

# STRATEGY FOR DEVELOPMENT OF INLAND FISHERY RESOURCES IN INDIA

Key Issues in Production and Marketing

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# BRACKISH WATER CULTURE FISHERIES

## A Comment

E.G. SILAS

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### INTRODUCTION

BRACKISH water fish culture is an important area included in India's fisheries development programmes. This aquaculture practice has been in vogue for a long time in West Bengal, Kerala, Karnataka and Goa. However, it was only from the fag end of the IV Five Year Plan that direct interest was generated in the development of this sector. Since then, several reports and documents describing its past and present status, and potential as an important source for augmenting fish production and enhancing the economic and employment opportunities in the coastal rural regions are available. To facilitate discussion on the resources, skills and knowledge available to us, constraints encountered, and risks involved in this field in achieving its pragmatic development, the Centre for Management in Agriculture of the Indian Institute of Management, Ahmedabad (IIMA) had already made available a comprehensive report covering the different aspects of the sector.

#### **Resource base**

The most important requirement for brackish water fish farming is water resource. It is true that India possesses a vast stretch of estuaries and brackish water estimated by different agencies, at 1.4 million ha. to 2 million ha. However, the matter of

concern to us is the availability of total area of quality water spread, unpolluted by effluents, and suitable for growing the crop animals. Although there is no information at present on the extent of such water spreads in the estimated potential estuaries and brackish waters in the country, and about whether or not the estimated potential area is accurate, it is evident that there are numerous sites in the brackish water regions suitable for culture. This and the fact that only a small percentage of the area, which again estimated differently from 26,270 ha. to 30,000 ha. is used in the prevailing brackish water culture practice, indicate that there is adequate scope to extend the technology to additional areas.

A wide variety of flora and fauna inhabit either temporarily or permanently in the brackish water ecosystem. However, all of them are not suitable for culture from the biological, environmental, and economic criteria of commercial scale farming.

The selection of species for aquaculture is a complex process. It is considered that the species which feed low in the food chain, show wide tolerance to environmental fluctuations, have limited breeding problems, and are amenable for controlled breeding; the species that grow fast have good consumer acceptance, adoptable for small farm operation, and could earn foreign exchange are the most suitable. From this point, there are six species of finfishes, five species of crustaceans, and eight species of molluscs which are immediately suitable for large scale culture. To this list could be added several potential species of finfishes and shellfishes. It is thus clear that a number of finfishes and shellfishes available in our country could be raised in the brackish waters through aquaculture for profit.

Another important resource component required for successful brackish water fish culture operation is labour. The plans and projects for the development of brackish water resource envisage it to be labour intensive, and amenable to generate rural employment opportunities. The statistics on fishermen population in the coastal area show the availability of abundant labour. Nevertheless, it is observed that fish farmers or aquaculturists differ greatly from the fishermen who catch fish rather than farming them. Also the traditional fish farmers involved in brackish water fish farming at present are restricted to only certain regions in our country. These factors emphasize

the need for careful consideration and appropriate training to utilise the labour resource available in the country.

### Technological base

Brackish water fish farming based on an empirical technology already occupies our country. However, inadequate venturesome attitude, limitations of developmental input, failure to provide the desired technological and managerial improvements greatly hampered the progress of this system over the years. Directed efforts to develop the sector started only one and half decades ago. Since then, considerable technological progress has been achieved.

A wealth of information on the biology and ecology of important cultivable finfishes and crustaceans are now available. The distribution pattern of the different life stages in different ecosystems to aid in seed prospecting and procurement of breeders from the wild population is also fairly known. Similarly, the growth pattern and reproduction of the cultivable species have been studied.

Because quality seed of the species selected for culture is an essential prerequisite for large scale culture, considerable efforts have been made to locate seed grounds in the surf region and in the important brackish water and estuarine regions of Hooghly-Matlah, the Chilka lake, Kakinada Bay, Tamil Nadu, Kerala, Karnataka and Goa. Factors influencing the seasonal fluctuations of seed in the grounds have been investigated and seed calendars including the index of catch per unit effort and peak periods of abundance for certain regions have been prepared. Various seed collection techniques, segregation of seed and their transportation have also been described.

