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Economic valuation of mussel farming in a tropical estuary of northern Kerala, India

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Original Article

Abstract

The green mussel (*Perna viridis*) is widely farmed in the estuaries of northern Kerala. The Palakkode estuary in the Kannur district of Kerala provides a suitable environment for culturing green mussel, providing livelihood for many coastal people. A study conducted from November to April 2024 recorded twenty-two active mussel farming units in the estuary. Economic analysis was performed on eleven farming units belonging to four groups, comprising four individuals each. Each farming unit had a 100 m^2 mussel rack with 400 seeded ropes. Females comprised 53% of the mussel farmers, with males making up the remaining 47%. The mean annual mussel production was 480 kg, sold at an average sale price of Rs.130/kg. The total annual fixed cost, total production cost, net operating income, net cash return, break-even price, and capital recovery factor are Rs. 5,620, Rs. 43,040, Rs. 24,980, Rs. 19,360, Rs. 90 and 1.8 respectively. While mussel farming provides employment opportunities, environmental changes such as increased temperature and salinity fluctuations due to unexpected rainfall have been affecting the farming operations. Besides, the inadequate availability of mussel seeds, the presence of the invasive mussel species, *Mytella strigata,* adversely affect mussel production. Despite these challenges, the study demonstrates the economic potential of mussel farming in the region.

Keywords: *Economic Valuation, estuary, mussel farming, Perumba River, rack culture*

Introduction

Mussels are bivalves with high nutritional value and play an important role in ecosystem services. In India, two species of mussels, *Perna viridis* (green mussel) and *Perna indica* (brown mussel), are cultivable. Among these, *Perna viridis* is an important seafood species that can be cultured with low investment in the backwaters of Kerala. During the 1970s, green mussel farming technology was developed in India, and its feasibility was tested by the ICAR-Central Marine Fisheries Research Institute (CMFRI), Cochin, at various locations along the southeast and southwest coasts of the country (Appukuttan and Alagarswami, 1980; Mohamed *et al.*, 2003). Attempts to culture green mussels in the sea, however, have been largely unsuccessful due to several risks, including poaching, loss of farm structure during adverse weather conditions, and limited awareness among farmers (Kripa and Mohamed, 2008). Subsequently, ICAR-CMFRI promoted mussel farming in the estuaries and backwaters of Kasaragod, Kannur, Kozhikode, and Malappuram districts of north Kerala, where farmers adopted the practice. These estuaries and backwaters proved to be highly suitable for green mussel farming because of favourable environmental, hydrological, geo-climatic, and socio-economic conditions. In Kannur district, mussel farming was initiated in 1995 by suspending four seeded ropes in the Dharmadam estuary of the district, while in Kasaragod district, the initiation was done in Padanne by a group of women. Significant progress in mussel farming occurred in the late 1990s (Appukuttan *et al.*, 2000; Asokan *et al.*, 2001; Mohamed *et al.*, 2019), with culture-based green mussel production increasing significantly from 1996 and peaking at 18,000 t in 2009. The subsequent declines were attributed to high temperature, salinity, inadequate availability of good quality seeds, disease outbreaks resulting in mass mortality, and deterioration of water quality (Mohamed *et al.*, 2019). The Palakkode estuary, located in the northern part of the Kannur district, at the confluence of the Perumba River and the Arabian Sea, constitutes a key site for mussel farming and has played a pivotal role in the district's mussel farming

activities. Despite its importance, studies on green mussel farming in this region remain limited. Therefore, the present study mainly focuses on the demographic profile of mussel farmers as well as the economic feasibility of mussel farming in the Palakkode estuary of Kannur district.

Material and methods

Kannur is a coastal district of Northern Kerala, with a coastline of 82 km and is endowed with several estuaries and backwaters. Green mussel, *Perna viridis,* which are commercially important bivalves, are cultured in the district using both on-bottom and off-bottom methods. The Palakkode estuary of Kannur district is formed by the drainage of Perumba River into the Arabian Sea at Palakkode, creating an ideal brackish environment highly suitable for mussel farming. Rack culture, an off-bottom mussel culture practice, is mainly concentrated in the Kunnaru region of the Palakkode estuary (Fig. 1).

Mussel farming in the study region was conducted both individually and in groups. During the study period (November 2023–April 2024), a total of 22 mussel culture racks were recorded in the estuary, consisting of 11 units operated by individual farmers and 11 units by groups (Fig. 2).

