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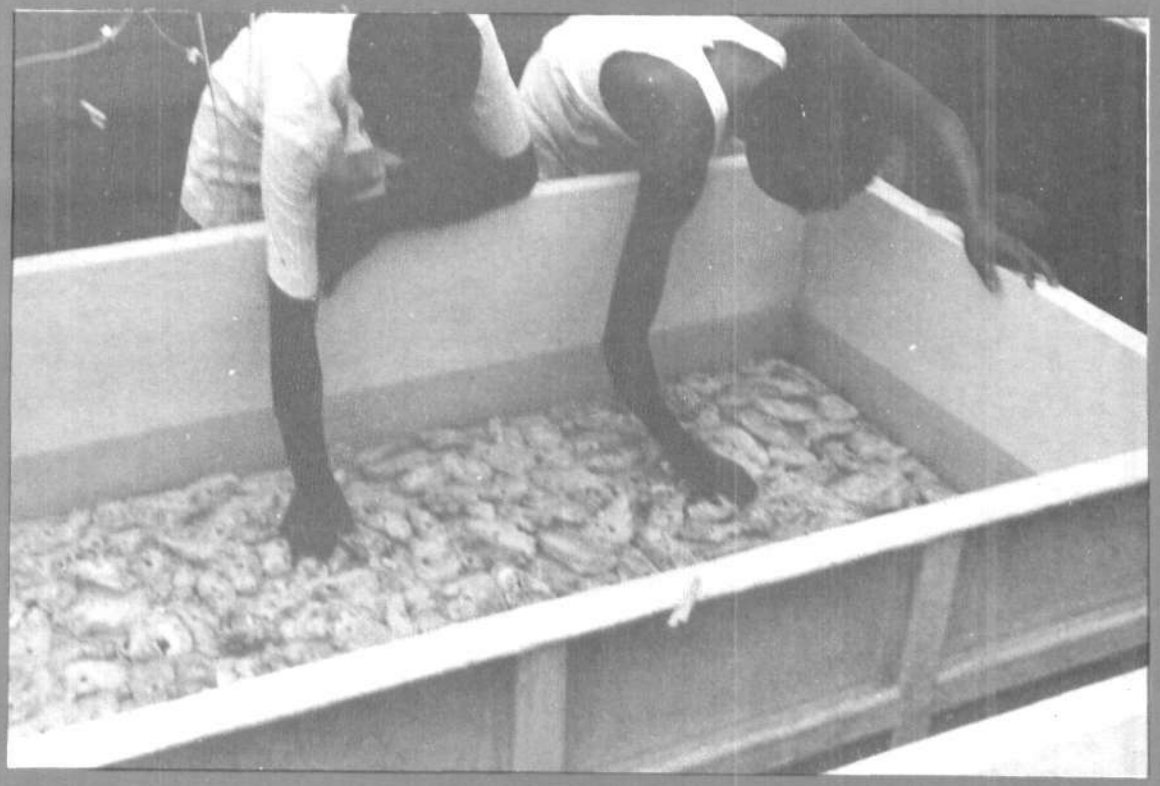

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EXPERIENCE PAPER ON THE OPERATION OF PILOT PROJECT ON OYSTER CULTURE AT TUTICORIN

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Introduction

The technology of oyster culture was developed in India at the Central Marine Fisheries Research Institute. An experimental farm was established at Tuticorin bay in an area of 0.25 hectares. Different growout methods have been tried and it has been assessed that the shell string method could be practised with relatively low cost inputs with a production rate comparable to highly efficient systems such as rack and tray method or raft culture. The expected production by the ren-culture or shell string method is 80 tonnes/hectare/year. The Institute could not so far take up any programme on large scale production of oysters to establish the

economic viability of the technology. At this juncture, the National Bank for Agriculture and Rural Development, offered partial assistance from its Research and Development fund to operate a pilot project on oyster culture in one hectare for three years at Tuticorin and the project has been in operation since 1991.

