NEW HORIZONS FOR FISHERIES RESEARCH

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THE ACUTE shortage of animal protein in the diet of a vast majority of the people of India has been the major contributing factor for the general nutritional deficiency. Fish constitute an important and plentiful source of such high quality animal protein in our country. The per capita consumption of fish is, however, estimated at about 2.6 kg/year which is only one-tenth of that in some of the advanced countries. India produces now about 15 lakh tonnes of fish and a modest target of 20 lakh tonnes annually has been set for the Fourth Five year Plan.

Although the fishery resources are self-generating, irrational exploitation or ill-planned development would eventually lead to irreparable damage to the stock. Already there are indications that some of the fish populations of our near-shore waters are subjected to very heavy fishing intensity. The situation is by no means alarming at present but requires careful study, analysis and watch if serious consequences are to be avoided. It is here that problem-oriented research is strongly indicated.

In many States, Fisheries Departments have been functioning and some of them have been carrying out research, but there was no attempt to carry out extensive scientific investigations or systematic surveys. Research and exploratory work of this nature are not only long-term projects but are also expensive. Therefore, the Government of India assumed responsibility for this work and set up in 1947 two Fisheries Research Institutes viz., the Central Marine Fisheries Research Institute (CMFRI) and the Central Inland Fisheries Research Institute (CIFRI). In 1957, a third institute, the Central institute of Fisheries Technology (CIFT) was established. These institutes were under the Ministry of Food and Agriculture until October 1967, when they were transferred to the Indian Council of Agricultural Research to achieve better co-ordination in research.

Inland Fisheries Research

The CIFRI deals with problems relating to riverine, lacustrine, estuarine and pond culture fisheries. The research schemes are directed towards a proper appraisal of the inland fishery resources of the country and for evolving suitable methods for their proper development, management and conservation. Broadly speaking, the schemes can be brought under culture and capture fisheries research.

The technique of induced breeding of Indian major carps, which has been developed by the Institute, has now been widely adopted in the country. In conjunction with this work, selective breeding and hybridization have been carried out successfully producing inter-specific and inter-generic hybrids some of which show better cultural qualities than either of the parents. Induced breeding has also been successfully carried on the giant freshwater prawns and catfishes. Although the technique of induced breeding has given a break-through in producing pure fish seeds, the natural source would continue to be important. Therefore, extensive study of the riverine fish seed resources led to the location of several new spawn collection centres.

The Institute has made significant contribution towards the development of methods for reducing carp fry mortality during their transport. Simultaneously, the development of suitable nursery management techniques resulted in the increased survival rate of carp fry in the nursery-ponds.

Although freshwater fish farming has been in practice for many years in this country, it has been carried out on traditional methods and the yield was, in general,

discouragingly low. It has now been demonstrated that by adopting scientific methods of mixed culture using either indigenous varieties alone or in combination with exotic fishes the average sustained yield could be stepped up substantially, while a still further increase could be achieved by manuring and artificial feeding.

It is estimated that about 2.02 million hectares of brackishwater areas are available for fish farming. Realizing the potentialities of this, attempts are being made to develop techniques of brackishwater fish farming. The brackishwater areas include the swampy and marshy regions where carp culture is not possible, while such areas could be profitably utilized for culture of air-breathing fishes and attention is being devoted to evolve suitable techniques for this.

One of the important problems confronting the fish culturists is that of aquatic weeds. Efficient techniques have been evolved to control these which will enable more and more water areas to be brought under fish cultural operations.

With the development of multi-purpose river-valley projects, the development of fisheries in the reservoirs located in different regions of the country occupies an important place. This calls for a thorough study of the behaviour of fish populations under various ecological conditions. Selected reservoirs are being studied so as to suggest methods for developing their fisheries.

Hilsa which contributes to one of the most important fisheries has been studied in detail particularly because of the apprehensions expressed in certain quarters about over-fishing. These investigations revealed the existence of different *Hilsa* populations in the various rivers, a necessary prerequisite information for the proper management of the fisheries.

