TRADITIONAL PRACTICES OF COASTAL AQUACULTURE AND SUSTENANCE FISHERY IN INDIA

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COASTAL AQUACULTURE

India is bestowed with about 2 million hectares of brackish water areas all along the coast. Though fish culture is as old as civilisation, practically very little of these areas are currently utilised for productive purposes even by traditional practices. On a modest estimate, if 20,000 ha could be brought under scientific culture operations to produce annually an average 500kg/ha, our country could produce an additional one million tonnes of fish (Jhingran, 1975).

There are three principal types of ecosystems where traditional fish culture is practised in India, *viz.* the *bheris* or *bhasabhada* of West Bengal (Pakrasi, 1976), the paddy fields of Kerala and West Bengal (Menon, 1954; Pillay and Bose, 1957) and the perennial fields of Kerala (George, 1974) and these are briefly discribed below.

BHERIS

These are large brackish water impoundments of 50-200ha extent in the inter-tidal zone of the Hoogly-Matla estuarine system. The total area under this type of cultivation is about 9000 ha. The tidal amplitude ranges from 1.8–4.6m. From January till March or April the tidal waters carrying prawns and fish seed are let into the *bheris* through improvised or permanent sluice gates. Split bamboo screens fixed inside the sluice gates prevent the escape of fish during the receding tide. After a period of growth, harvesting commences in September by drag nets. The yield varies from 320-3300kg/ha/year. Fishes, mostly of *Mugil* sp *Lates calcarifer, Polynemus tetradactylus* and catfish (*Mystus* sp.) comprise 70% of the catch and the rest is composed of prawns, *viz* species of *Penaeus, Metapenaeus, Macrobrachium, Palaemon* and crabs (*Scylla serrata*).

PADDY FIELDS

In West Bengal, the paddy fields adjoining the *bheris* are seasonally utilised for brackishwater fish and prawn culture. When the water level in the irrigation canal rises in August due to the outbreak of monsoon, bunds in the paddy fields are cut at selected places to allow the fish and prawn fry into the fields where they grow during the period of paddy cultivation. The capture operations precede the paddy harvest. The species cultivated are more or less similar to those of *bheris* with an yield of 100–300 kg/ha/year.

In Kerala, the low lying paddy fields (*Pokkali* fields) of about 4500 ha adjoining the tidal brackish waters are used for rotation of paddy and fish crops. Paddy is cultivated during June-September when the fields are filled with water of low salinity (1-2‰). After the paddy harvest in October, the bunds provided with sluices are strengthened. During high tide (tidal amplitude 1 m) prawns and fish seed are let in till November. Bamboo screens are used to prevent the escape of fish. Harvesting of fish commences usually in December using sluice nets at nights during low tide and is carried out for a week

around full moon and new moon till April Lights are used to lure the fish and prawns. The yield varies from 700-2100 kg/ha/year. The bulk of the catch (80%) is constituted by prawns (species of *Metapenaeus* and *Penaeus*) and the rest is comprised of mullets, pearl-spot etc.

PERENNIAL FIELDS

These are larger (upto 100 ha) and deeper (1-3.5m) than the *pokkali* fields and are used for culturing prawns thoughout the year. There are about 800 ha of such fields with an average catch of 840 kg/ha.

All the above described traditional practices have several advantages as well as disadvantages. On the plus side, these are simple practices not requiring much capital investment. The paddy fields are usable to raise two crops i.e. paddy and fish, either in combination or by rotation. However, the disadvantages of such extensive culture systems are many. Firstly stocking is indiscriminate and allows entry of predators and undesirable species. This results in great competition for food and space. Further the impoundment is only for short period not allowing any time to attain marketable size. The yield is, therefore, low and is of poor quality consisting of smaller varieties of prawns. It has been shown by George *et al.* (1968) that if the prawns are allowed to grow for a period of one month in the paddy fields, they attain a larger size fetching better returns. Further in the traditional farms, there are wide fluctuations in the yields from year to year due to fluctuations in availability of seed in the wild environment. Through proper management and selective stocking of compatible species these traditional practices can be vastly improved.

SUSTENANCE FISHERIES

India's total marine fish production averages 1.2 million tonnes. The greatest health problem in our country is malnutrition. It is estimated that about 4 million tonnes of fish would be required to meet the nutritional standards of our people (Samuel, 1968) In this context the role of sustenance fisheries is no less important which, if suitably harnessed for development, could, to a large extenrt, meet our needs for animal protein.

India is having a system of backwaters, bays and estuaries which support extensive shellfish resources belonging to diverse groups. These are either exploted indiscriminately to the detriment of the stock in some regions or altogether neglected as in most other regions. The molluscs are highly nutritious being a rich source of glycogen, protein and minerals. Yet, a vast majority of the fish-eating population has not developed a taste for the shell-fish meat. The shells are used for production of lime. Limited but valuable information on the biology and fisheries of commercially important species of mussels, edible oysters and clams is available. However, still there is a lacuna in the precise knowledge of the magnitude of the available molluscan resources in India. The present production is very much restricted. Nevertheless the shell fish potential is regarded as high. Compared to the temperate species, the growth rate of Indian molluscs is fast. They attain sexual maturity early in life and have protracted breeding period. These serve as favourable factors for culture purpose. There is therefore great scope to develop these fisheries through proper management such as assessment of the exploited resources and their rational exploitation, introduction of improved fishing methods, charting of grounds and scientific cultural practices.

