	12.80	4.55	5.13	5.79	6.53	7.37
All Coastal *	10.63	3.12	3.50	3.93	4.37	4.86
Delhi	15.99	1.93	2.24	2.60	3.02	3.50
Other non-coastal	23.10	0.20	0.37	0.46	0.57	0.70
All Non-Coastal *	14.29	0.08	0.10	0.12	0.15	0.18
ALL INDIA*	10.27	1.61	1.80	2.03	2.26	2.53

* Numbers in these rows are derived from respective total consumption and population data in Table 7.7

TRADE PATTERN AND PROSPECTS

A thrust to boost marine fish production and their exports has been the consistent policy of India, which has led to tremendous progress, both in terms of production and export. The home demand has recorded high increase but still a large surplus is available for export. Diversification, as well as foreign trade orientation has been the goal of marine fish industry in order to cope with the growing competition.

India is one of the aspiring nations which joined the race in sea foods in the 1950s; from a bare export of rupees (Rs.) 3.67 crores in 1952-53 our exports increased spectacularly to Rs. 236.01 crores in 1981-82. The exports have risen more than four fold in quantity and sixty-nine fold in value between 1961 and 1981. The prosperity of the sea-food industry actually lies in its export performance. This aspect has greater relevance in developing countries like India where export strategies have become an economic necessity for a bare survival, amidst severe competion faced from various quarters.

TRENDS: PAST AND PRESENT:

A review of the trend of marine products over a period of years, shows that the overall exports have risen both in terms of quantity as well as value.

TABLES V a. and GRAPH 17 show the quantity-wise growth of marine products exports from India from 1953-54 to 1981-82, the trend is marked by fluctuations and indicates not a very healthy situation. The export of marine products recorded a peak in 1978-79 (86894 tonnes) but fell down to 70105 tonnes during 1981-82. Regarding the export growth of Indian marine products in terms of value we find that from 1953 till 1965 the export earnings value about Rs.5.7 crores annually (TABLE V a. GRAPH 16), however after 1966 the export earnings have shown a steady rise after 1976-77 the increase has been markedly sharp and in 1981-82 the export of marine products fetched over 286 crores of rupees. The sizeable amount of foreign exchange which the marine products earn for the country give an indication of the importance of export trade in the development, not only of this particular industry but its role in the entire economy of the country.

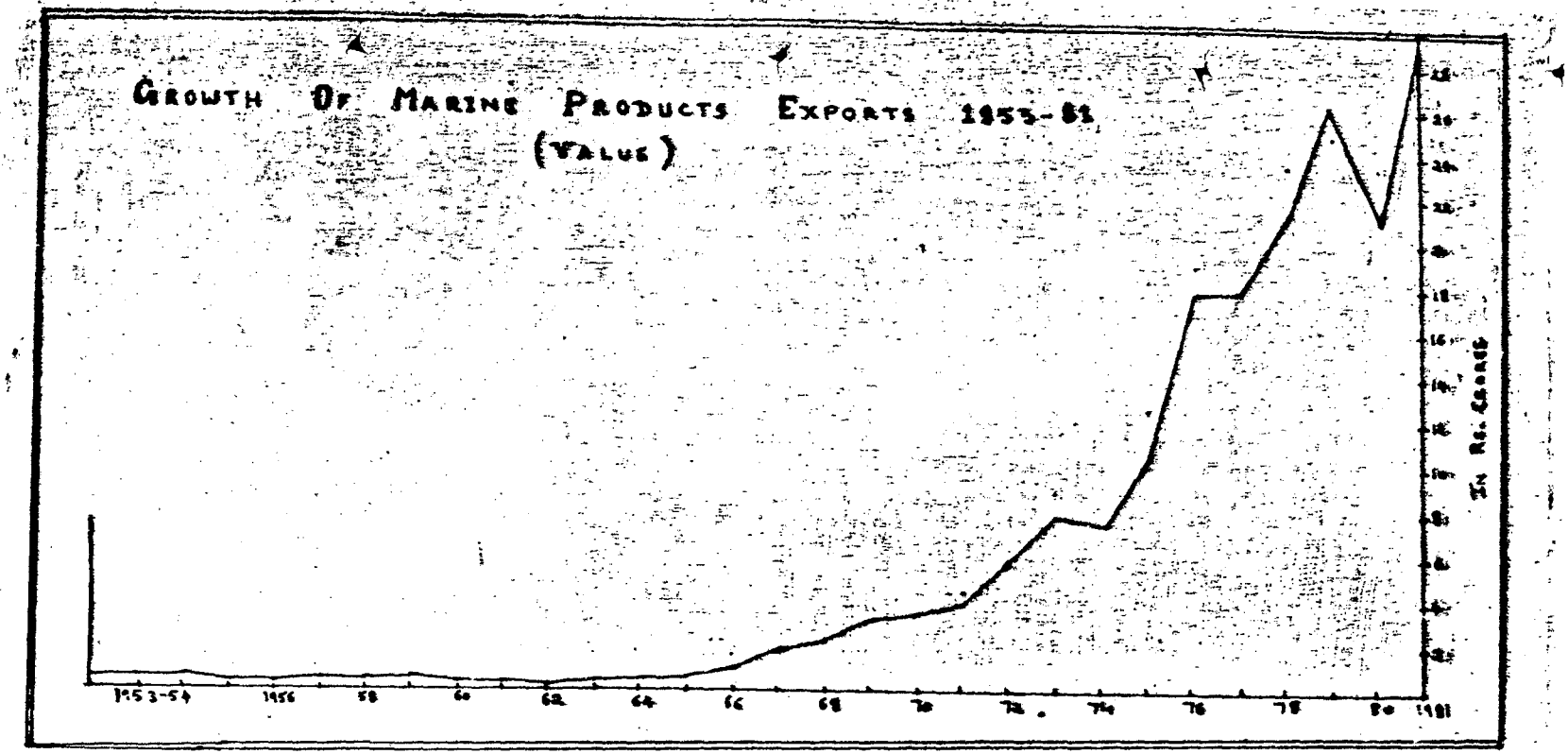
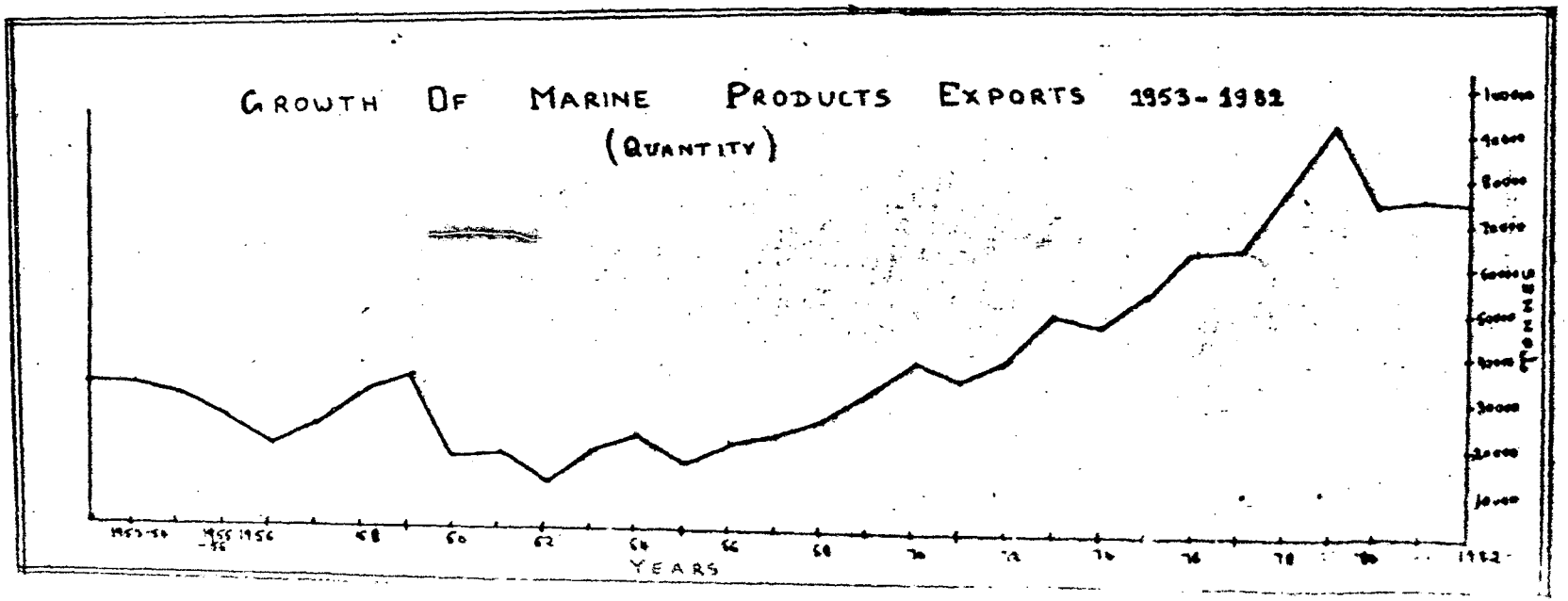

GROWTH OF MARINE PRODUCTS EXPORTS 1953-81
(VALUE)
IN Rs. CRORES
1953-54
1956
58
60
62
64
66
68
70
72
74
76
78
80
1981

FIG : 16

FIG: 17


GROWTH OF MARINE PRODUCTS EXPORTS 1953-1982
(QUANTITY)
TONNES
1953-54
1955-56
1956
58
60
62
64
66
68
70
72
74
76
78
80
1982
YEARS

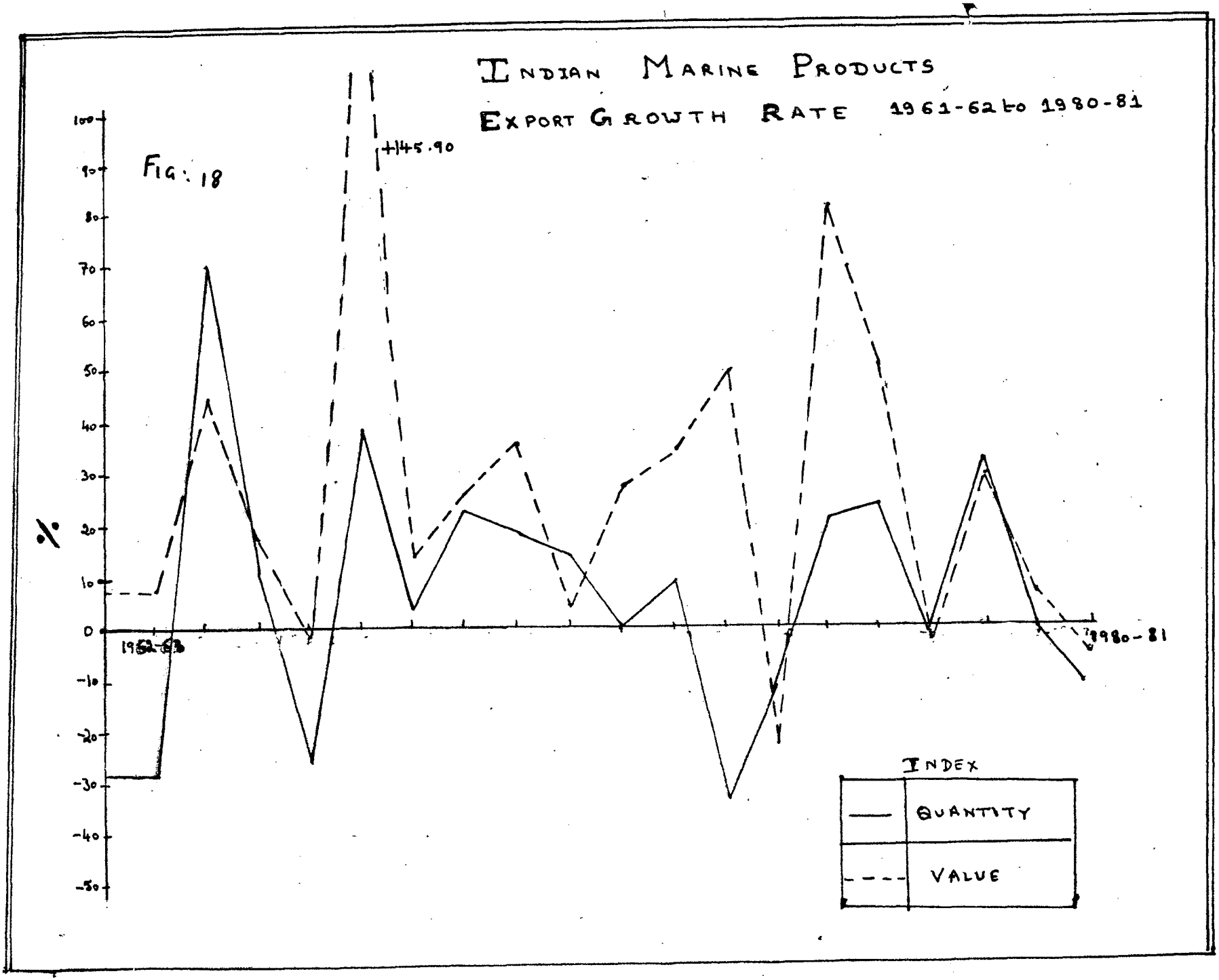
However when both the graphs are super imposed (GRAPH) and the figures compared the real picture of the current situation emerges. Increase in export earnings does not necessarily mean that the total volume of trade has also gone up. In 1981 export of marine products from India was 75375 tonnes valued at Rs. 286.71 crores, the average price received for Indian marine fish in the foreign market in the same year was Rs. 38 per kg, which is more that five times the average domestic price. However Indians share in world fisheries has been very small in value terms, it was 2.2 percent in 1977, 2 percent in 1978 and only 1.9 percent in 1980.[1]

