

Sea farming trials using hatchery-produced Brown mussel *Perna indica* seed along the Kanyakumari coast

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Mussels are regarded as excellent candidates for aquaculture due to their role as primary consumers, primarily feeding on phytoplankton. Their farming falls under non-fed aquaculture, as they require no additional feed or fertilisers. Embracing mussel farming can play a significant role in the blue transformation advocated by FAO, which recognizes aquatic food systems as catalysts for employment, economic growth, social development, and environmental recovery in pursuit of sustainable development goals. In India, the Brown mussel (*Perna indica*) and the Indian Peacock mussel or Green mussel (*P. viridis*) are available. *Perna indica* is limited to the southern coasts of India, spanning from Kollam in Kerala to Thiruchendur in Tamil Nadu. While both species can be farmed, the Brown mussel was preferred for sea farming due to its local availability and the favorable high salinity of the area, which is free from river inflow. There has been a recent surge in demand for mussels, causing the price to rise substantially to ₹15 per piece. Mussel meat is considered a delicacy in Kerala, Karnataka, Goa and Maharashtra. From capture fisheries, 420 tons of Brown mussels were landed in Vizhinjam, Kerala in 2020. Commercial fishing for mussels occurs only during the first and last quarters of the year due to the non-availability of larger-sized mussels during the rest of the period emphasizing the scope for farming mussels to meet the market demand.

Since the late 1970s, the ICAR-Central Marine Fisheries Research Institute made dedicated efforts to develop a viable mussel farming technology. In 1971 experimental mussel farming was initiated at Vizhinjam, using wild-collected Brown mussel *Perna indica* seed and employing floating raft culture techniques (Achari, 1975). The study demonstrated enhanced growth rate and successful

cultivation of mussels in sheltered waters. Furthered the research by studying Brown mussel farming with wild-collected seeds in Vizhinjam Bay and the open seas with a culture period of five months yielded an average production of 10-12 kg of mussels per meter length of rope (Appukuttan and Alagarsami, 1980). Since then, consistent endeavors were made to enhance mussel farming in marine and backwater environments. In addition to the challenges posed by the sporadic and unpredictable availability of wild mussel seed, farmers encounter significant issues such as poor seed quality, diseases, predation, and mussels dislodging from ropes due to rough sea conditions, including strong currents, wind, and wave actions. Moreover, the fast disintegration of mosquito netting used during the seeding process leads to the detachment of mussel seed from the ropes resulting in financial loss. Two trials were conducted at Kanyakumari waters to standardize culture techniques in open-sea conditions with innovations to overcome the above-mentioned problems and boost farming productivity. The first trial utilised wild-collected seeds, while the second used hatchery-produced seeds.

Innovative approaches and techniques

Custom-made combination rope

A specially crafted combination rope consisting of a nylon core and an outer coir rope layer was utilized as the branch lines. The inclusion of an inner nylon core significantly enhances the breaking strength of the ropes, allowing for the use of lengths exceeding 1 metre and

thereby improving productivity per rope. The outer coir layer offers a fibrous surface area, facilitating better attachment of mussels and reducing slippage.

Custom-made cotton netting

The mosquito netting was replaced with custom-made cotton netting for seeding process. The cotton netting was specially designed to endure strong weather and sea conditions while ensuring a secure attachment of the seed to the rope. Mosquito netting deteriorates rapidly and resulting in seed loss due to slippage and non-attachment, while the new netting helped in proper attachment of the seed mussel leading to increased production.

Outer mesh cover/mesh screen

To prevent predation by fish and crabs, an additional outer mesh covering was provided for the seeded rope. This mesh acted as a protective barrier and also facilitated retrieval of any detached mussels. This outer mesh covering is particularly recommended in areas where predation rates are high and is necessary for hatchery-produced seeds, which tend to be smaller and more susceptible to predation. Favorable outcomes, with mussels exhibiting enhanced attachment and retention were recorded.

Experiment with wild-collected seed

A trial was conducted at Kanyakumari coast, where a 30-meter longline was installed in the open sea. To facilitate buoyancy, three 200-liter air-filled HDPE barrels were placed at both ends and in the middle of the line. Additionally, thirty 20 L cans were attached to the longline, corresponding to 30 sets of 2 m seeded branch lines. The longline itself was constructed using 28 mm nylon rope and secured with two 75 kg metallic anchors at either end. The farming trial incorporated innovative elements. Firstly, a custom-made combination rope was utilized as the branch line for seeding. Each branch line had a length of 4 meters, with mussels being seeded up to 2 meters. The seeded mussel ropes were made using wild-collected Brown mussel *Perna indica* spats. The specially designed cotton mesh with thicker twine was employed for seeding to ensure proper attachment of mussel seeds to the ropes under rough sea conditions.

