

Cage Farming by Coastal Fishermen in Malabar-A Case Study

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The estuarine waters in India are highly productive, harbour rich diversity of flora and fauna, serve as nursery grounds for many fishes, support artisanal capture fisheries and provide livelihood to the coastal fishers. It is estimated that there are 12.40 lakh ha of brackish water resources in India, and comprise of backwaters, estuaries, lakes, tidal creeks, canals, coastal lagoons, mudflats, etc. Climate change and anthropogenic activities hassled to decline in fish catches which has affected the livelihood security of small-scale fishermen who depend on estuarine fisheries. Cage fish farming in the estuarine waters can be recommended as an alternative livelihood and income generation programme for the coastal population. The culture of high-value euryhaline marine fish species like seabass, pearl spot, mullets, milkfish, pompano, grouper, carangids etc. is being undertaken in cages to meet the demand in domestic market.

Cage fish farming has got immense potential for generation of income and employment for the coastal fisher folk population of North Kerala. One of the potential resources available for cage farming in North Kerala is the estuarine bodies or backwaters, holding huge volume of water maintaining higher depth and non-drainable in nature. With successful demonstrations and financial support through NFDB and CMFRI, cage culture was introduced in the estuarine and coastal waters in different parts of North Kerala. At present, more than 150 cages are installed across various estuarine water bodies of North Kerala with the technical support from ICAR-CMFRI.

Onsite demonstration of cage fabrication to farmers of North Kerala

The fishers living in coastal hamlets, farmers involved in aquaculture or owning homestead near backwater resources, fisherman societies or entrepreneurs residing along the backwaters of North Kerala namely Korapuzha estuary of Kozhikode, Kavvayi backwaters of Kannur, Bekal river of Kasargod and Karapuzha, Wyanad were identified as beneficiaries. The potential sites for cage installation were identified and the site selected contains ideal water depth (4 mts) and were free from domestic or industrial waste discharge. Demonstration of cage fabrication and installation were conducted at Atholi and Mujukunnu in Kozhikode district, Payannur and Kuppam in the Kannur district and Bekal in Kasargod district. The most successful GI cage dimension was 4x 4 x 3 m³ and netlon nets for stocking fish.

Floating cage of dimension 3x 3 x 3 m installed for culture of fishes

The major species selected for farming are Asian seabass (*Lates calcarifer*), pearlspot (*Etroplus suratensis*), tilapia (*Oreochromis sp.*) and red snapper (*Lutjanus argentimaculatus*). The stocking density varied depending on the cage volume and species of fishes selected for farming in the coastal areas. Seed production technique for red snapper is not developed in the country and capture based aquaculture is practiced for culturing this fish, whereby the juveniles are caught alive and allowed to grow to marketable size in cages.

Case study

The selected farmers are from Mujukunnu Village of Moodady Grama Panchayat in Kozhikode district residing near Akalapuzha backwater, one of the emerging ecotourism sites in Kozhikode district, Kerala. They were engaged in fishing activities in estuarine waters for the past 30-40 years and they had passion for fish farming practices too. During 2016, Mr. Sathyan had initiated a small-scale cage farm with 40 numbers of 2x2 m PVC cages stocked with 250 numbers of 5 cm size Asian seabass *Lates calcarifer* in each cage. But, due to lack of technical knowledge, he lost the entire stock due to cannibalism. During 2017, these farmers were identified for the participatory cage fish culture under the CMFRI in-house project at Mujukunnu (11°50'12.4"N 75°66'86.4"E), in Akalapuzha backwater, Moodady Grama Panchayat, Kozhikode District, Kerala. Field demonstrations on cage fabrication and installation were conducted at Mujukunnu and technical and financial assistance for cost-effective cage farming using Galvanized Iron (GI) cages was also provided. A floating cage of 3 m x 3m x 2m was stocked with 250 numbers of Pearl spot, *Etroplus suratensis* (5-10g). Fishes attained 175- 225 g with 95 % survival in 12 months culture period. The farmers could obtained a production of 50 kg from a single cage (18 m³volume) and the fishes were sold at Rs.550/kg.