Objectives of the project

The objectives of the pilot project include field testing of the oyster culture technology on a pilot scale, to modify the techniques where required, to generate adequate economic data on oyster farming and to create awareness among the concerned about the benefits of oyster culture. Successful implementation of this project would lead to the establishment of oyster culture on commercial lines in the country, generate income and employment in coastal rural areas and increased oyster production would help to improve the supply of animal protein in the diet of the people. There is also scope to export oyster products and earn foreign exchange.

Operation of the project

The project was initiated during February 1991 and the preparatory phase of the project extended for over 8 months. During this phase major efforts were put towards the production of seed required for the culture system, procurement of stores and arrangement of various facilities required in the scaling up of production of spat, arrangement of contract labour, organising systems for nursery and farming.

The important parameters or systems under study in the process of oyster culture are : seed production, nursery rearing, replanting in grow-out system, growing to marketable stage, harvesting, post harvest handling, processing and marketing.

The associated subsystems in oyster culture are : environment monitoring, control of predators and competitors, monitoring of growth and condition of oysters, management of materials and infrastructure facilities and management of labour force and training.

The final part of the programme is the evaluation of the results.

Seed production

This is accomplished in six operational phases namely : selection, holding and conditioning of brood stock, induced spawning, larval rearing, preparation of cultch materials, production of spat and culture of microalgae as food for larvae, spat and brood stock. These six functions, though there may be some variation in how they are accomplished, are common to both research and commercial operations. In our effort to scale up the operations, the existing facilities of some of the units viz. larval rearing, cultch preparation, larval setting and algal production are increased. The basic facilities such as filtered water and air supply system were toned up.

With sediment free and continuous supply of filtered seawater, uncontaminated and uninterrupted supply of microalgal feed, the growth and survival of larvae are increased. The larvae are reared in the semistatic water medium in which 50% of the water is exchanged every day and thrice in a week the rearing tanks are cleaned, filled with filtered seawater and restocked with the larvae. The tanks are continuously aerated and feed is provided every day. The larval density of the tank is assessed twice in a week and based on the density and size of the larvae the feed is regulated.

The factors that affect the survival and growth of the larvae are the quality and quantity of the algal food, the ecological parameters, such as salinity, 0_2 content, pH and temperature. The stress caused by metabolites and organic waste in the tanks is reduced by daily exchange of water before feeding.

In the preparation of cultch material for spat collection, a hole is drilled in the centre of the oyster shells (valves), soaked in water and cleaned with brush to remove the dirt and extraneous matter, rinsed in water and immersed in chlorinated (5 ppm) filtered seawater for 2 to 3 hours. The sterilized shells are further immersed in filtered seawater for 2 to 3 days in order to ensure that the pH of water in the hatchery tanks is maintained close to normal value. These shells are then laid on the bottom of the tank for settlement of spat.

When 70 to 80% of the larvae reach the 'eyed stage', they are transferred to the setting tanks. In two to three days they set on the shells especially on the concave side. The settlement is completed within 2 to 5 days. In each tank 500 shells are arranged on the bottom and about

50,000 eyed larvae are released. The optimum rate of settlement is 50 to 70% and on each shell around 70 to 80 spat may set. The factors affecting the settlement are pH, salinity, 0_2 content and water movement. Water exchange is carried out daily without disturbing the shells. The tanks are well aerated and the water is agitated to prevent uneven settlement in the tank.

Nursery rearing and replanting in grow-out system

The shells with spat set on them are arranged in 5 mm thick nylon rope with proper spacing. In a 1.5 metre long rope, 6 shells are arranged and suspended in the tanks filled with raw seawater, for further growth. After 15 days the strings are transferred to nursery area and suspended from racks in velon screen pouches. Three to four shell strings are held in each pouch. After 30 days of nursery rearing the velon screen pouches are removed and the strings are suspended from the racks in the farm with a space of 30 cm between adjacent strings. From a rack measuring 25 m in length 80 strings are suspended. The damage caused to the racks by wind and wave action are attended to and the fallen strings are retrieved and suspended again from the racks.

Growing to marketable size

In the farm, stocking of seed oysters have been carried out in 0.76 ha by constructing 96 racks. Each rack occupies an area of 80 m^2 and 80 strings are suspended from a rack. The growth of oysters have been assessed by periodical recording of the weight of the strings and the mortality by fallout of the oysters from the strings. The details of weight and number of spat/oysters per string from the time of transferring from the hatchery to the time of harvest (12 months) have been furnished in Table 1.

