AQUACULTURE PRODUCTIVITY

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Technology of Oyster Farming in India

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Introduction

Molluscan species such as oysters, mussels and clams are well suited for the development of new technologies of culture as a result of their high nutritional and commercial value. Besides, effecting substantial increase in the economy of the fishermen it can also meet the acute protein deficiency of a country like India. India has a long coastal belt studded with numerous river mouths, estuaries, lagoons, creeks and bays, and offers ideal environmental conditions for the growth of commercially important molluscs. Rich oyster beds were located in the east coast especially in Pulicat Lake, Ennore estuary, Marakkanam backwater, Edayar estuary, Marakkanam backwater, Chinnaveerampattanam, Coleroon, Athankarai estuary and Tuticorin bay. The oysters occur in a natural bed either in heaps or in patches to form heaps of 1 to 1.5 height covering many hectares of the bottom of an estuary or backwater of littoral and enlittoral zones. They are also found attached to the rocks, concrete piers, piles and submerged branches of mangrove plants. The aggregate of several dead oysters dry during the summer season.

Several attempts have been made on oyster cultivation in India wherever favourable conditions exist (Hornell, 1908, 1910; Devanesan and Chacko, 1955; Nayar and Mahadevan, 1983; Thangavelu and Sundaram, 1983 and Thangavelu and Sanjeevaraj, 1985). Hornell's work throws light on the vast scope of oyster farming in the Madras state. Oysters showed rapid growth in tropical countries like India and attained marketable size

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within nine months. The method of oyster culture adopted in the Pulicat lake has proven viable showing an average annual growth of 92 mm. Based on the results obtained in Pulicate lake, at Tuticorin and other places discussions ensued on the feasibility of oyster culture in brackish water with similar hydrological conditions.

Selection of site

The site selection for oyster culture is dependent upon the method which is to be adopted. For off-bottom culture method, a depth of water column ranging between 1 and 2 m is necessary. The selected site should be free from wave action to withstand the bags or the trays kept on the rack. Collection of seed oysters is very important and it should be nearer to the natural bed area where the mother oysters are quite abundant. Soon after spawning of oysters, veliger larvae occur which when dispersed by tidal action usually collect near the tidal pockets. After being fully grown, the spat settle on the cultch material that is provided. The cultch material should be laid wherever the maximum number of larvae are distributed, to attain maximum spat settlement.

Nature of bottom

Usually oysters grow well on a hard rocky bottom, on shore rocks or underwater structures which are left exposed at low tides. The hard sandy-mud bottom or peaty-mud bottom has been naturally improved by dead shell remains which give firmness. The oyster farm area should be thoroughly studied before establishing it to keep out predators such as crabs, gastropods and lobsters, if any. A highly slushy bottom may be avoided to enable the erected racks not to withstand. The algal growth or accumulation of algae in the farm area may lead to depletion of oxygen which may likely cause mortality. For healthy settlement and growth of oysters a replenishment of water from the waves and tidal action is necessary.

Methods of spat collection

For any culture system, seed requirement is a prerequisite. In the case of oyster, spat or young ones are collected by providing a suitable substrate for attachment at the time of setting of veliger larvae which is called the cultch material. The basic requirement of an oyster cultch should be clean and hard. Based on the availability and practicability a number of cultch materials have been used depending upon the depth and configuration of the bottom of the spat collecting area.

Methods of exposing cultch may vary from place to place due to the depth and location of the spat collecting site. Both off-bottom and on-bottom culture methods could be adopted in the brackish waters of India. The cultch material such as shells or tiles may be spread on the hard substratum near the mother oyster stock to get settlement of spat. Intertidal racks may be constructed near the natural stock of oysters and the

cultch material may be spread in rectangular iron cages (Plate 1). The nylon bags of 50×30 cm size made out of 2 mm synthetic twine are used for suspending the oyster or mussel shells for procurement of spat.

Hornell (1908) has initiated the experiments on spat collection of oysters in India by the method followed in France using the roofing tiles in Pulicat lake. Devanesan and Chacko (1955) tried casuarina twigs, oyster and cockle shells in Ennore estuary, but did not get encouraging results. Nair (1975) reported the suitability of cement-coated oyster shells at Athankarai estuary. Rao *et al.* (1983) have reported the spat fall on several spat collectors in Vaigai estuary, but the culture duration is restricted to avoid floods in the estuary due to north-east monsoon. The spat of oysters in Pulicat lake was collected by laying lime-coated roofing tiles and by suspending the old and weathered oyster shells from the racks in the oyster spawning areas. The lime coating is a process done by using 30 kg of lime mixed with 50 litres of sea water for first coating and 30 kg of lime with 40 kg of fine sand in 50 litres of sea water for second coating. The spat collectors were arranged in the form of a crate and kept on racks so as to be immersed completely in the water. The spat that settles on the tiles is scraped off when it attains 30 mm size. Apart from tiles and oyster shells, mussel shells, strings of coconut shells, cement-coated roofing tiles, tyres etc., have been used for spat collection (Thangavelu and Sundaram, 1983). Lime-coated tiles have been found to be successful and proved to be good spat collectors in the experiments conducted at Tuticorin, Pulicat, Muttukadu and Athankarai estuary. The scraping is a laborious process and care should be taken to avoid injury to the spat. The flakes of lime with spat of oysters come out very easily if gentle pressure is exerted by using the tip of a scraper or chisel. Further rearing in cages is to be done for two months.

