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WORKSHOP ON

MUSSEL FARMING

25 - 27 SEPTEMBER, 1980

MADRAS



CENTRE OF ADVANCED STUDIES IN MARICULTURE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

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TECHNICAL SESSION IV PRODUCTION AND ECONOMICS | CMFRI-CAS/MF/80/BP-16

PRODUCTION AND ECONOMICS OF MUSSELS IN GOA

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A B S T R A C T

The green mussel (Perna viridis. L) widely distributed along the Indian coastline, has great potential as a protein rich cheap food. The National Institute of Oceanography, India, has succeeded in developing a technique for the farming of green mussels on ropes suspended from floating rafts.

Raft culture of mussel gives an annual yield of 184 kg/m² and in terms of area, it works out to be 480 tonnes per hectare per year. The technique ensures continuous harvesting and is feasible, both technically and economically.

Cost of production is about Rs 375/m² and the value of mussel meat produced is about Rs. 1100/m², thus giving a high rate of return of 181%. The technique developed is accordingly an appropriate system of

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aquaculture involving minimum use of capital investment, low operational cost, production of low price high quality seafood having effective market demand and involvement of unskilled manpower.

The paper gives details about the criteria for site selection, fabrication of rafts, technique of transplantation on ropes, growth, food value, fouling, predators and parasites. Economics along with cost-benefit analysis has been worked out. Constraints and advantages of raft culture of mussels are discussed.

INTRODUCTION

The mussel culture in Goa was initiated by National Institute of Oceanography in early 1974. The mussels, both green and brown, occur abundantly along the shores and in estuaries of Goa and are greatly relished as food by the local population. The average market price in 1979-80 for mussels with shells was about Rs. 6 per kg and the mussel meat is sold at the rate of Rs. 10 per kg. The annual yield of mussels in Goa from natural beds is about 200 tonnes.

Our earlier studies (Qasim, Parulekar, Harkantra, Ansari and Nair 1977) on green mussels have revealed that due to excessive intertidal exposure and heavy mortality mainly due to predation, the attainment of marketable size in natural populations, takes more than a year or so. Considering the fact that the mussels are filter feeders and hence, if grown under constant submerged condition,

wherein food will be available all the time and if the rate of predation by natural enemies is monitored then the growth progression will improve resulting in the attainment of marketable size in less time.

CRITERIA FOR SITE SELECTION

As reported earlier (Qasim, Parulekar, Harkantra, Ansari and Nair 1977; Parulekar, Ansari, Harkantra and Nair 1978) the success of mussel culture on floating rafts, depends on the interplay of a number of biotic and abiotic factors, some of which may act as limiting factors and hence the selection of site should strictly be based on the baseline information about environmental and biological characteristics. In the course of our work on raft culture of mussels, the first site in the Caranzalem Bay of Mandovi estuary, inspite of a number of plus points had to be abandoned due to severe sub-aerial erosion during southwest monsoon season, resulting in the dislodging of rafts from mooring.

Important criteria to be observed are:

1. A good knowledge of currents, tides, waves, sediment transport and winds prevailing in the locality.
2. Baseline information on the seasonal changes in temperature, salinity, dissolved oxygen, suspended load, heavy metals, polychlorinated biphenyls, organochlorines etc.
3. Thorough knowledge of primary productivity, organic matter, detrital content, bacterial flora etc.

4. The proposed site should not be in the vicinity of industrial and sewage outfall.

FABRICATION OF RAFT

The rafts used are of wood, preferably of cheap quality like "mathi", which is very durable and readily available, locally. To start with smaller rafts of 6.25 m^2 , surface area, with four heavily tarred metal barrels were used. In later stages, even bigger rafts of 15 m^2 were used but difficulties in fabrication, towing, mooring and servicing were experienced. Moreover, during inclement weather, the smaller rafts are easy to manage in cases of breakdown. The rafts are anchored with steel anchors, and steel chains (15-20 m in length) heavily tarred to reduce deterioration. The fabrication of rafts is done on the shore adjoining the site and towing and mooring is done either by a small mechanised boat or even by a country craft. The servicing of raft which includes tightening of ropes, replacement of barrels etc, is done within every 3 months. The cost, including material, labour charges for fabrication, servicing etc, of each raft of 6.25 m^2 area is Rs. 1750/- and Rs.2900/- for a bigger raft of 15 m^2 .

