Farming Experiments and Transfer of Technology of Bivalve Culture along the Southwest Coast of India

K.K. Appukuttan, T.S. Velayudhan, P.S. Kuraikose, P. Laxmilatha, V. Kripa and K.A. Narasimham

Abstract

The Central Marine Fisheries Research Institute (CMFRI) in India developed bivalve farming technologies in the 1970s, but these were not widely adopted at the time. In 1993, CMFRI undertook an action research program to encourage farming of edible oysters, mussels, clams and pearls along the southwest coast of India. Successful demonstration of the viability of bivalve farming led to the initiation of commercial farming of mussels and generated interest among farmers and entrepreneurs in developing production of pearls and farming of edible oysters. Given the high potential for mollusc aquaculture, both for the local and export markets, issues such as demarcation and issuance of lease rights on aquaculture zones in public waterbodies by the government, organization of marketing systems and provisions for technical and financial support to farmers need to be addressed.

Introduction

Coastal aquaculture research for developing bivalve farming techniques in India was initiated in the early 1970s by the Central Marine Fisheries Research Institute (CMFRI). By the end of that decade, technologies for pearl, mussel, edible oyster and clam culture were developed. Though bivalve farming proved to be technologically and economically viable, it was not widely adopted by the farmers, primarily due to lack of awareness, social inhibitions and finance. In 1993, an action research program was initiated for location testing as well as for disseminating farming technology for edible oysters *(Crassostrea madrasensis)*, mussels *(Perna viridis* and *P. indica)*, clams *(Paphia malabarica)* and pearl culture in pearl oysters *(Pinctada fucata)* in selected areas along the southwest coast of India. The results of the action research program are presented in this paper.

Pearl Oyster Farming and Pearl Production

The pearl production technology developed by CMFRI in 1973 has been refined and upgraded for mass-scale commercial production in the Gulf of Mannar on the east coast of India. With the objective of expanding pearl production activities on the west coast of India, in 1994 the Institute launched a program on location testing for pearl culture at Andhakaranazhi, a coastal village 50 km south of Cochin (Fig. 1). A total of 659 spat of *P. fucata* with an average length of 15.9 mm were brought from the Tuticorin Shellfish Hatchery of the Institute and suspended from a longline unit moored at a depth of 5 m. The pearl oysters were held in cages and their growth and survival were studied. A batch of 400 nucleated oysters with an average length of 41.23 mm were also kept in cages and suspended from the longline for observations on pearl production. The spat showed a growth rate of 4.8 mm/month and reached an average length of 46.2 mm in 5 months. The nucleated oysters attained 57.7 mm in length with a growth rate of 3.27 mm/month when harvested after five months. The pearl production in these oysters was 33.3%.

In another experiment undertaken at Calicut (Fig. 1) in October 1994, 377 nucleated pearl oysters, 400 medium sized oysters and 2 500 spat of *P. fucata* brought from the Tuticorin Shellfish Hatchery were kept in 10 cages suspended from a floating raft launched off Calicut. However, rough sea conditions damaged the cages and rafts resulting in a high mortality of the oysters. In December 1994, another attempt was made with nucleated oysters and 1 000 spat. The spat with an average length of 17.7 mm grew to 43 mm in 5 months showing a growth rate of 5 mm/month. The pearls from the nucleated oysters were harvested in May 1995 giving 30% pearl production within 5 months.

Mussel Farming

The technology developed in 1977 for the culture of green mussel *(Perna viridis)* and the brown mussel *(P. indica)* was tested in several places along the east and west coasts of India over the past 20 years and has been improved for large-scale production. In these studies, rigid floating rafts were used for holding seeded ropes in inshore areas. However, the rafts could not withstand the high turbulence during the monsoon season and this became a problem. To over-

