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Note

Multistakeholder partnership in implementing cage fish culture as a livelihood venture for rural youth: A case study in Kerala State, South India

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Abstract

Rural development is a process of implementing location-specific sustainable models utilising ecosystem services with participation of local people. Ezhikkara is a coastal village surrounded by brackishwater creeks and Pokkali paddy-shrimp fields located in Paravur Taluk of Ernakulam District, Kerala, south India. To address the employment issues among rural youth, Ernakulam Krishi Vigyan Kendra (KVK) of ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI), initiated cage fish culture in the Veerampuzha public water body in association with Pallikkal Service Cooperative Bank (PSCB). Local youth were trained in the technical aspects of cage fish culture and the bank provided financial support to them for implementing cage fish farming. The fish produced were marketed directly to the customers through farmgate markets. Farmers sold live fish directly at the farm gate by attracting consumers through advertisements floated by the KVK. They were sufficiently educated to fix uniform pricing to avoid farmer-farmer competition in direct marketing. An online fish delivery mechanism by pre-bookings through a mobile application was also established. The cage fish culture got wide acceptance among the rural youth as an alternate income source. The main challenges faced during the implementation of cage fish culture was the presence of invasive black mussel (*Mytella strigata*), annual flooding and the massive accumulation of weed plant *Eichhornia crassipes*. This experience unravels the requirement of continuous technical backstopping for marginalised communities to successfully implement technology-based farming models as alternate livelihood sources.

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Community development is a participatory process in which multilevel stakeholders perform their roles by sharing experience, knowledge and skills (Sopchokchai, 1996). Conceptualisation of viable technologies as an income-generating way for the marginalised community and implementation of these location-specific sustainable models utilising ecosystem services with participation of local people is a well-proven approach to rural economic development (Bjorklund *et al.*, 2012). Sustainable income generation, contributing to the rural economy and enhancing the community well-being is the immediate outcome of rural development programmes. Poverty alleviation through employment generation by establishing small enterprises in rural areas is a globally recognised and proven method (Vandenberg *et al*., 2006). Aquaculture is one of the ideal enterprises suitable for coastal areas having sufficient water resources. Despite residing near these water resources, fisherman and the rural village folks often overlook farming and instead opt for fishing activities as and when needed.

In India, most of the coastal aquaculture activities are happening in a decentralised and small-scale manner. This unnoticed small-scale aquaculture production system in rural areas is catering to domestic demands rather than contributing to exports (Moffitt *et al*., 2014). Apart from employment generation, aquaculture can also provide high-quality protein and essential nutrients, especially for nutritionally vulnerable groups such as pregnant and

lactating women, infants and preschool children. It also provides low-cost protein generally affordable to the poorer community segments (Halwart, 2003).

Aquaculture enterprise development for marginalised communities living in small landholdings is challenging due to the economic scale of operation. However, aquaculture ventures in public water bodies coupled with community participation, offer a ray of hope. Cage fish culture is a proven technology that can be taken up in public water bodies by rural and landless poor, requiring minimal investment (Beveridge, 1996; Vikas *et al.,* 2010). Over the past decade, several estuaries and backwaters in Kerala have been utilised for aquaculture (Radhakrishnan *et al.,* 2012). The Kadamakkudy Grama panchayath in Ernakulam District of Kerala accorded permission for cage fish culture in Veerampuzha Backwaters coming under their jurisdiction, during the year 2013-14.

This paper describes the process of conceptualising and implementing community cage fish farming in a public water body as an entrepreneurial solution to address youth unemployment in Ezhikkara, a coastal village in Kerala, south India. The initiative is the result of collaborative efforts among various institutions.

Ezhikkara is a coastal village surrounded by brackishwater creeks and Pokkali paddy-shrimp fields located in Paravur taluk of Ernakulam District in Kerala State. Veerampuzha Canal, the primary water resource in the area, is an extension of Vembanad Lake. Ezhikkara is rich in biodiversity, having diverse species of mangrove and over thirtytwo species of euryhaline fishes including pearlspot, mullet, asian seabass, red snapper, giant trevally, shrimps and milkfish. The average water depth in the area ranges from 1.2 to 6.0 m, with a variation of 0.3 to 1.0 m depending on tidal fluctuations. The seawater intrusion from the Arabian Sea and freshwater from the Periyar River maintain the area's salinity in the range of 0-28 ppt with freshwater conditions during monsoon. The total population in Ezhikkara is 17,201 with a population density of 1,126 km^{-2} and a literacy rate of 95.49%. Out of the total population, 4303 individuals are engaged in various occupations including cultivation and agricultural labour. 1,126 km^{-2}.

The Palliyakkal Service Co-operative Bank Ltd. (PSCB), a local finance organisation established in 1943 plays a significant role in creating livelihood for residents through promoting rural enterprises, including farming in Ezhikkara. They form farmer groups, provide finance and facilitate farm produce marketing. The Krishi Vigyan Kendra (KVK) of ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI), is a district-level organisation of the Indian Council of Agricultural Research (ICAR), playing a significant role in identifying location-specific farming technologies, technology backstopping and entrepreneurship development in agriculture and allied fields towards assuring rural livelihood improvement. The Ernakulam KVK has identified many location-specific farming technologies for Ezhikkara and cage fish farming is one of these. The present paper aims to showcase the process, implementation and adoption of cage fish culture as an income-generating initiative, achieved through the collaborative efforts of multiple stakeholders.