GROWTH RATE :

GRAPH and TABLE , show the annual growth rate of marine exports from 1962-63 upto 1981-82, both in terms of quantity as well as value. The graph is marked by fluctuations and it is important to note that from 1979-80 onwards the growth has been negative in terms of quantity. In terms of value too a more or less similar trend is observed after

---

1. S.N. Rao, "Product Development for Export", (Paper presented at the National Seminar on Fisheries Development in India at Indian Institute of Management, Ahmedabad from April 9 - 11, 1982)p. 1.


INDIAN MARINE PRODUCTS
EXPORT GROWTH RATE 1961-62 to 1980-81
FIG: 18
+145.90
%
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1980-81
INDEX
QUANTITY
VALUE

1976 - 77 the trend is not very steady. As compared to 1979 - 80 the exports in 1980 - 81 fell by 12.5 percent in terms of volume and 5.62 percent in terms of value. However, in the year 1981 - 82 the exports picked up in terms of value (by about 21.79 percent) though not in quantity as compared to the previous year.

It is thus clear that the export growth of marine products has undergone significant fluctuations over the period of time, this is directly related to the fluctuations in the total production and demand in the foreign markets.

STRUCTURE OF MARINE PRODUCTS EXPORTS:

The species in order of importance regarding foreign exchange earnings are shrimp, frog legs, lobster, cuttle fish, squids and shark. The share of shrimps in the total exports has been overwhelmingly large, amounting by value to 87 percent and in quantity over 72 percent in 1981. This is mainly because India is the number one shrimp producing country in the world and also because shrimps fetch a good price in the international markets. (Fig : 20 TABLE : XVI)

Till the close of 1960, the exports of Indian marine products mainly consisted of dried items like

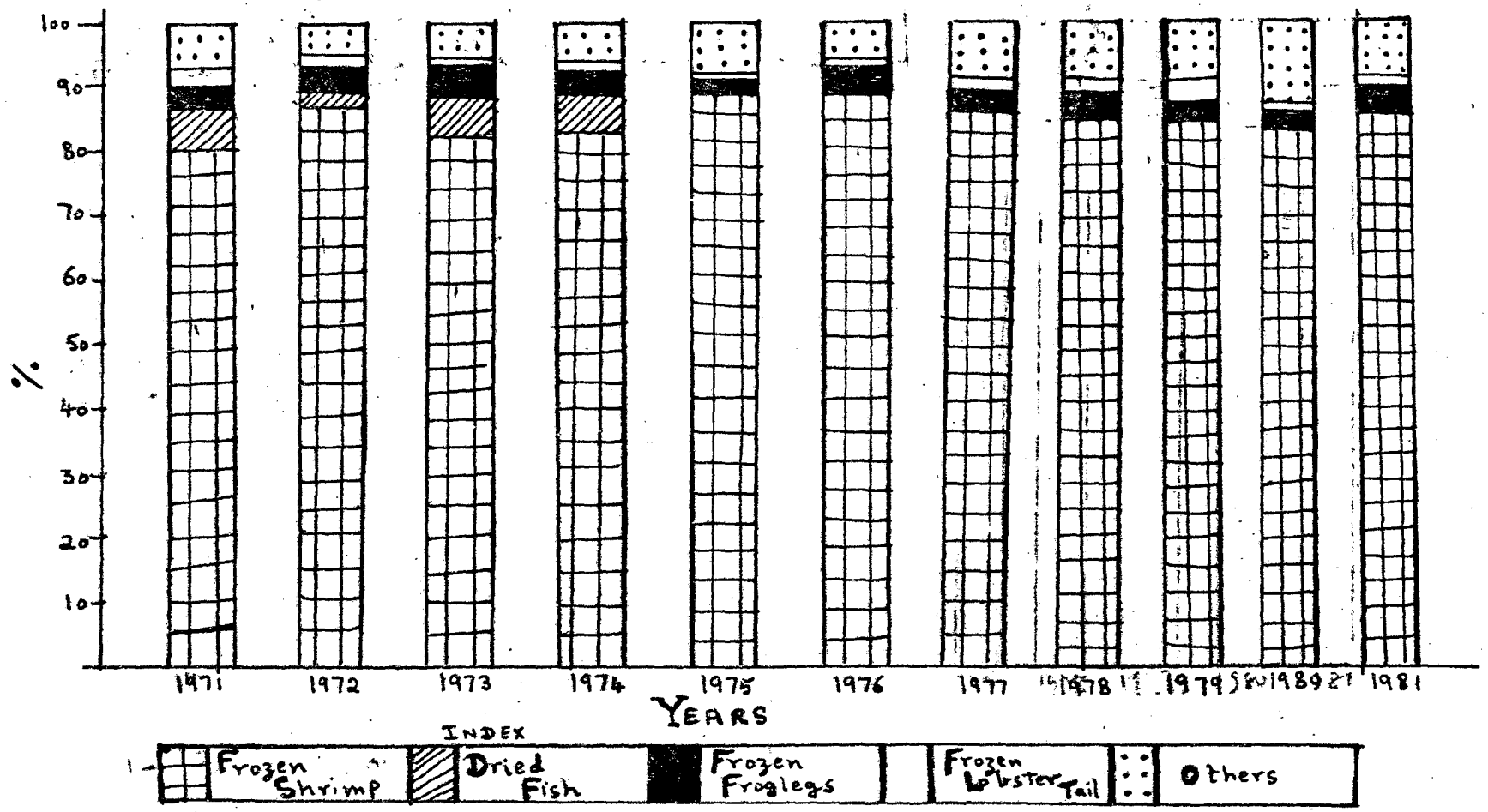
dried fish, dried shrimps, shark fins, fish maws etc. However after 1961, the position changed favourably, for while the exports of dried marine products were witnessing a downward trend, exports of frozen, items were increasing in importance and steadily progressing. It was only after 1966, that the exports of marine products particularly the frozen and canned items registered a significant rise, significantly related to the devaluation of the Indian currency in the same year.

GRAPH 19 (TABLE V b,f) gives us a clue to the understanding of the structural growth of Indian marine exports. In terms of quantity frozen shrimp has been the dominant item and its contribution to the total exports has ranged between 58 to 88 percent over the years; in 1975 its contribution was as high as 87.68 percent, after which its contribution has been steadily declining, however in 1981 it contributed 72.36 percent to the total. Fresh and frozen fish is another item which demands focus, as it has over the years shown a continuously rising trend (though with slight variations). Its share in 1979 was as high as 26.17 percent, in the same year the shrimp exports declined, however in 1980 it fell down to 15.02 percent and to 11.36 percent in 1981. Canned shrimp is one

Frg: 19

SHARE OF MARINE PRODUCTS EXPORTS FROM INDIA

1971 -1981 (VALUE)



item which has shown a declining trend over the years, it has fallen from 5.48 percent in 1971 to only .13 percent in 1981. Dried fish products have also shown a declining trend since 1971 (17.46 percent) and its contribution to the total was as low as 2.02 percent in 1981. Such items as shark fins and fish maws, frozen lobster tails and frozen frog legs have maintained a steady trend over the period of years under study.

Regarding the share of various items to the total earnings, (GRAPH 19, TABLE V b.) it is evident that value-wise too the frozen shrimp have dominated the export trade, it has not shown any major fluctuations in this trend. In 1979 though its contribution in terms of quantity had declined yet in terms of value it showed an increase and in 1981 it contributed 86.68 percent to the total exports. Such a situation prevails due to the large demand for shrimps in the international markets and its high price. Canned shrimp is the only item which has shown a decline in its share to the total, the other items have not shown any significant changes over the years.

MARKET STRUCTURE:

