Farming of Mussels

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Introduction

Mariculture of bivalves assumes greater importance in meeting the increasing protein demands of the human population. Bivalve groups such as oyster, mussel and clams are the most important cultivable organisms all over the world. Of these, *P. viridis* and *P. indica* forms the most dominant cultivable species. The Central marine Fisheries Research Institute (CMFRI) has developed eco-friendly techniques for mussel culture. Recently, CMFRI has taken efforts to popularize mussel culture in all coastal districts of Kerala. Although a package of practice for culture of mussels has been developed, for want of effort from entrepreneurs, financial and developmental agencies, farming of mussel has started on a commercial scale only in the northern districts of Kerala.

Scope for mussel farming in Kerala

Kerala state is endowed with rich mussel resources and survey reveals that two species viz., *Perna viridis* (green mussel) and *Perna indica* (brown mussel) are present along the rocky shores. The latter is mostly restricted upto the south of Kollam from Cape comorin in west coast and the former is distributed throughout. Annually about 15000 t of mussels are exploited from these regions. During post-monsoon period there is heavy settlement of mussel spat along the entire Kerala coast. This seed can be used for farming (see Annexure for a recent estimate of mussel seed resources in Central Kerala). Mussels reach harvestable size (55-70 mm) within 4-5 months when cultured.

Experiments indicate if farming activities confined to November to May, mussels can be successfully cultured in most estuaries of Kerala since ecological conditions will be congenial for good growth and survival. Similarly the Arabian Sea bounding the shores of Kerala can also be used to culture of mussels during the fair season (Oct to May).

Background information

The CMFRI has developed technologies for farming of mussels in early seventies and since then it has been upgraded and refined for commercial production. The institute has conducted a series of experiments on location testing in various estuaries and sea along the west coast of India. In Kerala, location testing for mussel culture has been done in estuarine areas using rack and ren method.

The Research Centre of CMFRI, Calicut took steps to expand mussel culture practices in the north Kerala region in small-scale with the involvement of fishermen. The Research Centre successfully demonstrated mussel culture in the Dharmadam Estuary during 1995-96. This created some awareness among the local fishermen. During 1996-97, mussel culture was done on a large scale at Padanna with the involvement of a group of twentyfive fisherwomen. Financial support was extended by the DWCRA. These programmes proved that mussel culture can be profitably undertaken utilizing the available water spread area in the estuaries of North Kerala. In Central Kerala it was demonstrated in the Chettuva estuary in Trichur district during 1997.

Open sea culture of mussels was initiated by the CMFRI off Vizhinjam and off Calicut during the 1970's. Recently, a pilot scale demonstration of long-line culture was also carried out off Andhakaranazhi near Alleppey. During 1998-99, a group of fishermen from Vypin Island took the initiative to launch raft culture of mussels in the sea off Narakkal with technical collaboration from CMFRI. Currently farmed mussel production from Kerala state is estimated to be nearly 10,000 tons.

Objectives

- Commercial production of mussels with technical support from CMFRI and financial support from Banks and developmental agencies.
- Provide employment opportunities and to generate additional income to the rural fishermen.
- Improve production and marketing of mussels.
- Ensure supply of mussel meat in domestic market and to an overseas market with MATSYAFED support.

Criteria for site selection

Site selection for mussel farming requires the following features in an estuary and / or open sea:

- Sheltered area with depth ranging from 2 to 8 metres offering protection from strong waves and free from pollution.
- Salinity range between 22 and 35 ppt; higher range of 30-35 ppt is ideal for mussels.
- Water temperature ranging between 21 and 31°C.
- Clean water with good phytoplankton production and moderate current to bring in the food and carry away the waste materials.
- Dissolved oxygen value ranging from 3.8 to 5.25 ml/l.

Candidate species

Perna viridis (green mussel) and *Perna indica* (brown mussel) (locally known as Chippi or Kallumekaye).

P. viridis is widely distributed along the Kerala coast; natural beds exist in the intertidal rocky shores and submerged rocks and also in some estuaries.

FARMING METHODS

Rack Method

Racks are constructed in shallow water bodies depth ranging from 2 to 3 m. There are several variations in the construction of rack to suit the area where farming is done. A series of vertical poles (bamboo or casurina) are driven into the bottom in rows and horizontal bars are connected on the top of these poles at a height of 0.5 m above the water level. The seeded mussel ropes can be hung from these racks.

For seeding of mussels the best season along the Kerala coast is October-November. Mussel seeds are placed around the rope and securely wrapped with knitted cotton cloth/cotton mosquito netting. The length of the rope in the rack can vary from 1 to 1.25 m. The ropes are suspended, at equal intervals from horizontal poles leaving 0.3-0.5 m from the bottom to avoid siltation and predation. It can also be suspended horizontally. The cotton cloth disintegrates within 10 days and by then the mussel seed is firmly attached to the ropes by producing fresh byssus threads. The harvest can be done in May-June before the onset of monsoon.

