

Technology for coastal cage farming of Indian pompano (*Trachinotus mookalee*): Towards sustainability

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Introduction

Cage farming technology is widely recognized as one of the most popular and intensive farming methods in mariculture for increasing fish production. Cage farming method is being adopted in different coastal ecosystems, among which the high saline backwater is considered as an important ecosystem for the culture of diverse species in cages. High saline estuaries are one of the unified ecosystems, considered for livelihood improvement of the selected rural populations. In India, huge estuarine resources are available bordering the coasts and these

potentially available under-utilized high saline waters bodies could be efficiently utilized by culturing different species of finfish in cages installed thereof. Different species of marine finfish can be cultured in high-saline estuarine cages and the Indian pompano (*Trachinotus mookalee*), is one such suitable potential candidate species. Pompano is a preferred species for cage culture with the following characteristics; quick adaptability to different culture conditions, ease of accepting artificial pellet feed, tolerance to a wide range of salinity, fast growth rate, and high consumer preference. Understanding the culture characteristics of the fish, coastal cage culture technology for the species was developed using

the hatchery-produced seeds under different institutional projects of ICAR -CMFRI. Thereafter, at the initial phase the technology was disseminated for selected marginalized families located near Krishna and Godavari backwaters in Andhra Pradesh under the blue revolution scheme by the National Fisheries Development Board (NFDB), Hyderabad, Government of India. Subsequently, the culture technology was disseminated to different coastal states in India under different welfare schemes by the Government of India. The culture technology is refined with experience gained and the package of the practice is developed for better adoption to increase production and profit.

Cage site selection

Site selection is one of the most important factors for the cage culture of the Indian pompano. The selected site should be free from pollutants, with optimum water flow, and should be at least 5 km away from sea mouth. Water temperature: 26-30°C, salinity: 15-35 ppt, water depth: 4-10 m, and continuous water movement for better dissolved oxygen content is preferred. The selected place should be away from human inhabitants, and have easy accessibility for reaching the cage site. The optimum speed of water current during high and low tides is essential. If the current speed is higher, then continuous force will be applied on cage mooring and net structure and may lead to frequent shifting of cage positions. Pressure due to water current will

affect the net structure, which will impact fish movement and cause stress to the fish.

Cage design and fabrication

Square-shaped cages made of Galvanized Iron (GI) pipes (B-class) of 1.5-inch diameter with inner dimensions of 5.0 m long x 5.0 m wide are preferred. In cage design, the base pipes and handrails are important, the handrail is placed at a distance of 0.8 m above the base pipes for ease of operation. Two base pipes are placed in parallel at a distance of 1.0 feet apart and working space is created with the help of wooden planks or steel plates for ease of operation while feeding and sampling. Air-filled barrels (200 L) are attached to the cage frame for floatation, and a total of 8 such barrels are used, two each at the four sides of the cage. HDPE braided nets are suitable with an outer net of 63 ply (2.5-3.0 mm twine thickness), 25 mm mesh size; (6 x 6 m size and 3.5 m depth); inner net of 36 ply (2.0 mm twine thickness), 12-15 mm mesh (5 x 5 m size and 4 m depth); bird's net of 80 mm nylon mesh are preferred for fish culture. The cage structure is stabilized in the water with the help of iron anchors (4 numbers; each 50 to 75.0 kg in weight). The anchors are connected to the cage with the help of 24 mm diameter polypropylene ropes or steel chains. As the bottom in estuaries is predominantly clayey soil, the use of a toothed anchor is recommended to have a good firm grip on the bottom. The shape and volume of



Cage site in Krishna Backwaters

the net are maintained in the flowing water with the help of ballast pipes made of 0.5 inch diameter perforated GI/ HDPE pipes. The corners of the ballast pipes are blunted and wrapped with tubes to avoid tearing off the nets due to friction associated with water movements. Ballast pipes should be directly hanged from the base pipe for ease of operation.