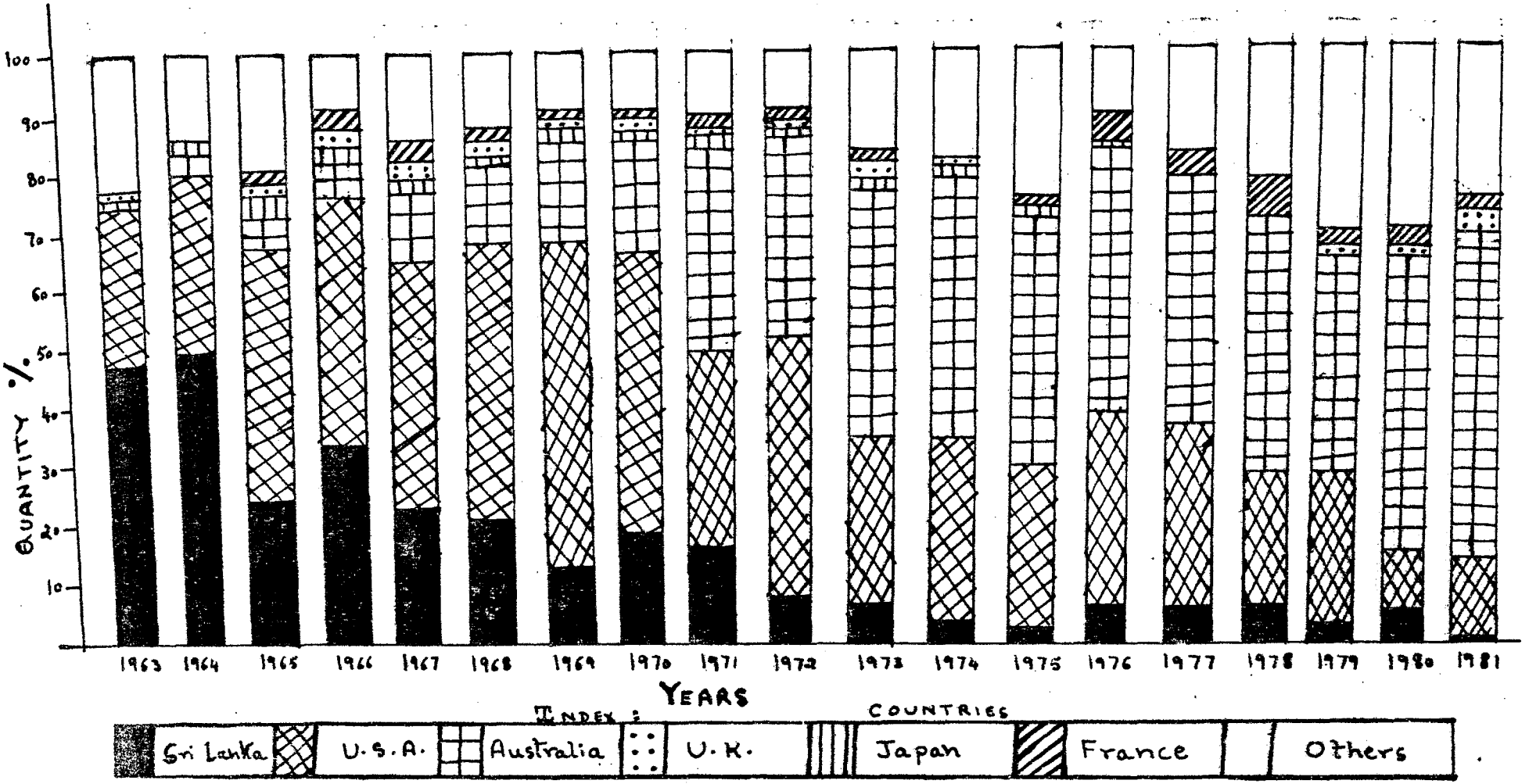
Before 1960, the markets for Indian marine products was largely confined to developing countries like Sri Lanka, Burma, Singapore etc. This position was maintained as long as our exports were dominated by dried items i.e upto the end of 1961. After the frozen and canned items started figuring in our exports increasingly the sophisticated and affluent markets like the United States of America (USA), the United Kingdom (U.K.), France, Australia, Canada and Japan etc. became more important buyers. Burma which used to light significant quantities of dried fish and dried shrimp from India, stopped buying on account of her internal problems, Sri Lanka also curtailed her off-take from India and looked else where for supplies. At the same time the exportable surplus of dried varieties available in India narrowed down, due to high pressure of domestic demand. All these factors together with the setting up of processing units with modern machinery for freezing and canning have led to the existing market structure of marine exports.

MAJOR IMPORTERS

GRAPH 20 and TABLE IV f. , throw light on the major importing countries and their percentage share

FIG. 20

MAJOR IMORTERS OF INDIAN MARINE PRODUCTS 1963-81



in our exports. Over the years there have been significant changes in our export trade with different countries both in terms of quantity and value. Sri Lanka, was the major importer in the early 1960s and in 1964 its contribution was 49.8 percent. After 1965 Sri Lanka was replaced by U.S.A. as the major buyer and this position it enjoyed upto 1970, when Japan replaced her and since then Japan's position has remained unchallenged. The demand for Indian products has been rising steadily in Belgium and Netherlands. U.K. is another important market and though during 1974 to 1978 the exports showed a considerable decline but since then the position is improving.

In terms of exchange earnings, U.S.A. has been the major supplier till 1970 after which Japan has been dominating and in 1981 her contribution to the total was as high as 71.25 percent. Sri Lanka and Australia have shown a gradual declining trend.

ITEM-WISE EXPORT TO DIFFERENT MARKETS:

Over the years, even the markets for frozen sea-foods have witnessed significant changes. Japan and U.S.A. are the two largest export markets for Indian marine products and in 1981-82, these two

jointly lifted over 91 percent of frozen sea foods in terms of quantity and about 93 percent in terms of value.

1. SHRIMPS : Frozen-shrimp is the most important item of export. Shrimp trade in India takes place in frozen, canned and dried forms. Japan and U.S.A. have been the premier markets for frozen shrimps over the last twenty years. Frozen shrimps accounted for Rs. 183.4 crores in 1980. Japan has been contributing more than 80 percent to the total earnings since last ten years. Japan, U.S.A. and Australia have been the leading importers of this item, however since 1981, U.K. has also emerged as an important market and lifted 4.84 percent of the total quantity exported in 1981. The major markets for canned shrimps are U.S.A., U.K., France, Australia and the European Economic Community (E.E.C) countries. U.S.A. which was a principal buyer till 1971, is nearly absent from the scene after 1975. In countries like Canada and Australia the demand for canned shrimp has also been falling, and these are being replaced by Union of Soviet Socialist Republic (U.S.S.R), Netherlands and United Arab Emirates (U.A.E.) and Newzealand. U.S.S.R. ranked second in the import of

this item in 1981 (31.33 percent) after U.K. (36.46 percent). The principal buyers of dried shrimp are Hong Kong, Sri Lanka and Singapore.

2. LOBSTERS: Frozen lobster tails rank next to shrimps as an item of export. About 98 percent of the export of this item is effected in frozen form, the rest being shipped in cans. The only market for frozen lobster tails from India has been U.S.A. over a long period of years (nearly 100 percent). The export of 53 tonnes of lobster tails in 1963 was the starting point, thereafter the export of this item has considerably increased. 1980 witnessed a 48 percent fall (Rs. 2.79 crores) due to sharp decline in prices together with poor catches. The emergence of Japan as an important market (45.08 percent) in 1981 and the development of other markets, indicates a desirable trend and should be encouraged since over-dependence on any one market is not safe.

3. FROGLEGS : Significant progress has been made in the export of this item in the recent years and the principal importers are, U.S.A., France, Belgium, Italy, West Germany, Switzerland and Australia. Till 1976, U.S.A. was the principal importer but from

1977 onwards France is the leading buyer. Netherlands which was not a very significant market suddenly gained prominence in 1981. The markets of frozen froglegs on the whole have experienced important fluctuations.

4. FRESH AND FROZEN FISH : 1980 witnessed a sharp fall in the export of this item, (quantity-wise over 54 percent) consequent on the cessation of charter arrangements for deep-sea fishing in Andaman and Nicobar waters, resulting in the fall in total fish production. As the unit value price recorded a 108 percent rise, there was not any significant effect on the exports in terms of value; the fall was marginal just 3 percent. Frozen fillets are exported to Kuwait, U.A.R., Greece, Saudi Arabia, Japan, Hong Kong and Singapore. Exports to the traditional market of Japan have shown a declining trend and in 1980 Kuwait was the main importer followed by Greece and Saudi Arabia. In the recent years new markets have emerged for this item of export.

5. FROZEN SQUIDS AND CUTTLE FISH : Frozen squids are mainly exported to France, Greece, Spain, U.A.R. Netherlands and Australia. Export of this group of products slid down to Rs. 2.51 crores only in 1980,

a fall of 10.5 percent value wise over the previous year, due to unfavourable export price. Japan and France are the main markets for cuttle fish and together take over 66 percent of the total (1980-81). In the recent years the markets for this product has widened and Kuwait, Spain and U.K. appear to be the potential markets.

6. CANNED CRAB MEAT: Crab meat has shown erratic performance over the period of years, however in terms of value its contribution has been steadily increasing due to rise in the prices of this item. Traditionally France and U.K. have been the principal markets but in the recent years its markets have spread to Australia, U.S.A., Saudi Arabia and Yugoslavia. In 1980, East Germany suddenly emerged as the top importer, followed by France and Australia.

7. DRIED FISH : Dried fish is mainly exported to Sri Lanka, Mauritius, U.K., Singapore, Hong Kong and Malaysia. Sri Lanka has maintained its position as the principal buyer over the years; Singapore has maintained a steady trend on an average, however Thailand made its entry in 1980 and ranked second in position after Sri Lanka. Dried Bombay duck and

mackerel form the bulk of dried fish export. In 1980 the dried fish exports fetched Rs. 2.08 crores.

8. SHARK FINS AND FISH MAWS : Singapore, Hong Kong, and U.K. are the major importers of Shark fins. Fish maws are sent to Hong Kong, Singapore, U.A.E., Belgium and Iceland. The Indian salmon, jew fish, cat fish and eels yield good quality maws. Quantity-wise fish maws has not shown much variations over the years, though in terms of value a rising trend is noticed, however no significant change in the market structure for this commodity is evidenced.

9. OTHER PRODUCTS : Other items of export include fish meal, fish manure, fish oil, fish bone, turtle meat, Sea Beache-de-mer, sea shells, prawn and fish pickles, cuttle fish bones, sea forks, acquarium fish etc. which individually contribute very little to the marine export trade at present. Fish meal exports have recorded a rise from Rs. 1.91 lakhs in 1972 to Rs. 56.6 lakhs in 1980. Its major markets are established in Phillipines followed by Iran, Belgium, Kuwait and Japan. However fish meal exports have shown large fluctuations both in terms of quantity as well as value, its markets too have changed over the years.

Beche-de-mer has recorded a rise from Rs.3.66 lakhs in 1971 to Rs. 19.72 lakhs in 1980. Singapore has been a traditional market and ranks first as an importer, other important markets are Malaysia and Taiwan.

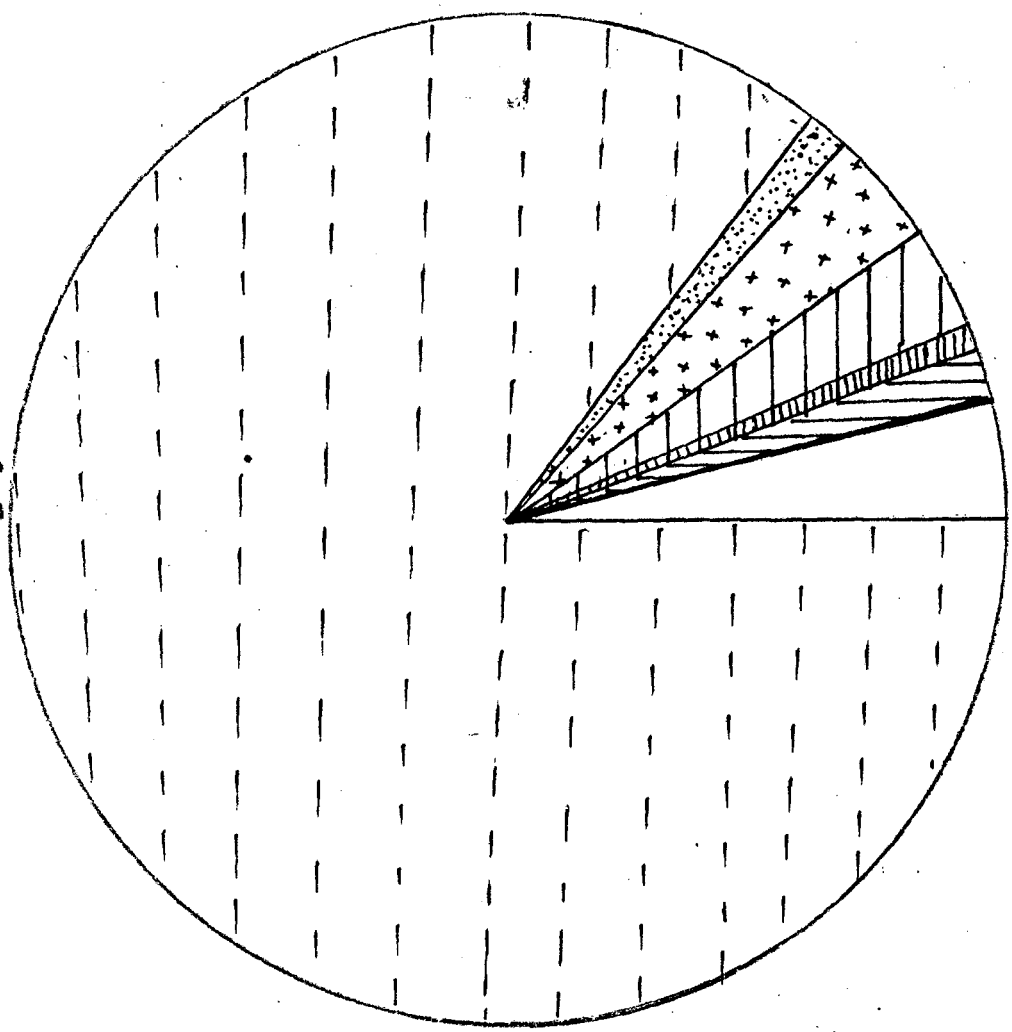
Fish oil exports have not maintained a steadily progressing trend and is marked by fluctuations. Most of the markets for fish-oil are in the Middle East countries. In 1980 the major importer was Kuwait followed by U.A.E. and Bahrein. The markets for sea-shells are widening and the principal buyers are U.S.A., U.K., UAE and Italy. The traditional buyers of our acquarium fish are U.K., Belgium and Netherlands, though in terms of quantity the exports have been declining. Major importers of Indian fish pickles in 1980 were U.K., Kenya and Bahrein, another item which has not shown consistency in terms of over all growth however it has considerable scope for expansion.