Fig. 1. Map showing the study area

Fig. 2. A view of mussel farming racks in the study area

The present investigation focused on 11 rack cultures operated by four groups comprising 16 individuals. The construction of the racks predominantly involved the use of bamboo poles. A total of 24 bamboo poles were inserted vertically into the estuary bed at an average spacing of 1m. Additionally, 16 bamboo poles were tied horizontally to construct a rack with an area of 100 m^2. The horizontal bamboo poles were positioned above the water level during high tide to ensure proper suspension of culture units. Each rack had 400 ropes of 2-inch thickness, seeded with mussel spats and suspended vertically from the rack. The culture period typically lasted for 5-6 months, from November until the mussels reached marketable size. Harvesting was generally carried out during low tide in the morning using a canoe. After removing the mussels from the ropes, they are rinsed in clean water and subsequently sold to wholesale agents and retailers. A structured questionnaire survey was conducted to gather demographic profiles, social and economic information from the 16 mussel farmers involved in the study.

Results and discussion

The present study is mainly focused on the green mussel farming in the Palakkode estuary of Kannur district. During the study period, 11 mussel racks of area 100 m^2, managed by 16 individuals, were analysed. For mussel farming, 8-9 sacks of mussel seeds, each weighing 50 kg and priced between Rs. 5,100 and 5,500 per 50 kg, were utilised (Fig. 3). Mussel seeds were procured from farmers across the regions of Kanhangad, Kozhikode, Thrissur, Ernakulam, and Kollam. After seeding (Fig. 4), the ropes were suspended vertically from the bamboo poles. Locally available bamboo poles, at an average price of Rs. 200 per pole, were used for rack construction. The mean mussel production obtained from the rack culture was 480 kg (Fig. 5 and 6), and the harvested mussels were sold to the wholesale agents and retailers at an average farm-gate price of Rs. 130/kg. The total capital investment, annual

Fig. 3. Pile of mussel seeds

Fig. 4. Mussel-seeded ropes

Fig. 5. Pile of harvested mussels

fixed cost, total operating cost, total cost of production, net operating income, net cash return, break-even price, and capital recovery factor of mussel farming were Rs. 10,680, Rs. 5,620, Rs. 37,420, Rs. 43,040, Rs. 24,980, Rs. 19,360, Rs. 90, and 1.8, respectively (Table 1). *Perna* species are regarded as an optimal shellfish crop due to their incredible growth rate, natural abundance, adaptability to new environments, and simple farming techniques (Vakily, 1989). Furthermore, green mussels, being sedentary filter feeders, primarily consume phytoplankton and other microorganisms, which contributes to the overall cost-effectiveness of the culture practice. In India, cultured green mussel production has shown a remarkable increase since 1996, reaching a peak of 18,000 tonnes in 2010, with Northern Kerala contributing more than three-fourths of this output (Shinoj *et al.*, 2021). The successful diffusion of green mussel farming technology in Kerala is attributed to the availability of suitable waterbodies, high literacy levels,

Table 1. Economics of mussel farming using raft culture of area 100 m^2 (10*10, 400 ropes)

Cost description	Amount (Rs.)
Bamboo poles	8,000
Rope for tying	280
Rope for seeding	2,400
Total capital investment	10,680
Annual Fixed Cost	
License fee	140
Registration fee	140
Depreciation	
Bamboo poles (50%)	4,000
Rope for tying (50%)	140
Rope for seeding (50%)	1,200
Total depreciation	5,340
Total annual fixed cost	5,620
Operating cost	
Labour for rack construction	4,000
Mussel seed	20,400
Labour for seeding	8,000
Farm maintenance	500
Labour for harvesting	1,500
Cotton netting	2,520
Minor implements	500
Total operating cost	37,420
Total cost of production	43,040
Annual yield	480 Kg
Sales price	130/Kg
Gross returns	62,400
Net operating income	24,980
Net cash return	19,360
Break-even price	90
Capital recovery factor	1.8

Life expectancy of bamboo poles and ropes: 2 years

Fig. 6. Harvested mussel-rope

easy access to mussel markets, increased consumption of mussels, a strong coordination among technology developers, promoters and credit advancers (Kripa and Mohamed, 2008). A comparative study conducted in the Chettuva estuary of Thrissur district identified off-bottom culture as the most suitable method under Kerala's estuarine conditions, based on growth rate, yield and net operating income (Sreedevi *et al.*, 2014).

