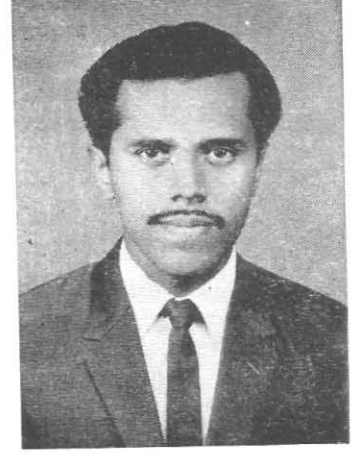
Mariculture in India, its potentialities and practical applications



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INTRODUCTION

India is passing through a very critical period of food crisis and consequently calling for the necessity of adopting various techniques and methods to augment the food production. Among them, mariculture is an important means of getting additional source of human food. In the developing countries the provision of cheap but nutritious diet for the people is a pressing necessity. Viewed in this context, mariculture would seem to offer promising returns to the society as evidenced from Japan, Spain, France and Netherlands.

BRIEF RESUME OF PREVIOUS WORK

In India, ever since the practical possibilities for mariculture were suggested by some of our pioneering fishery workers, there had been sporadic attempts to culture fishes and other commercially important aquatic forms in saline ponds and lagoons. The need for mariculture was emphasised by Panikkar (1952) who advocated the conversion of low-lying areas near the coast into fish farms. But most of these efforts were only on experimental levels.

One of the earliest attempts to start salt water fish farms was made by the Fisheries Department of Tamil Nadu near Tuticorin and another in Krusadai Island (Devanesen and Chidambaram, 1956; Devanesen and Chacko, 1958). The Tuticorin farm was swept away by coastal floods while the other at Krusadai (1933–1940) had gone to disuse for want of proper maintenance and upkeep. Attempts have been made in the Adyar estuary at Madras, Ennore and in Pulicat Lake also. An attempt started at Mandapam by the Central Marine Fisheries Research Institute was unfortunately affected severely by the cyclone (1964) and very recently attempts have been taken up again in its maintenance and now prawn and fish culture are being practiced.

Experimental prawn and fish culture in the brackish waters of Cochin have proved high rate of production. In recent years the Central Marine Fisheries

Research Institute has carried out pioneering research on this field and shown marvellous results on its potentialities, with regard to fishes, prawns, mussels, pearl oysters and sea weeds.

POTENTIALITIES

Among the several countries which make earnest efforts to obtain more food from the sea, India has the maximum potential for production of fishes and aquatic invertebrates by culture practices. In mariculture, unlike agriculture, it is not only the topmost layer that is cultivable but the entire water column down atleast to 200 metres depth is available for utilization. India has an extensive coastline of 4700 kilometres and a continental shelf of 259,000 square kilometres with an estimated 121,300 hectares of mangrove marshes and 214,500 hectares of lagoons and estuaries as well as vast expanses of backwaters and lakes, providing ample opportunities for the cultivation of fishes, prawns, molluscs, turtles and sea weeds.

Pisciculture

The backwaters, lagoons and estuaries in India, although highly productive, remain neglected except for brief spells of fishing activity. It seems worthwhile atleast now to draw our attention to the question of proper utilization of these gifts of nature for culture. Fish farming in such areas, which receive a perennial supply of nutrients throughout the year, is a simple procedure and the farmers are assured of a satisfactory yield. The fish farm at Narakkal (in Kerala) which was started on a modest scale in 1940 has shown the practical ways of utilising the extensive backwater region of the state and today these farms extend well over one hundred acres.

profitable fish culture aims at the production of maximum quality of edible fish flesh by employing rapidly growing fish, capable of shortening the food chain and converting decaying organic matters or the next link in the food chain, namely diatoms and algae effectively into edible fish flesh. These conditions are fulfilled to some extent by the herbivorous and detritus feeders like grey-mullets, milk-fish and cat-fishes.