CURRENT SITUATION:

A review of the exports of Indian marine product emphasises the fact that from a meagre export figure of Rs. 4 crores in 1961-62 the exports have gone upto

FIG: 21

STRUCTURE OF MARINE PRODUCTS EXPORTS - 1980-81
(Quantity)



INDEX

FROZEN PRAWN	FROZEN FROGLEGS	DRIED FISH
FROZEN LOBSTER TAILS	FRESH AND FROZEN FISH	SHARK FINS AND FISH MAWS
OTHERS		

Rs.286.01 crores in 1981 - 82. Japan is the premeir export market contributing about 70 percent to the total earnings from marine exports, followed by U.S.A. (9 percent) and Netherlands at present.

As compared to 1979 - 80 the exports in 1980 - 81 fell by 21.5 percent in terms of volume and 5.62 percent in terms of value; this set-back was a result of various underlying and direct causes, which need to be studied for providing us an insight to understand the problem and provides a background for future planning and management policies. Marine exports are governed by various factors, physical, economic and political, the combined effect of which caused hardship to the industry both in terms of income and employment generation during this period.

Some of the important factors responsible for this decline are:[2]

(1) Poor Shrimp Catches: The shrimp landings all along the coast were poor during 1980, which had a serious impact on the three-tier set-up of the industry; (1) the fishermen operating the mechanised fishing vessels, (2) the fish trade which depended on them

---

2. Report of the Task Force on Marine Products (New Delhi, Ministry of Commerce, Government of India, September 1982), pp. 30 - 32.

for procurement and (3) the fish processors which depended on the former two, for running the fish processing plants and thus effecting exports. Secondly the absence of big-sized shrimps among the landings in the East coast brought down the export value of shrimps. It is important to note that there was a short-fall of over 6500 tonnes in landings of penaeid marine shrimps going for exports during the preceding year 1980.

(2) Natural Factors : Due to failure of monsoons in the catchment areas drought conditions prevailed over major part of the year 1980; this affected frog-breeding, ultimately resulting in the decline in frog-leg exports, however this phenomena is beyond human control.

(3) High Cost of Diesel: Shortage in diesel supplies and a price-hike caused hardship to the operation of mechanised fishing vessels; the mechanised boats found it rather uneconomical to operate, thus resulting in the decline in landings especially of shrimp.

(4) Termination of Charter Arrangements with Thailand:

During 1980 the deep-sea vessels from Thailand stopped operating off the Andamans, thus adversely

affecting our exports of fresh fish due to considerable fall in the landings from Port Blair.

Export of Fresh Fish Through Port Blair[3]

	1980-81	1979-80	Decrease (-)
Quantity (tonnes)	2575	17627	-15052 (85.39%)
Value (Rs.Lakhs)	41.75	552.57	-510.82 (92.44%)

(5) Sharp Fall in Prices in the Export Market :

Partly due to weakening of Japanese yen and partly due to organised consumer resistance to high priced varieties due to shooting prices, there was evidenced a sharp fall in the shrimp prices in the Japanese markets. High grade frozen shrimps fell by 26 percent compared to 1979, frozen lobster tails by 28 percent and canned shrimp by 7 percent. Fish and fish products similarly experienced a downward trend ranging between 13 percent for frozen squids and 31 percent for frozen cuttle fish and fillets.

(6) Impact of Blocklisting: Due to block listing of Indian shrimps by the Food and Drug Administration

3. Report of the Task Force on Marine Products, n.2, p. 31.

(FDA) of U.S.A., the purchase of Indian shrimps by its importers continued to be selective. This affected the morale and psychology of the Indian exporter, who became extra cautious in making shipments to U.S.A. and chose to divert sea food to West European Countries or to Japan in order to play safe though even at lower rates.

(7) Over dependence on Shrimps: Due to attractive price offered for shrimps in the foreign markets, catching efforts in India have been mainly directed towards this item. Little efforts have been made to increase the landings of the other varieties of fish.

FUTURE PROSPECTS :

To sum up India's sea-food exports presents an optimistic outlook based on past performance. There appears to be a vast scope for expanding further exports of Indian marine fishery, not only to the countries already importing them but also enlisting other new markets in the field of Indian customers.

Ind has potential for expansion in this direction and this calls for the adoption of necessary steps to be taken. Based on the available data the Government

of India has fixed an export target of 155,000 thousand tonnes valued at Rs. 591 crores to be achieved by the terminal year of the VI Five Year Plan, i.e. 1984-85. The current rate of export of shrimp has reached almost a plateau around 50 to 51 thousand tonnes. The annual rate of growth for export of frozen shrimps has been fixed at 6 percent level for the plan period. Due to greater emphasis given in the plan schemes for commercial shrimp farming and the proposed diesel oil supply at subsidised rates for mechanised fishing boats, the shrimp production in the country is expected to increase (a potential yield of 180,000 tonnes of penaeid shrimps). The future of the Indian sea-food industry to a great deal depends upon the continued development of existing & new shrimp fisheries and the ability of the affluent countries to absorb the high-priced crustaceans.

An estimation of the distribution of lobster resources around the Indian coasts, indicated that its exploitation could be stepped up along the coasts of West Bengal, Tamil Nadu, Kerala, Maharashtra, Gujarat and also around the islands. An export growth rate of 10 percent was therefore assumed for

lobster-tails (about 25,000 tonnes from the inshore area and between 5000 - 10,000 tonnes from deeper waters). Although no resource data is available for frog legs; however in view of the demand for frog legs in the foreign markets and in the light of past experience a growth rate of 10 percent was assumed.

The Ministry of Agriculture is proposing to introduce about 350 vessels of 23 metres and above during the plan period and consequently a growth rate of 27 percent was assumed in the exports of fresh and frozen fish for which there is a very large potential which has not been properly utilised in the export trade. In working out the unit value realisation of exports the growth rate was assumed in a range from 4.5 percent to 19 percent depending upon the product keeping in view the past trends, future demands in export markets and general escalation in the prices of marine products.[4]

On International market projections the following assumptions were made for fixing the export targets:[5]

---

4. Report of the Task Force on Marine Product, n.2,p.33.
5. Ibid.

(1) India will continue to be a main producer and supplier of shrimps to the world markets in the coming years as well.

(2) The export growth of Indian marine products will continue to depend upon frozen shrimps for many years to come.

(3) Shrimp prices are expected to rise more than two-fold in the next ten years, due to the widening gap between the supply and demand.

(4) Japan and U.S.A. will continue to be the main markets for Indian shrimps.

(5) If the present trend continues, Japan will be importing much larger quantities of cuttle-fish in the next few years.

(6) For squids, West Europe (particularly Spain, France and Belgium) will offer good markets.

(7) Nearby markets of Sri Lanka, Middle East, Singapore, Malaysia etc. will be strengthened further for Indian marine products in the coming years.

It is clear that Japan and U.S.A. will continue to be our main markets, yet the proportion of our exports to these traditional markets will fall, when the share of off-take by West European countries

improves significantly. Larger shipments are also expected to West Asian countries. In view of the fact that the marine landings have been stagnant over the last few years, it is necessary to increase the quantum of landings and on the basis to fix realistic targets of exports. Such targets however can be achieved only when certain required and necessary steps are taken; such as by intensive exploitation of known fishery resources in view as well as existing under-exploited areas, by diversification of fishing and processing activities; by the introduction of aquaculture on commercial scale; by improving the quality of the products exported by modernising the processing and pre-processing units in a phased manner; by achieving higher unit value realisation etc..

It is significant to note that we still have not reached the stage of catering to the actual consumer market abroad even in the case of shrimp exports. We supply only bulk shipments which are reprocessed and repacked as per local demands in the markets. It is high time we developed our trade to supply consumer packs so as to establish a better image of our exports and consequently an increase

in demand which will be possible only when we are able to meet the required international standards of processing and packaging. Diversification of products and markets is the urgent need in the present situation. Diversification involves the identification of the right product for the right market at the right price, and this requires a comprehensive market plan and aggressive promotional efforts. Unless we are able to produce a product acceptable to the foreign buyers abroad marketing will be impossible, buyers taste preferences, competition in addition to packaging medium and the cost of processing etc. create further problems in international marketing. Intensive product and market development programmes are required, market surveys should be conducted to assess the specific requirements of different countries, trade could also be promoted by fairs and advertisements.

Over dependence on shrimps is not a desirable trend and thus the need arises for diversification, for instance sardines form about 25 to 30 percent to the total marine catch. Over dependence on shrimps has affected our exports in two ways:[6]

---

6. S.N. Rao, n.1, p.2.

assurance of a proper production base in India for the product. There is a great demand abroad for convenience food like fish fungers, fish fingers, fish wafers and balls etc. we can thus make use of low-valued fish available in our waters, which in turn gives rise to the need for specialised research development of suitable technology. There is ample scope to expand the exports of aquarium fish.

Constraints in the way of development of new products for export can be summed-up as;[7] (1) the relatively lower price offered for variation other than shrimp; (2) non-availability of resource information on many species for commercial ventures; (3) high freight rates and infrequent sailings; (4) inadequate processing technology for handling special products for exports; (5) absence of specialised equipment and machinery for preparing and packing special products; (6) insufficient market information on new products; (7) absence of adequate incentives for taking to new products; (8) unwillingness on the part of exporters to take risks and (9) inadequate and irregular supply of raw material in bulk for export processing.

---

7. S.N. Rao, n.2, p. 7.

(1) The fishing grounds in deep-sea regions are not being exploited, with the result that new products have not figured in our exports in significant quantities.

(2) The existing shrimp resources in the inshore waters in some parts of the coasts have been over-exploited the adverse effects of which are perhaps now being manifested by declining catches.

New markets for sardines for example in Spain and Portugal should be exploited and the shark-group of fishes could be exported to Italy, Yugoslavia etc.. Though there is a demand for tuna, we have not entered the world markets significantly, similarly a specialized commercial fishery is yet to develop in the case of squids and cuttle fish, and also perches, deep-sea lobsters and other varieties. Attempts need to be made to develop such fisheries in an organised manner. Fish meal has an excellent international market and could earn much foreign currency and the establishment of this fishery could in turn generate the funds needed for the develop-ment of fish canning.