TRANSPLANTATION OF SEEDS ON ROPE

Mussel spats suitable for transplantation are abundantly found in Goa from September to February. The size of selected seed is 5-10 mm and these are about 4-6 weeks old. The seeds before being transplanted are kept

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in well aerated sea water for 10-12 hours.

Different type of ropes, like coir, manilla, nylon etc. were tried but in the long run, the nylon ropes are found to be most suitable. The rope (12 mm diameter) of desired length (3 m) is placed over strip of cotton mosquito curtain cloth of about 35 cm width, and mussel seeds arranged on either side. Each rope was seeded with 600-700 young mussels. To prevent the clumping of mussels, small bamboo tags (about 10 cm long) are inserted through the twist of the rope at regular interval of 0.5 m. The cloth is stitched around the rope before transferring the rope to the raft. Care has to be taken so that the rope does not touch the bottom and the mussels are always, submerged. We have been using thin and short ropes as our rafts are anchored in a water column of 5-8 m depth. Moreover for handling thick and long ropes a mechanised device for hauling the ropes would become inevitable.

GROWTH

The mussels on rope grow to marketable size of 60-65 mm in less than 18 weeks. The growth of mussels is directly related to seasonal variations in environmental parameters and accordingly the growth in length is maximum (12mm/month) in premonsoon (February-May), average (10 mm/month) in postmonsoon (October-January) and minimum (8 mm/month) in premonsoon (June-September). In contrast the increase in weight is maximum in monsoon and minimum in postmonsoon. The average monthly increase in weight is 11.3 g.

FOOD VALUE

The protein and caloric content in the rope grown mussels is higher (56.5% and 6.2 Kcal/g dry wt) than in natural population (54% and 5.6 Kcal/g dry st.). Regular monitoring of the microflora of cultured mussels also indicate that there is less intensification of pathogenic vectors than in the natural populations.

FOULERS, PREDATORS AND PARASITES

The intensity of fouling varied seasonally but at no time it assumed alarming proportions. The fouling fauna, in order of predominance are bryozoans (50%) and barnacles (35%). As the ropes do not touch the sea bottom, predations by star fishes or crabs is completely eliminated. No infection by Mytilicola sp. or trematodes has been observed. However, rarely the pea crab, Pinnotheres sp. is found in the mantle folds of the mussel.

PRODUCTION AND ECONOMICS

Prolonged breeding, intermittent spatfall and the settlement of spat on ropes, make it possible to have uninterrupted harvesting and relaying of mussels for 8-9 months in a year. As shown in Table 1, the average production per rope in 18 weeks is 18 kg of shells or 9 kg of meat, and accordingly, the annual production per raft (6.25 m²) with 50 ropes, is 23 tonnes of mussels which works out to 184 kg meat/m².

The annual estimated yield (Table 1) of 480 tonnes per hectare is lower than the 600 tonnes reported (Bardach,

Rhther and Mclarney 1972) from Spain but many times greater than that has been recorded by Qasim and Achari (1972). One of the reasons for lower yield is due to the use of smaller rafts with shorter ropes. Further refinements in the techniques to be used on commercial scale are likely to increase the yield further and reduce the cost of production. As compared to the rafts used in other countries like Spain, Netherlands, Philippine and Japan, our rafts are cheaper to fabricate and maintain but equally effective and perhaps most well suited for sea conditions along our coast.