Nursery rearing and cage stocking protocols

The optimum size of the fish for stocking for the coastal cage-based system is 20 to 25 g. The fish stocked at the optimum size takes nearly ten months to attain a market size of 750-850 g. However, the culture duration could be further reduced if the fish stocked are of bigger sizes. Thus, the nursery culture of the Indian pompano is considered an important aspect in cage culture for reducing the culture duration. Three types of nursery systems are suitable for Indian pompano concerning cage culture: Flow-through based FRP or concrete tank culture, Recirculating Aquaculture System (RAS) based nursery systems and earthen pond-

based nursery systems. These nursery facilities should be established near cage site for ease of fish transfer.

Grow-out culture

After reaching the cage site, the transported juveniles are slowly released for acclimatization. The optimum stocking density suggested is 15-20 nos/m³, and thus, the cage can be stocked with 1500 numbers of fish seed. An artificial floating pelleted feed with high nutrient content (45% crude protein & 10% crude fat) is recommended for the grow-out systems. While feeding, feed should be broadcasted in the middle of the cage to avoid feed wastage due to drifting through net mesh along with wind action. Thus, to avoid feed wastage, feed mesh of 1 meter depth should be attached in the inner cage net. For better feed digestion and assimilation, a minimum time gap of 3 hours should be given between two feeding schedules, thus the feeding frequency should be decided accordingly. Feeding frequency of four times daily is found to be good for growth of the stocked fishes and since the estuarine cages are easily accessible, at least four times daily feeding is recommended. In grow out culture, fish growth should



Anchored cages in backwaters

be monitored fortnightly and feeding rate to be adjusted based on the weight. Based on several demonstrations, if the fish fingerlings of 20 to 25 g are stocked at 15 nos/m³, then it takes nearly 10 months for it to reach the size of 750-850 g, whereas if it is stocked at 100 g size, it takes 5 months to reach the same size. Most of the estuaries are abundant in small fishes and other small marine organisms; therefore, probability of feeding on these small animals by the cultured fish is more, and resulting in better growth. The fish growth and optimum feeding rate is given in the Table. 1. Most of the estuaries are prone to floods during monsoon, thus the fish culture is possible for a maximum of 7-10 months, and hence, grow-out culture should be

Table 1. Growth and feeding of Indian pompano in coastal cages

DOC	Fish Size (g)	Feed Size (mm)	Feeding Rate (%)	Feeding Frequency (time/day)
0-30	25 -50	1.2-1.8	8-6	5
30-120	50 -200	1.8-3.0	6-5	4
120-180	200-400	3.0-4.0	5-4	4
180-210	400-650	4.0-6.0	4-2.5	4
210-300	650-850	6.0-10	2.5-1.5	3

planned accordingly by efficient management of nursery system to achieve the complete cycle.

Cage structure management

Cage culture of Indian pompano requires culture duration for 10 months, thus the cage structure should be managed well and it includes net exchange, cage frame cleaning and mooring checking. The cage net is the structure which holds the fish, and is prone to barnacles, mussel seed attachment and silt accumulation. Thus the net needs to be exchanged periodically depending on the accumulation. This attachment and accumulation depends on the season and the location. Based on the experience in backwaters of Andhra Pradesh, silt accumulation is the major problem in the main rivers. On the other hand, in small creeks, cage nets are mostly infested



Seed stocking in high saline backwater cages



Grow-out farming of Indian pompano in coastal cages

and attached with green mussel seeds. Periodical cage net exchange is required in places where mussel attachment is more, whereas, in places with mostly silt accumulation, washing of cage nets by high speed jet pump is sufficient and net exchange is not required. Cage mooring helps to keep the entire cage structure in position, thus the mooring chain requires continuous monitoring, at least once in a month.