It has been experimented that the fishes cultivated in the farms grow faster than those in natural environments. These fishes can tolerate wide range of salinity and other climatic conditions, thus lending themselves to farming. Among the salt water mullets, *Mugil cephalus*, *M. cunnesius*, *Liza parsia*, *L. tade*, *L. macrolepis*, *L. waigiensis*, *Valamugil scheli* and *V. buchanani* are highly suited for cultivation and can fetch maximum yield within a short period. *M. cephalus* is reported to grow upto 29 cm. size in six months, *L. parsia* 15-19 cm. and *L. tade* 24-25 cm. in one year. The milk-fish *Chanos chanos* is also growing to larger size in farms.

Regarding these fishes there is practically no problem in the collection of fry and fingerlings. They can be collected, with less efforts, from almost all estuaries, tidal streams, creeks and swamps. They are more abundant close to full and new moon period. An alternative source of getting fish seed is by induced spawning. This technique (Chaudhuri, 1969; Menon, 1969) is not very complex nor expensive and can be practiced by the fish farmers with little effort.

Besides these euryhaline fishes, other commercially important perches and perch-like fishes may also be

cultured profitably, by adopting different techniques such as huge netted cages of different types in the natural habitats and thereby avoiding the predators and facilitating in such a way to get them back for food at any time without much efforts. In Soviet Union, such experimental under sea farms are reported to yield over 20 tonnes of fish per hectare per year. The Central Marine Fisheries Research Institute has prepared a scheme for culture-experiments recently and started experimental research on pisciculture, for the present at Cochin, Tuticorin, and Mandapam and are showing promising results.

Prawn culture

In spite of India being a leading producer and exporter of shrimps since a decade, neither the industry nor the government is enthusiastic to develop prawn culture like the Agencies of developed countries although some sporadic attempts have been made. Culture of prawns in paddy fields near the backwaters has been going on for the last few years, especially in Kerala and West Bengal.

In Kerala, seasonal culture practices exist. After the paddy harvest, the prawn culture popularly known as "Pokkali culture" is practiced in the paddy fields lying close to the backwaters during November to April. Before the commencement of the next paddy crop, the prawns are harvested and the paddy fields are flushed out with fresh water to remove the excess salts.

Some of the commercially important species are *Penaeus monodon*, *P. indicus*, *Metapenaeus dobsoni*, *M. affinis*, *M. monoceros* and *Parapenaeopsis stylifera* which could be cultivated on a commercial scale; of which *P. monodon* and *P. indicus* are best suited for culture as they possess such characteristics as size, rapid growth, flavour and appearence than the *Metapenaeus* spp.

Any attempt to culture prawns requires a prior knowledge on the life history of the concerned species. The difficulty is with the rearing of early stages of larvae. The Central Marine Fisheries Research Institute has taken much efforts on the rearing of various species of prawns and succeeded to a certain extent, particularly with regard to the genus *Macrobrachium*. The experimental research carried out by the Institute on prawn culture reveals that prawn production of 500-2000 kgs per hectare can easily be attained within a period of six months.

Culture of edible molluscs

In mariculture, the molluscs enjoy a supreme position as the quantity of edible molluscs far exceeds the amount of fish or shrimps produced under culture. The clams and mussels are by far the most abundant resources and simple transplantation experiments to other similar habitats could raise the level of production several times. The 'bay clam' *Meretrix meretrix*, the 'backwater clam' *M. casta*, the 'wedge clams' *Donax cuneatus* and *D. scortum*, the 'inflated clam' *Katelysia opima* and the 'false clams' *Paphia malabarica* and *P. marmorata* are some of the commercially important clams, lending themselves to farming. The 'green mussel' *Mytilus viridis* and the 'brown mussel' *Mytilus* sp. are highly esteemed as food and they could be cultivated commercially using artificial settlers such as suspended rafts, poles and ropes. Qasim and Achari (1972) have shown that the technique of rope culture can yield 60-70

tonnes of mussels per hectare per year. Recently culture practices of edible molluscs have been started by the Central Marine Fisheries Research Institute at Vizhingam, Tuticorin, Mandapam and Madras and some of them have already shown promising returns.

