Sea Cage Farming

The global mariculture production including the seaweeds is about 54.0 million tonne, which constituted 53.4% of the aquaculture production. In the recent past marine fish catch in the country is stagnating around 3.5 million tonne annually, indicating that increasing the fish catch from the existing fishing grounds is not sustainable economically and ecologically. Added to this dwindling catch in capture fisheries, rampant unemployment in the coastal region and demand for additional seafood necessitates the development of mariculture as a substantial seafood production sector. It has been projected that in India we need to produce about 18 million tonne of fishes by 2030 as compared to about 13 million tonne we produce today. It implies that our aquaculture production has to increase from about 5 million tonne to about 12 million tonne. Enhancing fish production from inland sector has limited scope and the major portion of the additional demand has to come from mariculture.

1. Resources

India is endowed with vast marine fisheries resources such as 8,118 km long Coast Line, 193,834 km^2 of Territorial Sea (12 nautical miles/ 22.2 km from shoreline), about 4 million Marine Fishermen living in 3432 Marine Fishing Villages in 66 Coastal Districts of 9 Maritime States and 2 Union Territories, besides 2 Island Territories of Andaman & Nicobar and Lakshadweep. Infrastructure available includes 6 Major Fishing Harbours, 40 Minor Fishing Harbours and 1537 Marine Fish Landing Centres.

The relatively shallow inshore water along the vast coast line of mainland and island territories offer scope for Sea Cage Farming. However, sheltered areas such as bays, lagoons, semi-exposed and exposed coasts having less wave action are preferable. The existing marine infrastructure and marine fisher population would be serving as complementary resources.

2. Status and Potential

Sea cage farming is viewed as a major option for increasing the seafood production and has been expanding rapidly in recent years at global level. When compared to many maritime countries, India is still in its infancy in cage culture. Recently, it has been estimated that total number of cages of varying sizes installed in the inshore and brackishwater areas number around 1500 with a total estimated production of around 1500 tonne. Hence, there is tremendous scope for the further expansion of cage farming in India. The ICAR-Central Marine Fisheries Research Institute (CMFRI) has projected that even if 1% of the inshore waters is used for cage farming, we can deploy 8,20,000 cages with a production potential of 3.2 million tonne. Thus, there is an urgent need to expand sea cage farming in India.

Sea cage farming in India was initiated by CMFRI with support from Ministry of Agriculture, Govt. of India and National Fisheries Development Board (NFDB) and is

gaining momentum as a commercial seafood production system. Several R&D programmes in cage culture, demonstrations and participatory mode of cage farming have led to the emergence of an economically viable farming method which resulted in popularization of the technology. The necessity of seed for farming has led to the development of hatchery technology for high valued finfish like Cobia, Pompano and Grouper. Consequently, seeds of these species also were made available for cage farming along with the already available seeds of Asian Seabass. As a result, cage farming of Cobia, Pompano, Asian Seabass and Grouper became popular among fishermen-groups and entrepreneurs along the Indian coast.

3. Project Location and Implementation

A. Site Selection: A committee comprising of representatives from State Fisheries Department/ Fisheries Development Corporation, ICAR-CMFRI and NFDB would identify and select suitable sites for project location and development in the sheltered bays/ lagoons/ open seas of coastal States and Island Territories. A minimum of 10 m seawater depth even during low-tide should be ensured.

B. Beneficiaries: Beneficiaries include SHGs/ fishers/ fisherman societies/ farmers/ entrepreneurs; selection would be based on their interest and awareness. Fishers living in hamlets along the coast could directly benefit from this project.

C. Project Implementation:

- Management of cages will be under the technical guidance of ICAR-Central Marine Fisheries Research Institute (CMFRI).
- The '*Aqua One Centre*' would provide training on fish and shellfish farming in cages besides technical services to the beneficiaries.
- Periodic evaluation of progress would be done by CMFRI Project Monitoring Unit (PMU) for the successful operation of the project.
- NFDB would provide financial assistance to the States having marine resources for enabling an institutional setup and development in a project-mode.