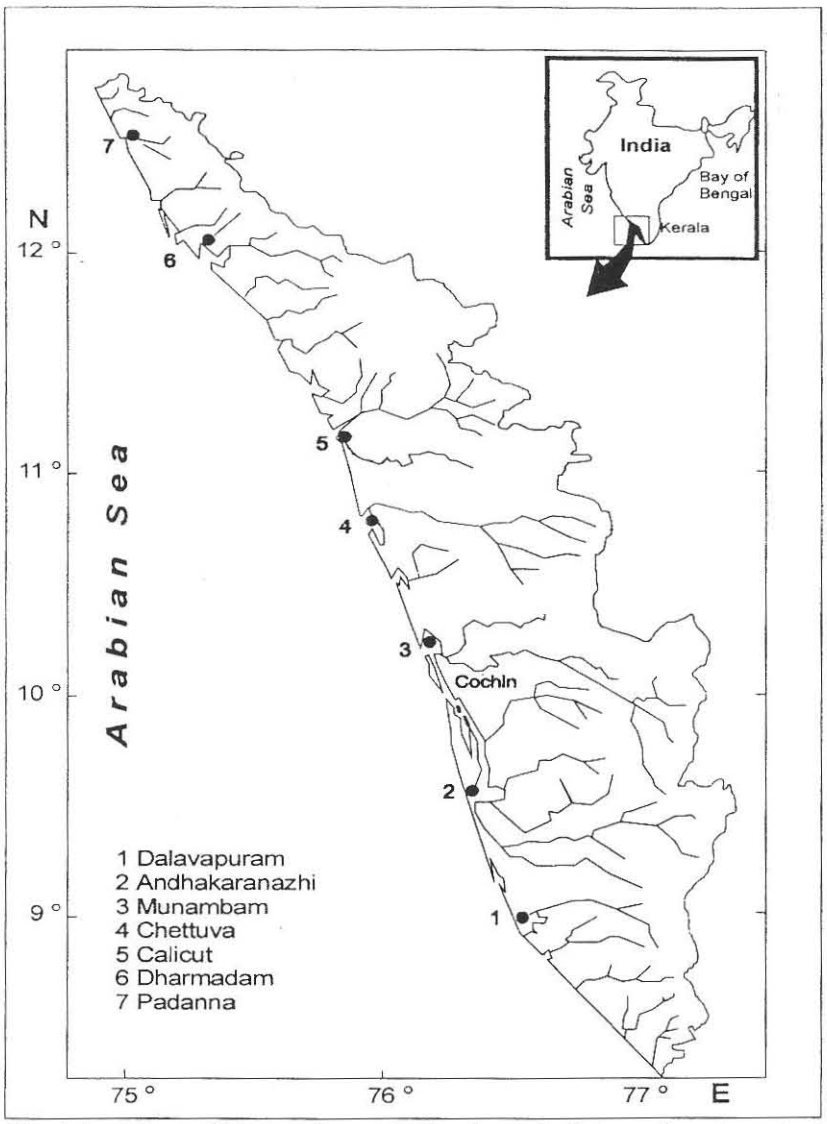


Fig. 1. Locations of bivalve demonstration farms in the southwest coast of India.

come this difficulty, longline mussel farming was initiated for the first time in the country on an experimental basis in 1995-96 at Andhakaranazhi (Fig. 1) with the active participation of local fishers. Seed collected from the granite surface in the same area was used in the study. Longline units were launched at a distance of 2 km from the shore at a depth of 8-10 m. A longline unit with 20 m long horizontal high density polyethylene rope of 20 to 24 mm thickness was anchored at both ends with 150 kg concrete blocks and four to five 100-liter plastic floats fixed at 5-m intervals. Vertical seeded lines of 4-6 m length were hung at an interval of 0.75-1 m. Five such longlines were used in the study. Seeding with *P. viridis* and *P. indica*, 20-30 mm in size, was done at the rate of 2 kg/m length. A total of 100 seeded ropes were suspended during October - December 1995 and harvesting was done in May 1996. At harvest, *P. indica* and *P. virdis* attained an average total length of 73.2 mm and 75.1 mm, respectively. Average production per meter length of the rope was 10-12 kg at harvest.

The rack system of mussel farming in estuaries was tested at Dharmadam and Padanne on the southwest coast of India (Fig. 1). Racks were constructed in shallow estuaries at 3-5 m depth. Seeded ropes, 1.25-2.0 m long, were suspended from the horizontal bars of the rack at a distance of 0.5 m. At Dharmadam, 100 seeded ropes were suspended during January 1996. The average length of seed was 30 mm and seed weight per meter length of rope was 1.5 to 1.75 kg. They grew to 65-80 mm in length by May 1996 with a total weight of 12-15 kg/m length. At Padanne, a progressive farmer set up a farm for mussel and edible oyster culture in a 200 m^2 area using seed collected from a natural bed nearby and seeded 175 ropes during January 1996. Mussels were harvested in May 1996. The meat yield was 30% of shell-on weight. This marked the beginning of commercial mussel farming in the estuaries in this area.