The 'Indian backwater oyster' *Crassostrea madrasensis* and the 'giant oyster' *C.gryphoides* have the advantage of growing faster and tolerating wide range of salinity and temperature. Even if there is not much demand for these oysters in our country, culture on small scale, if initiated, will help in raising a quality product to create an export market.

Pearl culture

Pearl culture has a great trade potential within the country as well as outside. In India, simple culture practices have been in existence for pearl oysters particularly in the Bombay region and also in Tuticorin. Japan is the country of cultured pearl industries and has enjoyed the virtual monopoly in this field. Alagarswami (1970) has described the Japanese pearl culture methods and has indicated the prospects of pearl culture in India. The implementation of such advanced methods in the case of 'Indian pearl oyster' *Pinctada fucata* can give promising returns. In India, besides the Fisheries Departments of Tamil Nadu and Gujarat, the Central Marine Fisheries Research Institute has organized a team of research workers to investigate the possibilities of pearl culture at Tuticorin. The increased attention paid by the Institute on pearl culture will, in the near future, pave the way for brighter and better harvest of pearls besides the other resources.

Turtle farming

About Rs. 40,000 worth of green turtles are annually exported to Ceylon from Rameswaram in India. Estimates show that turtle meat worth of Rs. 81,200, 58,500, 12,300 and 60,400 was exported from India during 1963, 1964, 1965 and 1966 respectively. The 'green turtle' *Chelonia mydas* is the commercially important species available in India, which grows to a length of nearly one metre weighing 150–250 kgs. The 'Hawkshbill-turtle' *Chelonia imbricata* is mainly used for its shell.

Owing to the value of turtle meat, many countries have started trials to farm them. Recently the Fish and Wild Life Service of the U. S. A. has been very successful in turtle farming at the Beaufort Station. In India Rameswaram, Laccadives and Minicoy will have the honour of having the first turtle rearing farms. With special modification, many of the coral atolls in the Arabian Sea can be converted to turtle farms. Work on an experimental farm has already been started in Minicoy.

Sea weed cultivation

The sea weeds form one of the most important resources of our country, as they can be used as food, fodder for cattle and poultry or as manure. They also form a rich source of agar-agar, algin and alginic acid. Some of the commercially important species which could be cultivated are the agar-yielding sea weeds such as *Gracilaria edulis* and *Gelidiella acerosa*, the algin-yielding sea weeds such as *Sargassum wightii* and *Turbinaria ornata* and the edible Sea weeds such as *Ulva fasciata*, *Padina gymnospira* and *Caulerpa racemosa*.

Attempts have been made in the Gulf of Mannar to augment sea weed

production by cultivating the economic important species in suitable sea beds and on ropes, and as a result manufacture of agar-agar and Sodium alginate within our country has already begun in places like Bombay and Ahamedabad. It may be stated to the credit of Central Marine Fisheries Research Institute, that the investigations on these have paved the way for the establishment of sea weed industries in India and in the development of an export trade of Sea weeds to foreign countries.

Vast rocky or coral substrata are ideally suited for the sea weed growth. Mandapam, Pamban, Rameswaram, Tuticorin (Gulf of Mannar), Cape comorin, Muttam and Colachel of Tamil Nadu, Visakapatnam of Andhra Pradesh, Chilka Lake in Orissa, Varkala, Kovalam and Vizhingam in Kerala, Karwar and adjacent areas in Mysore, Bombay and Ratnagiri in Maharashtra, Dwarka and Veraval in Gujarat and the lagoons of the atolls in the Laccadives are some of the potential areas for cultivating commercially valuable sea weeds. If proper attention is given on the cultivation of sea weeds, India can earn several crores of rupees annually in foreign exchange.

PRACTICAL APPLICATIONS IN MARICULTURE

While considering the economic aspects of mariculture, besides production, many other aspects such as construction and enrichment of coastal farms, nursery management, weed control and disease control come to play an important part.