Most of the cultivable marine prawns of the country have been successfully bred under controlled conditions. Species such as *Penaeus indicus* and *P. monodon* have been induced to reproduce in captivity, and hatchery technology is reasonably well advanced. With the research results achieved in recent years, the management of brood stock, spawning, hatching larval culture are carried out as a routine matter in the hatchery of the Prawn Culture Laboratory of the Central Marine Fisheries Research Institute (CMFRI) and at the Regional Shrimp Hatchery at Azhicode, Kerala. One of the most signi-

ficant technological achievement which aided in the breakthrough of the hatchery scale of penaeid prawn seed is the success achieved in the mass culture of live food organisms and production of artificial feed in micro particulate form to feed the larvae and postlarvae. With these, we now have an indigenous technology to establish penaeid prawn hatcheries. The ongoing research results further encourage to perfect these technologies with better understanding and elucidation of the reproductive physiology and nutritional regime of the candidate species, and with control over the environmental factors, to achieve higher survival rates.

Considerable attempts have also been made to improve the growth, survival and production of prawns and fish in the brackish water grow-out facilities. After initial experiments, it has been suggested that by introducing certain managerial inputs the traditional practice could be improved to realise enhanced production and income over those in the traditional practice. These inputs entail selection of fast growing species (in the case of polyculture, compatible species), preparation of the field by eradicating the undesirable organisms prior to stocking, stocking of the field with the known quality and quantity of seed, and management of the water quality. The penaeid prawns in the ponds grow very fast and attain a size of 6 to 25 gm. depending on the species, within 90 to 120 days, and fishes such as milkfish fry (4.5 cm.) grow to 45 cm. in about 4½ to 5 months. This short term culture operation would also facilitate to take at least 3 harvests in an year, and this has been shown to realise higher production of quality prawns and fishes. However, the technology of field culture and the management of the aquatic ecosystem are complex and the vagaries of biological, environmental, physical and social factors interact and decide the ultimate production and economics of operation. Information on various individual and combined effects of these factors on the growth, survival and production of stocked animals in the field are at present meagre, and it is imperative that further investigations are carried out to devise improvements to obtain stabilised production in the field culture operation.

## DEVELOPMENT POTENTIAL

There is growing demand for animal protein due to the increase in population and income. Aquaculture is a definite means for generating animal food production. It is also considered as a potential source for supply of luxury food and for earning foreign exchange. Several reports are also now available projecting its potentials pointing to its relatively higher productivity per hectare than in the traditional agricultural or fishing methods, favourable feed conversion rates and as an alternative to fight rising cost of capture fisheries and depletion of wild stock of certain fishes.

Brackish water fish culture in India is classified into three types: (1) seasonal paddy and fish culture, (2) perennial fish culture, and (3) paddy-and-fish culture. In all these types, the basic technology involving seed supply, water supply and grow out and harvest procedures are generally similar. According to another classification, the culture system is categorised into extensive, semi-intensive, and intensive system.

In the extensive system, the stocking of the field is accomplished by the seed brought in by the incoming tides, holding them in the field to grow by feeding on the natural food available in the pond, and harvesting them periodically. This system does not involve fertilisation of the pond, feeding of the impounded stock and control over the competition and predation as stocking is unselective. The cost of operation and production is relatively low; the yield varies from 215 to 750 kg./ha./year. The present brackish water fish culture practice in our country, by and large, comes under this category.)

In the semi-extensive system, the field is carefully prepared by eradicating the undesirable organisms; fertilisers are often applied to increase the productivity of the field; seeds of selected species that grow fast and are in great demand are stocked. Supplementary feeding is offered to enhance the growth and the water quality is monitored to certain extent. The stocked crop is allowed to grow till it attains the marketable size. In this system, the cost of operation is found to be relatively higher than in the extensive system, but the production and margin or profit are found to be several fold more than those in the extensive system. The production in this system is found

to be varying from 1,000 kg. to 2,000 kg./ha./year. This system is now being followed by some of the progressive fish farmers in the country.

In the intensive system, the entire culture operation is carried out under controlled conditions with higher stocking density, quality water supply and intensive feeding. Both the cost of operation and production are found to be higher than in the other two systems, the latter being above 2,000 kg./ha./year. This system is not practised in India. Considering the different system and the level of transferable technology available at present in the country, it is indicated that by improving the traditional practice to adopt the semi-intensive culture system, the production from the existing fields could be appreciably increased, and extension of the system to additional suitable areas could bring in substantial increase of fish production to the country and could improve the economic condition of the fish farmers.

