

NEW CHALLENGES IN THE DEVELOPMENT OF INDIAN FISHERIES*

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INTRODUCTION

I feel deeply honoured by being invited to give this technical address to the Indian Society of Agricultural Statistics. Not being a Statistician I have no contribution to make on the subject but have chosen to speak on certain aspects of Indian fisheries in which I have taken an interest for nearly three decades. The subject is one which requires intensive study and attention in your hands and I shall endeavour to present some of the salient problems to you.

The development of Indian fisheries which began in a modest way since the achievement of Indian Independence has made important strides during the past twenty five-years. During this period, it is possible to say at the outset, that fisheries has become a significant sector in the Indian economy which it never was before. Progress has been achieved in different facets. There is first of all the increased production, from something like 600 thousand metric tonnes per annum, to nearly 1.8 million tonnes of sea and inland fish annually, assuring for the country a place among the few nations of the world which have an annual yield of over a million tonnes. The leading fishing nations of the world are Japan, the United States of America, the Soviet Union, China, the United Kingdom, Peru, Norway and Canada. The nations which have acquired importance in recent times in addition to India, are Thailand, Spain and the Phillippines. During the last few years, Peru topped the list because of the phenomenal rise in the yield of the Peruvian anchovy, *Centengraulis ringens* which flourishes in the rich up-welling waters of the Pacific

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Coast of South America. Oceanographic factors and over exploitation have created unstable foundations on which these fisheries are based as shown by the virtual collapse of the Peruvian Anchovy fisheries in 1973, but subsequently there has been a slight revival. The entire production of anchovy is used as fish meal in cattle and poultry feeds. The increase in sea fish production by India has been gradual but has been kept up and the expected annual yield should touch something like six million tonnes towards the close of the century. Together with this increase, there has occurred a far better utilisation of our fishery wealth within the country itself and a phenomenal development has been that of the entry of India into world fish trade in a big way.

The increased production which we have achieved is, however, only a very small part of the gap that exists in the potential demand for fish in India and the available supply. If we were to take the modest estimate of the annual protein requirements of the fish-eating population of the country, usually computed at about 65% of the total population, based on a per capita consumption of $1\frac{1}{2}$ oz. or half the total protein intake per day recommended by nutrition experts, it would be seen that our present population would need something like 6 million tonnes of fish per annum as against the production of about 1.8 million tonnes. This is the maximum we have reached, including subsistence fishing. It would, thus, be seen that we are starting with an enormous gap in providing what is today the most valuable and inexpensive source of protein even not excluding the pulses, and which does not throw any additional pressure on land resources. If this quantity of nutritious food could be available to people of all incomes, it will, no doubt, have to be supplied at a low price because increasing the cost of production will make this valuable food beyond the reach of the vast majority of the people for whom it is particularly needed and whose purchasing power is woefully low.

Methods of meeting the gap

The new challenges to which I would like to refer today are mainly certain aspects which have come out in bold relief in the efforts which we on a national scale have to make to meet the gap between the requirements and potential supply. To outline our strategy very briefly, substantial increases in the catches of sea fish have to be raised through an all round effort at mechanisation, off-shore fishing, deep-sea fishing and coastal fish culture. In the field of inland fisheries

we have made very important strides in the culturing of the major carps and not only has the area under inland fish culture been substantially increased but also the yield per hectare has improved considerably. The new challenge in inland fisheries is to see whether the improvements effected in the yield per hectare is sufficient to attract the prospective fish farmers to take to fish raising as a full-time occupation. This worked very well when fish culture was subsidiary to agriculture, bringing an added income to people who were essentially agriculturists but fish farming as an industry has yet to develop because the yield per hectare has still to attain the level of economic yields.

The third principal challenge is that although we have enormous amounts of water which are estuarine and brackish, where biological productivity has been established to be of a very high order, these important water resources have not been utilized adequately for raising the desirable species as a brackish water fish culture industry. Interest in these coastal regions is equally linked with the development of inshore stocks of fish which are already heavily exploited for certain species. All over the world, interest is now fast growing on the utilisation of coastal regions for aquaculture and one of the ways in which fish production in India should be augmented will be through extensive utilisation of these coastal waters. Our country has several suitable species for estuarine and coastal farming such as species of mullets (*Mugil spp*), the milk fish (*Chanos chanos*) and the Bhakti (*Lates calcarifer*) all of which are excellent table fish fetching high prices. Finally, the great interest in prawn fishing which has developed in recent years can be sustained and the operations stabilized only if we attain a break-through in the artificial breeding and raising of prawns in the coastal areas which form their natural habitat. These are some of the principal points which I would like to discuss in the following paragraph.