On an average the oyster attains 15.2 g per month and the mortality or fallout of oysters is estimated at 3.9% per month. The survival rate at the end of one year is 52.7%. At the time of harvest the oysters weigh 165 to 181 g per piece with an average of 175.0 g.

Harvesting and post harvest handling

Oysters could be harvested at the end of tenth month if the condition of the meat is at optimum level. The condition factor of the oyster

TABLE 1. *Average growth of oysters in strings by weight and percentage survival for 12 months period in oyster farm*

Period of rearing in months	Average weight (kg) of one string with spat/ oyster	Average Nos. of spat/ oyster/ string	Average weight of an oyster in g	Percentage of survival
1	0.525	74.0	—	—
2	0.980	65.0	7.00	87.8
3	1.755	61.0	20.16	82.4
4	2.585	58.4	35.50	78.3
5	3.350	56.0	50.40	75.6
6	4.295	53.5	70.10	72.2
7	4.800	51.0	83.80	68.9
8	5.250	49.0	96.40	66.2
9	5.800	47.0	112.20	63.5
10	6.240	45.0	127.00	60.8
11	6.920	43.0	148.00	58.1
12	7.350	39.0	175.00	52.7

which indicates the fullness of meat in the shell cavity is an important factor to be considered before harvesting. The increase in size of the gonad is associated with the optimum condition of meat in the shell and the condition value between 120 and 150 is considered to be good for harvesting the oysters. The condition factor is generally estimated by using the formula :

$$\frac{\text{Weight of dry meat} \times 1000}{\text{Volume of the shell cavity}}$$

Although a seasonal pattern has been observed in the values of condition index of the oyster population of the area, diurnal variation of temperature show a well defined relation with the changes in the stages of gonad. The mean value of condition factor of oysters was found to be at optimum level when there is a pronounced diurnal variation in water temperature. This feature has been observed during March-April and August-September.

During harvest the strings are untied from the racks and transported to the shore. The strings are then suspended in cleaning or depuration tanks. After initial cleaning of the oysters by using a strong jet of water, the oysters are depurated in running filtered seawater for 12 hours. With the existing facilities at Tuticorin, on an average, 1.5 tonnes of oysters could be

depurated at a time. The depuration process has been carried out from 6 pm to 6 am and rest of the post-harvest activities such as heat-treatment of the oyster, shucking of the meat, processing and preservation of oyster meat have been carried out during the day time. On an average 115 kg of oyster meat has been shucked, processed and preserved per day.

Since July '92, around 3655 numbers of shell strings have been harvested on four occasions, yielding 27.95 m tonnes of shell-on oysters.

Marketing

Oysters are marketed in live condition; oyster meat is marketed fresh, frozen and in canned condition.

Experiments indicate that live oysters packed in wet gunny bags can safely be transported for 25-30 hours without mortality and in good condition. Small holding tanks having filtered seawater or artificial seawater and provided with adequate aeration, would keep the oysters alive for a few days at the whole-saler's premises. During the present study live oysters have been transported from Tuticorin to Cochin and Madras.

There is regular local demand for fresh oyster meat in Tuticorin. Frozen (block) oyster meat is supplied in bulk quantity to the Integrated Fisheries Project (IFP), Cochin. The IFP has developed and standardised the canning techniques for various types of oyster products. 'Oysters in brine', 'smoked oysters in oil' and 'oyster curry' are some of the value added products marketed directly to consumers in various regions of the country through the State Fisheries Development Corporation, Cooperative Department Store, Super Bazzar and other outlets on preferential basis in order to make the products available at reasonable prices. The whole of northeastern India seasonally responds well to these products. At present there is large demand for canned oyster products in the northeastern states viz. Mizoram, Nagaland, Assam etc.

Oyster shells, the co-product, account for about 85 to 90% of the total weight of live oysters and contain 52-55% of calcium oxide by weight. The shells are used in the manufacture of calcium carbide, lime, fertilizers, cement and in other lime-based chemical industries. Locally there is very good demand for oyster shells. Investigations on the following subsystems associated with the operation of the project, have been carried out.

