



Economic Evaluation of Composite Culture Practices OF CRAB FATTENING AND FISH-SHRIMP FARMING IN KERALA

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The aquaculture industry in India is picking up rapidly in view of its high income and employment generating potential. Recently there has been a drastic reduction in the production of shrimps from our aquaculture farms due to the outbreak of disease. The declining demand for shrimps in export market further induced our farmers to look for alternative lucrative farming practices. The farming of crabs, spiny lobsters, pearl oysters, edible oysters, mussels, sea cucumbers and groupers offers immense scope not only for augmenting the aquatic production but also to increase our export earnings. Among the edible crustaceans, shrimps, lobsters and crabs occupy a predominant place by virtue of their importance as table delicacies.

Collection of live mud crab from the wild as well as its culture have been expanding in Kerala in recent years because of its attractive prices and its high potential as an export commodity. Since mud crab production and its export provide excellent scope to enhance income and employment generation in the coastal rural areas, the present analysis is undertaken with the following specific objectives.

- to assess the statewide production trend of crabs from the capture fisheries and to analyse the export earnings.

- to work out the economics of composite culture practice of crab fattening and fish-cum-shrimp farming undertaken on commercial basis, and

- to identify the problems encountered by the crab farmers in the existing crab farming techniques and suggesting remedial measures.

Materials and methods

Both primary and secondary data have been used for the present analysis. The secondary data pertaining to the annual crab production have been obtained from the National Marine Living Resources Data Centre (NMLRDC) of Central Marine Fisheries Research Institute and the export figures from the publication of Marine Products Export Development Authority (MPEDA). The primary data on production patterns, packages of practices followed, cost and earnings, employment and labour utilisation were col-

lected from 10 sample crab fattening and fish-shrimp culture farms having a total area of 12 acres located in Cherai, Parur, Valappu and other parts of Ernakulam district for a period of one year (1995 - 96).

Results and Discussion

An overview of production trend in capture fisheries

The crabs belonging to the families Portunidae (9 species), Calapidae (2 species), Ocypodidae (3 species), Grapsidae (one species) and Xanthidae (one species) are the edible crabs in India and these crabs are exploited mostly as a by-catch by both artisanal and mechanised units in the inshore waters.

Though some of these crabs migrate into the backwaters, estuaries and coastal lakes, two species of larger crabs belonging to the family Portunidae namely *Scylla tranquebarica* and *Scylla serrata*, commonly known as "mud crabs" or "green crabs" or "mangrove crabs" form a sustenance fishery in brackishwater bodies.

The All India average annual crab landings from the marine sector during the ten year period from 1985 to '94 is recorded as 23,528 tonnes (Table I). In the marine crab fishery, the share of mud crab is about 4.5% and the rest by *Portunus spp*, *Charybdis spp*. etc (CMFRI 1969). But in the brackishwater sector mud crabs formed about 65% and the rest by *P. pelagicus*.

Among the maritime states, Kerala ranks third in the production of crabs from the capture fisheries in the marine sector and there is also an increasing trend in the exploitation of crabs from the brackishwater sector. Commercially, fishing for mud crab is done from the sea as well as from the backwaters. In the sea, they are caught from the shallow coastal regions in abundance during the monsoon season from June to August, mainly in trawlnets, gillnets and castnets. In brackishwater regions, crab is a regular fishery throughout the year and caught in stakenets, castnets *mudvala* (gillnets), ring nets and crab traps.

In recent years the backwater fishermen intensified mud crab fishing due to its high profitability with lesser input than that of the

other types of fishing. Mud crab fishing is done throughout the length and breadth of Kerala wherever backwaters are available. Though the exact quantity of mud crabs caught every month from different regions in Kerala is not available, it is caught regularly by about 4815 Chinese Dip nets, 12,909 stake nets and innumerable castnets, crab ringnets, gillnets and the crabtraps irrespective of any season.

Export trend: The export of frozen crab meat from India to countries like Japan, USA, Belgium, Thailand, Portugal, Brazil, U.K., Netherlands and France increased from 1.04 million tonnes in 1990 to 1.93 million tonnes in 1994 with the export earning of Rs. 3.63 crores in 1990 moving up to Rs. 22.96 crores in 1994. The export value of the live mud crab also increased from 1.65 crores to Rs. 6.27 crores during this period. (Table II).