Indian Ocean Fisheries

There is ample evidence to show that the Indian Ocean could support a much larger fishing effort than is now taking place. Out of the total world catch of about seventy million tonnes of fish per annum, the contribution from the Indian Ocean is hardly three million tonnes. It will equally be seen that while enormous increase has taken place in the fishing yield from the North Atlantic and the North Pacific during the past two decades, the corresponding increase in the Indian Ocean fisheries has only been marginal. There are

extensive and valuable stocks of fish in the Indian Ocean, which could be exploited many times more than at present and it is the special duty of our country, which is now the largest fishing nation in the Indian Ocean area, to take on a bold and vigorous programme of fishery development which will make use of the Indian Ocean resources. Students of fishery biology very well know that tropical waters do not contain the same long-lived stocks of demersal fish as temperate waters and that their composition is different. Nevertheless, we do have important pelagic species; sardines, mackerals, tuna, skipjacks, carangoids, sciaenids and many other tropical families of fishes which offer high yields. Crustacean fisheries consisting of several species of penaeid and palemonid prawns, lobsters and crabs offer possibilities of greater exploitation. Indian fishing has been based on the traditional sailing craft, largely confined to the coastal belt, which limits fishing operations normally to not more than 15 miles away from the shore. Efforts to mechanise the boats and to introduce new types of fishing boats with trawling gears have been one of the most rewarding improvements in fishing industry. Today there are almost 11,000 mechanized boats operating from our coast. These have not merely enlarged the scope of operations but have begun to exploit the areas hitherto not fished. It is safe to say, however, that even the present operations are restricted to only a small part of the continental shelf and the greater part of the seaward side of the continental shelf and the entire continental slope remains untouched. Returns from fishing have also been nearly doubled by using synthetic fibres for nets as against hemp and cotton. Exploratory deep-sea fishing carried out by the Deep-Sea Fishing Station of the Government of India have given a fairly good picture of the fishery resources in off-shore waters from the coast of Kathiawar to Bombay. Information is much less for other areas. By and large, the picture of deep sea resources built up by actual fishing has been incomplete and not such as would encourage private industry to go forward with heavy investments. The redeeming feature here has been the phenomenal rise in the Indian shrimp industry. Penaeid Prawns which figure about 10% of the catches by trawls form the raw material of a processing industry for frozen shrimp and have attracted great attention as an export product with a high profit margin. From the rather negligible export of fish products during the early years of independent India, the export value of marine products have gone up steadily since the sixties and may this year touch an all time record of a hundred crore of rupees. In olden times,

export trade was based mainly on very inferior quality of dried fish and prawns to the neighbouring countries of Burma and Ceylon and their slow replacement by the frozen shrimp for export to the more lucrative markets of the U.S.A., Japan and Europe has itself been a tremendous stride in the utilisation of fishery products. This new development has done much in recent years to give support to the marine fishing industry, both in the public and private sectors and to push asides the reluctance in Central and State administrations to make adequate investments in fisheries.

A question is often asked as to the ultimate expansion to which Indian marine fishing industry could be subjected and whether Indian Ocean resources would justify such an expansion. Here it is pertinent to indicate that the resources of the Indian production are fairly high indeed although not as high as in temperate waters, and something like 20 to 25 million tonnes of fish per annum is considered well within the range of accomplishment. A more critical assessment of the known stocks, gives a conservative figure of fish yield of something like 14 million tonnes per annum, which is a certainty. These are without the induction of new technology, aquaculture or other methods of resource development. Tapping intermediate stages of the food chain like the crustacean and molluscan fisheries could also raise the yield substantially. When this is compared with the present production at 3 million level, it may be seen easily that the annual production could be raised many times and as I have indicated elsewhere, the operational efficiency could also be increased by the advent of newer technology, such as, the use of light and power in fishing operations. Oceanographic studies of the Indian Ocean have shown that there are certain highly productive regions in the Indian Ocean which could give a high yield, although this may not be so for the entire area of the Indian Ocean.