Floating Raft Method

This method is practiced in areas with water depth of more than 3 m. The raft is made of wooden poles (bamboo or casuarinas) placed parallel and across and tied with nylon rope to make a rigid frame. Four empty water tight barrels of 200 l capacity are tied to the underside

of the raft at the corners as floats. The raft is moored by anchors. The size of the raft varied from 5 x 5 to 8 x 8 m. Mussel ropes of required length can then be suspended from the rafts.

Long-line Method

This is a variation of the raft method, wherein the system is made more flexible by using thick nylon ropes (20-24 mm dia) of 20 m length. Foatation is provided by attaching 50-100 l capacity water tight polyurethane barrels at an interval of 2 m. The system is moored by anchors and anchor ropes attached to the corners. Seeded mussel ropes can be suspended from such horizontal ropes adjusting the height so that the ropes are at least 2 m from the bottom.

Improved seeding method (semi automated mussel seeder)

The most tedious job in mussel farming is attaching cleaned and separated seed mussel on ropes. Biodegradable cotton net is used to wrap seeds around the central core of rope. Utmost care is required to stitch the net around the central rope. Usually seeds attach unevenly causing slipping of mussels during the grow-out. This results in considerable production loss.

In the new system using the seeder; seeding is done in pre-stitched cotton net tubing of dimension proportionate to the seed size. A PVC pipe of suitable dimension is first inserted in to the net tubing and the centre rope introduced and tied at the lower end with the net tubing. The tubing is kept in vertical position in the seeder. Cleaned and separated seeds can be filled easily in to the PVC pipe. After filling, the PVC pipe can be removed. Nylon strips of 5 mm can also be used to reduce cost of seeding ropes.

Improved harvesting method

Refinements in the technology have been made to reduce capital costs (mainly on nylon ropes) by using alternate core materials (Flexible Plastic Strips – FPS) and pre-stitched cotton net tubes. Seeding is one of the most critical activities in mussel farming. The process which is physically demanding (as farmers have to kneel and bend down to do it) is crucial to the success of farming as the uniform attachment of mussel seed around the rope is dependant on how well it is done. Now, to reduce the physical strain and to increase efficiency during this process, a ***semi-automated mussel seeder*** has been designed, developed and field tested. The seeder, which has an estimated cost of Rs. 2500, was successfully field tested and demonstrated to mussel farmers in Kerala.

The chief advantages of the seeder are reduction in time taken for seeding resulting in increased efficiency and lower labour costs and reduction in physical strain during the process. The time taken for manual stitching of 1m rope by the conventional method is 8 minutes whereas in the seeder the same can be accomplished in 2 minutes.

Harvesting and declumping (separating mussels from the rope) farmed mussels is by lifting the mussel ropes and by plucking the mussels from the rope or by stamping if the byssal attachment is very strong. To easily separate the mussels from the rope the concept of a ***semi-automated mussel declumping machine*** was developed. The machine had two separate units, a metal drum and a metallic circular fixed shield with a central opening with a diameter of 10mm fixed on a stand and a ramp for placing the harvested rope. One meter mussel rope could be de-clumped in two minutes. The chief advantages were that physical exertion during harvesting could be avoided and that it was more hygienic and efficient.

Depuration

In most countries, mussels can be marketed only if they originate from clean water and regular analysis is mandatory to ensure that quality is maintained. Bivalves are filter feeders and during this process they accumulate suspended biological materials including harmful microorganisms. Before the product reaches market, these materials have to be removed. This process of purification is called depuration. This can be achieved by starving the mussels in clean and filtered seawater/ brackishwater for a certain period of time or by using disinfected water in the depuration process.

The basic principle for purification or depuration involves providing clean purified water in tanks whereby the mussel takes in and filters such water for a period of 24 hours or more if required. Chlorination @ 3ppm is the method to proposed in the project for purification of water for depuration. After chlorination for 12 hours; de chlorination by vigorous aeration is to be done.

Mussels may be kept in perforated plastic trays in tanks with de chlorinated water for 24 hours in two cycles with one complete flushing.

Heat shucking

At present mussels are heat shucked by steaming them using conventional methods using firewood and cooking utensils

Marketing

At present the market for mussels is restricted to internal markets. There is good demand for shell-on mussels in local bars and restaurants in and around cities. The harvested mussels from Padanna were sold at the rate of Rs.55-70 per kg of shucked mussel meat and in cities like Kochi,the price can go as high as Rs 100/kg in some season. A number of marine products export houses are interested in shell-on mussels at a rate of Rs.14/Kg.