MUSSELS

There are only two important species of sea mussels along the Indian coast *viz.* the green mussel *Mytilus viridis* and the brown mussel *Mytilus* sp. The former is widely distributed all along the coast whereas the latter is confined to the southern sections of the Tamil Nadu and Kerala coasts. They form thick beds on rocks and also on man-made structures like piers and wharves The mussel resources are very much exploited in Kerala during November-May resulting in the denudation of the beds, especially of brown mussels (Jones, 1968b). The mussel beds in the Sonapur backwaters of Orissa are reported to have become sparse (Rao, 1974) perhaps due to indiscriminate removal. Elsewhere, the mussels are subject to limited exploitation forming a sustenance fishery.

The production of mussels in India is provisionally estimated to be about 1000 tonnes (Jones and Alagaswami, 1973), compared to

the world production of 8 lakh tonnes. The leading mussel-producing countries are Spain, Holland, France, England and Philippines. Three types of culture are resorted to in these countries (Table 1) which account for bulk of the production, *viz* (1) on poles projecting from the substratum between the tide marks (2) on the sea bed itself and (3) on ropes hanging from either fixed frames or freely floating structures. Thes culture operations depend largely upon the spat collected from the wild. However the wide fluctations in the spatfall in Britain have led to the production of seed in hatcheries (Qasim *et al*, 1977). From Table 1 it could be seen that the best yield is obtained from hanging culture which eliminates the risk from the predators.

As it is, mussel culture is not practised in India on a commercial scale. The experiments carried out by the Central Marine Fisheries Research Institute have shown that mussel could be successfully cultured on ropes hanging from floating rafts in the bays as well as open seas. Qasim *et al.* (1977) have estimated an annual yield of 480 tonnes ha with a return of 181% from similar experiments in the Goa region.

EDIBLE OYSTERS

Among the molluscs the oyster is considered as a delicacy. They thrive on rocks, cement surfaces and hard muddy bottoms. Though substantial resources exist in India, they are underutilised but for some exploitation in certain regions for personal consumption or for catering to the hotel industry. Four species viz *Crassostrea gryphoides, C. discoides, C. madrasensis* and *C. cucullata* occur in our waters. The first two species are important in the northern parts of the west coast. They grow to a large size of 15-17 cm in about 4 years. *C. madrasensis* is the common backwater oyster on the east and also south-west coasts and attains a marketable size of 8 cm in about 2 years. This species has been indiscriminately exploited to the detriment of the stock in Vembanad Lake (Kerala) and backwaters of Pulicat and Ennore (Tamil Nadu) and Sonapur (Orissa). *C. cucullata* is the common rock oyster, widely distributed on both the coasts. It thrives well under marine conditions. The species is economically less important because of its small size and difficulty in shucking.

World production of edible oysters is estimated to be about 8 lakh tonnes. The principal producers are U. S. A., Japan, Mexico, France, Korea, China, Australia and Canada, where the oysters are extensively farmed. The spat are collected from wild on fixed poles or on cultches such as limed tiles and oyster shells, which are

TABLE 1

Details of mussel culture in various countries,

Country	Type of culture	Harvesting period in months	Size harvested in cm	Annual yield in tonnes ha
Spain	Floating suspended	12-18	7.5 - 10.0	600
Holland	Bottom culture	30	5.5 - 6 5	80
France				
(a) West Coast	Bouchot (Fixed poles)	12-15	5.0	5
(b) Southern coast	Fixed suspended	15-18	6.0 - 7.0	-
U. K.	Bottom culture	24-30	6.0 - 6.5	250
Philippines (a)	Fixed poles	10	3.0 - 8.0	250
(b)	Fixed suspended	10	,,	500 (Projected yield)

laid at the bottom or suspended from rafts. After a period of growth, the young oysters are removed and reared adopting bottom or off-bottom culture methods (Table 2). As in the case of mussels, off-bottom culture yields better results. In the bottom culture followed in France when the oysters grow to full size in one year they are transferred for fattening to small shallow artificial ponds rich in diatoms. The oyster meat doubles in weight in 6 months and are then marketed. There is also a seed production industry in Japan. The seed are exposed for several times over a period of several months at ebb tide for hardening. Only the healthy oysters that survive, are transported to meet the local seed demands as well as to U. S. A.

Oyster culture is practically non-existent in India though it was advocated as early as in 1910 by Hornell. In the Kelwa backwaters near Bombay some sort of oyster farming of *C. gryphoides* is practised on a small scale in which one-year old young oystes are transplanted from natural beds on to hard grounds for fattening. They are harvested during October-April. The C. M. F. R. I. has recently initiated experimental oyster culture in the Gulf of Mannar area. The results are encouraging which augur well for an extensive and profitable oyster farming in India.

