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ECONOMICS OF DIVERSIFIED COASTAL AQUACULTURE PRODUCTION SYSTEMS IN KERALA

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The farming of shrimp, crabs, edible oysters, mussels, pearl oysters and lobsters offer immense scope not only for augmenting the aquatic production but also to increase our export earnings. Kerala is bestowed with 65,000 ha of brackish water area suitable for aquaculture activities. Shrimp farming has been the thrust area all these years and it is currently confined to less than 15,000 ha. There is enough scope to develop diversified culture practices in the unutilised potential areas. Different production systems like semi- intensive and more intensive prawn culture, crab farming and crab fattening with composite fish-prawn farming are analysed to assess their cost and earnings and their comparative economics. Semi-intensive shrimp farming and crab fattening are found to be the highly profitable ventures. Indicative economics of open sea mussel farming and edible oyster culture are also given. The problems in adopting these production systems are discussed and some suggestions have been put forth for their further expansion and improvement.

1. Introduction

Capture fisheries in India has almost reached the optimum level and aquaculture is fast emerging as an alternative avocation for coastal rural fisher folks. Aquaculture also immensely helps to enhance forex earnings of the country by way of exports. In India, farmers were concentrating mostly on shrimp farming due to its high export market and lucrative price. In recent years, there has been a continuously increasing international demand for several other items like crabs, oysters, mussels, lobsters and finfishes. As far as Kerala is concerned shrimp farming is still the thrust area with crab fattening picking up slowly. There is immense scope for other culture practices like open sea mussel farming, crab farming and edible oyster culture

2. Materials and Methods

Primary data has been collected from Vypen-Parur-Cherai belt of Ernakulam District by surveys conducted during 1998-99. Secondary data has been obtained from various CMFRI publications updated after consultation with experts in the field. Indicative economics of open sea mussel farming has been based on experimental culture done in Andhakaranazhi area of Alleppey

District and edible oyster culture at Dalavapuram of Kollam District

3. Results and Discussion

In Kerala, there is enormous scope to enhance the earnings from fisheries by shrimp farming under semi-intensive and more intensive farming systems, crab fattening and crab farming in the low lying fields under brackish water conditions and adopting edible oyster culture in brackish water systems and also through open sea mussel farming.

3.1. Shrimp farming

The seasonal paddy-prawn filtration is an age-old practice done on a commercial scale in Kerala. A saline resistant variety of paddy- 'pokkali' is cultivated during Southwest monsoon (June-October) in the fields adjoining backwaters. The paddy fields are leased out for prawn culture operations for 5 months (November-April), bunds are strengthened and sluice gates are fixed before prawn culture operation is initiated. Labour costs account for 60-65 % of the operating expenses. Juvenile prawns are trapped, held and harvested. Harvesting by filter net starts by November middle and is carried out for a week around every full moon and new moon period till the middle of April.

By April middle, just before the contract terminates a complete harvest of the entire stock of prawns and fishes is made by operating cast nets, drag nets and even hand picking, after draining out the water to the extent possible. This process is called 'Kettukalakkal'.

There is another type of prawn culture carried out in perennial ponds, which are deeper than the paddy fields where prawn culture is undertaken throughout the year. Both owner operated farming and leased out systems are followed. The traditional type of prawn filtration and scientific farming are prevalent. Although trapping, holding and harvesting is the same in most of the perennial ponds, now almost 90 % of the farmers stock additional prawn seeds.

In recent years semi-intensive culture of shrimps is picking up in Kerala. Pond preparation is done to eradicate predators and unwanted species. Ponds are deepened (0.5 –1m), a peripheral canal and 2 cross- channels are constructed. Selective stocking is done with fast growing species like *Penaeus monodon* @ 30,000 –60,000 / ha / crop and supplementary feeding is also done.

The economics of semi-intensive shrimp farming system with selective stocking of both *P.monodon* and *P.indicus* along with autostocking and locally prepared feed is given along with

the economics of more intensive farming system using seeds of *P.monodon* with high density and imported feed are given in Table 1.

