CMFRI

Course Manual

Winter School on

Recent Advances in Breeding and Larviculture of Marine Finfish and Shellfish

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EDIBLE OYSTER FARMING

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Introduction

Oysters are one of the most valued seafood and are farmed extensively. Nearly eleven species of oysters are commercially popular and of these *Crassostrea gigas* is the most important. In Asia during the year 2003, 4.2 million tonnes of oysters were produced of which 3.6 million tonnes was from China contributing to 87% of the continents oyster production . Korea and Malaysia also produce significant quantities of oyster. Concerted efforts to develop the oyster farming technology have been made since 1970 's at the Tuticorin Research Centre of CMFRI. Initially natural seed were used. The development of hatchery technology for large-scale oyster seed production in 1982 at the Shellfish Hatchery of CMFRI, Tuticorin gave further impetus for oyster culture. Several location testing programs for oyster culture have been taken up at many centres along the Indian coast, using both the natural and hatchery seed.

Selection of Farm Site

Open sea and estuarine areas where salinity does not drop below 15 ppt are suitable for oyster farming. To ensure maximum production the site selected should be biologically suitable for the species. Farm structures should not cause hindrance to navigation and fishing. The main aspects which should be looked into before fixing the site are given below

1. Open seas free from strong wave action
2. Salinity range of 15-32 ppt
3. High plankton production
4. Moderate water current
5. pH above 7 and less than 8.5
6. Low silt load
7. Dissolved oxygen > 3.5 ml/l
8. Market for selling the produce should be nearby.
9. Avoid sites prone to toxic algal blooms
10. Away from industrial pollution and domestic sewage discharge points

Nursery Rearing of Spat

Oyster spat are reared in nurseries by providing protection till they grow to a size of 25-30 mm. Nursery rearing ensures good survival of the spat and they are better off to withstand the adverse conditions and predation. There are several types of nursery systems, either land-based or located in the water body. In India, nursery rearing is felt necessary for the hatchery reared spat since it is expensive to maintain them in the hatchery till they reach 25-30 mm size for grow out culture. For the natural spat the nursery and grow out cultures are combined in India.

Natural Spat

In the rack and tray method of farming at Tuticorin, *C. madrasensis* spat were collected on lime coated tiles laid in box type cages and held on racks. Spat set on these tiles attain size of 25 mm in 2 months, and were scrapped from the tiles for further rearing in box type cages. In the rack and ren method of culture practiced at Ashtamudi, strings of

oyster shells suspended from racks for spat collection are also used for grow out culture and no additional protection is provided to the spat in the early growth phase. Thus both nursery and grow out cultures are combined, more oyster shells are added to the strings, which are set much nearer to each other. This practice reduces the water flow and enables heavier spat set.

Hatchery Spat

Throughout the world, the hatcheries prefer to take out the spat at the earliest since it is expensive to maintain them longer. In the rack and ren method of culture followed at Tuticorin, the hatchery raised spat were cultured in the nursery. Each string of 1.5 m length having 6 oyster shells, with spat attached were taken out from the hatchery tank 15 days after the spat was set. In the nursery, 3-4 strings are held in a velon screen bag and these bags are suspended from racks. The velon screen bag is periodically cleaned to remove silt, foulers and predators. After 30-50 days of nursery rearing the bags are removed and the strings are transferred to the oyster farm for suspension from racks. The velon screen is removed after 2-3 months of nursery rearing when the oysters attain 25-30 mm length.

Grow out Culture

There are several methods of farming the oysters,broadly they come under two categories namely 'bottom' (also called 'on-bottom') culture and "off-bottom" culture.

Bottom Culture

This is a very old method and it is low intensive both for capital and labour. It is practiced in intertidal or subtidal areas. A major requirement for this method of culture is a firm and stable bottom, with minimum siltation. This method of culture has been attempted in the Karapad creek and Korampallam canal by planting cultchless and attached spat, set on oyster shells. The oysters attained 75 mm average length at the end of one year.

Rack Culture

The rack is a fixed structure and is constructed either in intertidal or subtidal area. The advantages of rack culture include a) independent of the type of substratum b) faster growth compared to bottom culture c) fewer predator problems and d) low silting mortality. A variety of culture devices such as oyster shell strings, trays, tyres, different types of nets, tubing and sticks may be held on or suspended from racks. There are several types of racks and in India single beam and parallel beam racks are mostly used. The single beam rack, as the name implies consists of a single beam (pole) placed horizontally and secured on several poles, vertically driven into the substratum. This rack is good for suspending strings or trays. Two single beam racks running parallel and connected by cross poles is known as parallel beam rack; it is suitable for tray culture. Casuarina, eucalyptus and bamboo poles depending upon local availability are used in the country for rack construction.