During 2019, an attempt for capture-based aquaculture was done using juveniles of mangrove snapper, *Lutjanus argentimaculatus* and pearl spot, *E. suratensis* collected from Kadalundy and Korapuzha estuaries by local fishermen using traps. A total of 125 numbers of *L. argentimaculatus* measuring 10±3 cm and 500 numbers of 10±2.5 cm *E. suratensis* juveniles were stocked in the cage during January 2020. Locally available low-value fishes were used for feeding the fish. After a grow-out period of six months, the fishes were harvested in July 2020, during the COVID-19 lockdown period. Red snapper had attained 500-700 g with an average weight of 655 ± 45g and pearl spot 100-150 g with an average weight of 125 ± 25g. A survival of 60% for red snapper and 90% for pearl spot were recorded. Total production from the cage was 90 kg (40 kg snapper and 50 kg pearl spot). The fishes were sold at farm gate itself @ Rs.600/ kg for snapper and Rs.550/kg for pearl spot and the revenue generated was Rs.51, 500/-.

Further the farmers got an opportunity to attend a three days training programme on “Open Sea Cage Farming and Mariculture” conducted by ICAR- CMFRI under the NFDB Skill Development Programme in 2019. The farmers initiated the farming in two cages provided by ICAR-CMFRI, later on with the support from Department of Fisheries,

Kozhikode, and the number of cage units have been increased to 10 in 2020, 24 in 2021 and by 2022 the farmer's own a total of 76 cages. Currently, 76 cages are under operation out of which 55 cages are engaged in seabass farming, 15 cages are used for pearl spot farming, three cages for red snapper and three cages for chitralada farming. The economic performance of cage farming of different species of fishes were calculated for comparing the profitability. Depreciation on cage frame and accessories were calculated using straight line method with an expected life of 5 years and the financial indicators such as NPV, BCR and IRR were calculated for a project period of 5 years at 15% discount rate as per the method followed by Aswathy *et al.* (2020).

Experience shared by Mujukunnu fish farmers

The farmers prefer monoculture of fish species like Asian sea bass (*Lates calcarifer*), pearl spot (*Etroplus suratensis*), Red snapper (*Lutjanus argentimaculatus*) and Nile tilapia (Chitralada) in cages based on qualities like fast growth rate, good market price and availability of good quality hatchery produced seeds and ease of culture

Culture details

Sea bass

The farmer's prefer farming of sea bass locally known as Kannikan or Kalanji because of their faster growth rate, good market price and availability of good quality hatchery produced seeds. They prefer low stocking density farming of sea bass by stocking 300 numbers of hatchery produced sea bass fingerlings of 5.0 – 5.5 cm size purchased @ Rs.30/ fingerling in 3 m x 3 m x 3m cages. During the first two months of culture, they fed the fishes with pellet feed (Growel) initially at 15 percent of the body weight, then reducing to 5 percent of the body weight as the culture progressed. From 3-8 months, they fed the fishes with low-value fishes. Fishes reached 1-2 kg within 8 -9 months culture period with 100 percent survival and the fishes were sold at the rate of Rs.500-700/kg. The farmers could get an average production of 300-350 kg of sea bass from a single cage of 27 m³ earning a gross income of Rs.1,50,000-2,00,000 per cage.

Red snapper

The farmers prefer the farming of red snapper locally known as “chempalli” because of their faster growth rate and good market price. One of the major constraints in red snapper farming is the non-availability of hatchery produced seeds. Farmers usually collect the snapper fingerlings from the estuary and stock them in cages. About 300 numbers of wild collected snapper seeds were stocked in 3 m x 3 m x 3m cages. The fishes were fed with low value fishes initially at 15 percent of the body weight then reducing to 5 percent of the body weight as the culture progressed. Fishes reached 1-1.5 kg within 8 months culture period with 99 percent survival and the fishes were sold at the rate of Rs.500-700/kg. The farmers could get an average production of 250-300 kg of sea bass from a single cage of 27 m³ earning a gross income of Rs.1,25,000-1,50,000 per cage.