Table 1: Comparative economics of semi - intensive and more intensive shrimp farming in Kerala

ITEMS	SEMI-INTENSIVE (1 ha) (in Rs.)	MORE-INTENSIVE (1 ha) (in Rs.)
A. INVESTMENT		
1. Pond Construction	50,000	4.8 including land cost
2. Lab and farm equipments	6.00	
3. Pump	16,000	– –
4. Sluice gate	18,000	– –
5. Miscellaneous	6,000	0.20
TOTAL	90,000	11.00
B. FIXED COST		
1. Depreciation @ 10%p.a	9000	0.55
2. Interest @15 %p.a.	13,500	1.65
3. Lease value of land	5200	– –
4. Permanent staff salary	– –	0.15
SUB-TOTAL	27,700	2.35
C. OPERATING COST		
1. Predator eradication	800	0.35
2. Seed	7200	1.80
3. Feed	30,000	2.25
4. Labour	12,000	0.08
5. Fuel	1600	0.30
6. Maintenance and repair	– –	0.10
7. Harvesting	– –	0.34
8. Miscellaneous	800	0.12
SUB–TOTAL	52,400	5.34
D.TOTAL COST(B+C)	80,100	7.69
E. Cost for 2 crops in a year	80,100	15.38
F. YIELD (in kg)	900	1,000
G. REVENUE	99,000	20.00
H. NET PROFIT (G-E)	18,900	4.62
I. ANNUAL PROFIT (Rs/ha)	18,900	4.62
J. RATE OF RETURNS	36 %	57 %

The cost structure and profitability are different in the two systems for which economics have been worked out on the basis of the variations in the intensity of the inputs used. Investment requirement in the former is less than 0.5 lakh whereas in the latter it is about 2.35 lakhs.

Semi-intensive prawn farming practice is replacing the traditional prawn culture system of Kerala. This can be accelerated by creating proper motivation among farmers through well-organised extension services and removing financial constraints by establishing links with rural funding agencies. It is all the more essential to provide major inputs such as good quality seeds and efficient feed to farmers in sufficient quantity at the right time through public agencies at reasonable prices so as to enable them to utilise all these factors of production to optimum levels.

3.2. Crab culture

Crabs are in high demand in foreign markets especially Southeast Asian markets. Crab culture is done in two ways– Crab farming and crab fattening. In crab farming small crabs caught alive from back waters are cultured until they attain a market size of more than 550 g. The crab can be cultured alone or in combination with shrimp and other fishes. Crab fattening is retaining soft shelled / water crabs for 20-30 days until their shells are hardened.

With the increasing incidence of disease problems in shrimp farms, crab fattening/ farming is emerging as an alternative enabling the farmers to resort to the measure of adopting rotation of crops in their farms. Economics of mud crab farming and fattening with composite fish-prawn farming is given in Table 2.

The increasing export demand coupled with general increase in price of all the fishes in the international markets has stimulated the crab culture. Crab fattening and farming are picking up in Kerala. The only constraint is the availability of enough stocking materials at the appropriate time. It is therefore imperative that concerted efforts are needed to develop commercial hatchery for adequate and sustained supply of baby crabs to make mud crab farming an organised industry. As indiscriminate and excessive exploitation of crabs from wild is bound to affect the natural population, mud crab farming may be popularised in a phased manner with less emphasis for large scale grow-out operations so that the pressure on wild stock can be minimised until hatchery production of crab seed is established in the country.