This enhanced special mesh could withstand weathering for approximately 14 days, providing sufficient time for mussel seed attachment to the combination ropes. Furthermore, an outer net cover made of nylon material and plastic line rings used as extenders to maintain a cylindrical shape for the outer cover effectively prevented the predation of mussel seeds by fish during the juvenile stage. After a four-month rearing period, the longline system yielded 1,050 kg of mussels. The mussel seed which had an initial average size of 45 mm and weight of 5.4 g reached an average length of 65 mm and weight of 16.4 g at harvest, resulting in an average production rate of 17.5 kg per metre.



(a) Mussel rope seeded with wild collected seed (b) Ropes with cover-net being tied to the long line (c) Harvested brown mussels from Kanyakumari District

Experiment with hatchery produced seed

The second farming trial used hatchery-produced seed measuring 9.1 ± 1.1 mm in size and 0.1 g weight. The seed was stocked at a density of 2000 per meter of rope and nursery reared in Vizhinjam Bay from December to March, 2021. During this time, the seed grew to an average length of 38 ± 5.4 mm and weight of 4.42 ± 1.90 g. Subsequently, the mussel ropes were transferred to the sea in Kanyakumari district and were tied inside a cage used for rearing pompano, with the addition of an outer mesh screen/cover net in March 2022. Prior to the transfer, the seeded mussel ropes from the



Mussel rope seeded with hatchery produced seed and cover net protection

raft underwent a thorough washing and cleaning process to remove fouling organisms. Throughout the culture period, the water quality parameters remained within the following ranges: salinity between 35-38 ppt, pH between 7.7 and 7.9, and dissolved oxygen (DO) at 4.848 mg/L.



Seeded ropes being taken to the sea for farming

Mussels were allowed to grow for 12 months and harvested in January 2023. Mussels grew to the size range of 68-106 mm with a weight range of 15.86-82.01 g (average length and weight were 83.68 ± 10.13 mm & 48.73 ± 14.4 g). The average production rate of mussels achieved was 20.4 kg/meter rope. Flesh weight (wet weight) constituted 38.7% of the total weight of mussels.

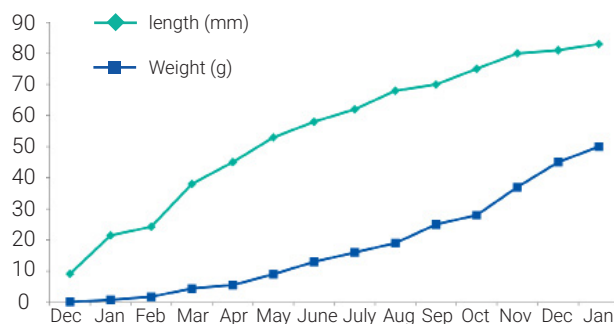


Fig. 1. Summary of an average growth of hatchery-produced brown mussel seed at sea



Harvested brown mussels from Kanyakumari District

Utilizing hatchery-produced seed offers numerous advantages. Firstly, it allows for the production of seed in the desired quantity and quality, addressing the limitations of wild-collected seed. Further, seeds can be made available for an extended period, and there is also a possibility to make genetic improvements through selective breeding and triploid production. Moreover, relying on wild seed collection can lead to conflicts with the fishing community, as overexploitation can negatively impact the fishery's health. As a result, mussel seed collection from wild is not recommended as a sustainable farming method. In contrast to mussel farming in estuaries, farming at sea offers a distinct advantage by providing an extended farming period, which allows for harvesting during non-fishing seasons. This flexibility is highly advantageous, especially compared to the typically restricted fishing timeframes along the brown mussel belt, such as December to February in Enayam and November to February in Thiruvananthapuram. Most of the world's mussel production occurs in temperate regions, which face challenges like low temperatures, slower growth rates, and higher labour costs, particularly in regions like Europe, America, Australia, and New Zealand. However, as a tropical country, India shows faster mussel growth,

making it a highly advantageous location for mussel farming. The present study highlights the tremendous potential of mussel sea-farming in India, particularly as an export-oriented industry. By capitalising on hatchery-produced seed and the advantages of farming at sea, India can tap into sustainable and profitable mussel production, positively contributing to the country's aquaculture sector.

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