Pearl spot

The pearl spot required longer culture duration of 12 months in cages at Mujukunnu to reach marketable size (200-250 gm). Five hundred fingerlings (4 cm) purchased @ Rs. 10/ fingerling were stocked in 3 m x 3 m x 3m size cages. During the twelve months of culture, the fishes were fed with pellet feed (Growel) initially at 12 percent of the body weight then reducing to 3 percent of the body weight as the culture progress. Pearl spot is also having very good market demand (about Rs 500-600/ kg) in local market. An average production of 100 kg/cage with a gross income of Rs. 50,000 could be obtained.

The pearl spot required 8 months in cages at Payyanur, Kannur to reach marketable size (200-250 gm). Two thousand fingerlings (4 cm) purchased @ Rs. 10/ fingerling were stocked in 4 m x 4 m x 3m size cages. During the eight months of culture, the fishes were fed with pellet feed initially at 12 percent of the body weight, then reducing to 3 percent of the body weight as the culture progressed. Pearl spot is also having a very good market demand (Rs.500-600/ kg) in local market. An average production of 350 kg/cage with a gross income of Rs.1,75,000 could be obtained.

Chitralada

The farmer opined that Chitralada requires only 6 months culture duration and two crops could be harvested annually. The farmers stocked around 500 number of Chitralada fingerlings (4.0 cm) purchased @ Rs. 8/ fingerling in 3 m x 3 m x 3m size cages. The fishes were fed with pellet feed (Growel) throughout the culture period. Fishes reached 800-900 g within 5-6 months culture period with almost 100 percent survival. They could obtain an average production of 400-450 kg of Chitralada from cages of 27 m³ within a farming period of 6 months and the fishes were sold at the rate of Rs.250/kg. They earned a gross income of Rs. 1,00,000-1,10,000 per cage.

Economic Performance

The 27 m³ cage with a stocking density of 300 numbers of sea bass yielded a gross revenue of Rs.1.5 lakhs and net profit of Rs.74,200 in an 8 months culture period. The internal rate of return was 99.5% with a benefit cost ratio of 1.92.

The 27 m³ cage with a stocking density of 300 numbers of red snapper yielded a gross revenue of Rs.1.4 lakhs and net profit of Rs.68,700 in an 8 months culture period. The internal rate of return was 93.19% with a benefit cost ratio of 1.74.

The 48 m³ cage with a stocking density of 2000 numbers of pearl spot yielded a gross revenue of Rs.1,75,000 and a net profit of Rs.55900 within a culture duration of 8 months. The internal rate of return was 86.9% with a benefit cost ratio of 4.25.

The 27 m³ cage with a stocking density of 500 numbers of chitralada yielded gross revenue of Rs.1,12,500 and net profit of Rs.40,900 in 6 months culture period. The internal rate of return was 70.9% with a benefit cost ratio of 2.36. The details are given below:

Economic performance of cage farming of sea bass, red snapper, chithralada (3 x 3 x 3m³ cage), and pearl spot (4x4 x 3 m cage) for a culture period of 8 months

Sl. No	Particulars	Amount (Rs.)			
		Sea bass	Red snapper	Pearl spot	Chithralada
I. Capital Investment					
1.	Cost of cage frame	25,000.00	25,000.00	30,000.00	30,000.00
2.	Cost of nets	30,000.00	30,000.00	30,000.00	25,000.00
3.	Cost of floats and accessories	10,000.00	10,000.00	10,000.00	10,000.00
4.	Mooring and installation charges	5,000.00	5,000.00	5,000.00	5,000.00
5.	Deep freezer	15,000.00	15,000.00	-----	-----
Total fixed cost (1+2+3+4+5)		85,000.00	85,000.00	75,000.00	70,000.00
6.	Depreciation (20%)	17,000.00	17,000.00	15,000.00	14,000.00
7.	Interest on fixed capital (12%)	10,200.00	10,200.00	9,000.00	8,400.00
Annual Fixed cost (6+7) (A)		27,200.00	27,200.00	24,000.00	22,400.00
II. Operating costs					
8.	Seed (Cost of seed & Transportation)	9,000.00	10,500.00	20,000.00	4,000.00
9.	Feed (Trash fish/ pellet as per species)	28,000.00	22,000.00	63,500.00	36,000.00
10.	Labour 2 hrs/day @ Rs.1200/month for 8 months	9,600.00	9,600.00	9,600.00	7,200.00
11.	Harvesting & Miscellaneous Expenses	2,000.00	2,000.00	2,000.00	2,000.00
Total operating cost (7+8+9+10) (B)		48,600.00	44,100.00	95,100.00	49,200.00
Total cost (A+B)		75,800.00	71,300.00	1,19,100.00	71,600.00
III. Returns					
	Production	300 KG	280 KG	350 KG	450 KG
13.	Gross revenue	1,50,000	1,40,000	1,75,000	1,12,500
14.	Net profit	74,200	68,700	55,900	40,900
15.	Cost/ kg of fish (Rs.)	252	254	340	159
16.	Price/ kg of fish (Rs.)	500	500	500	250
17.	Operating ratio	0.32	0.31	0.54	0.43
18.	NPV	2,31,256	2,12,819	1,71,967	1,22,713
19.	BCR	1.92	1.74	4.25	2.36
20.	IRR	99.5%	93.19%	86.9%	70.9%