Among the various methods, the 'rack technique' modified to combine 'tray culture' has been taken up in Tuticorin bay for collecting the spat and rearing them till they attain marketable size. In this method, lime-coated tiles 24×15 cm in size were kept in nylon knitted cages of 100×90×15 cm size made out of 6 mm MS rod. The first layer of tiles is arranged in such a way that the concave side of the tile faces downwards and the second row is perpendicular to the first row. Fifty tiles in two tiers of 25 each are placed in each cage. These cages are arranged on the racks of size 14×2 m immersed in a water column. Suspension of oyster shells and coconut shells racks made out of galvanised wire or shells packed in synthetic nylon bags is another method of spat collection (Plate 2). Cement-coated tiles, asbestos sheets, palmyra lattices, bamboo mat, etc., are spread near the natural bed of oysters where the veliger larvae are expected to settle. Though the cement-coated tiles and asbestos sheets yield very good results than the lime-coated tiles, they cannot be used for large scale culture, since the scraping of spat could not be done without

damaging the spat. While considering further transplantation to the rectangular iron cages and rearing them on racks, the lime-coated tiles seem to be highly accessible.

Season of spat collection

The gonadal condition and the breeding season of oyster are ascertained by examining the gonadal smear under microscope before laying spat collectors for getting successful spat collection. Soon after spawning larval density may be found to be high in the plankton. The presence of early stages of veliger larvae indicates a recent spawning and the number show whether the spawning is a major or a minor one. The oyster is a biannual breeder with the major peak during September-October and April-May in the Pulicat lake. The peak occurrence of oyster larvae was noticed in the first fortnight of May and October during the respective seasons. Identical conditions in the oyster beds of Madras, Muttukadu and Tuticorin with slight variations were observed. The laying of cultch material in appropriate timings when the larvae were found to settle may be helpful in reducing the intensity of fouling and silting and enhancing the setting of the required oyster spat on the cultch.

Hydrological parameters

The natural habitat of the oyster is usually in the riverine mouths, estuaries or backwater where salinity is less than sea water. The rich bed of oyster population is closely related with the factors such as the character of the bottom, salinity, water temperature, water movement and abundance of planktonic food. The biological balance of oyster 'biocoenosis' or a social community of living beings being affected by excessive sedimentation, is taken care of by turbidity during the monsoon and pollution caused in the oyster bed areas. The edible oysters can withstand very wide fluctuations of salinity ranging between 2.5 and 56 ppt. But they flourish well in the salinity ranging between 19 and 35 ppt. In the salinity higher than 40 ppt and lower than 15 ppt, the growth of the oyster seems to be retarded. The temperature in the oyster beds is usually varying between 20° to 34°C during the monsoon and summer months respectively. The temperature regime affects the life of the oyster by controlling the rate of transport, feeding, respiration, growth, gonad formation and spawning. The pumping rate of the oyster is normal at 7.75 pH. The species do not reproduce successfully in waters where the pH remains above 9.00. Very high turbidity or silt may inhibit pumping completely as also the feeding mechanisms and thus restrict the growth.