Rack and Tray Culture: The advantages of tray culture are rapid growth, production of single oysters with good shape and high quality meats, and control of stock. The disadvantages include high production cost, fouling and yield limited to single oysters. The rack is constructed by driving six poles, each of 2.4 m in length into the substratum up to 60 cm depth. These poles are fixed in a line, 2 m apart and another set of six poles are driven parallel to the first row. These two rows of poles are connected by tying 2.4 m long cross poles. Above these cross poles, 8 poles of 5.5 and 6.5 m length are placed and tied to form a platform which is used for keeping oyster trays. Coir and 3 mm diameter synthetic ropes are used for tying the poles. Each rack covers 25 m^2 area and accommodates 20 rectangular trays. In 0.25 ha area 60 racks each of 25 m^2 can be erected.

Spat, set on lime coated tiles are grown for two months by which time they reach 25-38 mm size and are scrapped for further rearing on racks. The detached single spat are reared in 40 x 40 x 15 cm box type cages made of 6 mm M.S.round rods and covered by 12 mm mesh synthetic twine. After two months rearing, the oyster seed reach 50 mm length in suspended cages, and are stocked in 90 x 60 x 15 cm trays at the rate of 150-200 oysters/ tray. By the rack and tray method the actual production was 27.5 t shell-on / 0.25 ha/ year. The yield of oyster meat from this farm was 2,475 kg at 9 % of shell-on weight.

Rack and Ren culture: This method became popular in India and was adopted by the farmers. The CMFRI is maintaining rack and ren oyster farms for Research and Development for two decades in the Tuticorin bay, and in the Ashtamudi Lake since 1993. The development of oyster farming as a small-scale industry has led to employment generation in coastal villages. Self-employment of villagers as owners of aqua farms and as part time workers in activities related to seed collection, seeding, heat shucking and marketing has led to economic empowerment of villagers especially women. On an average it has been found to benefit more than 1500 families. Oyster farming is done either individually or through Self Help Groups.The average production from a commercial farm has been estimated as 2.5 tonnes from 500 rens. The BFFDA provides grants or subsidies of Rs.1500 per farmer for stocking 500 rens.

Purification of Oysters for Market

During the course of feeding, several pollutants occurring in the aquatic environment are collected by the oysters and accumulated in their body. Consumption of these oysters by humans causes several diseases and at times proves fatal. Bivalves such as mussels, oysters and clams are used as sentinels to monitor aquatic pollution. The pollutants broadly come under three categories, namely (a) pathogenic bacteria and viruses, (b) toxins produced by algae and (c) heavy metals, pesticides and hydrocarbons.

Depuration is the process where the live oysters are maintained in filtered seawater, usually in a flow-through system for periods varying from 1-2 days. The oysters clean themselves of the pollutants and also the extraneous particles such as sand grains by pumping the water. It is essential that care is taken to ensure the optimum survival of the oysters during harvest, transport and depuration process. Weak, injured and animals under stress should be removed before depuration. The harvested oysters should be brought to the depuration plant quickly and during transport and storage, the shellfish should be kept cool and moist. The temperature, dissolved oxygen, salinity and pH of the water should be maintained at levels optimum for the concerned species. Filtration of seawater helps to remove suspended particles. It is desirable that the water is sterilised for use in the depuration plant. It involves (a) Chlorination. It is the cheapest option. (b) Ozonation. It is an effective sterilizing process and leaves little residue. However, it is a costly process. (c) UV light sterilization. It is a widely used method of sterilizing water for depuration. A great advantage of this process is the low cost and the absence of residual taints and odours from chemical residues.

Economics of edible oyster culture by rack and ren method in an area of 300 sq.m (30 x 10 m) of unit

I	**MATERIAL COST**	**Rs.**
(a)	Poles	
1.	Horizontal poles (6m) 33 Nos. @ Rs. 80/pole	2,640
2.	Vertical poles (3m) 126 Nos. @ Rs. 40/pole	5,040
	Total	**7,680**
(b)	Nylon ropes and oyster rens	
1.	Nylon rope for rens and racks:15 kg @ Rs.120/-kg	1,800
2.	Cost of 6,360 shells @ Rs. 0.10 for making 1060 strings including cleaning charges	636
		2,436
	Total (a+b)	**10,116**
II	**FIXED COST**	
1.	50% depreciation on Rs. 7,680(item No.I (a)	3,840
2.	Interest @ 18% on initial investment of Rs. 10,116(Item No.I)	1,820
	Total	**5,660**
III	**LABOUR COST AND OTHER CHARGES**	
1.	Fabrication of oyster rens (1060) @ Rs. 0.65	690

2.	***Fabrication of racks***	300
3.	Harvest	750
4.	Depuration @ Rs.250 / t	1,075
5	Heat shucking including fuel cost @ Rs.15/ kg (240 kg)	5,100
	Total	**7,915**
IV	**Total cost(II + III) (5,660 +7,915)**	**13,575**
V	**EXPECTED PRODUCTION:SHELL-ON OYSTERS**	4.25t
1.	Wet meat weight (10% of total weight)	425kg
2.	Meat shucked meat (8.5 of total weight)	340 kg
3.	Shell alone	3.4 t
VI.	**REVENUE**	
1.	Heat shucked meat @ Rs.60/kg (340 kg)	20,400
2.	Value of shell @ Rs. 400/t	1,360
VII.	**Total revenue**	**21,760**
VIII.	**Net profit (VII-IV) 21,760 – 13,575**	**8,185**

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