Indian pompano health management

The cage cultured fish should be periodically checked for its feeding and health status, and thus sampled fortnightly. Apart from critical monitoring, daily observation while feeding is essential for understanding their feeding behaviour, which is a good indicator for the health status of the fish. The major possible health issues in estuarine cages are bacterial infections and gill choking. Bacterial infection is mostly by *Vibrio* species and occasionally by other bacteria, largely occurs during peak summer season. Hence, stocking of fish during summer should be avoided and the net depth should be maintained at least 3 to 4 m in water to avoid heat transmission and minimize stress to the stocked fishes. Bacterial infection in fish could be controlled by the use of medicated feeds and probiotics. Fish mortality due to gill choking by silt accumulation is another major problem and can be avoided by frequent cleaning of the cage net.

Fish harvest and marketing

Cage cultured fish remains in a small confined environment, so harvesting the fish is easier than any other culture methods. The fishes in the inner net are harvested with the help of a hand scoop net, after lifting inner net from four corners. Immediately after harvest, washing in clean water and chill killing is suggested to maintain the freshness and quality of the harvested fish. Harvested fishes are packed in plastic trays or thermocole boxes by adding layers of ice in equal quantities at the bottom and top of the fish. Apart from bulk harvest, the estuarine cages are also suitable for batch harvest, based on local market demand. Hence, required amount can be harvested



Harvesting of the farmed Indian pompano



Transportation of harvested fish for marketing

daily based on demand. For marketing the fish, states like Kerala, West Bengal, and selected pockets in Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra offer the best opportunities. Some of these customers include Maxwell exporters and MATSYAFED, from Kerala and the West Bengal Fisheries Development Corporation, Kolkata.

Economics of coastal backwater culture of Indian pompano

The total operational expenditure and profit was calculated for a battery of 10 cages (Table 2). Culturing the fish at the stocking density of 15/m³ will support the farmer with net profit of approximately ₹6.5 lakhs with a price realization of ₹325 per kg of fish. The calculated profit margin can be improved by proper husbandry practices and adopting

Table 2. Total operational expenditure and profit

Particulars	Cost (₹) (lakhs)
Depreciation value on cage and accessories with an average life of 5 years (Cost of cage and accessories: 1,36,400/unit) and depreciation is 23,700/ unit/year	2.73
Seed cost-15750 nos @ ₹15/seed (Including transportation): 1500 nos/cage and additional 5% to compensate mortalities till nursery rearing	2.36
Nursery rearing in hapa	0.5
Feed @ FCR 1:1.60; Total of 17.30 tons of feed (based on FCR and production from column 8) @ ₹110/kg	19.03
Opportunity cost (@ ₹3000/cage /month) – towards cage maintenance	3.0
Miscellaneous expenditure including electricity and feed medicines and probiotics	1.0
Expenditure (Sl no: 1-6)	28.62
Production: 10.80 tones @ 85% survival with harvest size of 850 g at selling price @ ₹325/kg	35.1
Net profit: (8-7)	6.48

cluster based culture approach. Also, the profit margin can be increased by executing proper fish harvest plan aiming the fish harvest during the lean period.

Best Management Practices (BMP) for backwater cage culture of Indian pompano

- The following best BMP are recommended for sustainable culture with better economic return
- It is advisable to install the cage at least 5 km away from sea, as it will have optimum current speed and less salinity fluctuations during the high / low tide periods.
- Fish fingerlings of greater than 20 g should be stocked to obtain maximum survival
- Feed mesh of 1 m width, and 1 mm mesh size should be attached in inner cage net at water interface for avoiding wastage of floating feed due to water flow and wind.
- Feed should be broadcasted slowly in cages to ensure its accessibility to all fishes and avoiding feed wastage.
- Periodical monitoring of fish, cage net and other cage system is essential.
- Continuous observation for vibriosis and gill chocking to ensure that the fishes are free from the disease, and immediate treatment of the infected fishes. Use of probiotics at regular time interval is the way to control bacterial infection in fish.