INTRODUCTION

Marine pearls are precious gems which are the most attractive objects of human adornment. The natural pearl is a product of the pearl oyster (Pinctada margaritifera). Production of pearls is very limited and their harvesting is affected by the natural pearl pearl oyster population, in course of time. In view of this, the technology of sea based pearl culture was developed in Japan and later in a few other countries including India. There are only a very few locations along our coast suitable for pearl culture. Consequently, the marine pearl culture in India has not attracted entrepreneurs, in spite of the availability of technology including hatchery production of seeds. Till date marine pearl culture works on a small scale in the Gulf of Mannar area only where natural beds (pans) exist in the sea at around 20 m depth. Against this background the Central Marine Fisheries Research Institute (CMFRI) has recently developed the land based marine pearl production technology which has several advantages over the sea based raft technology.

Present state of world production

About 32 countries are in some stage of pearl culture of various species, from pilot sea research to substantial production and in recent years some of them have expanded the industry very quickly. However, India is yet to attain the status of pearl production country. The present world production of marine pearls from different species is estimated at about 76.4 metric tonnes per annum.

Suitability of land

1. The land for onshore pearl culture should be closer to the sea. The water intake should be only from the sea and in no circumstance from a creek.
2. The area should be free from domestic/industrial pollution.
3. The sea water salinity should not fall below 18 ppt at any time of the year.
4. Loose sandy areas should be avoided as there are chances of large scale accumulation of sand particles in the culture system by wind.

Backyard hatchery

1. Hatchery shed shall be of low height, thatched/asbestos roofing of 6 x 20 m including air conditioned for algal culture, broodstock maintenance etc.
2. Hatchery shed of 8 x 16 m provided with filtered sea water and facility to drain excess water. This shed can easily accommodate 12 FRP tanks of 14 capacity, and other required equipments. The above two structures are of brick and cement construction of 7 ft. (2.1 m) high walls with false ceiling.
3. Sand filter of standard design, with a pump to store the filtered sea water for supply to the hatchery.
4. The above facility can be used to produce at least one million pearl oyster seed/year. It has the capacity to produce 400 I of algal of desired species (Chlorella vulgaris) for hatchery use.
5. Properly maintained broth stock can be used for spawning by thermal stimulation. It requires 3 months to get seeds from hatchery. The methods of hatchery seed production of P. fucata have been already standardised by the CMFRI.

Oyster rearing

The integrated onshore (land based) pearl production technology can be divided into three phases, viz., the hatchery, mother oyster rearing and nucleus implantation and post-rearing period for rearing. The entire operation can be carried out in about 1 hectare area of suitable land. In this system site selection plays a very important and critical role.

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The pearl oyster spat of 5-10mm are transferred into the cages. At this stage the mesh size of the cages will be 2-3mm. They can be stocked at a rate of 10000/m². The population will be thinned in tune with their growth so as to reach an average density of 200m² at the final stage of above 40 mm (DVM). It takes about six months for oyster seed of 5-10 mm size to reach nucleus implantation size. It may be mentioned here that, it takes one year in the open sea raft culture for the pearl oyster to attain implantation size.

Feeding

The pearl oysters are fed with a mixed diet of Chaetoceros 75% and Tetraselmis Isochrysis 25% at cell density varying from 20,000 to 80,000/ml depending on the size, water temperature, season etc. Roughly about 125 to 150g of phytoplankton of size 100,000 million cells/l is required to feed the entire stock of pearl oysters. This requires adequate numbers of outdoor tanks for mass culturing phytoplankton of 2 or 3 species. For algal production, sand filtered sea water has to be used. The basic inoculant can be obtained from the algal culture room and mass cultured in the open area using large transparent containers and outdoor cement tanks.

Sea water requirement

The total waterspread area is about 4,000 m². The ideal water retention capacity of tanks is about 4,000t. The exchange of water is at the rate of 25% per day. The bottom water is let off into the drainage and fresh seawater is pumped in, to make up its volume and maintain a depth of about 1 m.

Implantation and rearing

Implantation of 3-4 mm shell bead nuclei (imported) is carried out when the pearl oysters reach a mean size of 50mm, by specially trained persons with the help of surgical instruments available for this purpose. This operation is carried out in an implantation shed provided with FRP tanks, sea water etc. After implantation, the implanted oysters are kept in FRP tanks for 2 hours for recovery and transferred next day to the rearing tanks, where they are reared for about 6 to 8 months before harvesting pearls. The chance of nucleus rejection is about 50% as revealed by the expert so far. This rate can be reduced by better management of implantation and feeding. Although about 46% of gross pearl production was obtained under onshore tanks condition, only 25% can be taken for economic projection as a measure of abundant precaution.

The rejections are likely to continue for about 60 days from the date of implantation. By X-ray screening, the rejected oysters can be segregated and re-implanted after two months, thus enhancing the rate of pearl production.