The increased tempo of industrial development and the establishment of factories particularly on the banks of river systems have given rise to extensive pollution of inland water which is highly detrimental to fisheries. Added to this the large-scale application of insecticides and pesticides, some of which are highly toxic, has created many new problems to fisheries. This important problem has been receiving the attention of the Institute and certain remedial measures have been suggested for rendering the industrial effluents innocuous.

The inland fisheries statistics is still greatly a matter of guess work. In any organized fishery research and developmental work reliable statistics are a *sine qua non*. The Institute has therefore made a beginning in the collection of inland fisheries statistics.

In recent years a lucrative export industry of froglegs has developed. Since frogs are believed to exercise some control over the insect pests, fears have been expressed by some about the adverse effects large-scale frog catching will have on agriculture and public health. Surveys, however, revealed that this fear is unwarranted. Frog culture also is attempted to supplement the natural resources.

Marine Fisheries Research

The CMFRI has been engaged in the study of the marine fishery resources, location of new fishing grounds and new resources, study of the life histories, abundance, migrations, etc. of component species and a study of the environmental factors responsible for the fluctuations in fisheries and eventually to forecast the trends. These studies have become all the more necessary in view of the increasing intensity of fishing consequent on the large-scale introduction of mechanized fishing vessels.

Much valuable information on the biology of the commercially important fishes like the oil sardines, mackerel, tunas, bill fishes, prawns, lobsters, oysters, mussels, squids, flat fishes, perches, Bombay duck, etc., have been collected. Charting of off-shore trawling grounds, particularly along the west coast of India, has provided a clear picture of the distribution pattern of trawl fishes. New and hitherto unexploited marine fishes and prawns have been located. Studies have also revealed the presence of various deep sea fishes some of which occur in dense concentrations so as to enable commercial exploitation feasible. In addition, attention is also being devoted to the study of the various minor fisheries along the east and west coasts.

In order to study the migrations, age, growth, recruitment, mortality, etc. of some of the commercially important fishes and lobsters, a tagging programme has been initiated for sardines, mackerel and lobsters. For the successful implementation of a programme of this nature the whole-hearted co-operation of the public, the fishermen and the industry is essential. It is interesting to note that it has now been established that lobsters do not undertake extensive migrating and are restricted to near about shore-areas.

For the first time an under-water survey of the pearl and chank beds of the east coast has been carried out which has given information on the precise limit, extent and the biology of these two important groups. The deleterious effects of silting and suspension of sediments over oyster beds have been studied and certain remedial measures have been attempted. The survey has revealed rich source of sponge fauna the potentialities of which for commercial exploitation remain to be assessed.

Environmental studies, both biological and non-biological, are of great significance in understanding the fluctuations in fisheries and with this object in view the Institute has been carrying out extensive studies on plankton which forms directly or indirectly the food of fishes. Similarly, the extent of primary organic production for estimating the fishery potentials, nature of currents, upwellings, temperature structure, salinity, dissolved oxygen, nutrient salts, all are being studied.

These environmental studies have positively shown that the west coast of India is more productive than the east coast and have helped in identifying certain factors responsible for the fluctuations in the pelagic fisheries like the oil sardines and the mackerel.

Agar-agar, which has many industrial uses and essential for bacteriological work, was being imported in large quantities. The Institute successfully developed a method, on cottage industry lines, for the manufacture of agar-agar. Recipes for using sea-weed in edible foods, methods for the preparation of seaweed meals and manure have been worked out. Studies on the colonization and seasonal succession of marine algae and the extent of resources in certain selected areas have been carried out. Alginates, another phyco-colloid extracted from brown algae, also have many industrial uses and so a study of these is in progress.