Edible Oyster Farming

Experiments carried out in the Institute's oyster farm at Tuticorin indicated that the rack and ren method is best for culturing *C. madrasensis*. In October 1993, 432 oyster spat produced in the Tuticorin Shellfish Hatchery with an average length of 28.2 mm, were transplanted in Ashtamudi Lake and suspended from the horizontal poles of Chinese dip net. The oysters grew to 63.9 mm in 11 months with an average total weight of 35.5 g and meat weight of 4.11 g. The meat yield was the highest during the May-June period. In the same area, 125 shell rens were prepared and suspended from the horizontal poles of Chinese dipnets in November 1993 and good spat settlement was observed in December. Spat measuring 24 mm reached 57 mm by July and 78.5 mm by November 1994. The average meat weight in November was 8.10 g and total weight was 76.1 g. In November 1994, 825 shell rens were released in the rack to observe spatfall. Profuse spat settlement was noted from the end of

November to January. The spat of 6.67 mm average length in January grew to 68.3 mm by August, with a growth rate of 8.66 mm/month. The total weight of oysters increased from 0.265g to 43.5g and meat weight from 0.019 g to 5.6g. Full grown oysters were harvested in August 1995 with a total yield of 2.5 t in 8 months. In December 1995, a demonstration farm of 0.4 ha was set up in the same estuary. Spat settlers were released to collect spat in December and profuse settlement of spat in the rens was noted right from December onwards. As a result, several farmers took up small-scale edible oyster farming during 1996-97 in some of the estuaries.

In another experiment conducted in October 1993, 13 strings with 50 spat each were transported from the Tuticorin Shellfish Hatchery to Calicut and Dharmadam estuaries (Fig. 1). At Calicut, initial mortality was 30%, whereas at Dharmadam it was insignificant. The oysters reached an average length of 71.2 mm and 63.5 mm by June at Dharmadam and Calicut, respectively. The oysters could survive the monsoon stress without mortality at Dharmadam, whereas a 70% mortality was observed at Calicut. In January 1996, 500 rens with oyster spat were transported from the demonstration farm at Ashtamudi to Dharmadam and the oysters showed good growth (reaching 67.5 mm in length by June) and survival rates (90%). These observations indicate the potential for farming *C. madrasensis* throughout the year.

Clam Culture

The CMFRI developed technology for the seed production of venerid clams *Paphia malabarica*, *Meretrix meretrix* and the blood clam *Anadara granosa* in 1988 at the Tuticorin Shellfish Hatchery laboratory. These methods have since been standardized.

A longline unit off Andhakaranazhi for mussel farming.

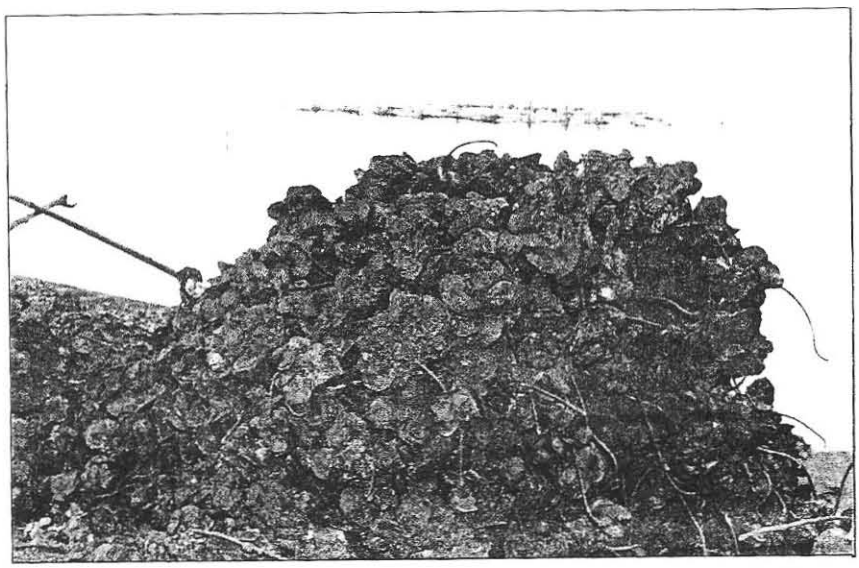
Mussel and oyster farm at Padanne, southwest coast of India.

Beginning in February 1993, a total of 521 670 hatchery-raised seed of *P. malabarica* were transported from Tuticorin to Ahstamudi estuary in Kerala and released in pen enclosures on seven occasions. Data on growth and survival were collected on four of these, while the remaining three attempts failed for various reasons. These data indicate that clam seed of 10.7 to 12.4 mm attain a marketable size of over 30 mm within 3.5 to 5 months. They can be stocked at high densities up to 4 000/m^2 with production rates ranging from 142.5 kg to 593 kg shell-on/100 m^2. The retrieval varied from 7.05% to 17.64% at harvest.