Table 2: Cost structure and profitability of crab farming and crab fattening with composite culture

ITEMS	CRAB FARMING	CRAB FATTENING WITH COMPOSITE CULTURE
A. INITIAL INVESTMENT (Rs)		
1. Land	50,000	3,00,000
2. 5 HP diesel pump	15,500	15,000
3. Watchman shed	5000	5000
4. Pond preparation, sluice gate, fencing and other expenses	11,500	25,000
TOTAL	82,000	3,45,000
B. ANNUAL FIXED COST (Rs)		
1. Lease value of the land@10 % of the cost	5000	15,000
2. Depreciation @ 20% of the initial investment excluding land	6400	9000
3. Interest @15 % of the initial investment	12,300	51,750
SUB-TOTAL (Rs)	23,700	75,750
C. OPERATING COST (Rs)		
1. Pond preparation	500	1000
2. Water crab	17325	3,52,000
3. Feed	2000	18,000
4. Operational cost of the pump	750	10,000
5. Prawn and fish seed	– –	5000
6. Labour charges	3000	36,500
SUB-TOTAL (Rs)	23,575	4,22,500
D. ANNUAL OPERATING COST (Rs)	1,41,450	4,22,500 (6 CROPS)
E. TOTAL ANNUAL COST(B+D) (Rs)	1,65,150	4,98,250
F. REVENUE (Rs)		
1. Quantity of crabs	1404 kg	3200 kg
2. Revenue from crabs	2,80,800	7,04,000
3. Revenue from prawns	– –	38,600
4. Revenue from shrimps	– –	32,500
G. TOTAL REVENUE (Rs)	2,80,800	7,75,100
I. PROFIT (Rs)	1,11,650	2,76,850

3.3. Edible oyster farming

Edible oyster can be considered as a renewable resource of much needed animal protein. In addition to this it offers employment potential to the rural communities. Oysters fetch high price and demand in international markets. In Indian conditions rack and string system is advocated (1-2.5 m depth). An yield of 80-105 tonnes per ha per crop is indicated. Meat yield accounts for 10% of the total weight of the oyster. In West Coast edible oysters take 7-9 months to reach harvestable size. The economics of edible oyster farming indicates its enormous growth potential in our backwaters (Table 3).

The experimental works carried out at Dalavapuram near Kollam have given highly encouraging results for developing Edible oyster culture along Kerala coast. Legal problems regarding ownership rights in backwaters is a major problem. Generating local market is another constraint. Diversification of the products may be helpful in generating local market.

3.4. Open sea mussel farming

Sea mussels give the highest production rates among all known cultivable organisms for two reasons – they feed directly on primary producers namely phytoplankton and that they are

Table 3:
Indicative economics of edible oyster farming by rack and ren method (300 m^2 area)

ITEMS	AMOUNT (Rs.)
A. INITIAL INVESTMENT	
1. Poles (vertical and horizontal)	3840
2. Nylon ropes	6750
TOTAL	10590
B. ANNUAL FIXED COST	
1. Depreciation @ 50 %	5295
2. Interest @15 %	1588.5
SUB-TOTAL	6833.5
C. OPERATIONAL COST	
1. Fabrication of oyster racks and rens	720
2. Harvest	640
3. Depuration	640
4. Shucking	880
SUB-TOTAL	2880
D. ANNUAL COST(B+C)	9763.5
E. ANNUAL PRODUCTION AND REVENUE	
1. Shell-on weight of oyster	4.25 t
2. Meat weigh t(10%)	425 kg
3. Meat value (Rs.30 / kg)	12750
4. Shell value @Rs.350 /t)	1190
F. TOTAL REVENUE	13940
NET PROFIT	4176.5
RATE OF RETURNS	54.4 %

farmed three dimensionally in the water column at the farm site. Seeds are collected from ropes suspended from rafts during peak spawning season. Longline culture is practised in shallow waters of 10-15 m depth. This can withstand

severe monsoon conditions in the West Coast.

The indicative economics of open sea mussel farming by longline method (0.36ha) is given in Table 4. In longline method duration of farming was 5-6 months and 2 crops were taken in a year. From the longline unit of 3600 m2 a total production of 54720 kg shell-on mussels was obtained of which 40% will be meat.

Capital expenditure comes to about 2.5 lakhs for long line method. Another two lakhs have to be spent by the entrepreneur to meet the operational expenditure. In long line method net profit works about to 1.88 lakhs per crop in area of 0.36 ha.