Economics

The economics of production of mussel farming rack and ren method in estuaries and raft method in the open sea is detailed separately. These estimates are only indicative and conditions could vary with location. Financial institutions like cooperative banks, local banks, ADAK, BFFDA, MATSYAFED and MPEDA have come forward to support these ventures.

Risk

- The availability of good quality mussel seed from their natural bed is unpredictable since it depends on the natural spawning and spat settlement.
- Marketing – When harvested in bulk quantity, disposal within the internal markets may pose some problem.
- Poaching and theft – in some areas this could be a source of loss.
- Social problems – some groups perceive floating structures as a source of hindrance to their fishing activities.

Recommendations

1. The farming technology developed by CMFRI offers scope for small-scale farming of mussel in estuaries of Kerala.
2. The areas most suitable for mussel seed collection and farming in Kerala have been identified. Small-scale farming and seed collection from the wild by farmers, entrepreneurs can be initiated in these areas.
3. CMFRI can provide training and adequate technical support for these ventures.

Cost benefit of mussel farming-raft method in open sea Multiple (12)units of 5m x 5 m rafts(300sq.m) (600 ropes of 4m)

A. Initial investment

I. Farming

1. Bamboo poles of 5 m length 240 nos @ 125	30000
2. Empty oil barrels of 200 lt capacity,60 nos @ 500	30000
3. Cast iron anchors of 30 kg,26 nos @ 40	31200
4. 18 mm nylon rope for anchorage,240 kg @125	30000
5. 4 mm nylon rope for lashing, 60 kg @ 125	7500
6. Rope for seeding 600 ropes of 4 m; 480 kg @ 125	60000
7. Semi automated seeder	5000
	1,93,700

II. Post harvest

8. Declumper	8000
9. Semi automated seeder	5000
10. FRP tank of 2 ton capacity, 2 nos @ 12000	24000
11. FRP tank of 1 ton capacity 3 nos	18000
12. HP pumps with accessories and hose	10000
13. Plastic crates for depuration	12000
14. Aluminum vessels for heat shucking	10000
	87,000

B. Capital cost

Depreciation @ 50% for item 1-7	96,850
Depreciation @ 20% for item 8-14	17,400
Total	**1,14,250**

C. Recurring expenditure

1. Cotton netting for 600 mts @ 15	9000
2. Labour for raft fabrication and mooring	24000
3. Cost of mussel seed 4200 kg @ 6	25200
4. Seeding charge,50 man days @ 200	10000

5. Canoe hire charge @250 x 30	7500
6. Harvesting and transportation	15000
7. Labour for depuration	20000
8. Labour for heat shucking	20000
9. De clumping and washing	10000
10. Buckets, troughs and other items	10000
Total	**1,50,700**
Total expenditure (B + C)	**2,60,950**

D. Income

Production @ 10 kg/meter rope 24000 kg
Meat @ 20% (heat shucked) 4800kg
Selling price @8 3,84,000

E. Net profit **1,13,050**

Cost benefit of mussel farming- rack culture Rack size 30m x 10 m (1200 ropes of 1 m)

A. Initial expenditure

1.Bamboo poles of 4 m length 160 nos @ 110	17600
2. Bamboo poles of 5 m length 110 nos @ 125	13750
3. Seeding rope 18 mm (1500 m),300 kg @ 125	37500
4. Rope for lashing, tying the seeded rope;4mm,20 kg	2650
5. Semi automated seeder	5000
	76500

II. Post harvest

6. De clumper	8000
5. Plastic creates for depuration, 30nos @ 400	12000
6. Aluminum vessels for heat shucking	10000
7. FRP tank,2 ton for chlorination	12000
8. FRP tank,1 ton for depuration 2 nos	12000
9. HP pump, hose & accessories	10000
	64000

B. Capital cost	
Depreciation @ 50% for item 1-4	38250
Depreciation for item 5-9 @ 20 %	12800
Total	**51050**
C. Recurring cost	
1 .Cotton netting 250 mt @ 15	3750
2. Twine	100
3. Cost of seed (1800 kg) @6	10800
4. Charge for seeding 30 man days @ 200	6000
5. Hire charge of canoe	2500
6. Charge for harvesting, de clumping and cleaning	10000
7. Labour for depuration	3000
8. Plastic wares	4000
9. Marketing	5000
10. Miscellaneous	3800
Total	**48950**
Expenditure Total (B + C)	**1,00,000**
D. Income	
Production of mussel 12000 kg	
Heat shucked meat (20%) 2400kg	
Selling price Rs 80/kg	1,92,000
E. Net income	**92,000**