In recent years, attempts are being made to integrate fish farming not only with a combination of compatible species, but also with crops and livestock to increase the production as well as earnings. The polyculture-experiments carried out have already demonstrated the advantages over monoculture. In the integrated farming experiments conducted with fish (*Sarotherodon niloticus*), and pig, a production of 3,549 kg. of fish/ha. using 103 pigs/ha. was obtained during a production cycle of 180 days; with poultry-fish, the yield was 1,758 kg./ha. of fish with 1,000 chicken for 90 days. Here the productivity of the fish feed was increased using the manure derived from pigs/chicken. The organization of brackish water fish farming on this pattern, integrating crop and livestock has great potential to increase the production and earning from an unit ecosystem.

#### DEVELOPMENT NEEDS

Policies, strategies, and guidelines form valuable indicators of a favourable climate for aquaculture. As a 'pioneer' industry, inducements and incentives to attract entrepreneurs and investment should be offered. The policies of distribution of water spread, (which is under the control of the state government), among the small and marginal farmers, private entrepreneurs

and large business houses, leasing of land, the conflict between the agriculture and aquaculture and competition from the establishment of industries in the vicinity of aquacultural sites, should be formulated. The regulations regarding environment management limiting pollution and ecological damage, and those pertaining to labour, their wages, and working conditions are to be prescribed. These policy guidelines are essential in the context of the development and acceptance of the new venture into the social, economical, and political milieu prevailing in the country.

Site selection and farm construction are important components of the brackish water fish culture. These require biological, environmental and engineering considerations. There is an urgent need to develop this skill so as to establish the venture as a viable industry. Similarly, supply of adequate quantity of stockable seed of both fishes and prawns is of paramount importance for the spread and accelerated development of brackish water culture. Enormous quantity of seed, which nature may not be able to provide as and when required by the fish farmers, is needed. Continued seed prospecting from the wild in which process the seed of less important species are also collected, may adversely affect the capture fisheries, causing imbalance in the natural population and often lead to wastage of seed. Establishment of adequate number of hatcheries is, therefore, an essential prerequisite. While we have the technological base to establish hatcheries for penaeid prawn seed production, efforts are necessary to develop seed production technology for cultivable finfishes.

Brackish water fish farming needs finance to establish hatcheries, construct farms, their maintenance, and for seed, feed, fertilizers and labour. Although, immense potentials in the field are recognised, entrepreneurs and financial agencies are hesitant to enter into the field due to lack of adequate and proven data on the economies of culture. While it is true that reliable data on economic possibility of culture are scarce, it is evident that it is a profitable business and could be compared well with any land-based animal industries or the capture fisheries in the sea. Encouragement should be provided for the flow of finance and to formulate schemes for providing finance and loans through simplified procedural formalities.



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We are now advocating a technology of culture entailing production of seed in hatcheries, stocking of quality seed, feeding them and growing them with better managerial inputs to obtain increased production. In this practice, feed form an important component and would contribute greatly to the cost of operation, affecting the economies of the project. It is, therefore, imperative to develop cheaper, but nutritionally effective feed for different phases of culture and establish feed manufacturing units. At present, there is no feed manufacturing industry in the country for aquatic farm animals.

Although there may not be any difficulty for marketing the prawns produced through aquacultural sources as they are in great demand both in the internal and external markets, several marketing problems are likely due to competition, existence of middlemen, and inadequate infrastructural facilities to handle the catch when large quantities are produced. As a long range programme, it is essential to develop an effective system of distribution and marketing of produce so that the actual producer as well as the entrepreneurs are ensured of the benefits and profits of the business.

Failure in aquaculture or its slow pace of development are often attributed to the lack of trained personnel, extension service, and dissemination and transmission of information relating to technologies developed and other developments in the field to the fish farmers. While endeavours are made to provide training to actual and prospective fish farmers in coastal aquaculture at the Krishi Vigyan Kendra and Trainers Training Centre at Narakkal, and to develop a cadre of managers and executives to man the projects at the Centre of Advanced Studies in Mariculture at the Central Marine Fisheries Research Institute, it is essential to strengthen these organisations to meet the requirements in the field. Similarly, the extension activities in the states, and demonstration of culture operation in the farmer's fields are to be strengthened to meet the growing demand of transfer of technology and extension of the venture.

Last, but not the least, is the need for continuation of intensive research efforts to develop viable low-cost technologies which can be adopted by the fish farmers and entrepreneurs to

obtain higher, but sustained production and profit and to the benefit of the country as a whole.