Before the introduction of any marine food product into the international market there should be

If India wants to lead in the field of marine food exports it has to improve the refrigeration facilities for at a large number of landing centres there are no preservation facilities and provide other infra-structural facilities. Besides we should be constantly on the look out for capturing and identifying new markets as over-dependence on one market is undesirable.

However, it can be optimistically stated that India is today well-placed and poised to reach new heights in export promotion.

Growth of Marine Products Exports from India

Year	Quantity (Tonnes)	Value (Rs. '000)
1953-54	30,851	44,033
1954-55	28,641	46,675
1955-56	23,972	39 219
1956 (April to December)	18,140	37,201
1957	22,778	45,861
1958	30,683	58,647
1959	33,716	62,342
1960	16,337	40,216
1961	17,297	41,318
1962	11,619	37,475
1963	17,908	58,646
1964	21,458	68,489
1965	15,457	69,237
1966*	19;153	1,35,246

(1953-66)

(1967-80)

Year	Quantity (Tonnes)	Value (Rs. '000)
1967	21,764	1,99,286
1968	24,810	2,20,846
1969	30,584	3,30,731
1970	37,175	3,55,359
1971	34,032	3,91,725
1972	38,271	5,81,317
1973	48,785	7,95,763
1974	46,629	7,63,127
1975	53,412	10,49,063
1976	62,151	17,98,620
1977	64,964	17,97,374
1978	77,946	21,21,574
1979	92,184	26;20,292
1980	74,542	21,88,756

TABLE : V a.

Annual Growth of Marine Products Exports : 1953-54 to 1980

Q – Quantity
V – Value

Structure of Marine Products Exports (1971 – 80) Percentage Share

TABLE V b.

Items		1971 %	1972 %	1973 %	1974 %	1975 %	1976 %	1977 %	1978 %	1979 %	1980 %
1. Frozen Shrimp	Q.	68.11	79.84	73.58	73.69	67.68	77.15	72.72	65.72	58.05	64.07
	V:	80.00	87.53	82.70	83.52	89.93	89.32	86.92	84.40	85.15	89.78
2. Frozen Froglegs	Q:	4.26	4.76	5.53	3.12	2.47	5.10	4 36	4 58	4.08	4.15
	V.	3.52	3.73	5.65	3.75	2.67	4.33	3 67	3.97	3.33	3 94
3. Frozen Lobster tails	Q:	0 96	0.96	0.78	0.98	0.75	0.82	0.92	0 89	0·82	0·67
	V:	2.78	2.20	1.34	1.65	1·50	1.77	2.16	2.15	2.04	1.27
4. Fresh & Frozen Fish	Q·	0.07	0.06	0.30	0.14	0.25	2.55	5 80	4.74	26.17	15.02
	V:	0.03	0.02	0 09	0.10	0 18	0.91	2.15	2.99	4.41	5·11
5. Canned Shrimp	Q.	5.48	2.76	4.51	3.25	0.49	0 17	0.20	0.26	0.15	0·49
	V·	7.60	3.62	6.58	6.27	0·57	0.22	0.29	0.43	0.25	0·72
6· Dried Fish	Q:	17.46	9.09	6.94	3.75	4.30	7.51	6.50	8.10	4.04	5·82
	V·	3.53	1.37	1.38	0.87	0.86	0.97	1.26	1.51	0.72	0·95
7. Shark Fins & Fish Maws	Q·	0.87	0.77	0.52	0.56	0.57	0.43	0·44	0.54	0.40	0·45
	V:	1.32	1.04	0.83	1.11	0.94	0.85	1.25	1 63	1.12	1.49
8. Others	Q:	2.79	1.76	7.84	14.51	3.49	6.27	9 06	15.17	6.29	9·33
	V:	1.22	0.49	1.43	2.73	3.35	1.63	2·30	2.92	2.98	3.34
All	Q:	100.00	100.00	100.00	100.00	100.00	100.00	100 00	100.00	100.00	100.00
	V·	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Actual Exports — Qty. Tonnes	Q:	34,032	38,271	48,785	46 629	53,412	62,151	64,964	77,946	92,184	74,542
Actual Exports — Value Rs. Lakhs	V:	3917.25	5813.17	7957.63	7631.27	10490.63	17986.20	17973.74	21215.74	26202.92	21887.56

(1970-1980)

TABLE : V f.

(on the basis of quantity)

Items of Exports & Major markets	Market Share (%)										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
FROZEN PRAWNS											
U. S. A.	63.18	41.00	49.25	30.79	36.91	29.07	39.50	39.49	30.92	24.51	13.85
Japan	29.93	49.93	43.59	61.47	55.80	64.54	56.01	55.39	63.68	68.37	76.23
Australia	3.25	3.10	2.57	2.50	3.32	2.60	1.36	1.09	0.49	0.74	0.87
Others	3.64	5.97	4.59	5.24	3.97	3.79	3.13	5.12	4.91	6.38	9.05
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
FROZEN LOBSTER TAILS											
U. S. A.	99.87	100.00	99.45	93.16	93.18	90.72	86.89	70.40	55.14	34.32	60.08
Others	0.13	—	0.55	6.84	6.82	9.28	13.11	29.60	44.86	65.68	39.92
FROZEN FROGLEGS											
U. S. A.	85.97	77.95	74.62	64.26	79.75	46.68	45.17	37.69	35.49	27.57	17.54
France	8.02	14.47	18.37	10.36	1.29	31.86	43.48	41.50	42.21	29.74	38.04
Belgium	3.42	3.66	1.55	19.78	16.04	13.01	7.89	10.48	3.59	2.34	22.64
Others	2.59	3.92	5.46	5.60	2.92	8.45	3.46	10.33	18.71	40.35	21.78
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
CANNED PRAWNS											
U. K.	27.31	26.72	42.01	51.72	45.42	7.91	44.53	46.09	53.43	77.77	50.74
France	4.81	9.26	34.54	15.67	13.26	36.09	12.46	7.03	0.98	9.19	4.19
U. S. A.	43.29	32.54	6.50	15.30	22.78	8.55	4.03	—	—	—	—
Canada	1.63	2.32	3.48	2.22	1.19	—	—	—	—	—	—
Fed. Rep. Germany	7.41	3.11	6.79	5.90	4.18	29.13	22.89	3.91	—	2.12	1.74
Australia	1.20	2.45	0.89	2.11	3.85	0.12	4.46	4.69	—	—	—
Others	14.35	23.60	5.79	7.08	9.32	18.20	11.63	38.28	45.59	10.92	43.33
DRIED PRAWNS											
Hong Kong	56.46	36.49	22.27	21.11	37.50	26.16	11.86	2.13	—	—	10.43
Sri Lanka	9.29	18.82	7.69	—	—	—	—	86.38	—	—	63.72
U. S. A.	4.71	2.55	5.48	12.94	2.85	0.97	—	2.13	—	26.15	—
Singapore	9.83	6.00	0.22	4.92	3.42	0.71	—	—	—	—	—
U. K.	3.90	3.31	16.21	15.49	1.67	11.46	3.39	—	—	—	2.62
Malaysia	2.76	4.35	1.10	3.26	—	3.04	—	—	—	—	—
Others	13.05	28.58	47.03	37.28	54.66	57.66	84.75	9.36	100.00	73.85	23.23
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
DRIED FISH											
Sri Lanka	96.22	94.44	90.42	89.96	79.24	43.57	89.27	90.78	93.93	90.18	90.61
Mauritius	3.11	4.79	6.30	7.32	17.50	10.39	7.87	7.60	4.02	5.27	—
Others	0.67	0.77	4.28	2.72	3.26	46.04	2.86	1.62	2.05	4.55	9.39
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note. — Represents nil

TABLE V f. (1970-80) (on the basis of value)

ems of Exports & lajor Markets	Market Share (%)										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
ROZEN PRAWNS											
apan	43.66	65.52	54.78	70.26	61.24	72.60	71.32	68.95	77.13	77.40	81.18
S. A.	48.56	27.66	38 94	23.46	31.44	21.23	25.16	26.68	18.51	16.04	9.44
ustralia	4.34	3.14	2.40	2.63	4.02	2.82	1.26	1.32	0.49	0.92	0.98
Others	3.44	3.68	3.88	3.76	3.30	3.45	2.26	3.05	3.87	5.64	8.40
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
FROZEN LOBSTER TAILS											
U. S. A.	99.90	100.00	99.28	91.53	93.02	93.94	86.64	66.88	50.30	31.66	59.30
Others	0.10	—	0.72	8.47	6.98	6.06	13.26	33.12	49.70	63.34	40.70
FROZEN FROGLEGS											
U. S. A.	83.22	67.62	69.97	65.79	82.66	40.31	39.33	23.96	31.51	27.05	13.44
France	9.56	21.46	22.22	11.21	0.77	38.72	48.89	53.75	48.69	30.76	33.01
Belgium	4.12	5.07	1.61	17.70	13.94	11.81	8.69	12.45	4.00	2.99	20.18
Others	3.10	5.85	6.20	5.30	2.63	9.16	3.09	9.84	15.80	39.20	33.37
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
CANNED PRAWNS											
U. S. A.	40.30	29.67	5.24	11.74	19.24	7.94	3.27	—	—	—	—
Canada	1.65	2.08	3.12	2.01	1.00	·	—	—	—	—	—
U. K.	28.85	27.79	44.33	54.06	50.15	6.08	52.87	42.25	53.38	77.08	66.20
France	5.08	9.56	33.92	15.87	12.58	36.66	11.25	6.74	0.16	8.21	2.90
Fed. Rep. Germany	7.50	3.20	6.71	6.21	3.99	27.58	—	3.35	—	2.24	0.86
Australia	1.19	2.10	1.02	2.33	4.05	0.13	3.46	4.42	—	—	—
Others	15.43	25.60	5.66	7.78	8.99	21.61	29.15	43.24	46.46	12.47	30.04
DRIED PRAWNS											
Hong Kong	52.46	36.14	18.20	20.13	23.34	22.04	6·90	2.16	—	—	21.00
Sri Lanka	4.96	7.25	1.41	—	—	—	—	81.71	—	—	36.36
U. S. A.	8.19	4.43	7.05	17.94	5.32	1.48	—	1.69	—	11.24	—
Singapore	10.13	6.93	0.07	4.05	2.87	1.61	—	—	—	—	—
U. K.	5.02	4.16	19.98	17.21	2.14	15.66	6.31	—	—	—	7.66
Malaysia	2.51	3.78	0.89	1.61	—	2.99	—	—	—	—	-
Others	16.73	37.31	52.40	39.06	66.33	57.22	86.79	14.44	100.00	88.76	34.98
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100·00	100.00
DRIED FISH											
Sri Lanka	94.40	90.42	81.53	75.34	62.55	63.71	81.75	85.45	87.80	79.11	85.90
Mauritius	3.85	7.59	7.91	10.03	30.10	14.92	11.80	7.93	8.13	8.02	—
Others	1.75	1.99	10.56	14.63	7.35	21.37	6.45	6.62	4.07	12.87	14.10
All	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: — Represents nil

TABLE: Vc. [redacted] GROWTH RATE OF MARINE PRODUCTS (1961-62 to 1980-81)

Year	GROWTH RATE % QUANTITY	VALUE
1961-62		
1962-63	-29.06	+7.15
1963-64	+70.04	+44.96
1964-65	+10.84	+17.44
1965-66	-27.59	-1.20
1966-67	+38.06	+145.90
1967-68	+3.74	+13.52
1968-69	+22.39	+25.26
1969-70	+18.22	+35.47
1970-71	+13.21	+4.83
1971-72	-1.00	+27.03
1972-73	+9.52	+34.08
1973-74	-34.38	+49.48
1974-75	-13.73	-23.57
1975-76	+20.76	+82.03
1976-77	+22.56	+51.87
1977-78	-1.17	-4.32
1978-79	+31.72	+29.66
1979-80	-0.57	+6.05
1980-81	-12.51	-5.62

SOURCE: MPEDA

TABLE: Vd. [redacted] STRUCTURE OF MARINE PRODUCTS EXPORTS - 1980-81

	ITEMS	QUANTITY %	VALUE %
1.	FROZEN PRAWN	67.54	85.92
2.	FROZEN LOBSTER TAILS	0.81	1.48
3.	FROZEN FROGLEGS	4.57	3.58
4.	FRESH AND FROZEN FISH	11.60	3.51
5.	CANNED PRAWNS	0.37	0.48
6.	DRIED FISH	5.14	1.04
7.	DRIED PRAWNS	0.15	0.05
8.	SHARK FINS AND FISH MAWS	0.52	1.55
9.	OTHERS	8.90	2.39
ALL	TOTAL	100.00 %	100.00 %

SOURCE: Marine Products Export Review of MPEDA.