Near the Indian coast itself, the south-west coast of India constitutes one of the most productive regions of the World. Not far way from the coast, valuable fisheries exist in the Andaman Sea and the Seas around the Laccadives Islands for Scombroids. It is obvious that these fisheries can only be exploited if we are able to work fishing fleets which have compactness and a high degree of efficiency. Already there is considerable interest in tapping the resources of the Indian Ocean from far off countries like Japan, the Soviet Union, Korea and Taiwan and if the food resources of the Indian Ocean have to be harvested and utilized by our people, it is imperative that methods

and organisations to utilise these resources from India are developed even now. It is not generally known that the resources of the Ocean are open to all nations to be utilized. The emerging laws of seas provide the reservation of the living resources adjacent to a coastal state for its exclusive use in what is called the exclusive economic zone. The current thinking is that the exclusive economic zone will extend to a width of 200 miles outside a twelve mile territorial sea. This development has minimised the importance of distant water fishing fleets throughout the world in favour of the medium and pocket size trawler fleet. Most of the pelagic tuna and skipjack would still be in the high seas. Most Indian Ocean countries lack modern fishing technology. These are all circumstances which point to the need for India having a long range plan for maximum fisheries development in the Indian Ocean. As the main fishing country in this part of the world it devolves on us to develop and maintain research institutes of a high calibre and foster international collaboration in the exploitation of oceanic fisheries which form an international resource.

Culture Fisheries

In fresh and brackish waters, capture fisheries are a dwindling factor and the future essentially lies in culture fisheries, Indian major carps, *Rohu* (*Labeo rohita*), *Mrigal* (*Cirrhina mrigala*) and *Catla* (*Catla Catla*) have been used for pond culture for centuries by the people of Bengal and Bihar and the practice has been assiduously spread to the neighbouring States and to far off places. The past three decades have witnessed commendable expansion of the technique of rearing carps by the collection of fry and fingerlings from the spawning areas of the rivers and growing them in the culturable waters.

Like agriculture, fish culture could also expand in two distinct ways, extensive as well as intensive. In the initial years of inland fisheries development, the effort was first of all to survey all the available culturable waters and to put them to productive use through stocking of fry and fingerlings of Indian indigenous carps and harvesting them after an optimal period of growth. In this type of development work it was natural, that the operations worked extensively and covered very wide areas. The species chosen for stocking were the well known Rohu, Mrigal and Catla because the entire fish culture operations in the north east sector of India

depended on carp culture. This was made possible by the natural spawning areas of carps in the river systems soon after the monsoon rain. The time honoured practice has been that the spawn and fry of carps in a mixed state *i. e.* consisting of different species were collected and used for stocking in ponds and the larger bodies of inland waters. There was no definite idea of the rate of stocking, except possibly in Bengal where, century old practices crystallised into certain accepted field norms. By and large, it can safely be said that almost throughout the country the inland waters are even now stocked only at a very low density so much so, this is reflected directly in an extremely low yield. Even if all the stocked individuals of fry and fingerlings reach a marketable size, the yield would never be impressive and obviously such a situation can never be achieved. Even today the rate of stocking of many inland waters for fish culture is so low that the yield is quite unprofitable. What then is the remedy? Indian fish culture almost entirely depended on the naturally occurring spawn in the river systems for stocking purposes. They were collected, packed and transported to long distances, some times even by air, and express trains, and even to the extent of making use of oxygen charged plastic containers. The excessive dependence of the entire country for the supply of seed fish for stocking from the North eastern region of the country made the whole situation untenable that a breakthrough had to be achieved. In regard to cultured fish one of the basic requirements is that they should be able to breed in captivity so that the seed fish would be available in large numbers at any time of the year and available for distribution to any place. Towards attaining this desirable objective the first attempt was to make Indian indigenous carps spawn in captivity. As a result of the researches of the Central Inland Fishery Research Institute it was possible to make them breed in the cultured waters by the administration of the pituitary hormone. The induced breeding technique was first successfully employed on experimental scale in 1958. Although many years have gone by since the technique was originally developed the real breakthrough for mass application of this procedure is yet to be achieved because research has not been carried out to the logical conclusion of defining a prescribed dosage, a fool-proof method of treatment, and a low mortality for spawn and fry after successful spawning. Several improvements have no doubt been made, but we are still to isolate the active principles of the pituitary extract involved in the process. Identification of this principle with the existing and known pharmacological products

would abundantly simplify the whole process. We still depend on the adult fish to get the gland, and prepare the injection material and follow a hit and run procedure in getting the adult fish to spawn; success is by no means certain.