Spat transplantation

Further rearing of seed oysters is mainly depending upon the cultch

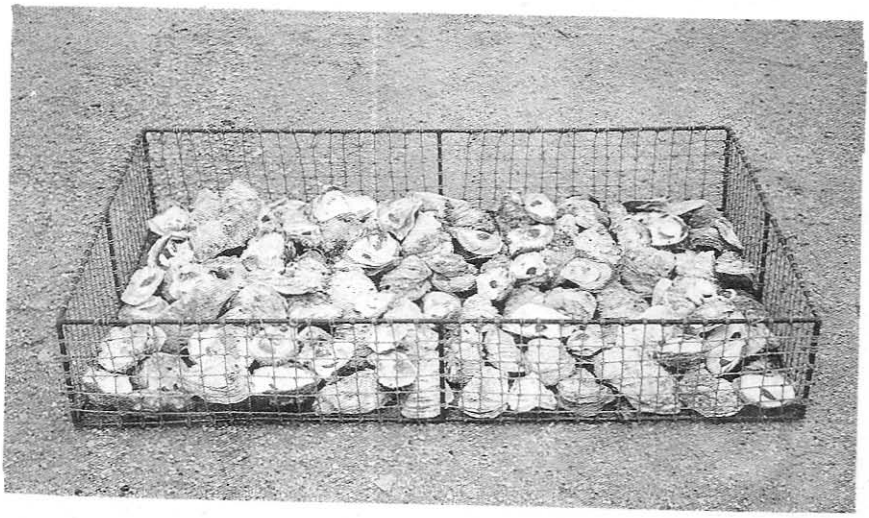

Plate 1. Rectangular iron cage with oyster shells for spat collection

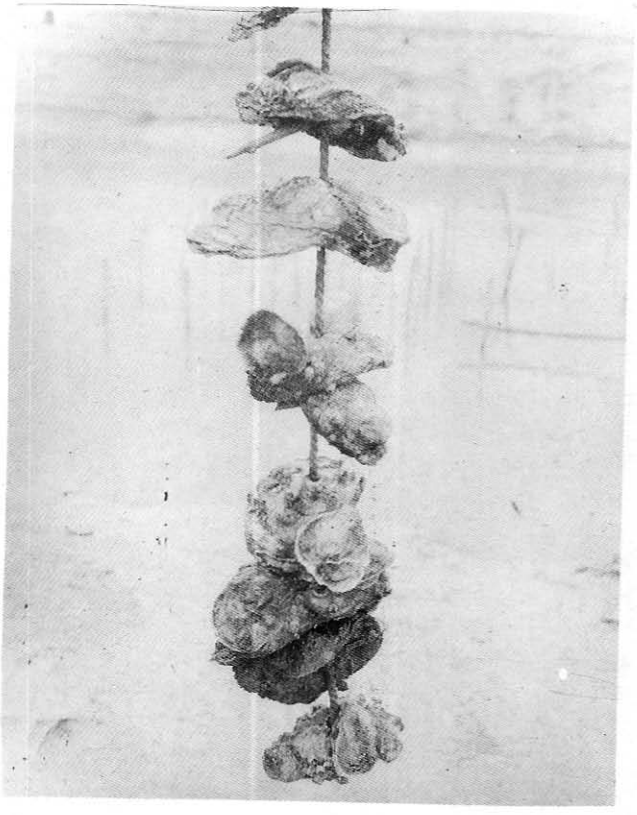

Plate 2. Rens made out of oyster shells

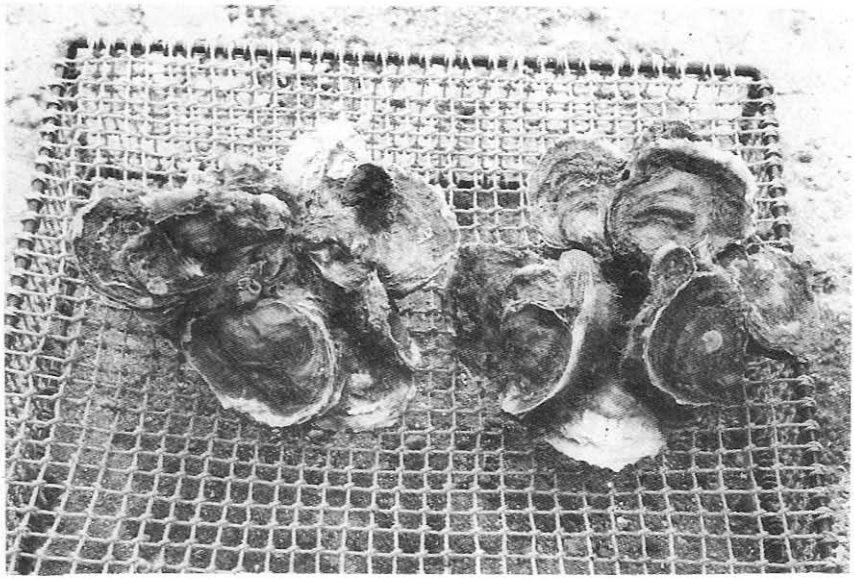

Plate 3. Clusters of oysters grown on oyster shells

Plate 4. Box-type cages used for rearing oyster spat

Plate 5. View of the oyster farm during high tide

material used. If the spat is obtained on shells of oysters of mussels, it may be allowed to grow in clusters (Plate 3). The growth is found to be irregular or sometimes stunted. Spat settled on lime-coated tiles is allowed to grow on the tiles for a period of two months. When the spat attains 25 to 30 mm size the layer of lime with spat is scraped off using a scraper. The detached spat may be separated from one another and reared in rectangular iron cages of 40×40×15 cm made out of 6 mm MS rod or nylon bags of 30×20 cm size made out of 2 mm synthetic twine (Plate 4). The box type cages or bags of transplanted seed oysters may be suspended from racks.