Mussel production rates are very high in tropical waters when compared to temperate waters. Besides generating alternative employment to fishermen, entrepreneurs can earn substantial profit by adopting mussel-farming technologies. Diversification of products ie. value added products may help in further spreading of mussel farming and its successful adoption.

A perspective planning is required for mussel culture with full realisation of its potential. Government support and assistance from public financial institutions with an element of risk coverage in initial phase will help in the establishment and growth of industry. Mussel culture should be viewed as a social security with a bias on nutritional improvement of the people and employment potential and later even for export market.

Table 4:
Indicative economics of open sea mussel farming (0.36 ha)

ITEMS	AMOUNT (Rs.)
A. INITIAL INVESTMENT	
1. Cost of construction	1,28,000
2. Floating platform for watch and ward	25,000
3. FRP dinghy and OB engine	75,000
4. Spat collectors	10,000
5. Others	12,000
TOTAL	2,50,000
B. FIXED COST (Annual/crop)	
1. Depreciation @ 50%	1,25,000
2. Interest @ 50%	37,500
SUB-TOTAL	1,62,250
C. OPERATIONAL COST (Per crop)	
1. Seed	30,000
2. Materials (cotton cloth, cement block etc.)	15,000
3. Labour	1,33,000
4. Miscellaneous	22,000
SUB-TOTAL	2,00,000
D. TOTAL COST (B+C)	3,62,500
E. EXPECTED PRODUCTION	55 t
F. GROSS REVENUE @ Rs. 10/Kg.	5,50,000
G. NET PROFIT	1,87,500
H. RATE OF RETURNS	90%

4. Conclusion

The study indicates that all types of aquaculture production systems are highly profitable depending upon specific locations. Location specific suitability of culture systems and availability of seeds are most important pre-requisites for the success of aquaculture programmes. Kerala is blessed with back waters and lot of brackish water areas. The need of the hour is to locate and map the areas suitable for particular culture systems specifically, rather than identifying potential areas generally suited for aquaculture. Socio- economic acceptability of the inhabitants of the region has to be looked into before initiating new venture.

Hatchery production of crab seed has to be initiated to ensure the success of crab farming. Other wise it may result in depletion of natural stock and shortage of adequate seed for crab culture. Framing of suitable legislation to give property rights in open seas and back waters is a necessity to ensure the security and profitability of open sea culture practices and farming in brackish waters. This will motivate more farmers to take up mussel and edible oyster farming. Further product diversification (ie. value added products) and market promotion are to be reoriented to boost the exports of all aquaculture products rather than concentrating only on shrimps.

REFERENCE

Ajith Kumar, V and K.K.P. Panikkar 1993. An analysis of factor-product relationship in prawn farming: A production function approach. *CMFRI Spl. Publ.*, 1993, **54** pp 85-93.

Appukuttan, K.K and P.Muthiah 1996.Technology of edible oyster culture. Artificial Reefs and seafarming technologies (Dr. K. Rengarajan ed.) *CMFRI, Bulletin* **48** pp 64-69.

Jayagopal, P. and R. Sathiadhas 1993. Productivity and profitability of prawn farming practices-An economic analysis *CMFRI Spl. Publ.*, 1993, **55** pp 16-25.

Kuriakose, P.S. and K.K. Appukuttan 1996. Technology of mussel culture Artificial Reefs and seafarming technologies (Dr. K. Rengarajan ed.) *CMFRI, Bulletin* **48** pp 70-75.

Sathiadhas, R, R. Reghu and V.K. Suresh 1996. Economic evaluation of composite culture practices of crab fattening and fish-shrimp farming in Kerala. *Fishing chimes* Vol.**16** (4) pp 31-34

Sathiadhas, R., D.B.S. Sehara, K.K.P. Panikkar and R. Narayanakumar 2000. Economics of different production technologies in culture fisheries. *Marine fisheries research and management* (V.N. Pillai and N.G. Menon eds.)pp. 827-845.

Suseelan, C. 1996. Crab culture and crab fattening. Artificial Reefs and seafarming technologies (Dr. K. Rengarajan ed.) *CMFRI, Bulletin* **48** pp 99 - 102.