CONCLUSION

Clearly the problems assessed will be ameliorated neither by mere euphoria, nor by defeatist gloom, but, only by a realistic formulation of policy planning and action. There arises a need to re-evaluate our past efforts and consider other policies and strategies for a more rational and efficient exploitation of our marine fish resources. Upto now fisheries development has stressed the aspect of increasing production but the current situation demands that fishery development must be viewed as a multi-dimensional process having economic, political, social and ecological objectives.

India declared an EEZ of 320 km which has taken effect from 15 January, 1977. This extention of limits of jurisdiction is a milestone in fishery history, affecting all elements from research to administration and from planning to the industry and also the individual fisherman.

The changing realities, the technological and political developments are bringing about a change in the traditional legal order in the oceans. In broadest terms the current transformation of the international order in the oceans must be considered in the content

of a two fold revolution, that is, shaking the entire international order during the second half of this century and the change in the structure of international relations owing to the entry of 'new nations' into world affairs and the 'technological revolution', which transcends the traditional nation-state and transforms the traditional concepts of sovereignty and property.

Until recently the ocean space and its resources were regarded as inexhaustible and based on this assumption freedom of fishing formed one of its most basic principle. It was also assumed that man could not seriously impair the quality of the marine environment and that the oceans were so vast and their uses so unlimited that serious conflicts of use were impossible. However, the change has been brought about because the traditional rule of freedom of fishing agreements, whereby states had generally claimed and had been accorded relatively narrow limits of jurisdiction and fishermen had free and open access to all stocks on the 'high seas', has been unable to conserve fish and settle international controversies related both to the resources as well as the ecosystem. Obvious contamination of some areas of the sea has aroused concern and requires adoption of measures of control of marine pollution, which cannot be effective under the old freedom of the seas principles. Depletion of living resources calls for effective measures of conservation and

management but these cannot, be implemented, under the concept of the 'freedom of seas'.

Due to both, the need for resources and the need to avoid adverse consequences of other nations activities in the general vicinity of their coasts, coastal states are under constant pressure to take unilateral and sometimes regional action to subject wider areas of ocean space to their authority. It is obvious that equalisation of opportunities regarding the exploitation of the marine resources cannot be achieved under the present law of the sea, hence the alternative left for the weaker maritime states is to subject progressively wider areas of the oceans to their own jurisdiction, thus restricting the area in which the technologically advanced countries can freely exploit the ocean resources. If the present trends continue unchecked and as revealed by our past experience there is a serious possibility that the greater part of the ocean would be covered by conflicting national claims. A division of ocean space between coastal states on the basis of sovereignty is not the correct solution[1], as it obstructs the transnational uses of the marine environment (example, scientific research), which is an essential prerequisite to national resource

---

1. Arvid Pardo, and Elizabeth N. Borgese, 'The New International Economic Order and the Law of the Sea', (International Ocean Institute, Malta) Occasional paper No.4, pp. 2 - 6.

management, similarly management of several important commercial fisheries would be extremely difficult and effective control of marine pollution almost impossible; besides it would undoubtedly aggravate world tensions. Finally, about twenty nations would appropriate some two-thirds of ocean space leading to gross inequalities between states and causing grave economic damage to geographically disadvantaged states. Hence the need arises for the creation of a new international legal order, based on a new principle which; (1) safeguards the common interests of all peoples in the ocean space as a whole, (2) flexibly accomodates multiplying inclusive and exclusive uses of ocean space, (3) provides expanding opportunities to all countries, especially developing ones, (4) makes possible, through effective and rational management, development of the resources of ocean space beyond national jurisdiction for the benefit of all man kind and equitable sharing in the benefits derived, (5) leads to reduction in world tensions and promotes international cooperation and understanding, (6) and accords reasonable protection to marine environment through conservation and pollution control.

A new international order in the oceans will require considerable changes in the nature and functions of the existing United Nations (UN) agencies, whose activities are related to the marine environment. The

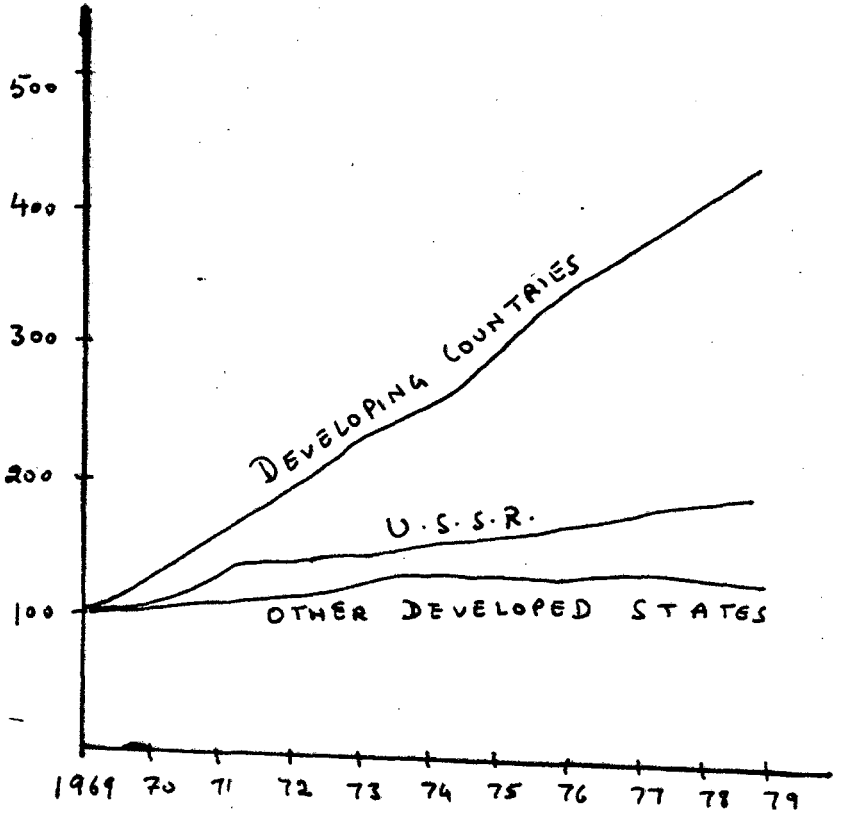
success of this new international regime, would prove that, the third world with strength of its members can change the statusquo through persistent peaceful negotiations, but its failure will doom the very process of international negotiation and undermine all that the charter of UN stands for.

Widespread adoption of 320 km EEZ or 'fisheries zone', regarded as the single most dynamic and important development in the Law of the Sea (LOS) since the early 1940, has resulted in enclosing the great preponderance of marine living resources within the national jurisdiction and control of the coastal states. The EEZ contains within itself the continental shelf, only in a few cases does the continental shelf exceed the limit of the EEZ and the coastal state enjoys sovereign rights for exploring and exploiting, conserving and managing the living resources. In matters of exploitation of the living resources, the discretion is left with the coastal state to decide upon the surplus, to be used by the land-locked and geographically disadvantaged states (LLGDS). The coastal state is thus placed in a pre-eminent position in this zone of vital economic interest.

In such a situation a clash of interests arises between the coastal states interested in protecting its recognised interests in the fisheries of its economic zone and

Fig: 23

INDICES OF TONNAGE OF TRAWLERS AND FISHING VESSELS OVER 100 GROSS TONNES ANNUALLY - 1969 - 79



SOURCE: OCEAN YEARBOOK 3 (Chicago, 1983) P. 44

the flag states using these areas for navigation by all types of vessels. We find that half the countries among the top ten fishing nations now belong to the so-called Third World. (FIGURE 23) In 1950 the developing countries accounted for only 27 percent of the world catch, compared with about 46 percent in 1980, indicating a weakening grip of the few developed nations that have traditionally dominated world fishery.[2] The extent of the EEZ has raised the 'Maximum Systainable Yield (MSY) tremendously by decreasing the competiton from superior technologies, who previously fished in these waters. In view of the declaration of 'economic zones' by majority of coastal states the possibility of 'cold wars' is remote, for example, the fishery disputes existing between the U.S.A. and Peru, Ecuador are no longer persisting.

However, there are certain issues that have been left unresolved and which could generate conflicts both at the national and international levels in the near future. The fundamental questions of, which individuals should utilize the resource and how remains unresolved. For most species, especially the highly migratory ones, for example, the Tuna the artifact of EEZ has not changed

---

2. Kenneth C. Lucas and Tony Loftas, "FAO's EEZ Programme Helping to Build the Fisheries for the Future", in Elizabeth M. Borgese and Norton Ginsburg, ed., Ocean Year Book 3 (Chicago 1982) pp. 42 - 43.

anything except special protection clauses. The major problem concerning the shelf is its definition, as its legal definition differs from the geographical one.

No greater challenge can exist for international cooperation than that of finding a solution, satisfactory to all nations, on the question of how marine resources should be shared. The United Nations and the several international funding and research institutions and the bilateral donor countries play a major role in improvement of the present state of affairs. Greatly intensified international cooperation and coordination in all peaceful uses of the ocean is needed to encourage and advance beneficial exploitation of the marine resources and technological developments for this purpose to ensure the conservation and rational uses of resources and to minimise interference among different users of the same resource.

Five major areas of cooperation from Indian point of view are:

(1) Oceanic Tuna fisheries.

(2) Areas where rivalries between neighbouring states exist, for example, northern Bay of Bengal.

(3) Migratory species for example Hilsa.

(4) Activities of non-Indian ocean states.

(5) Oceanic research and chartered vessels.

The future expansion of fisheries is beset with economic, legal and technical problems. Some new approach to international cooperation will be needed if fisheries are to maintain and improve the present catch. The concept of the marine environment as a common heritage of mankind, could be emphasized to foster international cooperation and open new avenues for international 'understanding'. The future of the world's sea fisheries will depend on much more comprehensive, vigorous and harmonious international action, in order to promote the appropriate forms of management by which wastage of costly skills and equipment can be avoided and the yields from the living resources improved and eventually, perhaps to achieve some form of 'husbandry' through which the food resources of the sea can be put to best use to supply human needs, through fundamental research at the sub-regional or even global level and by improvement of the international system of data and exchange.

There are many conflicting claims on the oceans which in the past have been used for various uses, the same uses are likely to be important even in the future, but increasing population pressure in the world will intensify all these demands. Recent demand for fish has been strong and it is expected to grow. At present a little over 52 million tonnes of fish is consumed annually

in the world. Demand for food fish is expected to reach about 70 million tonnes by 1985 and 93 million tonnes by 2000 A.D. Population growth is expected to account for more than half the increase. The gap between food production and the requirements in India is substantial, therefore, there is an urgent need to tap all sources of food and protein and as a source of food, fisheries stand next to only agriculture.