In Kerala, due to the recent increase in the price of the export quality live mud crabs, very intensive fishing in the brackishwater area has been started for the mud crab alone. They get a price of about Rs. 200-220 per kg for the large sized export quality live ones which weigh more than 550 grams. While the quantity of crabs exported from our country increased from about 1.7 million tonnes to 2.7 million tonnes from 1990 to 1994; the export earnings increased from Rs. 53 million to Rs. 294 million for the same period. The unit value realised for the live crabs and frozen crabs steadily increased over the years and led to the six fold increase in export earnings from 1990 to 1994 (Table III).

Scope for expansion of crab culture in Kerala

Though Kerala is bestowed with 65,000 hectares of brackishwater area suitable for aquaculture activities, shrimp farming is confined to an area of less than 15,000 hectares. Hence there is enough scope to develop crab farms in the unutilised potential areas not fully suitable for shrimp farming. Some of the present traditional shrimp farms which are less productive due to various reasons are also suitable for crab farming. Many of these less productive farms are now being con-



verted for crab farming which is more profitable than shrimp farming mainly because of its lesser input requirements.

Crab Fattening: Mud crabs caught from the backwaters with hard shell and weighing more than 550 grams each alone are used for export purposes. "Mud" quality is determined by pressing at the metabranchial region of the crab. The soft ones or the ones less hard, called water crabs, are discarded by the exporters and large quantities of these discarded water crabs in Kerala are used by the crab farmers for fattening. They are collected daily from the collection centres at the rate of Rs. 80-110 per kg and deposited in the ponds. They are fed 5-10% of their body weight by fresh or salted trash fish which cost about Rs. 3-4 per kg. They are harvested after 1-2 weeks. This is a regular and continuous process.

Ponds having an outlet to the backwaters either directly or by a service canal and with one to one and a half meter depth are used as crab fattening farms in Kerala. Small farmers with less than 5 cents of water area are also doing successful crab fattening and very often the activity is a family enterprise.

Crab Culture: Smaller sized crabs caught alive from the backwaters are stocked in culture ponds and are grown till they attain the marketable size of more than 550 grams each in weight. Small farmers with one or two acres of ponds do not show much interest because of the longer period involved in this culture practice. However, these are stocked, in considerable numbers in large traditional shrimp filtration farms without giving any additional food. The process continues for a period of about one year and they earn good profit.

Fish-shrimp farming with crab fattening

Crabs occupy only the bottom area of the pond and always prefer to bury themselves into the mud and they come out from the slushy bottom mainly for feeding. The water column of 1 to 1.5 metre depth is used for other aquaculture activities which are a regu-

lar feature in Kerala. Juveniles of shrimps and fin fishes, are allowed to enter into the pond during high tide as in the traditional shrimp filtration farms and are allowed to grow. They are caught during new moon and full moon "Thakkam", when the tidal influence is the maximum. In Kerala this type of composite culture practice of shrimp and fin fish along with crab fattening is rapidly picking up momentum because of the very high income received from polyculture than monoculture of the different varieties of shrimps finfishes. Shrimps such as *Penaeus monodon*, *P. indicus* and *Metapenaeus dobsoni* are caught in viable quantities without any additional labour or input. Apart from the shrimps, *Etroplus suratensis* (Pearlspot) *Mugil cephalus*, *Chanos chanos*, smaller varieties of mullets, and Tilapia, are the most important fishes caught under polyculture system. In addition to the natural entry by tidal influence, fishermen also stock young ones of *Etroplus suratensis*, *Mugil cephalus*, *Chanos chanos*, and seeds of *Penaeus indicus* and *P. monodon* according to the availability of seeds and the area of the fattening pond and these are harvested when they attain marketable size. Even the productive traditional shrimp filtration farms are also utilised for this type of polyculture in many of the areas in Ernakulam District.

Marketing of the mud crab is easy in Kerala as they are purchased at the production centres themselves by the exporters. Innumerable mud crab collection centres have come up in the brackishwater areas of Kerala and their agents visit the small crab fattening farmers daily and collect the material from the site itself. The prices are competitive and vary from Rs. 200 to 220 according to the size of the crab.

Economic analysis: The average annual cost and earnings of one acre crab fattening-cum-shrimp and fish culture farm in Ernakulam district of Kerala state is worked out and given in Table IV. The initial investment on a one acre farm works out at Rs. 3.45 lakhs. With the increasing thrust on aquaculture practices in recent years farms

suitable for fish culture fetch a premium price. The average purchase value of one acre farm works out to Rs. 3 lakhs and the remaining initial investment of Rs. 45,000 is towards pond development, diesel pump, sluice-gate and watchman shed. Depreciation of assets and interest for initial investment are the two components of annual fixed cost. However, in case of the value of land, it always appreciates far more than the usual appreciation of other assets. Hence the opportunity cost of land is taken into account while working out the annual fixed cost. In other words, the opportunity cost of land is nothing but the existing lease value of the farms in this region. The interest for the initial investment is worked out at the rate of 20% per annum. Thus the average annual fixed cost works out at Rs. 93,100 for one acre farm.