#### ROLE OF DIFFERENT ORGANISATIONS AND AN APPROACH TO DEVELOPMENT

Brackish water fish farming as compared to land-based agribusiness has certain unique characteristics. It requires not only the common principles of management, but also a knowledge of biological characteristics of the animals living in water, dynamics of the ecosystem, vagaries of the environment, technology of culture, financial and marketing management and the agility to confront unpredictable changes, and to take up appropriate remedial measures. The development of the sector, therefore, demands both individual and organizational responsibilities. Among the organisations, government is the principal participant. Government formulates policies and provide funds for research management, and advisory services. Recognising the importance of brackish water fish culture, several schemes formulated by the government are underway at present. Several research projects to tackle the problems encountered in different aspects of seed production and field culture of coastal water finfishes and crustaceans are being carried out at the CMFRI and CIFRI. Besides, basic studies on reproduction, physiology, nutrition, pathology and genetics are carried out at several universities in the maritime states and at the Centre of Advanced Studies. Regional problems in certain aspects of coastal aquaculture are also investigated at the Agricultural Universities. To meet the technical manpower requirements, the Centre of Advanced Studies in mariculture has started a post-graduate course in the specialised field of mariculture including coastal aquaculture. At the grass root level, training is provided at Krishi Vigyan Kendra for mariculture although it requires further strengthening.

In the development front, a centrally sponsored scheme is operated by Government of India in all the maritime states. Brackish water fish farming being a state subject, all the maritime states have also formulated schemes for its development, although the degree of investment and financial allocations vary from state to state. These schemes are aimed principally to

generate interest among entrepreneurs and demonstrate the techno-economic feasibility.

The role of government organisation being mainly towards R&D programmes they are not directly involved in the business. Here Fish Farmers' Cooperatives could play an important role and we have to consider how best they could be made effective and functional to meet the operational and business needs of the brackish water fish culture. Among the organizational set up which should be considered is the Fish Farming Development Agency (FFDA) which in several states plays an important role in developing the freshwater fish culture. The other agencies which are interested in brackish water fish culture are the large business houses and the small scale individual private entrepreneurs, and small and marginal fish farmers. For the latter groups it is necessary to link institutional lenders to provide loans at the initial stages of establishment. As brackish water fish culture could be practised and provided to the different categories of entrepreneurs, a carefully considered organisational pattern with viable linkage and set up has to be formed.

Due to different geographical, topographical and ecological characteristics prevailing along the coastal zone of our country, the technological, developmental, and managerial inputs required to establish viable aquafarming in brackish water area are found to be location-specific. It is often observed that same yardsticks could not be considered to work the economic feasibility of the project in different locations. Considering these aspects area approach concept is mooted. A well planned area development programme could definitely help to accelerate the process of development as exemplified in certain agriculture sector.

A new strategy has to be developed for fully utilising the saline groundwater situation in landlocked states such as Haryana for culture of brackish water finfishes and prawns. However, this needs a thorough study of the soil and water characteristics, productivity of the waters and the compatibility of the species for developing economically viable culture practices.

## CONCLUSION

In concluding this discussion, it may be observed that brackish water fish farming offers great potentials and prospects, although there is considerable debate on the *modus operandi* of its organisation on a large commercial scale bringing in the resources, technologies, finance and skills available in the country. Aquafarming in brackish water is simple as well as complex and what we need at the moment is to consider and plan an integrated systems-approach to provide a thrust for its development.

At the Fifteenth Session of the FAO Committee on Fisheries held in Rome from 10th to 19th October, 1983, it was agreed that proposals for the following five action programmes should be developed for the World Conference on Fisheries Management and Development scheduled to be held under the auspices of FAO in June 1984.

1. Action programme on fisheries management and development (covering both marine and inland fisheries);
2. Action programme for the development of small-scale fisheries;
3. Action programme on aquaculture;
4. Action programme on trade in fish and fish products, and
5. Action programme to promote the role of fisheries in alleviating under-nutrition.

Aquaculture was given considerable stress as a ready source of food, source of employment greater participation of women, in diverting more fish to family consumption, income and foreign exchange. The focus was on integrating aquaculture into rural development programmes for integrated farming. In fact, India's suggestion that an "International Year for Aquaculture" be observed in the near future "to focus attention on the need for experimental research, on starting pilot and definite projects in countries, on exchange of information relating to aquaculture, and on increased flow of credit from national and

international financing bodies to raise production was endorsed by the Committee. In all these brackish water and coastal aquaculture is going to play a major role in augmenting production, alleviating under nutrition, and improving the quality of life of the coastal rural poor.