The hypothesis has been developed that, a well-nourished nation is an essential precondition for economic development and social equality. Marine products supply protein and ensure proper growth of the human body. Food has often served as a bargaining power in the international scene, the aim therefore should be to increase self sufficiency and self reliance in food matters, both qualitative and quantitative.

It is cheaper to produce fish as compared to the cost of production in raising any other protein from land animals. If the 'Maximum Sustainable Yield' limit is not exceeded, the same amount of fish can be taken out year after year without depleting the stocks. Besides, if there is no fishing, the fish will have its own mortality as most of the fishes do not have a longer chain of life. Then why should man not utilise them for his own consumption, instead of letting them

become a waste resource. Keeping the current situation of 'nutritional crisis' and 'protein gap' in mind, it can be strongly predicted that we will turn increasingly to the oceans for sustenance and security. There is great potential for increased production of marine fisheries, a large part of which remains either unexploited or under exploited. It is time we shifted over priorities to the deeper waters, from where a large part of this increase would come, instead of over-taxing the inshore fisheries. However, to evaluate and forecast the possible yields keeping the rising demand in mind more knowledge and information is required about marine biology and oceanography, as all these factors are linked together in a causal-effect relationship. (CHART. 1)

It is our duty while using the oceans resources to see that they are preserved and replenished. Increased dependence on the sea for food and recreation, establishment of new industries, indicate that modification of marine environments will not only continue, but will drastically increase. Judicious use of the marine living resources will not only strengthen international cooperation, but also contribute to the future well-being of mankind. Delay will only increase the cost in money, time, manpower, resources and missed opportunities. Environmental effects should not be

over looked at any cost. The turning point where environmental costs begin to exceed economic benefits can be pushed back somewhat by using technologies that cause the least possible environmental damage. However, we should remember that it cannot be pushed back indefinitely for no technology can be free of environmental impact.

There is now a high priority need for joint action among pollution experts, fishery ecologists and economists and planners and also for the use of common mechanisms to reduce costs and to increase efficiency. It is in the long-term interests of all to manage the stock as efficiently as possible, rather than to obtain maximum short-term gain, thereby depleting the stock for future use. To avoid the undesirable consequences of hasty decisions made on the basis of inadequate understanding and to proceed in an effective way, it is imperative that we improve our communication, cooperation and coordination.

Development of marine fisheries and allied industry is significant as this sector is eminently suited to assist large masses of backward and economically weaker sections of the community. There is tremendous potential in fish production which can only be realised if the fishermen get a better deal and their

due share. Policy makers do not always adequately understand the 'human resource base' and are often unaware of the socio-economic complications in the coastal zone, which often prevents the developmental plans from being successful. Too often the fishery manager treats the biological 'symptoms' of over fishing and destructive fishing practices, while the 'disease' is really imbeded in the socio-economic framework of the local fishing community or in the national economy.

There is a wider acceptance that fishery management does not deal with 'fish' or with 'fish' and 'Money' but with 'fish', 'money' and 'people', a concept particularly applicable to inshore fisheries. It is evident that our artisanal fisheries are basically more economically viable and socially desirable. Mostly the interests of the small-scale fishermen are ignored and benefits from fishery policies hardly ever reach them. It is therefore necessary to establish a better mechanism whereby the interests of the small-scale fishermen are represented when plans are being formulated and decisions made. However, industrial fisheries also need to be provided with a role in the marine fisheries sector, particularly for the harvesting of certain types of mobile, monospecies off-shore.

Developing an export oriental fishery with the emphasis on earning foreign exchange and strategies making available fish as food to the national protein deficient population need not necessarily be seen as mutually exclusive, though the relative importance assigned to each will significantly influence the character and structure of fisheries sector which emerges.

The biggest management problem is the conflict between the inshore fishermen and large-scale mechanised vessels. Small-scale artisanal fisheries continue to form the back-bone of our marine fishing industry. For future expansion, strategies need to be devised which integrate small-scale fisheries and industrial fisheries due to the specific role played by each of them. This complex situation must be recognised and steps taken to ensure that far-sighted plans are developed and programmes undertaken to achieve clearly defined national goals and objectives.

For optimal utilisation of this natural resource it is necessary that we understand it, hence more knowledge and research is required in this field. The yields of marine fisheries can certainly be increased by developing new regions and new items for fishery. It is clear that sizeable energies must be devoted to the comprehension of the problem of 'understanding', 'prediction' and 'control' of the marine fish resources. Research would

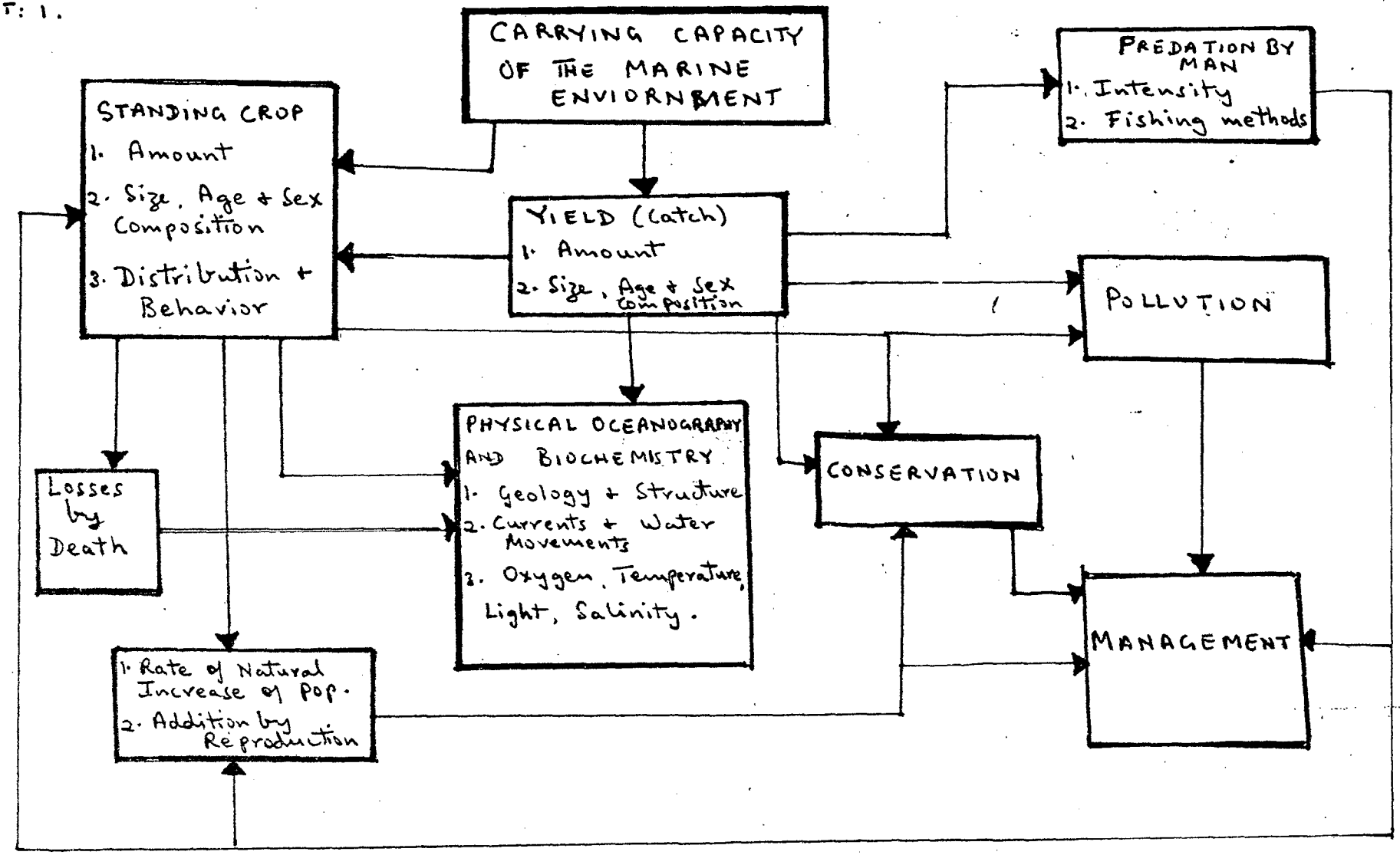
provide a clear picture of the process of biological production in the ocean, together with a quantitative evaluation of the resources and potential.

For every increased investment in fisheries there will be a greater increase in incomes, which will be generated due to the establishment of many allied and ancillary industries. Marine fisheries have a good multiplier effect. Growth in population will accentuate the existing employment problem, however development of this sector would generate sufficient employment.

The over all expansion of marine sea-food industry can continue only if, dietary habits of the people change to accomodate marine animals other than those traditionally caught. With regard to fisheries, the points needs to be emphasised that, increased production is not the only solution to the food problem. Consumption is controlled by demand which in turn is the outcome of 'acceptance', 'availability' and 'accessibility'. There is a great potential for sea-weeds and plankton resources, hence steps should be taken to create demand for the marine food products and expansion of the markets. Before introducing any new products the sociological and cultural problems will have to be understood and accordingly solved.

CAUSE-EFFECT RELATIONSHIP DETERMINING CARRYING-CAPACITY, STANDING CROP AND YIELD

CHART: 1.



India is yet to enter into the field of deep-sea fishing, we have not ventured beyond our traditional fishing grounds. The resource potential in the off-shore waters in considerable and it is also understood that much of additional marine fish production would come from the deeper shelf waters of all states and regions.

Establishment of the EEZ offers new opportunities and stimulates us to look for nationally determined fisheries plan using models adapted to local conditions, which will constitute the basis for a socially oriented, technologically sound and a self reliant developmental process. In the new geo-political environment the future development and management of the EEZ will depend on the interaction of ecological, social, economic, legal and political factors and on whether an international understanding can be reached on the basis of scientific data and information.

In order to make the EEZ an instrument for development that will benefit not only the coastal states but mankind as a whole from the exploitation of the living resources, the coastal states would have to acquire or increase the necessary managerial ability and technical competence to 'identify', 'preserve' and rationally 'manage' fish stocks, thus ensuring optimum utilisation of the resources.

The future of Indian marine fisheries seems to be one of endless monitoring, refinement of theory and careful management policies. The out look for the future of this sector is therefore one of moderate optism. The hope that the Indian EEZ can provide a substantial contribution to the food supplies as well as contribute to the national development, is fully backed by the growing knowledge of oceanography.

BIBLIOGRAPHY

PRIMARY SOURCES

UNITED NATIONS ORGANISATION

Food and Agricultural Organisation (FAO) Rome.

Report No. 21, 1977

Report No. 201, 1977

Report No. 208, 1978

Report No. 271, 1982

Report No. 293, 1983

FAO Fisheries Technical Papers

Paper No. 7, 1968

Paper No. 70, 1968

Paper No. 74, 1968

Paper No. 81, 1969

Paper No. 84, 1969

Paper No. 97, 1978

Paper No. 218, 1981

Paper No. 223, 1982

Paper No. 238, 1982

Yearbook of Fisheries Statistics FAO: 1970, 1980.

FAO Atlas of the Living Resources of the Sea, FAO, 1981.

The State of World Fisheries: World Food Problems. No.7, FAO, 1969.

Fisheries Bulletin, FAO, Vol.VIII, No.2, April-June 1955.

Advisory Committee on Marine Resources Research, FAO, 1970.

"Marine Fisheries in the New Era of National Jurisdiction", The State of Food and Agriculture, FAO, 1984.

