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RECENT TRENDS IN FISHERIES RESEARCH

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ABSTRACT

The potential of the sea serves as an important protein to augment the world's food supplies and the recent developments in the technology of fishing have significantly helped the increased exploitation of fishery resources. But considering the protein requirement of the increasing population more resources have to be found and exploitation of untapped offshore resources besides culture of fast growing species has to be resorted to. Meanwhile, trends in the depletion of the existing fishery in certain areas have to be monitored and adequate preventions taken. The problem of environmental degradation owing to pollution and consequent destruction of fishery in the estuaries and near shore waters have to be assessed. Extension of aquaculture in areas unutilised at present is suggested as the immediate solution for increasing fish production. But procurement of adequate seeds of finfish and shell fish as and when required is one of the major handicaps experienced by the fish farmer.

Exploration of unutilised and under exploited grounds, research on probable depletion of existing commercial species, prevention of pollution in the estuaries and coastal waters, determination of factors responsible for the breeding of fast growing species such as milkfish, mullets and penaeid prawns, hatchery management for the production of fish seed under controlled conditions and evolving of fast growing hybrids suitable for different environment are suggested as some of the problems which need immediate attention.

INTRODUCTION

THE WORLD now has a critical population food dilemma of major proportions. Production from the sea and the land is not keeping pace with a world population that is doubling up every thirty five years. The situation has stimulated substantial international interest in the sea and other water bodies as a source of food and raw materials. The potential of the sea serves as an important protein to augment the world's food supplies. At present, fish provide approximately 9 per cent of the world's protein. Animal protein is especially valuable to man as it contains two essential amino acids (lysine and methionine) not found in adequate amounts in vegetable protein. A pound of fish can also be produced more cheaply than a pound of meat.

In 1950-1970, the world fishery catch expanded rapidly increasing from 21 million to 70 million tonnes, evidently owing to better technology. Since 1970 however, the world catch has either declined or remained constant. But human population continues to grow and how could we meet the demand for protein food ? The exponential expansion of the world's population coupled with rising affluence in highly developed countries has placed increasing pressure on fishery resources. Despite international agreements and conservation regulation on the coastal fisheries, there is widespread exploitation and depletion of some of its most valuable fishery resources.

In recent years there has been significant development in the technology of fishing. Besides the conventional fishing methods

employed in the inshore waters, mechanised fishing using small and big trawlers and factory ships capable of fishing and processing the catch away from the shore came into existence in many parts of the world. Various types of echo-sounders are being used and research has advanced so much that it is possible to identify even the species of fish from the nature of the echograph, besides locating the school and identifying its intensity. Electrical fishing has become a possiblity and USSR have done much work with encouraging results. Remote sensing surveys are a common feature in the European waters for fishing operations. Recently in India also some experiments on remote sensing and aerial surveys have been carried out with encouraging results. Exploratory surveys using aeroplanes are advantageous as large areas are covered and schools of pelagic fish located within a short period. However, the development of fishing technology had its adverse effect of overfishing in certain regions. The North Atlantic was the first area of the world's oceans to witness substantial overfishing, a fact that is due to population increase, rising affluence and the advent of the modern fishing technology.

Given the current fishing efforts at various trophic levels, it is estimated that the potential marine fishery production is approximately 120 million tonnes. Although current catches are running at only about half of this potential, it is apparent that the most popular food finfish are either fully exploited or over exploited. It is estimated by some that 100 million tonnes of conventional species only can be taken from the oceans on a sustainable basis. However, unutilized species may still be very important in the future, as a source of protein. An unquantified and untapped reserve of lesser known fishing stock, pending the development of efficient and economical harvesting methods may prove to be a significant addition to the world's sources of fish and protein. To a large extent such stocks are located off the shores of the developing countries in the southern hemisphere. These will include some fish as well as cephalopods and some estimate the figure upto 200 million tonnes. The Antarctic krill has recently received much attention and it is estimated to have a potential of 200 million tonnes. New technology is required for catching and processing these unconventional species and make them acceptable to the consumer. USSR have already initiated the capture of krill and some products have been developed for human consumption.

Biological investigations of the entire life-cycle of various fish have been going on for years. The purpose is to understand more about the organism's behaviour in both normal and abnormal environments. One of the most important considerations in the use of fishing gear and impact on fishery is the selection of mesh size for the trawl net. In order to enhance the capture fishery resources, regulations have been imposed in some countries on fish size (*i.e.* mesh size) and on other characteristics such as male or female. 'Closed seasons and areas' is probably one of the most widely used tools to enhance the fishery stock and thereby increase the catch. Closed seasons are generally designed to reduce the total fishing pressure on a stock, and closed areas are generally designed to protect part of the stock. Man can enhance or increase the productivity of the resource through proper mesh selections, closing nursery grounds to fishing and improved hatchery operations. When and where are we to impose the above? For identifying the same, detailed research is required.