The rate of pearl growth has to be monitored in relation to environmental parameters while the "pearl" is still inside the body of the oysters. This will help to determine the exact period of harvest and quality, in advance. By the computerised image processing of pearl oyster X-rays, it is possible to monitor the minute details of the growth of pearls.

Thus, it takes about one year from spat to pearl production in land based pearl production technology compared to 1.5 years under sea based raft culture in India and 2.5 years in Japan.

Disease and pollution control

The used sea water (discharge) from the tanks is let into a separate tank, stored for about 24 hours and green mussels are cultured in that water. The mussels have the capacity to feed on the organic matter contained in the discharged water, thus effecting filtration and purification of the water. Thus clean sea water free from pollution is let out into the sea. The green mussel meat and shell have good demand. As green mussels are proposed as pollution controlling agents, their monetary utility is not taken into account here when calculating the economics of the technology. As the pearl oysters are fed with live feed (phytoplankton) and no chemicals are used, environmental parameters are not expected to vary from the natural conditions. This is a natural preventive measure from the occurrence of diseases.

Future developments

There is possibility of rapid development of land based pearl production. It is suggested that the three stages described above are taken up by different entrepreneurs, one category of entrepreneurs could concentrate on hatchery production of seed, while another group can concentrate on rearing of mother oysters while the third category of entrepreneurs can concentrate on implantation of nuclei, rearing of implanted pearl as the land based pearl culture is still in an infant stage.

<table>
<thead>
<tr>
<th>ECONOMIC PROJECTIONS (1 ha area)</th>
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<tbody>
<tr>
<td>INFRASTRUCTURE</td>
</tr>
<tr>
<td>1. Hatchery</td>
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<tr>
<td>2. Growout tanks (4000 m².)</td>
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<tr>
<td>3. Oyster cages</td>
</tr>
<tr>
<td>4. Outdoor algal culture structures</td>
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<tr>
<td>5. Implantation shed</td>
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<tr>
<td>6. Other buildings</td>
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<tr>
<td>7. Miscellaneous</td>
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</tbody>
</table>
8. Power installation and generator 3.0
9. Pumping system including filters 5.0
10. Blowers and associated aeration system 2.0
Total 10.0

Cost of land, land development, vehicles, staff quarters are not included.

RECURRING EXPENDITURE
1. Wages Rs. (in lakhs) 6.0
2. Nuclei 7.0
3. Surgical instruments 0.5
4. Chemicals & glasswares 1.5
5. Power charge/ammun 4.0
6. Miscellaneous 2.0
Total 21.0

EXPECTED REVENUE
Total oysters proposed for implantation = 640,000
Pearl yield (at 25%) 160,000 at a price Rs.40/- pearl Rs. 64.0 lakhs

EDIBLE OYSTER HATCHERY AND CULTURE
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INTRODUCTION
Edible oyster is one of the most widely cultivated bivalves. It is among the first of the marine species to be cultured and hence has a long history. As early as in the first century B.C., the Romans were first to culture the edible oysters. Then Japan developed various methods for farming the edible oysters. Other leading oyster producing countries are U.S.A, Korea, France and Australia. In 1992, edible oysters formed 29% of world mollusc aquaculture production of 2.6 million tons. In India, Horneil initiated experiments on spat collection of Crassostrea madrasensis at Pulicat Lake. Realising the resource potential, nutritive and commercial values of edible oysters, the Central Marine Fisheries Research Institute made attempts to evolve suitable farming techniques for edible oysters in the early 1970’s. This paper contains various aspects of technology of farming the edible oyster C. madrasensis along with its distribution and a few biological details.

The edible oyster, popularly known as ‘Aali’ in Tamil and ‘Maringas’ in Malayanam, is a sedentary bivalve. The flesh is encased by two shell valves, the lower valve is cemented to the substratum and the upper valve acts as a lid. The hinge mechanism connecting both valves, allows the valve to open or close. The animal feeds by filtering the microscopic organisms in the water which pass through the gap between the two valves. The flesh of oyster is highly nutritious containing 8-10% protein and 2% fat, in addition to minerals like calcium, phosphorus, zinc and iodine.

Edible oysters occur attached to hard substrates in the intertidal areas, backwaters, muddy bays, lagoons, and creeks along the east and west coasts of India. The four species of commercially important edible oysters are Crassostrea madrasensis (Indian Backwater oyster), C. gryphoides (west coast oyster), C. rivularis (Chinese oyster) and Saccostrea cucullata (Indian Rock oyster).

RESOURCES AND DISTRIBUTION
Oyster fishery is localised and at subsistence level. Surveys indicate an estimated annual production potential of 2000 t of oysters along our coast. Among the four commercially important edible oysters, C. madrasensis is the dominant species distributed along the coasts of Orissa, Andhra Pradesh, Tamil Nadu and Kerala. In Karnataka, C. madrasensis is distributed in Nethravathi, Muli and Kali river estuaries. It also occurs in Andaman Islands as Port Blair, Havelock Island, Mayabander and Diglipur.

C. gryphoides is well distributed in northern Karnataka, Goa and Maharashtra.

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