The annual operating cost works out to Rs. 4.22 lakhs in which seed cost alone constitutes about 85%. Two labourers are required daily to carry out the fattening of fish cum shrimp farming in an efficient manner. The total cost works out to Rs. 5.2 lakhs. Although most of the small farms less than one acre size are managed as family enterprises, the opportunity cost of Rs. 100 per labour day is included in working out the operational cost of this culture practice. Mostly trash fish is used as the feed and the cost of the same for a farm pond of one acre works out to Rs. 18,000 per annum.

Crab fattening is a continuing process. The availability of water crabs determines the success and profitability of farmers. The study indicates that during 1995-96 the average quantity of crabs fattened in a farm of one acre size works out to 3200 kg fetching a revenue of Rs. 7.04 lakhs. The high investment-turnover ratio of crab fattening has encouraged many farmers to venture into this farming. Consequently there is scarcity of water quality crabs. It is reported that there is a steady decline in the stocking rates of water quality crabs in the current year which has reduced the gross earnings.



Slanting net fencing of the crab fattening pond with a progressive farmer



Weighing of fattened crabs



Fattened crabs-ready for sale



It is well known that fish and shrimp constitute substantial quantity in the final harvesting of traditional shrimp filtration farms. In addition to the natural entry the tendency of collecting the seeds of several varieties of shrimps and quality fishes and growing them in the crab fattening farms are fast expanding among the farmers. The average catch per acre from these farms comes to about 1650 kg (850 kg of shrimps and 800 kg of fishes) fetching a revenue of Rs. 7.75 lakhs. Thus the annual net profit of well managed one acre farms in Ernakulam region used for crab fattening and composite prawn-fish farming works out to Rs. 2.59 lakhs.

Conclusion and Policy Implications

The All India marine crab landings from 1985 to 1994 have shown a steady increase from 22 thousand tonnes to 30 thousand tonnes annually. However there is a declining trend in the landings from Gujarat state and not much improvement has been observed in the landings from West Bengal, Orissa, Pondichery and Goa. The unit value realisation increased from Rs. 24 to 78 per kg for live crabs and Rs. 35 to 119 for frozen crabs from 1990 to 1994.

The export earnings from crabs (live and processed) increased from Rs. 52.8 million during 1990 to Rs. 294 million during 1994. The increase in export demand coupled with general rise in prices of all fishes in the internal market has stimulated the crab culture and fattening practices in our country.

Economics of crab fattening in association with shrimp and fish farming in Kerala indicate high profitability and investment turnover ratio. The annual gross earnings of one acre farm works out at Rs. 7.75 lakhs with a net profit of Rs. 2.59 lakhs. High profitability of this type of polyculture of crab fattening, and shrimp fish farming is inducing many new farmers to enter into this lucrative business.

The crab culture in Kerala is concentrated mainly on fattening and small farmers are reluctant to do the grow-out culture because of the longer period involved in the practice. The owners of a few larger traditional shrimp filtration farms alone are doing the grow-out culture. The smaller crabs are purchased in larger numbers and are stocked in the farms without giving any additional food and are caught only once during the annual harvest.

Farms with slushy bottom are more suitable for crab culture. Observations revealed that crabs in sandy or hard clay bottom ponds are more restless and try to escape over the

bunds whereas in the slushy bottom ponds, crabs embed themselves in the mud most of the times and come out only for feeding when fresh seawater enters into the pond either during high tide or when water is pumped in. Further, slushy bottom is also safer for the crabs to hide from predators after moulting. Slanting net fencing over the bunds to prevent the escape of crabs could be avoided if one feet depth of sand from the sandy bottomed pond could be replaced by the slushy mud from the surrounding backwater area.

Many of the farmers have erected strong net fencing around the pond upto a height of 5-6 feet to avoid poaching. Watch dogs are also kept around the farm to alert the watchman from the poachers during the night.

Non-availability of sufficient big water

crab is a serious problem faced by the farmers. The seeds are mainly from the wild backwater crab fishing. Big water crabs rejected by the exporters are the major source of seed and the hatchery production of the seed is the best alternative for ensuring availability of seed.