As regards 'Prawn fishery' in Indian waters the total catch during 1980 (170,739 tonnes) is 3.85% less than the previous year. Considering the penaeid and non-penaeid prawns separately, then also there is a decreasing trend and it is existing from 1977 onwards. Is it due to overfishing or lack of recruitment in

the inshore fisheries? It has already been established that most of the commercial penaeid prawns have their nursery phase in the estuaries and so careful management of estuaries is essential for increasing inshore resources. The effect of 'prawn filtration' in the pokkali fields, and the operation of the close meshed 'stake nets' in the estuaries on the size and intensity of penaeid prawn fishery in the inshore waters of Kerala is worthy of investigation. Unless proper protective measures are taken there will be damage or depletion of this foreign money earning item as has happened to *Macrobrachium rosenbergi*, which has become an insignificant fishery in recent years.

The problem of environmental degradation—air and water pollution, solid wastes, threats to wild life and the destruction of natural resources is often summed up as environmental crisis. Shellfish areas are often closed to fishery because of a danger to public health. Fish kills are directly attributable to various pollutants. Deterioration in water quality reduces fishing productivity. A chemical plant may use water in a production process that results in polluted water being discharged back into the ecosystem and this results in deteriorating environmental quality. Estuaries which serve as nursery grounds for prawns are sensitive ecosystems that are supplied with water from rivers. Chemical factories situated by the side of rivers discharge large amount of waste materials in the rivers which find their way into the estuaries and these toxic materials have an adverse impact on the shrimp nursery grounds which ultimately affect the catch. Thus the chemical industry prospers at the expense of the prawn industry. So, it is necessary that we should first investigate the interaction between various classes of pollutants and water resources.

The pollutants may be degradable or non-degradable types. Domestic sewage, pulp and paper mills and food processing plants produce greater amounts of degradable organic effluents. Bacteria present in water, feed on degradable waste and break them to inorganic form of nitrogen, phosphorus *etc.* In the process some of the oxygen in the water is utilised and the inorganic material created becomes fertilizer. But if the degradable organic waste discharged into the water becomes excessive, the process of degradation may exhaust the dissolved oxygen and endanger the fish and animal life.

Non-degradable pollutants cannot be broken down chemically by the bacteria in water. Such inorganic substances as DDT, detergents and heavy metals (mercury, lead, zinc) and pesticides are toxic to fish even in minute concentration.

Commercial shellfish areas are most often closed because of bacterial pollution. The health problems dictate shellfish closure by public health authorities if there is a high coliform count. Although many species of estuarine shell fish are affected by water pollutants, clams and oysters are probably the most affected. Because of their filter feeding mechanism, clams and oysters are particularly susceptible to pollutants. Mercury enters fish primarily through the food chain and is deposited in the fatty tissues in amounts that vary directly with the size of fish. Oil is another pollutant which hampers the fishery. Eutrophication and other forms of pollution are becoming increasingly harmful to fish life.

'Aquaculture', the farming and husbandary of fresh water, estuarine and marine organisms is a very old and highly productive management practice. The history of aquaculture shows that it originated and developed under different social and economic conditions in various parts of the world. The greatest concentration of aquaculture is in Asia and the far east, particularly in China. Aquaculture currently provides about 6 million tonnes of food. The over-exploitation of traditional wild stock

species has created an interest in aquaculture as a source of increased supply of fish protein in this food-starved world. The reasons for the rapid growth of aquaculture activities are (1) the growing world demand for protein, (2) the rising cost of commercially caught fish as maximum sustainable yield of more and more wild stock species are approached or exceeded, (3) aquaculture gives more favourable feed conversion rates and higher productivity per hectare than in traditional agricultural methods and products. It is estimated that aquaculture of finfish production is about 3.98 million tonnes from an area of 2.6 million hectares. China, India, USSR and Indonesia are the leading producers. Besides finfish, prawns, oysters, mussel, clams and sea weeds also contribute to the yield from aquaculture. The average production per hectare is 1.5 metric tonnes per year. In Israel mullet farms yield 2,000 to 4,000 kg from intensive culture. In Taiwan milkfish yield 1,000-2,500 kg/ha. In Japan intensive culture of common carp yielded 5,000 kg/ha and in Philippines the figure is 5,500 kg/ha. But, above all Chinese claim to have produced upto 7,500 kg/ha in pond culture as early as 1959. But there are many constraints especially in India and these have to be overcome with research in various fields. Many commercially valuable aquaculture species cannot be completely controlled by man. For example milkfish, mullets, penaeid prawns and many other species cannot be spawned in captivity. About 20 species of finfish, 25 species of crustaceans, 20 molluscs and 10 algae are being cultivated in the coastal areas of Indo-Pacific region. Besides, there are fresh water species as well. Aquaculture species that could serve as economical sources of protein would have to be those that are fairly popular as food, but also that are low on the food chain, hardy, easy to culture and fast growing.

In selecting species for aquaculture the following should be considered :

1. species that feed on low food chain,
2. species that have fairly wide temperature tolerance,
3. few feeding problems,
4. good growth rate,
5. fair amount of research on biological aspects of fish or plant in question and
6. potentially high consumer acceptance.