CLAMS

Though the estimated production is only of the order of 5000 tonnes (Alagarswami and Narasimham, 1973), the resource is considered to have a high potential. The clams support only subsistence fisheries in different parts of the Indian Coast. The meat is consumed by the economically weaker sections of the society. Species of *Meretrix* (*M. meretrix, M. casta*) *Villorita cyprinoides, Tellina pinguis* and *Katelysia opima* are commercially important. Others like *Donax* spp. (wedge clam), *Mesoderma glabratum, Gafrarium tumidum* (cockle clam), *Solen kempi* (razor clam), *Anadara granosa* (ark shell), and *Pinna bicolor* (fan shell) are of limited importance. However, they hold great potential for exploitation.

TABLE 2

Edible oyster culture in various countries.

Country	Type of culture	Harvesting period in months	size harvested in cm	Annual yield in tonnes ha
U. S. A.	Bottom culture	24-60	7.5-9.0	30
Japan	Off-bottom culture			
	a) (Hanging) in inland seas	6-12	5.0-7.0	120
	b) Longline (Hanging) in open seas	12-24	–	200
France	Bottom culture	36-48	7.5	2-6
Australia	Off-bottom culture			
	a) Rack (fixed)	12-24	8.5-10.0	12
	b) Tray (Hanging)	24-36	8.5-10.0	32
Philippines	Off-bottom culture			
	a) Fixed pole	6-9	7.5	–
	b) Platfrom (Hanging)	"	"	84

Species of *Meretrix* and *K. opmia* are injudiciously exploited which has resulted in the dwindling of the beds. Hence these valuable resources need suitable management measures. Comprehensive information on the biology of the various species is a prerequisite. Observance of short closed seasons wherever necessary, especially during the peak spawing periods. minimum legal size, restocking of the areas from other beds besides bringing in barren areas under cultivation through transplantation and pest and perdator control are some of the steps require careful consideration to save the reseurce from depletion

Cultivation of clams is not practised in India though the method involved is one of the simplest. The leading countries in the culturing of clams are Japan, Taiwan, U. S. A. and S. E. Asian countries. Laying out separate beds for culture of seed clams and for fattening is a common practice Durve and Dharmaraja (1965) have shwn that the production of clams can be increased four to five-fold by transplantation to new beds in shallow waters. In Japan, clams are gown in multichambered net cages suspended in the sea. In Malaysis the ark shells are cultured (7000 tonnes annually) on soft muddy bottom with 90% silt. Hatchery techniques nave been evolved in U. S. A. but it takes 5 8 years to grow clams to the marketable size and it is likely that the clam culture industry may shift southward to the subtropics to take advantage of the faster growth rate.

EDIBLE GASTROPODS

The gastropods from the biggest group of molluscs, shells of which are used for making fancy objects. Only a few species are edible which are represented by the limpets, trochids, whelks, sacred chank, olives and the green snail Turbo. Fishermen catch them during the lean season for other fisheries. The button shell (*Umboni vestiarium*) is the only species that finds a place in the stalls of the market at Malwan in Maharastra, In our country, fishing for trochids and chanks is licensed by the government. The edible gastropods are considered as a delicacy in other countries.

Abalones are commerically cultured (growing period 4-5 years) in Japan and in U. S. A involving hatcheries, though feeding of the various life stsges particularly the juveniles poses a problem. The young are reared in indoor tanks and then transferred to plastic waste baskets which are suspended in the sea and are fed on sea weeds. To protect the resource, size limits and closed season are in force in U. S. A.

OTHER ORGANISMS

Among the crustacea, crabs support a sustenance fishery of appreciable importance in the seas, backwaters and estuaries, particularly on the west coast and the southern coast of Tamil Nadu. They form generally an ancillarly catch along with other crustaceans and fishes. Rao *et al.*(1973) have estimated a a potential resource of 49000 tonnes, though the present level of production is about 3500 tonnes. The main species appearing in the fishery are *Scylla serrata Portunus pelagicus P. sanguinolentus, Charybdis* sp. and *Paratelphusa* sp. The ffshery is not well organised at present since the returns are poor. However, there is immense scope for developing the fishery considering the demand tor frozen crap meat for export. Rearing of larval and juvenile stages of craps had met with some degree of success in Japan and U.S.A. It is necessary that the cannibalistic behaviour of crabs has to be controlled to make the farming economically viable.

The brachiopods (*Lingula* sp.)are reported to be of local improtance in the coastal areas around Ratnagiri which are consumed by the economically poor people. More attention has to be paid for the proper utilisation and management of this hitherto neglected, resource.

ACKNOWLEDGEMENTS

The author is thankful to Dr.E G. Silas, Director, Central Marine Fisheries Research Institute, Cochin, for the opportunity given to present this paper and to his colleague Shri M.H. Dhulkhed for his suggestions to improve the manuscript.

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