The Institute has successfully evolved a sample survey design and has been carrying out a full-fledged all the year round fishery survey to obtain monthly and annual estimates of total marine fish landings, their groupwise composition for each maritime State as well as catch per unit-of-effort. This helps in keeping a constant watch over the trends in fisheries and also facilitates framing of sound management policies.

Technological Research

In recognition of the need for application of technology in the exploitation of fishery resources and in the processing and preservation of fish, the CIFT was established.

The investigations undertaken at the Institute have helped the fish processors to maintain a very high standard of their products which are being exported. Several problems referred to the Institute by the fish processors have been satisfactorily solved. This has immensely benefited the export trade. To mention just one such case, the frogleg exporters had difficulty in maintaining the desired creamy white colour in the frozen froglegs. The Institute worked on this problem and developed an effective method of treatment of the froglegs which considerably helped the industry in sustaining a good market for the product. Quality control standards have been prescribed for processed fish products and these have been accepted by the Indian Standards Institute and the countries receiving the products.

Preparation of standard designs of mechanized fishing boats made it possible for the fishing industry to have efficient mechanized boats thereby increasing the fish catch per-unit-of-effort put in. Boat designs have also been prepared against specific requests from State Fisheries Departments. Likewise, designs for different types of trawl nets have been prepared, specifications have been drawn up for fish net twines, and indigenous substitutes have been developed for certain imported components resulting in sizable savings in foreign exchange. The prohibitive cost of copper sheets traditionally used for protecting the hulls of wooden boats necessitated the finding of a suitable, cheap but efficient substitute. Work carried on along these lines has shown that aluminium magnesium alloy available indigenously is an acceptable substitute for the expensive copper sheets. Similarly, the possibility of effecting substantial savings in the overall cost of fishing boats by using certain types of country wood, GI fastenings and cast iron fittings has been demonstrated. Winches and other fishing accessories have been designed and all these have helped the progress of the mechanized fishing operations.

Transport of fish over long distances is a major problem particularly if cheap but wholesome product is to be made available. This problem has been receiving the attention of the Institute and some progress has been made in developing suitable inexpensive containers for transport of fresh fish.

Several fish products and bye-products like factice, sulphonated oil, base for oil paint, printing ink, etc., have been developed in the Institute. In addition to these a variety of culinary products such as fish flake, fish cake, fish paste, fish noodles, fish soup powder, etc., have been prepared. A technique for the manufacture of good quality fish protein concentrate, which could be used for fortifying bread, biscuits, atta, etc., has been developed. Being odourless such fortified products will have acceptability even among non-fish eaters.

All India Co-ordinated Projects

A total outlay of Rs. 215 lakhs has been made in the Fourth Five Year Plan for the three fisheries research institutes to develop adequate facilities by way of buildings, research vessels, equipment and staff.

In addition, the Indian Council of Agricultural Research has undertaken a new programme through planning and execution of agricultural research including animal husbandry and fisheries on a national basis. The genesis of the philosophy of the All India Co-ordinated Projects is through the lessons learnt from operating the so-called "*ad hoc* research schemes" financed by the Council until recently. The Council recognized the fact that such *ad hoc* schemes in an isolated and uncoordinated manner were for various reasons not a very effective approach to the solution of research problems in the country as a whole. Consequently, the Council has now decided to sponsor several major All India Co-ordinated research projects. In the field of fisheries seven projects have been formulated.

Investigations on riverine carp spawn prospecting and collection techniques is one such co-ordinated project. The main objectives of this are to chart exploited and likely economic carp spawn collection centres on rivers throughout the country, to provide

a basis for developing a possible national index of exploitable riverine carp spawn, assessment of spawn yielding potential of selected river stretches in regard to quantity as well as quality, behaviour of spawn in relation to environmental factors and to evolve optimum nets in relation to the size, mesh size and material for operation under various hydrological conditions. Investigations will be carried out simultaneously at three centres to be chosen annually on the Ganga river system.