Demographic profile of mussel farmers

In the study area, women constituted a larger proportion of mussel farmers (53%), compared to men (47%) (Fig. 7), highlighting the potential of mussel farming as an avenue for promoting women's economic empowerment. Various factors, such as flexible working hours and proximity of mussel farming site to the household premises, attract women to mussel farming (Kripa and Mohamed, 2008). The educational qualification of most mussel farmers fell under the secondary education category (63%), followed by upper primary education (25%), while only 6% of the mussel farmers were illiterate (Fig. 8). Education plays a significant role in the adoption and effective implementation of mussel farming practice (Kripa and Mohamed, 2008). With respect to age distribution, half of the mussel farmers belonged to the age group above 50 years. The remaining group comprised 38% of individuals in the 40-50 year age range, while 12% were younger than 40 years (Fig. 9). The lower physical effort and maintenance required for farming make it an attractive livelihood option for older individuals. However, age is not always a significant factor influencing the adoption of technology (Kripa and Mohamed, 2008).

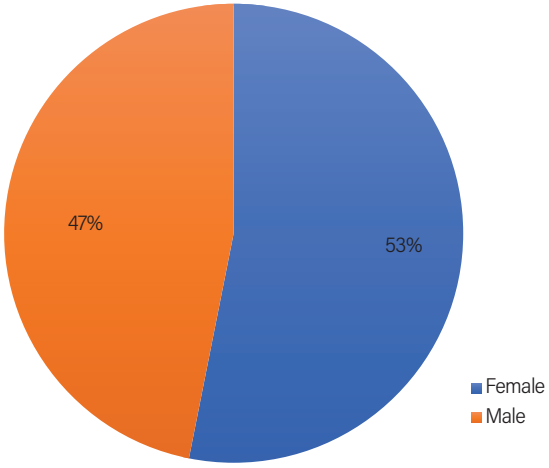

Fig. 7. Percentage composition of male and female individuals involved in mussel farming

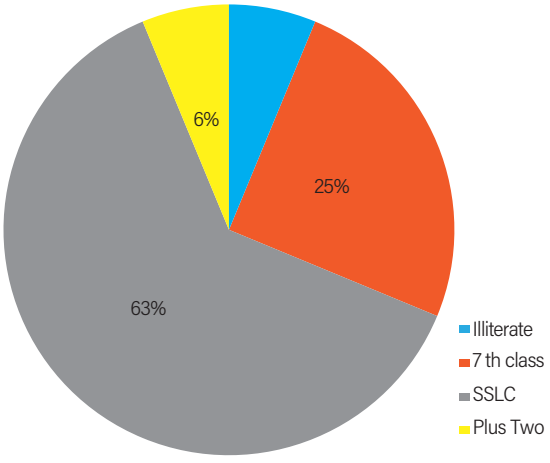

Fig. 8. Percentage composition of educational status of mussel farmers

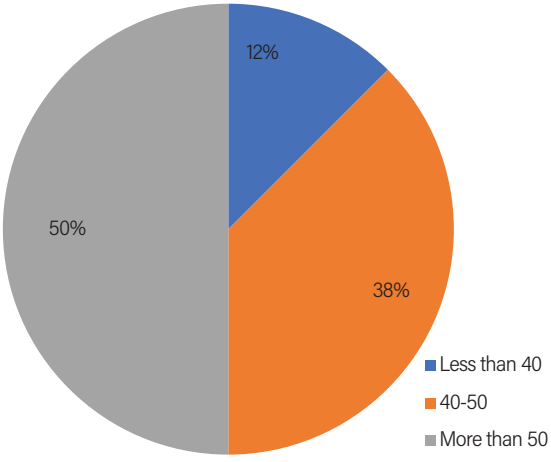

Fig. 9. Percentage composition of age groups of mussel farmers

Conclusion

The present study demonstrates that mussel farming in the Palakkode estuary of Kannur district is economically viable and offers a sustainable livelihood for local households. Beyond its financial benefits, the activity significantly contributes to women's empowerment by enhancing their income opportunities, decision-making roles, and social visibility within the community. Overall, the findings underscore the dual potential of farming to strengthen rural economies while promoting gender-inclusive development. If supported through appropriate policies and training initiatives, this sector can further expand as a resilient and equitable livelihood strategy in the region.

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Author contributions

Conceptualisation: VVG, KV; Methodology: VVG, KV; Data Collection: VVG; Data Analysis: VVG; Writing Original Draft: VVG; Writing review and editing: KV, PKA; Supervision: KV.

Data availability

The data are available and can be requested from the corresponding author.

Conflicts of interest

The authors declare that they have no conflict of financial or non-financial interests that could have influenced the outcome or interpretation of the results.

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Publisher's note

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