Raising of a large number of fry and finger-lings in an intensive way certainly requires availability of acceptable food for these stages of young fish in a form which can easily be formulated and marketed. On this we have done very little work. The present low average production per hectare of 200 kg. per annum on an average for the whole of India excepting Bengal, Bihar and Orissa with as low a figure as 30 to 40 kg. per hectare as in Kerala can be raised only through availability of large quantity of seed fish which will have to be produced many times more than is now available in all States. The development of inland fisheries and culture depends upon the country's ability to raise the seed fish output. It calls for the most energetic steps both on the part of the research scientists as well as developmental fishery workers.

The future trend no doubt is towards intensive fish culture, using less area of water but with higher inputs. This would mean first of all a more intensive stocking of the waters with fry and fingerlings. Such stocking can be productive only if the natural food available in the water is supplemented with artificial feeds. The combination of Rohu which feeds on the column of water, catla which feeds on the surface and mrigal which feeds on the ground is exceedingly scientific in the sense that the three main niches of food in a pond are fully used. Exotic carps introduced to supplement would consist of the silver carp which is a plankton feeder and the grass carp which selectively feeds on weeds. Artificial feeds in acceptable forms which the different species would take directly as food call for research based on compositions of materials such as wastes from coarse grains, oil cake, fish meal, etc. Practically no work has been done in this direction towards developing a fish feed industry.

Intensive stocking, higher rate of feeding and good combination of species can give high yields from fish culture. Up to 8,000 kg. per hectare has been achieved in experimental ponds of the Central Inlands Fisheries Research Institute. While this is exceptional, an yield of 2,000 kg. is quite reasonable without much inputs. Even if the all India average is brought to 400 kg. per hectare, the increase in Inland fish production would be quite impressive.

Crustacean Fisheries

In the foregoing sections some mention has been made of the phenomenal rise of the prawn fisheries trade which has brought a great deal of prosperity to the fishing industry. Today the crustacean fisheries which account for something like 20% of the total marine catch of the country is worth nearly 60% of the total value and in course of time owing to the enormous demand in the world market for this product the value may be expected to mount up still further. All over the world there has been a great awakening of interest in crustacean fisheries and the Indian situation is not exceptional in this regard. The yield from crustacean fisheries is generally much higher in terms of total availability of food than from bony fishes. In popular terms it may be explained something like this:

At the base of the food chain, there is the nutrients, in sea water which in the presence of sun light produce organic carbon in the form of plant plankton. Feeding on the plant organisms or phytoplankton are the zooplankton which in terms of weight will be much lower than the entire plant crop and feeding on the zooplankton are a large number of intermediate organisms in the marine food chain. The Crustacea predominate in the intermediate food chain, particularly the shrimps, prawns and various other organisms whereas at the apex of the food pyramid we have the fishes. If one may draw the analogy from the Antarctic situation the whales there form the apex of the food pyramid, in other places the harvested fish. It stands to reason therefore that instead of harvesting the apex of the pyramid if we were to harvest something lower down the food chain *viz.* Crustaceans and the Molluscs the availability of food will be many times more than as fish in terms of weight. The Antarctic Krill which is a crustacean i.e. a small shrimp which forms the basic food of the whales has been estimated to be available in the order of something like 100 to 500 million tonnes per annum whereas the entire world fish production today is only 70 million tonnes. Throughout the world it is expected that in the coming years there will be increasing attention paid to the development of Crustacean fisheries and we in our country will be able to see not merely the large scale expansion of the prawn fisheries as we understand it today but further development and location of new crustacean resources such as deep sea prawns, deep sea lobsters, smaller shrimp resources, and many others which are at present unutilised. A small shrimp *Acetes* which occurs in enormous quantities right from Orissa coast to the Gulf of Kutch throughout the

Indian coastline is a resource which is to be opened up as a regular fishery for conversion into an acceptable product. Likewise are the many other crustaceans based on species which can easily be cultured and expected to give progressively high yields because of their rapid growth and ready availability.