Another co-ordinated project deals with the studies on the ecology and fisheries of freshwater reservoirs. Development of inland fisheries in reservoirs, located in different regions of the country, has assumed great importance on account of impounding of large number of water areas for various purposes. The proper development of the fisheries of these reservoirs would necessitate a thorough study of the behaviour of fish populations under the varying ecological conditions. This can be achieved only through a co-ordinated research project carried out under different environmental conditions. To begin with Bhavani Sagar (Tamil Nadu), Rihand reservoir (H.P.) and Nagarjuna Sagar (Andhra Pradesh) have been selected for the study.

In recent years, prawn fisheries have come into a prominence as a major foreign exchange earner. Fears have been expressed in certain quarters about the possibility of over-fishing. In order to check this it is imperative to have an all-India picture of the prawn resources and, therefore, a co-ordinated project for studying their biology and resources has been drawn up with centres at Bombay, Goa, Cochin, Colachal, Nagapatnam, Madras, Masulipatam and Puri. This project envisages an accurate assessment of the commercially important marine prawn resources of the country and to study their biology, age and growth, maturity and spawning, recruitment, population size, etc.

The Indian major carps are extensively used in fish cultural operations but they are not suitable for culture in swampy or marshy areas. Extensive swampy areas are available in various parts of the country which have not been properly utilized for fish culture. There are several species of air-breathing fishes suitable for culture in these swamps. Therefore, a co-ordinated project 'on propagation and stocking of fish seed of air breathing fishes' has been formulated with centres in the States of Bihar, Assam and Mysore to study the suitability of various species, their propagation, production of pure seeds of these varieties and stocking of the swamps with fry and fingerlings to increase the overall fish production in the country.

Considerable improvement has been achieved in recent years in fish cultural practices and by adopting scientific methods an increase in the average yield from about 600 kg/ha/year to over 2,000 kg/ha/year has been achieved in small fish farms using only indigenous varieties. Preliminary investigations have indicated the possibility of increasing this yield further by a composite culture of Indian and exotic fishes. Therefore, to develop suitable formulae of species composition of fishes, stocking intensity, etc. under different soil and climatic conditions, a co-ordinated project on composite culture of Indian and exotic species for maximum fish production in culture operations will be started in centres located in Bengal, Andhra Pradesh, Uttar Pradesh, Haryana, Maharashtra and Tamil Nadu.

As a result of the increase in the trawl fisheries a new problem has arisen. Fifty to seventy per cent of the trawl catch particularly of certain areas is what is called 'trash fish', which though edible, does not fetch good price and is generally converted into manure or thrown back into the sea. Considering the present protein shortage this is to be considered as wasteful and there is urgent need to develop techniques for the utilization of this trash fish for human consumption. For this it is proposed to have a co-ordinated project on the utilization of trash fish with centres in Cochin, Mangalore and Tuticorin. This utilization would also improve the economy of the fishing operations.

In a tropical country like India, the transport of fresh fish over long distances bristles with many problems because fish is a highly perishable commodity. In order to tackle this problem with special reference to the study of types of fish and their composition, processing, packing, transport and marketing a co-ordinated project on the study of technological problems of handling and transporting of fresh fish has been formulated. The investigations will be taken up at Veraval, Kakinada, Calcutta and Delhi.

For these seven co-ordinated projects, each of which is at present planned for a period of five years, a total outlay of about Rs 67 lakhs is proposed to be made.

Conclusion

Fisheries research is highly complex and involves multi-disciplinary approach and the successful achievement of the targets fixed for the Fourth Five Year Plan would depend on the availability of adequate funds, facilities and the co-operation and concerted efforts of the research workers in the different disciplines connected with fisheries science. Fisheries research and development cannot progress without creating a proper cadre of trained personnel both for research and administration. The Central Institutes of Fisheries Education and Fisheries Operatives have been functioning for a few years now. While these have partly met the requirements of training personnel both in the operational activities and the administrative level there was an urgent need for a fisheries educational Institute for

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