Species such as oysters, shrimp and mussels are examples of aquacultured shellfish that feed low on the food chain. Failure in aquaculture may be due to lack of trained personnel, aquatic pollution and diseases and parasites. The world potential for aquaculture development lies in expansion of areas already under cultivation, increase in productivity through research and development and improvement of present day technology considering the environment. With better technology and introduction of more areas under aquaculture, about 20-25 million tonnes per year could be produced. It is estimated that the output could be 50 million tonnes by the year 2000.

We have advanced a great deal in inland aquaculture with fast growing species of carps. One of the difficulties in the expansion of aquaculture is the lack of enough seed of fast growing species for stocking and this has been overcome with regard to carps. Production of fish seed with hypophysation has been perfected for fish seed production. The technique developed in Brazil in 1934 involves the injection of suspension or extractions of pituitary gland material to female and male breeders. The treatment raises the concentration of sex hormones in the blood stream of the recipient and facilitates maturation and shedding of the sex products.

Despite intensive research it has not yet been possible to produce mullet and milkfish fry on commercial scale under controlled conditions, so the fry have to be collected in the wild. *Mugil cephalus* is one of the fast growing species which feed on micro-organisms. Some

are of the opinion that it spawns in the 'high sea'. But in the Ashtamudi as well as Kayamkulam Lakes (Kerala) *M. cephalus* with very advanced stage of maturity and just liberated eggs have been collected showing that breeding could take place in estuaries as well. Milkfish is known to reproduce in the sea, but its larvae migrate into estuaries and brackishwaters in search of diatoms and blue green algae. They return to sea for sexual maturation and spawning. Gonads are not found to mature in estuaries though the species grow even upto 4 kg. Philippines has been successful in spawning milkfish under controlled conditions. But commercial production of seed has not yet been possible. More intensive studies are required for the production of mullet and milkfish fry on a commercial basis. This is one of the fields which requires attention by researchers.

Penaeid prawns, especially *Penaeus monodon, P. indicus* and other related species are good foreign exchange earners. As the harvest of these in the wild has almost reached maximum, particularly in the inshore waters as already mentioned, culturing the same in ponds is the only solution for increasing production. Here also supply of seed is limited especially in certain seasons. In India there are about 2 million hectares of brackishwater or marshy areas of which only about 30,000 hectares are at present fully utilised. For the extension of further area, seeds have to be produced by artificial means. Fujinaga in 1933 succeeded in the laboratory spawning of mature shrimp (*Penaeus japonicus*). Gravid females were collected from their natural habitat in the sea and kept in filtered sea water tanks. They spawn the same night or next night. The larvae are reared in tanks and post-larvae liberated into ponds. Here again difficulty occurs in getting the required gravid female as and when required. There are about 14 shrimp farms in Japan with about 100 ha of water producing 200 tonnes of prawns year. Liberation of post-larvae of *P. japonicus* reared in the laboratory in the inshore waters also helped in getting better catch from the sea. The above experiment on spawning has been successful in *P. indicus, P. monodon* and other commercial species in India also.

Eye ablation techniques applied on different species of penaeid prawns were successful in Philippines and India as well. Unilateral or bilateral eye ablation techniques have been adopted. In the eye stalks are found the production and storage sites of an ovary inhibiting hormone which prevents the maturation of the ovaries. In nature, 'some' environmental factor or factors cause the decrease of this substance as the prawns migrate from the estuaries to offshore areas where they normally spawn. Eye stalk ablation eliminates or atleast reduces this inhibitory hormone to a level where full maturation of the ovaries can take place. Maturation of the ovaries follows a few days to a few months after ablation and spawning may occur as quickly as 7 days after ablation.

Both the above techniques require much improvement and commercial production of seed for stocking ponds has yet to be attained. Feeding of larvae at different stages and prevention of mortality of larvae are some of the problems which have to be overcome. Meanwhile it is desirable to find out as to what 'factor' or 'factors' help the prawns to attain maturity in the sea and if these could be isolated and introduced in the culture ponds it might be possible to help the prawns spawn in the pond itself.

Hybridization among strains and sub-species of carps have been helpful in genetic improvement. Some of the hybrids are proved to have more rapid growth rate. However, further studies in this field are necessary for evolving fast growing forms suitable for culture under varied environments.

Summing up, for increasing the catch of fishery resources, research in the following directions may be helpful :

1. exploration of unutilised grounds,
2. catching of under-utilised species with better technology,
3. research on the depletion of certain fisheries and recoupment by protection measures and
4. prevention of pollution in the coastal waters and estuaries—research on optimum condition for each fishery and determination of maximum tolerable limit of pollution by different species.

For increasing fish production by aquaculture the following may be considered :

1. Survey of unutilised bodies of water usable for ponds—their suitability.
2. Selection of profitable species.
3. Procurement and transport of fish seed.
4. Hatchery management and production of seed of finfish and shellfish under controlled conditions.
5. Determination of the factors responsible for the breeding of certain species of mullets, *Chanos* and penaeid prawns and introduction of the same for obtaining seed.
6. Evolving of fast growing hybrids suitable for different environment.