The Molluscan Resource

The molluscan resources which consist of clams, oysters, mussels, marine snails, cuttle fish, squids and many other related species are exploited in this country only in a very marginal way. In fact in the production statistics the figures given are either omitted or shown as some negligible quantity. The clams form a very important article of food for the poor coastal communities throughout India. In places like Goa it is extensively marketed during the monsoon months. Edible oysters are common in certain regions, but at present they do not fetch a high price. The squids hardly form a fishery, the cuttle fish form a good fishery in some parts of South India and it is expected that there are untapped resources of considerable magnitude in the Bay of Bengal. The importance of clams, oysters, green mussels and other mollusca is that these are capable of being farmed on a large scale and can be transplanted also to give a regular yield. In fact the yield per hectare in terms of production of meat per unit area has been estimated to be the highest in respect of the clams as compared with the yield from any other group whether of fresh water, estuarine or Marine biota. The aquaculture possibilities for mollusca are therefore immense and this has the tremendous advantage that as they are ground dwellers, they do not interfere with the aquaculture for the conventional fish in the superjacent waters. It is here that the molluscan resources have a significant part to play in the development of the living resources of the coastal zone. In addition to the food that can be produced by molluscan certain species have added value such as for example, the pearl which can be produced from pearl oysters in culture pearl industry and the window pane oysters which can be used for various handicrafts. Molluscan shells yield high grade calcium carbonate of industrial and pharmacological value. In the same manner that Crustacean fisheries have developed in recent times, we expect that in the coming two decades the molluscan fisheries will make similar large strides both for food and industrial products.

Fisheries Statistics

Speaking at a gathering of Statisticians it will be superfluous for me to stress the importance of good statistics but perhaps it may not be out of place to indicate where data are most deficient and in areas where further work is essential. When the Central Marine Fisheries Institute was established in 1947 a simple fisheries survey was included because we then had very little information of the magnitude and composition of Indian marine fisheries. Although this survey was first started by non statisticians, it was soon given statistical support and the procedures were periodically improved and brought within the scope of the theories of sampling by the work of Sukhatme and Panse. Much of the field and experimental work on the same was done by Banerjee and the techniques were reviewed by Sarma and Sastry at different times. The operations as now carried out give a fairly good picture of the landings of marine fish in India, species wise, according to landing centres and the seasons. The whole development has been a creditable achievement in fisheries survey and this technique is now applied in certain other countries. The defect in the marine fisheries statistics is that while the data from indigenous craft are reasonably good, the figures for the catch composition and landings of mechanised craft continue to be unreliable. This is due to various factors but with the rapid growth of mechanised fishing, improvements in the collection of data from this source has become important. Further, the question of economics of operation of motorised fishing vessels has become extremely important because, with the rise in cost of fuel, equipment etc. the fishing operations in many areas have to be developed with a keen sense of economy in operating costs where the returns have to be evaluated against capital, operating costs, depreciation of boats and gear, number of personnel, catch composition and possibly other factors. Evolution of reliable statistical methods to meet this situation is a subject which I would submit for your consideration. Similarly, the statistical data on utilising the catches after they are landed are very poor and any sampling procedure developed in this direction would be most welcome.

In the field of inland fisheries the collection of statistics is even more complex. Even the available landing data are faulty. Production data with reference to yields for ponds and larger bodies of water are often biased, exaggerated or incomplete. Obvious answer given by many is better and more reliable enumeration, but we have

to rule out full or even large scale enumeration, which would require the services of a very large number of persons. This is something which we cannot afford. The situation is not unique to fisheries but is common to other fields as well and is part of the larger problem of evolving efficient, cheaper and accurate methods of compiling agricultural statistics. This is one of the principal functions of this Society. While thanking you for inviting me to address this Society I cannot do better than to submit before you some of these pressing problems pertaining to fisheries.