As seen from Table 2, the value of produce per raft is Rs.6,900/- as against the cost of production which amounted to Rs. 2,450/-. This gives a gross profit of Rs. 4,450/- at a profitability rate of 181%. In fact, the rate of returns can be much more higher as the base figure of Rs. 3 per kg, used for evaluating the produce is almost 100% less than the present day market rate. Moreover, the proceeds which may accrue from the sale of empty shells (extensively used for lime making) are also not included in the return.

CONSTRAINTS AND ADVANTAGES.

The major shortcomings and constraints in mussel culture, in spite of its being highly remunerative are:

- i) Labour intensive operations at least in the initial phase.
- ii) Losses of ropes, anchors, mussels, etc. due to tampering by inquisitive fishermen and miscreants.

- iii) Intensive care of rafts during the monsoon season due to turbulent sea conditions.

Advantages: The raft culture of green mussels has the following advantages:

- a) High tolerance of mussels to wide variations in salinity, makes the species an ideal organism for cultivation in estuaries and marine environments of tropical seas.
- b) Growth occurs throughout the year and culminates in attaining marketable size within 18 weeks as against 12-13 months in wild population.
- c) Protracted breeding and continued settlement of spat ensures prolonged recruitment, which finally can give rise to 3 harvests in a year.
- d) Mussels being feeding on microscopic algal and detrital matter occurring abundantly in tropical seas there is no necessity for the use of artificial feed and thus a substantial saving in operational cost and recurring expenditure, can be exercised.
- e) Being almost immobile, culture and harvesting becomes cheap and easy.
- f) As the species can withstand a high degree of atmospheric exposure, marketing it "live" is possible.
- g) The high production of quality seafood in unit time and area guarantee a very substantial return on the investment.

- h) Small initial and low operational cost, simple technique, involving unskilled labour and a good market demand made the raft culture of mussels, an appropriate technology, both technically and economically.

Mussel culture, therefore, besides being highly profitable offers the best scope for utilization and management of resources. In fact, if the mussel culture is taken up as an industry on medium to large scale basis all the calculations of yield and profit will become an underestimate.

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TABLE 1

Details of Raft Culture Of Mussels in Goa

Time taken for commercial production	.. 18 weeks
Average marketable size of mussel	.. 62 mm
Average Weight of marketable mussel	.. 24 g with shell or 12 g meat
Number of 3 m ropes per raft	.. 50
Average Production per rope in 18 weeks	.. 18 kg mussels or 9 kg meat
Annual production per raft (6.25m ² area with 50 ropes)	.. 2300 kg
Annual production of meat per m ²	.. 184 kg
Annual production per hectare (By Computing 1/4 area of water occupied by Raft-each of 6.25 m ²)	.. 480 tonnes

TABLE 2

Investment, Return And Profit In Mussel Culture In Goa

1. <u>COSTS:</u>	
a) <u>Direct Cost:</u>	<u>Amount</u>
i) Material for fabrication of raft including wooden poles, planks, bamboos, drums, paints etc.	Rs 450.00
ii) Anchor, mooring chains etc.	Rs 750.00
iii) Rope and other materials	Rs 200.00
iv) Labour charges for fabrication, transportation and anchoring	Rs 150.00
Sub Total	Rs 1,550.00
b) <u>Indirect Cost:</u>	
i) Servicing and upkeep of raft (per annum)	Rs 200.00
ii) Travel and Overtime to staff	Rs 200.00
iii) Unforeseen expenditure	Rs 200.00
iv) Depreciation of raft and other materials (per annum)	Rs 300.00
Sub Total	Rs 900.00
Total cost	Rs 2,450.00
2. <u>RETURN</u>	
Value of mussel per raft (from Table 1)	Rs 6,900.00
3. <u>PROFIT</u>	
i) Value of produce	Rs 6,900.00
ii) Cost of production	Rs 2,450.00
iii) Gross profit	Rs 4,450.00
4. Rate of return on Investment	181%