Papers presented at the International Technical Conference on the 'Conservation of the Living Resources of the Sea', FAO, Rome 18 April - 10 May, 1955.

UNESCO, Report of the Fishery Aspects of the Expedition by the subject leader of the International Indian Ocean Expedition, Inf-53, Paris 1964.

PROCEEDINGS

Proceedings of the Symposium on Food and Needs, New Delhi, 1962.

Proceedings of the Symposium on Development of Deep Sea Fishing, Cochin, 1970.

Proceedings of the Symposium on 'Living Resources of the Seas Around India' Cochin, Central Marine Fisheries Research Institute (CMFRI), 1973.

Proceedings of the United Nations Economic and Social Commission for Asia and the Pacific, Committee on Natural Resources 3, 1976.

Proceedings of the UNESCO Symposium on 'Physical Oceanography', Tokyo, 1955.

Proceedings of the 'Second International Oceanographic Congress', Moscow, 1966.

Proceedings of the Symposium on 'Indian Ocean, National Institute of Sciences, New Delhi, 1969.

OTHER SOURCES: REPORTS, PAPERS ETC.

Report of the National Commission on Agriculture, Part XIV (New Delhi, Ministry of Agriculture, 1976).

National Committee on Science and Technology, Sectoral Report on 'Marine Resources', New Delhi.

Report of the Task Force on Marine Products (New Delhi, Ministry of Commerce, September 1982).

Report of the Indian Participation in the International Indian Ocean Expedition, (New Delhi, Indian National Committee on Oceanic Research, 1967).

Statistics of Marine Products Exports Development (Cochin, 1970, 1980).

Results of Exploratory Fisheries Project of Bulletin No.9, (New Delhi, Ministry of Agriculture and Irrigation, December, 1979).

Souvenior Indian Fisheries Project, "Fisheries Resources of the Indian Economic Zone" by George, P.C., Antony, Raja, B.T. and George, K.C. (Cochin, 1977).

National Workshop on Fisheries, 6, 5. (New Delhi, Ministry of Agriculture, 1982).

Workshop on Marine Living Resources, Background Paper An Approach for Assessment and Management of Marine Living Resources of India and Creation of Fisheries Estate" by Diwedi, S.N. (Cochin, 3-4 December, 1981).

Pardo, Arvid and Borgese, Elizabeth, Mann, The New Economic Order and the Law of the Sea, Occasional Paper No.4 (Manila International Ocean Institute).

Diet Atlas of India, Hyderabad, National Institute of Nutrition, 1977.

Central Institute of Fisheries Technology, Fish Technical News Letter, Vol.3, no.10, Cochin, 1983.

Central Marine Fisheries Research Institute, Cochin. Marine Fisheries Information Bulletins of 1970, 1980.

Marine Fisheries Information Service No.2, October 1978.

PAPERS

Papers presented at the National Seminar on Fisheries Development in India, Indian Institute of Management Ahmedabad, April 9-11, 1982.

Bhakta, N.P., Development of Infrastructure Facilities for the Optimal Exploitation of Exclusive Economic Zone.

Chidambaram, K. Strategies for the Exploitation of Deep Sea Resources in the Indian EEZ: A long Term Perspective.

Gupta, G.S. and George, P.S. Marine Fish Consumer Behaviour and Demand Forecasts.

Raghavachari, N. Marine Fish Supplies: Trends and Projections.

Rao S.N. Product Development for Export.

Reddy, M. Dhanma, Bharathi, V. Ravindra and Singh Amarjeet: Data Base in Marine Fisheries: An Overview.

Shyam, Manjula, R. Strategies for Developing offshore Fisheries in the Exclusive Economic Zone.

Srivastava, V.K. and Reddy, M. Dharma. Investment in Harvesting, Processing and Marketing Sectors of Marine Fisheries Required to Attain and Utilize the Projected (1985) Fish Landings.

PAPERS

Papers presented at the National Symposium on: Oceanic Realities and Prospects, New Delhi, 26-29 March, 1984.

Kutty, M. Krishnan: Some Thoughts on the Exploitation and Scientific Management of the Fishery Resources in the Seas Around India.

Prabhu, P. Vasudeva, and Nalinavan, P. Diversified Fish Products and Byproducts.

Puri, Rama: Development of Ocean Resources: Inter-National Legal System.

Rao, K. Srinivasa: Migration of Sear Fish in Relation to the Circulation Pattern in The Bay of Bengal.

Rao, P.S: Management of Fisheries in the Exclusive Economic Zone of India.

Untawale, Arvind, G.: Status of Marine Algal Resources of the Indian Coast for Research and Development.

SECONDARY SOURCES

Books

Ahmad, E., Coastal Geomorphology of India (New Delhi, 1972).

Borgese, Elizabeth Mann and Ginsburg Norton, ed., Ocean Yearbook 3 (Chicago, 1982).

Bouchez, L.J. and Kaijen, L. eds. The future of the Law of the Sea (The Hague, 1973).

Burk, C.A. and Drake, C.L. Geology of Continental Margins (New York, 1974).

Chandy, M. Fishes (New Delhi, National Book Trust of India, 1983).

Christy, T., Francis, Scott, Anthony. The Commonwealth in Ocean Fisheries (Baltimore, 1966).

Clawson, Marion, ed; Natural Resources and International Development (USA Published for Resources for the Future, Inc., 1964).

Critchlow, Keith, The Hidden Environment. Oceans: Lifestream of our Planets (USA, 1972).

Cushing, D.H., Marine Ecology and Fisheries (Cambridge University Press, 1975).

Daniel, Dahzman, The New World of the Oceans, (Boston, 1969).

Dasman, Rajmond, F., Environmental Conservation (Inc. Canada, 1959).

Devraj, M. A critique on Indian Ocean Fisheries Development. Ocean Management No.8, pp.90-97, 1982.

Edwards, R.W. and Gaxnad, D.J. Conservation and Productivity of Natural Waters (New York, 1972).

Firth, F.E., Encyclopedia of Marine Resources, (New York, 1969).

Gullion, Edmund, A., ed. Uses of the Seas (Prentice-Hall, Inc., N.J. 1969).

Gupta, Ranjan, The Indian Ocean: A Political Geography. (Delhi, 1979).

Hamlisch, R., ed. Economic Effects of Fishery Regulations (FAO, Rome, 1962).

Hardy, A. The Open Sea Its Fish and Fisheries, (London, 1959).

Jhingran, V.G. Fish and Fisheries of India (Delhi, 1975).

Johnston, Douglas, M. The International Law of Fisheries (New Haven: Yale University Press, 1965).

Khan, Rahmatullah, Indian Ocean Fisheries (New Delhi, 1977?).

King, Cuchlaine, A.M. Introduction to Physical and Biological Oceanography (London, 1975).

Knight, H. Gary, Managing the Seas Living Resources, Legal and Political Aspects of High Sea Fisheries, (Lavington, 1977).

Knight, H. Gary, Managing The Sea Living Resources. Studies in Marine Affairs (Toronto, 1977).

Marine Fish Marketing in India, Indian Institute of Management, vol.I to VIII, Ahmedabad, 1981.

Manual of Geology of India and Burma, Vol.II, 3rd ed. Delhi, 1964.

Maxwell, Arthur, E. The Sea, (Inc. USA, 1971).

Moiseev, P.A., The Living Resources of the World Ocean (Jerusalem: Keter Press, 1971).

Nairn, Alan, E.M. and Stehh, Francis, G., eds. The Oceans Basins and Margins, Indian Ocean, vol.6, New York, 1982.

Patel, B. ed. Management of Environment (New Delhi, 1980).

Pascoe, E.H. A Manual of the Geology of India and Burma, (Delhi, 1964).

Pirie, R., Gordan, ed., Oceanography Contemporary Readings in Ocean Sciences (Inc, USA, Oxford Univ. Press, 1973).

Prasad, Banni, ed. The Wealth of India, vol. IV, Fish and Fisheries, (New Delhi, 1982).

Rao, P. Srinivasa, The Public Order of Ocean Resources A Critique of the Contemporary Law of the Sea (The MIT Press, 1975).

Rao, P.S., Fishery Economics and Management in India, (Bombay, 1983).

Rothschild, Brain, J. ed., World Fisheries Policy: Multidisciplinary views (Washington, D.C. Univ. of Washington Press, 1972).

Sharma, R.C., Population Trends, Resources and Environment Handbook on Pop. Education (Delhi, 1975).

Smith, E., Conservation of Natural Resources. Fishery Resource for the Future (John Wiley and Sons, Inc., 1971).

Srivastava, V.K., Reddy, M. Dharma and Gupta, V.K. Management of Marine Fishing in India, (Ahmedabad, IIM, 1982).

Srivastava, V.K., Reddy, M. Dharma, eds. Some Aspects of Policy Management, (New Delhi, 1983).

Tomasevich, Jozo, International Agreements on Conservation of Marine Resources (New York, 1971).

Turvey, Ralph and Wiseman, Jack, eds. The Economics of Fisheries, (FAO, Rome, 1957).

Tussing, Arlon R. and Robin, A. Hiebert, Fisheries of the Indian Ocean: Report of International Management and Law of the Sea (Washington, D.C. Inc., 1974).

Wadia, D.N. Geology of India (New Delhi, 1971).

Walford, L.A., Living Resources of the Sea: Opportunity for Research and Expansion (New York, 1958).

Weyl, P.K., Oceanography An Introduction to Marine Environment (USA, 1970).

ARTICLES IN PERIODICALS

Alverson, Dayton, document L; Opportunities to Increase Food Production from the World's Oceans, NYS Journal 9 (1975).

Chapman, W.M. "Some Problems and Prospects for the Harvest of Living Marine Resources to the year 2000". Journal of Marine Biological Association of India, vol.XI, No.1 & 2, December 1969.

Eydal, A. Fisheries, Proceedings of the Annls of of American Geographer, No.2, 1970, pp.56-66.

Gulland, J.A. and Carroz, J.E. "Management of Fisheries Resources", Advance Marine Biology, No.6, 1968,pp.1-71.

Iman, D.L. and Bush, D.M. The Coastal Challenge, Science, No.181, 6 July 1973.

Krishnaswamy, S. The Coasts of India, Indian Geographical Journal, Vol. XXIX, No.1, 1954.

Mishra, G.N. India and the Indian Ocean, Sea Food Trade Journal, Vol.2, No.1, 1967.

Mittal, Renu, "Fishing in Troubled Waters", Surya, 15 February 1984.

Nair and Banerjee, S.K. A Survey of the statistics of Marine Fish Catch in India from 1950 to 1962. Indian Journal of Fisheries, 1965, pp.124-135.

Narain, H., Kalia, K.L. and Verma, R.K. "Continental Margins of India", Canadian Journal of Earth Sciences, Vol.5, 1968, pp.1051-65.

Narain, P. and Kathuria, O.P. "The Status of Fisheries Statistics", Agricultural Situation in India.(New Delhi August 1983).

Panikkar, N.K. "Exploring the Indian Ocean", Science Reporter, 1(2), 1964.

Panikkar, N.K. The Year of the Indian Ocean, Sea Food Journal, Vol.2, No.4, 1964.

Panikkar, N.K. "Fishery Resources of the Indian Ocean" Current Science, No.18, 20 September 1966, pp.55-60.

Qasim, S.Z. "Potential Fish Resources of the Indian Ocean" Journal of the Indian Marine Fisheries Association Vol.3, 1973.

Qasim, S.Z. Biological Productivity of the Indian Ocean, Indian Journal of Marine Sciences, No.6, 1977, pp.120-122.

Thirunavukkarasu, S.N. "Indian Fisheries" The Geographer Tanshar, Vol.IX, No.3, May-June 1974.

NEWSPAPER

The Hindu,

The Times of India