Environmental monitoring

The temperature salinity, pH, primary production and turbidity of the water in the oyster farm have been investigated. The dissolved oxygen ranged from 2.69 to 9.13 ml/l. The 0_2 content remained high during October and low during January. Inversely, the gross primary productivity was observed to be low during October and high during January. The turbidity varied from 0.77 to 12.3 NTG. High values of turbidity were observed during August and September and low values during April & May. The pH value remained uniform at above 8.0 with an average of 8.26 except during November and December when it was around 7.92. Water temperature was high during October and low during November. The changes in values of the various parameters were mainly due to the southwest and northeast monsoons. During the course of the investigations, extreme changes in the values of environmental parameters, which adversely effect the oyster population were not observed. Fouling organisms such as *Balanus*, *Modiolus* and tubiculous polychaetes are known to settle over oysters. Fouling was found to be high during April and May when turbidity in the water was low. During the rest of the period fouling was moderate.

Control of predators and competitors

Crabs of the genus *Charybdis* and oyster drills (*Cymatium*) are common predators of this area. Predation has been found to be size specific and young oysters are more vulnerable than grown up oysters. Hence young oysters (spat) are enclosed in velon screen pouches and reared till the shell valves become thick enough to withstand the attack of predators. Oyster drills occur commonly in tray culture system, but found very rarely in the ren method of culture.

The suspension of shell strings from the racks are so arranged that the oysters are exposed at least two to three hours during low tide. This helps in reducing the intensity of settlement of foulers, especially barnacles and polychaetes.

Monitoring of growth and condition factor

The growth of oysters is expressed in terms

of increment in weight and shell length. Unlike the oysters grown by rack and tray method or bottom culture, in shell string culture the growth shoots are found all over the edges of the shells and the oysters are roundish or ovate in shape. In rack and tray method the growth rate, in terms of increment of weight has been estimated as 10.5 g/ month and at the end of one year the oysters attain an average weight of 126 g. The oysters raised through shell string method register a growth of 15.2 g by weight/month and at the end of one year attain 175 g. In this method of culture, oysters could be harvested at the end of 10 months.

The percentage of meat weight in the weight of whole oyster varies from 4.5 to 12, with an average value of 9.2. The values of condition index exhibit variation in respect of time, sex and stages of development of gonad. In the farm it ranges from 70.8 to 180.6 with a mean value of 85.7.

Management of materials and infrastructure facilities

The infrastructure facilities required for the project have been partially acquired. One fibre glass dinghy, motor, pump set, and a deep freezer have been procured. Arrangements have been made to carry out the works connected with construction of nursery pond.

Expenditure towards the procurement of farms materials, farm labour, fuel charges, other contigencies and office contingencies have been spent to the extent to which the works have been carried out. 96 racks (each 25 m in length) in the farm and 25 racks (each 10 m in length) in the nursery area have been constructed. Around 600 number of 18 m long eucalyptus poles have been utilised for the construction of these racks. Nylon rope of 5 mm thickness for stringing the spat collectors (shells), coir rope for lacing the poles, velon screen pouches as nursery bags have been procured in bulk quantities for the farm work.

Accessory farm tools such as sickles, hammers, drillers, scrappers, hand gloves and canvas shoes have been procured to facilitate the farm labours to carryout the construction of racks and maintenance of the farm.

Management of labour force and training

Labour force required for the conventional industrial and agricultural sectors can be easily organised. However, mariculture being a new avocation, in this area, the labour required are not readily available. Hence unskilled, semi skilled work force have been trained and the various manual inputs required for the operation of the project have been clearly identified and classified.

On reviewing the progress of work of the project, it has become clear that although the expected target could not be achieved in stipulated time, the results are very much encouraging in respect to the production rate of oysters. The main constraint is that the Institute's experimental hatchery is not able to supply the required quantity of oyster seed in stipulated time. While scaling up the production of oyster seed in the hatchery, we faced problems such as inadequate supply of filtered seawater and algal feed. However, we have not faced any problems related to the field culture of oysters.

Further work is under progress. The final evaluation of the work of this project will be taken up on the completion of the project.