Technology upgradation introduced by farmers of North Malabar in cage farming Surveillance

The farmer's installed surveillance unit at cage site for continuous monitoring of culture activities. The fish cages are fitted with solar panels, cameras and sensors to collect data and monitor images. The data and images are transmitted to the shore station via a mobile phone network. This system allows the remote monitoring of fish and the installation of surveillance unit costs around Rs.80,000.

On-field feed storing shed-cum-watch shed:

The farmer's fabricated and installed an on-field feed storing shed-cum-watch shed for feed storage, management and monitoring of culture activities. The fabrication and installation of feed-cum-watch shed unit costs around Rs.50,000.

On-site marketing facilities

The partial harvest of fishes was undertaken as per the demand from consumers. The support through social media like Facebook, Whatsapp etc. played an important role in achieving good sales for the farmer. The harvest of fishes are planned to coincide with occasions like Onam, Vishu, Bakrid etc.

New ventures initiated by cage farmers of North Kerala:

Mr. Sudhish, one of the progressive cage fish farmers of Payyanur, Kannur initiated cage farming during 2018 under ICAR-CMFRI –NFDB scheme. He was an electrician previously and now he is full time engaged in cage fish farming and mussel farming along with his family. During 2018-2019, he initiated farming in two GI cages provided by ICAR-CMFRI, and later on he added 6 more cage units and now the farmer owns a total of 8 cage units culturing mainly seabass, pearl spot and red snapper. He is a pioneer in cage farming at Payannur who motivated many others at Payyanur to initiate cage farming. Recently in 2021, he started an enterprise "SS distributors -Fish feed and fish farming material" which is engaged in supplying fish farming materials to the farmers of Kannur district.

Constraints faced by the farmers in adoption of cage farming technology:

According to the farmers, cage fish farming is a profitable venture. The vast unutilized areas in the estuarine and brackishwater region offer promising scope for augmenting fish production through cage farming in North Kerala. However the farmers have listed the following constraints as major bottlenecks for large-scale cage fish farming.

1. Lack of credit facilities
2. Lack of insurance
3. High seed cost
4. Natural calamities
5. Attack of beavers
6. Conflict with tourism boat



Farmer’s suggestions for increasing adoption of cage culture technology:

1. Establishment of finfish hatchery in North Kerala for continuous supply of hatchery produced good quality fish seeds
2. Financial support from the government to initiate cage farming

Conclusion

Cage farming is a lucrative business with proper planning, information and management and offers tremendous scope for boosting the fish production in North Kerala mainly from the estuarine water bodies. The vast unutilized water resources and conducive environmental conditions in the coastal waters are excellent for large-scale cage farming. Cage culture appears to be a rapidly expanding industry and it offer opportunities even on a small-scale. Recently, due to the frequent occurrence of flood in Kerala farmers are unsure about the returns from cage farming. Therefore, insurance schemes for mitigating risks due to natural calamities or anthropogenic activities are also necessary for large-scale commercialization of cage farming in the coastal waters. In addition, there is an urgent need for the formulation of leasing policies and regulatory measures for large-scale promotion of cage fish farming.