Veerampuzha, the northern end of Vembanad Lake in Ernakulam District, was selected as the location for the cage culture enterprise in Ezhikkara Village. The Grama Panchayath is the local administrative unit and is the responsible agency for permitting any activities/interventions in this selected public waterbody. The Grama Panchayath facilitated individual entrepreneurs in submitting applications for permission to engage in cage fish culture. Subsequently, a committee constituted by Ezhikkara Grama Panchayath (EGP) conducted necessary inspections and issued licenses for undertaking cage farming in the Veerampuzha River. The timeline of developing farm enterprises in Ezhikkara is detailed in Table 1.

The cost incurred for establishing a single cage unit for all was ₹1.6 lakhs, for which the bank provided ₹1 lakh as a loan towards cage installation (₹60,000/-), seed procurement (₹30,000/-) and feed cost (₹10,000/-). The rest of the amount was contributed by the farmers. The bank provided a 3% reduction in the interest on agriculture loans and start-up capital at the rate of 4%. Twenty-two numbers of floating fish cages each having size 4×4×2 m were fabricated locally as per the design of KVK and installed in September 2018. Asian seabass fingerlings (10 cm), 300 to 500 nos. and pearlspot (8 cm) 100 to 150 nos. were stocked in each cage. The fishes were fed during dawn and dusk. The salinity was monitored by a handheld refractometer (ERMA, India). Average survival and growth rates were observed and periodical grading was done. Periodical review meetings were also conducted, and technology backstopping was extended from KVK.

After ten months of culture, Seabass attained 1000±300 g, and pearlspot attained 130±30 g weight. The survival percentage was 90±3 and 95±2% respectively (Table 2 and 3).

Cage culture was continued in the location using the same cage structure for two more years. Average production ranged from 12 to 15 kg m^{-3} and no significant variation was noticed in the subsequent two cultures. The average cost and revenues from cage culture are presented in Table 4.

The production exhibited variability among the farmers, primarily attributable to factors such as cage location, variations in water current, water depth and management practices. Of the 22 cage units installed in the year 2018-19, three units were discontinued due to personal issues. In 2019-20, thirteen new farmers joined the initiative, resulting in a total of 32 cage units in operation. However, three more members dropped their activity due to their other engagements and financial losses were incurred due to mass mortality during the monsoon period. Nevertheless, during 2020-21, successful farmers expanded their cage units to two and in some instances, to three and the total number of cage units increased to 48.

The fish produced at Ezhikkara traditionally finds its way to the Paravoor market, where prices is fixed by auctions facilitated by agents. Prices in this market vary depending on the product abundance and demand. Surplus products lead to price reductions, while scarcity tends to drive prices up. The prevailing system places more emphasis on abundance rather than on quality, affecting pricing. Additionally, farmers need incur expenses on ice, vehicle rentals, and auction commissions ranging from 10 - 20% to sell their produce through this system. To bypass this conventional marketing system, the KVK introduced and promoted farmgate sales enabling farmers to directly sell their produce live, at the farm gate. The KVK facilitated attracting consumers to the farms through advertisements. This approach facilitated the consumers with the opportunity to see the farm, understand the farming method and trace the source of live fish. The main advantage of this method

Table. 1. Timeline of developing farm enterprise in Ezhikkara

Time	Milestones	Organisation
May 2018	Self-help group (SHG)formation	PSCB
June 2018	Orientation class on cage fish farming to the group members	KVK
July 2018	Field inspection and selection of suitable location	KVK
July 2018	Documentation for getting a license	PSCB
	Inspection and issue of license	EGP
	Training on cage fish farming	KVK
	Exposure visits	PSCB
	Follow-up training on cage fish farming	KVK
August 2018	Credit support*	PSCB
September 2018	Cage installation and fish stocking	SHG
October 2018 to March 2019	Technology backstopping	KVK
	Periodical inspection and review meet	PSCB
	Training on fish harvesting and marketing	KVK
April 2019	Live fish sale mela and online marketing	PSCB
	Loan repayment	SHG
July 2019	Training on cage maintenance	KVK
August 2019	Credit support*	PSCB
September 2019	Cage installation and fish stocking for the second crop	SHG
October 2019 to March 2020	Technology backstopping	KVK
	Periodical inspection and review meet	PSCB
	Live fish sale mela and online marketing	PSCB
April 2020	Loan repayment	SHG
July 2020	Follow-up training	KVK
August 2020	Credit support*	PSCB
September 2020	Cage installation and fish stocking for the third crop	SHG
October 2020 to March 2021	Technology backstopping	KVK
	Periodical inspection and review meet	PSCB
April 2021	Live fish sale mela and online marketing	PSCB
	Loan repayment	SHG

Table 2. Average seabass production per cage in the community farming units

Year	Asian Seabass (kg)	Stocking density (Nos. m^{-3})	Survival (%)
2018-19	432±22	12	90
2019-20	390±40	16	87
2020-21	398±32	14	89

Table 3. Average pearlspot production per cage in the community farming units

Year	Pearlspot (kg)	Stocking density (Nos. m^{-3})	Survival (%)
2018-19	13.34	3.5	92
2019-20	14.55	3	95
2020-21	14..00	3.3	93

lies in farmers gaining an additional 35% income by avoiding the middlemen and various post-harvest expenses. The bank played a crucial role in planning strategies to attract consumer attention through media publicity facilitated live fish marketing, including organisation of sales mela and supporting direct marketing initiatives.