The mortality was very high when 3 mm seed were transplanted. Covering the transplanted clam bed with a protective net not only prevented crab predation but also helped the clams to maintain their position in the substrate against strong water currents.

Technology Adoption

The pearl farming experiments undertaken in two locations (Andhakaranazhi and Calicut) showed that pearl production is feasible along the southwest coast of India. Growth was fast and pearl production was 30-33% in these

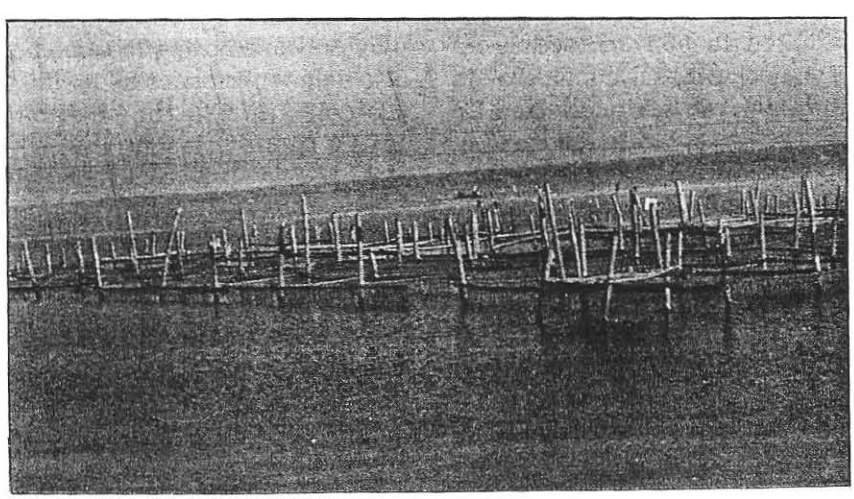


A view of the harvested oysters from a farm on the southwest coast of India.

areas. After the success of these two experiments there was a good response from private entrepreneurs to initiate commercial production of pearls.

The longline mussel culture trial at Andhakaranazhi and rack culture method of mussel farming in the estuaries were the first successful efforts to transfer mussel culture technology to the end users. The successful demonstration of mussel farming has created an awareness among fishers of the potential for commercial farming of mussels in the estuaries along the west and southwest coasts of India. A few fisher groups in these areas initiated small-scale mussel farming in estuaries using rack culture methods in 1996-97. CMFRI is extending technical help to the farmers and is also demonstrating the potential of mussel farming along the east coast of India.

Demonstration of oyster seed collection from the wild and farming in estuaries of the west coast of India has created awareness and generated interest among the farmers and entrepreneurs on the possibilities of farming of edible oysters in the estuaries. The Institute is providing technical assistance to farmers in establishing pearl oyster, edible oyster and mussel farms in the country to augment production through scientific farming in the coastal waters and estuaries of various maritime states.



Edible oyster farm at Dalavapuram.

Conclusion

Though the CMFRI developed the technologies for pearl culture, mussel, clam and oyster farming in the 1970s, the response from fishers and private entrepreneurs for technology adoption was poor. In recent years the technology was demonstrated in the field and upgraded for commercial use. The setbacks in shrimp farming due to the outbreak of viral diseases prompted farmers and entrepreneurs to look for other species to farm. Culture of molluscs provides a good alternative. Farming of bivalves is not only a lucrative venture, given the increasing export demand for these seafoods, it is also ecofriendly and less polluting than shrimp farming.

Having established the technical viability of bivalve farming, the potential for group farming or community farming by the people living around the semi enclosed/open coastal waterbodies needs to be tapped. This calls for the Government to lease out public waterbodies for aquaculture. Demarcating potential areas of coastal waters as aquaculture/mariculture zones and leasing out these areas on long leases to coastal population for farming would provide employment and income to the coastal farmers as well as add to national aquaculture production.

Schemes to provide technical, financial and administrative support to a large number of farmers interested in adopting bivalve farming are being put into place. There is a need to organize marketing systems for both the domestic and export markets for mussels, clams and edible oysters.

K.K. Appukuttan, T.S. Velayudhan, P.S. Kuraikose, P. Laxmilatha, V. Kripa and K.A. Narasinham *are from Central Marine Fisheries Research Institute, PO Box No 1603, Ernakulam, Cochin-682 014, India.*