Construction of coastal farms

Although some basic facts are being gathered, it must be admitted that there are major gaps in our knowledge which remains mostly empirical such as in the construction of farms and their management principles. A bold and dynamic approach to this problem, by following the techniques used by the developed countries, is essential at this stage. The highly skilled techniques employed by them are new to us and call for expert guidance under foreign collaboration. In this respect, Government should take the necessary steps in collaboration with the Seafood Industries.

Enrichment of farms

Our knowledge on the use of fertilizers in salt water is also extremely poor. The basic productivity of the farms could be temporarily enhanced to some extent by supplementing with cheap and easily available compost manure made up of materials like sea weeds, fish manure, cow-dung and the like. Extensive experimental studies in the use of organic fertilizers for enrichment of farms is a line of work to be pursued further.

Nursery management

Besides the development of coastal farming, nursery management is another field in which little work has been done so far and more information has to be gathered to get a steady supply of healthy seeds, fry and fingerlings which alone can sustain a good farm. Due attention will have to be paid by the scientists in the improvement of the stock through artificial selection and breeding to promote rapid and healthier growth. Fish fry and seed collection and their trade can also develop into a very profitable supporting industry.

Many of the shallow bays and tidal creeks serve as excellent collectio i grounds for the seeds, fry and fingerlings of important cultivable species of fishes, prawns and molluscs. On the southern coast alone, there are about 60 fry collection centres giving wider scope for fry trade. In view of these, suitable manipulation techniques of stocking could also be developed.

Weed control

Weed control is a must in mariculture, especially of fishes, prawns and molluscs. Accumulations of unwanted seaweeds not only prevent us from collecting the cultured forms but also may pollute the water with highly toxic metabolites and decomposition products which, by themselves, directly affect the cultured forms. They have to be reduced by manual or mechanical manual labour or by biological control, by culturing commercially important herbivorous forms feeding on them.

Disease control

In India, although mariculture has been going on for the last few decades, our knowledge on the parasites, disease and their pathology is still very meagre. Disease control is also another major aspect of research, left to the scientists to be investigated.

ROLE OF FISHERY SCIENTISTS

The role of scientists is more important in mariculture, especialy in the construction and enrichment of farms, nursery management and in disease control as stated earlier. Studies on the problems of water pollution in relation to mariculture should also be investigated.

Culture of multi-species of commercially important forms (fishes, prawns and molluscs) must be tried experimentally to save time and space, provided one's biological role is not affecting the other; for which a good deal of biological information is required on their food and feeding habits. The biology and life-history of such commercially important forms should be studied in detail to get a fair knowledge on the duration of the planktonic phase of the larvae, food and feeding habits and spawning behaviour as they form the guide-line in mariculture.

ROLE OF GOVERNMENT AND SEAFOOD INDUSTRIES

Government has to successfully intervene and support the poor fish farmers as in agriculture. They should be given proper encouragement and scientific advice and Governmental agencies should function in a supervisory capacity to render technical assistance and by giving them the extensive lagoons on nominal lease for a specific period. Substantial progress can be achieved with the creation of cooperative organizations to supply the farmers with selected seeds, fish fry, artificial fertilizers and adequate financial assistance on suitably evolved credit systems. Besides these, Government should take necessary steps to train the scientists with the know-how of the new techniques and progress made by the developed countries, under foreign collaboration.

The role of industries is paramount in this regard as the fruits of research are ultimately a gain to them. Seafood Industries can also develop fry trades in India to get a steady supply of healthy seeds, fry and fingerlings of commercially important cultivable forms which alone can sustain a good farm.

At present, during monsoons when fishing operations are rendered difficult, the seafood industries are faced with a set-back. If intensive culture methods are implemented by adopting the different techniques such as rafts, ropes, poles, cages and framed nets, a regular supply of raw-materials can be assured and India can become the most leading nation in seafood production and also can save several crores of rupees in foreign exchange, while rendering wider opportunities for employment to the people.

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