The farmers were well-informed and educated on implementing uniform pricing to avoid farmer-farmer competition during direct marketing. Additionally, an online fish delivery mechanism was established through a mobile application to effectively market surplus fish. The study revealed that direct marketing has the potential to enhance income by 20%, attributed to elimination of intermediaries. Cage fish culture proves to be an appropriate technology for providing livelihood opportunities to the landless poor by utilising public water bodies, depending on the provision of requisite technical skills and accomplishment of marketing without intermediaries.

The main challenges faced during the implementation of this culture included the presence of invasive black mussel (*Mytella strigata*), annual flooding and the extensive accumulation of the weed plant *Eichhornia crassipes*. Among these issues, the substantial accumulation of the black mussel can be managed through proper management measures, such as stocking adult pearlspot fish in both inner and outer nets of the cages. Pearlspots feed on the black mussel, helping to control its population with in the cage nets. Additionally, routine cleaning of the nets on a weekly basis would help to minimise the attachment of the mussels in the cages. The extensive flooding during August 2018 in Kerala resulting from

Table 4. Economic analysis of cage fish culture

A. Capital cost (₹)	2018-19	2019-20	2020-21
Cage cost (4 m X 4 m X 2.5 m) HDPE net with GI Frame cage	65000		
Temporary watching unit	10000		
Light unit	10000		
Total A	85000		
B. Operational cost			
Asian Seabass fingerlings, 400 nos. @ ₹ 50/-	20000	20000	20000
Pearlspot fingerlings, 100 nos. @ ₹20/-	2000	2000	2000
Pearlspot feed	26 kg @ ₹ 120/- 3120	28 kg @ ₹ 125/- 3500	29 kg @ ₹ 130/- 3770
Low-value fish as feed for Seabass	2800 kg @ ₹ 30 /- 84000	2496 kg @ ₹ 28 /- 69888	2547 kg @ ₹ 32 /- 81504
Cage maintenance cost		5000	10000
Total B	1,09,120	100388	117274
C. Cost-Benefit analysis			
C1. Annual fixed cost			
a. Depreciation on capital investment, @20%	17000	17000	17000
b. Insurance premium @ 2% of the capital investment	1700	1700	1700
c. Interest on capital investment@ 12%	10200	10200	10200
d. Administrative other expenses	1275	1350	1500
Total annual fixed cost C1 (a+b+c+d)	30175	30250	30400
C2. Annual variable cost			
a. Annual operational cost (B)	1,09,120	100388	117274
b. Interest on operational cost @ 12%	13094.4	12046.56	14072.88
Total Annual variable cost C2 (a+b)	1,22,214	112435	131347
Total cost (C1+C2)	152389	142685	161747
D. Income			
a. Income from Seabass sale	432 kg @ ₹600 259200	390 kg @ ₹620 - 241800	398 kg @ ₹.610 242780
a. Income from Pearlspot sale	13.34 kg @ ₹.650/- 8671	14.55 kg @ ₹620/- 9024	14 kg @ ₹670/- 9380
Gross revenue	267871	250821	252160
d. Net operating income	145657	138386	120813
e. Net profit	115482	108136	90413
BC ratio	1.76	1.76	1.56

consecutive extreme rainfall events, affected millions of people and caused substantial damage to both infrastructure and the physical environment (Sudheer *et al.,* 2019). Hence, the farmers are alerted to reduce the fish stock by harvesting before August, to avoid potential losses. The invasive weed plant *E. crassipes* poses a menace in brackishwater resources (Jayan *et al.,* 1012), entering freshwater areas after the monsoon through runoff and establishing itself in backwater areas. In orderto restrict its entry into the cages, a proper blocking mechanism, such as the installation of floating bamboo poles at the cage mouth is ideal. With proper monitoring and periodic clearing, management of this issue can be achieved to some extent.

The outcomes of the present initiative indicated that the ideal season for taking up cage culture in Veerampuzha backwater spans from September to May. The study also emphasises that direct marketing by the farmers is an important aspect for realising a viable profit. To avoid competition between farmers, fixing uniform pricing is essential and the success of farming primarily depends on technology backstopping for production and marketing support. In community farming, partner farmers' teamwork and confidence level play important roles. Ensuring the availability of quality inputs, including seeds and feed, at the commencement of farming, is also crucial. Fish being sensitive organisms, regular monitoring of the water quality is imperative. Periodical cleaning of the cages to ensure sufficient water flow and oxygen availability are also key factors contributing to overall success.

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