Rearing of oysters

The box-type cages with transplanted seed oysters are allowed to grow for further two months. Periodical checking during this period is necessary to avoid predation if any. In the meantime seed oysters grow to an average of 50 mm size. The oysters from the box-type cages are transferred to the rectangular trays of 90×60×15 cm each tray holding 150 to 200 oysters. Twenty such trays could be placed on a single rack of 14×2 m size. Periodical cleaning and supervision is necessary to remove the predators and clogging of cages by the seaweeds if any. The oysters reared in Tuticorin attain a marketable size of 80 to 90 mm weighing about 80 to 100 g with meat forming 8 to 10 per cent (Nayar and Mahadevan, 1983). The oysters in Pulicat lake attain mean and maximum sizes of 92.1 mm and 113 mm respectively at the end of one year (Thangavelu and Sanjeevaraj, 1985).

Management of the oyster farm

Management is an integral part of the developmental processes which involves maintenance of the farm. Monitoring the environmental parameters while collecting multi-disciplinary data from the culture site and programmes may be intensified for better management of the culture habitat. To assess the quality of water requires regular monitoring of the environmental parameters such as salinity, temperature, dissolved oxygen and pH at the farm site. Periodical cleaning of the oyster cages by a wooden brush may avoid clogging of oyster cages and thereby easy flow of water will pave the way for easy reach of planktonic food items. The worn out racks and cages may be replaced regularly. Growth of the oyster is to be monitored regularly to ascertain when it attains the marketable size. The silt and fouling organisms may be delimited by periodical cleaning.

Harvest

Oysters attain marketable size within a year in the Pulicat lake. Maxi-

mum meat content could be obtained only when the oysters are sexually ripe and attain 80 to 100 mm size during this period they are usually creamy in colour, tasty and in the best condition with the maximum weight. Soon after spawning the oyster meat will become thin, watery and not very tasty. Hence, harvesting should be carried out when the oysters are fully ripe. The condition factor of oyster will be ranging between 40 and 180. The highest condition factor is obtained in April and September in Pulicat, Muttukadu and Tuticorin. Harvested oysters are cleaned in pure sea water by using a jet of water; and fouling organism and silt may be removed by using a wooden brush and then kept in filtered sea water for 24 hours to remove the faecal material and other unwanted germs if any. The oysters are shucked by placing the depurated oysters in hot water for two minutes. The oyster meat is thoroughly washed and then used for consumption (Plate 5).

Economics of oyster culture

The basic technology for oyster culture has been developed, but the production rates are fairly high when comparable with those obtained elsewhere adopting similar technology. Culture duration is considerably less in the tropical waters. The cost of production of culture produce includes the pocurement of tiles, cultch material, lime coating, fabrication of cages, purchase of poles, coir rope, synthetic nylon twine 2 mm, rope 4 mm size, boat and other farm materials. So the rack-tray culture require high capital investment and involves short-term replacement costs and recurring maintenance expenditure. A cost benefit study of oyster culture by the rack-tray method on 0.25 hectares producing 3 tonnes of oyster flesh annually, has been made. With cost production at Rs. 19 per kg flesh, and at a selling price of Rs. 28 per kg, the net income before tax would be Rs. 27,000—about 30 per cent return on investment (Silas *et al.*, 1982). A simple estimate of oyster culture shows the per annum cost of Rs. 800 per rack and gross income of Rs. 920 per rack based on production of 4,600 oysters per rack and selling cost at Rs. 20 per 100 oysters. On the above basis 250 racks in one hectare areas can produce 140 tonnes of whole oysters grossing Rs. 30,000 a year (Nayar and Mahadevan, 1983).

Recommendations

Rack and tray culture of oysters require a huge investment. Further innovations are required to establish simple and unexpensive methods to be adopted even by lay fishermen along the coastal areas. The oyster culture does not provide lucrative income as in other fisheries.

Marketing is a major constraint in oyster culture if large scale culture is attempted. Eating habits of people hardly change. Except in small areas of coastal regions, the delicacy and nutritive value of the oysters are not known among the people. The situation would improve only with a major thrust in popularising molluscan sea food through appropriate nutrition

extension programmes. The gap between production and marketing efforts can be linked only through a well-planned strategy for simultaneous action of both the fronts. Marketing promotion can be done only when there is assured supply of production.

The entrepreneurs hesitate to invest money on aquaculture as it is a risk-proof project proposal for appraisal and investment. Mariculture is risk prone and requires all support, particularly insurance, subsidy, soft loan, longer gestation period and other incentives.

Land and water use policy in the coastal sector for aquaculture is yet to be developed on a firm footing and the beneficiary groups for leasing will have to be identified on a realistic basis. Unless farm sites come under the control of lessees for appropriate period of time, investments will not be forthcoming.

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