Sea ranching of the berried female crabs during the spawning season is another solution to increase the wild production of the crab. Destruction of large quantities of smaller crabs by bottom trawling is another factor which is to be taken into account to preserve the natural production.

There is immense scope to increase the crab production in our country both from the capture and culture fishery sectors by following appropriate extension and management

Table I. Statewise landings of crabs during 1985-94

Year	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondi-cherry	Kerala	Karna-taka	Goa	Mahara-shtra	Gujarat	Total all India
1985	210	127	1587	6575	430	973	595	1789	494	9452	22232
1986	93	180	3220	5875	326	1400	1868	2872	361	4560	20755
1987	130	368	2312	7801	205	2560	2575	2325	389	4433	23098
1988	66	230	2116	7039	377	2151	762	497	211	3973	17422
1989	26	398	2695	5842	86	2664	771	327	195	3445	16149
1990	24	148	2063	6830	310	4704	948	569	414	7960	23970
1991	125	199	3447	10016	413	4317	1181	435	638	7469	28240
1992	27	548	3768	8851	282	4864	2069	332	674	5434	26849
1993	139	712	3963	10742	296	5612	1174	890	1027	2383	26938
1994	241	267	3278	10067	251	4778	1462	451	1660	7077	29631

Source: C.M.F.R.I., Cochin-14.

Table II. Export of crabs from India (1990-94)

Item	Live crab	Frozen crab meat	Canned crab meat	Total				
Year	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)
1990	683805	16479105	1040584	36297321	-	-	1724389	53776426
1991	517643	13481660	730489	32456153	-	-	1248132	45937813
1992	699588	32144417	538835	42804464	55084	2972537	1293507	77921418
1993	559410	39746897	1243574	128918534	-	-	1802984	168665431
1994	797184	62651918	1934574	22957175	16818	1687275	2748576	293910945

Source: MPEDA, Cochin

Table III. Unit Value Realisation of Crabs in Export Market, (1990-94)

Year	Live Crab Rs/kg.	Frozen Crab net Rs/kg.	Canned Crab net Rs/kg.
1990	24.10	34.88	-
1991	26.04	44.43	-
1992	45.95	79.44	53.96
1993	71.05	103.67	-
1994	78.59	118.67	100.33

Source: MPEDA, Cochin.

measures. Currently in India, only about 120,000 hectares are used for shrimp culture which is less than 10 per cent of total potential area. Crab farming will enable us to utilise these unutilised or underutilised water bodies for aquaculture.

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FISHING CHIMES



Table IV. Economics of crab fattening and composite fish-prawn farming in Ernakulam Distt., Kerala

(Rs.)

I. Initial investment (average)

1. Value of land (1 acre)	3,00,000.00
2. Development of fish pond bund construction and fencing	15,000.00
3. 5 HP Diesel pump	15,000.00
4. Sluice gate	10,000.00
5. Watchman shed	5,000.00

Total 3,45,000.00

II. Annual fixed cost:

1. Lease value for the land	15,000.00
2. Depreciation (20% of initial investment excluding land)	9,000.00
3. Interest (20% initial investment)	69,100.00

Total 93,100.00

III. Annual operating/working cost

(Rs.)

1. Pond preparation	1,000.00
2. Cost of big water crabs (3200 Nos at Rs. 110/kg)	3,52,000.00
3. Average cost of prawn/fish seed	5,000.00
4. Feed	18,000.00
5. Fuel/Electricity for pump	10,000.00
6. Labour charges (2 persons @ Rs.50/- day)	36,500.00

Total 4,22,500.00

IV. Total annual cost

(II + III) **5,15,600.00**

V. Annual production and revenue

a. Crab (3200 kg/Rs.220) (present market rate)	7,04,000.00
b. Prawns & fishes	
a. <i>P. monodon</i> ,	

(Rs.)

50 kg @ Rs. 260/kg	13,000.00
b. <i>P. indicus</i> 100 kg @ Rs. 130/kg	13,000.00
c. <i>M. dobsoni</i> 700 kg @ Rs. 18/kg.	12,600.00
d. <i>Thilapia</i> 200 kg @ Rs. 40/kg	8,000.00
e. <i>Mugil cephalus</i> (Thirutha) 100 kg.(Rs. 80/kg.)	8,000.00
f. Mulletts (smaller size) 150 kg	4,500.00
g. Pearlsport 100 kg (Rs. 70/kg)	7,000.00
h. Miscellaneous fishes 250 kg (Rs.20/kg)	5,000.00

Total 7,75,100.00

VI. Profit

(V-IV) **7,75,100.00 - 5,15,600.00**

= 2,59,500.00