4. Project Components

A. Cage Setup: Circular Cage having minimum diameter of 6 m and depth of 4 m (113 m^3 volume) or Rectangular Cage measuring 6 x 4 x 4 m (96 m^3 volume) can be installed at the selected location. They are encircled by a bigger outer net (predator net) with one metre gap all around, and a bird net is overlaid on the cage frame. Cages may be free floating or fixed. Mooring system/

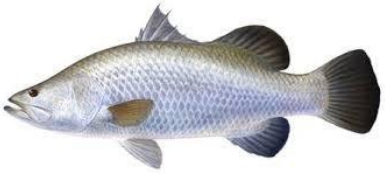
assembly holds the cage in desired position and at desired depth using mooring lines, chains and anchors. Cages with appropriate mesh size can be used to rear fish fry to fingerlings (nursery cage) &/or to grow table fish.

Each sea cages are considered a Unit, and in a given location a maximum of 20 cages will be installed by a group of fishers/ society/ entrepreneur to form a cluster. Sea Cage Units usually form part of an Integrated Project comprising of Marine Fish Hatchery, Feed Plant, Ice Plant, Cold Storage, Refrigerated Truck, etc

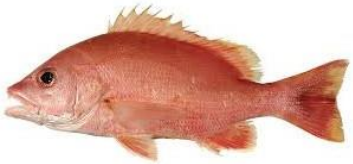
B. Targeted Fish Species: Cobia (*Rachycentron canadum*), Silver Pompano (*Trachinotus blochii*), Seabass (*Lates calcarifer*), Snappers (*Lutjanus sp.*), Groupers (*Epinephelus sp.*) and Spiny Lobster (*Panulirus sp.*) are highly suitable for sea cage farming

Cobia (*Rachycentron canadum*)

Silver Pompano (*Trachinotus blochii*)

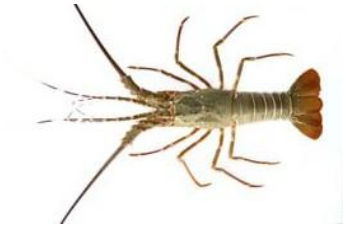


Seabass (*Lates calcarifer*)



Snappers (*Lutjanus sp.*)

Groupers (*Epinephelus sp.*)



Spiny Lobster (*Panulirus sp.*)

C. Stocking and Yield: Stocking density influences growth and production; it has been determined empirically; stocking and estimated harvest quantities are as follows:

Species	**Stocking Size (Length/ Weight)**	**Stocking Density (Nos./ m^3)**	**Production per Cage (kg)**
Cobia	15 cm/ 35 g	8-10	2400 kg/ 7 months
Pompano	10 cm/ 35 g	30-40	1800 kg/ 8 months
Seabass	10 cm/ 30 g	30-40	2000 kg/ 8 months
Grouper	15 cm/ 40 g	15-20	2000 kg/ 7 months

D. Cage Management: Sea Cage management involves optimizing production at minimum cost. Efficient management largely depends on the competence and efficiency of farm operator with regards to feeding rate, stocking density, minimizing loss due to diseases and predators, monitoring environmental parameters and maintaining efficiency in all other technical aspects.

The entire structure including cage frame and mooring must be routinely inspected and necessary maintenance and repairs should be carried out. Bio-fouling clogs the mesh of net cages and thereby reduces rate of water exchange causing stress due to low oxygen and accumulated wastes leading to mortality of fish. Therefore, regular brushing of the net cages mesh is essential.

E. Harvesting: Harvesting can be done as per the market demand to ensure maximum returns. Partial harvesting of stock may be practiced, by harvesting the larger fish first, to avoid glut in the market and consequent fall in sale price. Records of harvest should be maintained at the site. It is necessary to have a post-harvest and marketing strategy while undertaking large-scale sea cage farming activity. The production centres should have facilities

such as proper craft and gear to harvest fish, facilities for icing, holding and storage of fish, live-fish transport, linkages to post-harvest processing centres and market chains.

5. Technical Details

Sl. No	Component	Salient Feature
1	Cage Specifi-cations	Circular Cage having minimum diameter of 6 m and depth of 4 m (113 m^3) or Rectangular Cage measuring 6 x 4 x 4 m (96 m^3) **i. Base Collar** • Inner Ring - 6m ø • Outer Ring – 7 m ø • Middle Ring (Catwalk ring) – 6.5 m ø • Base Supports - 8 nos. • Vertical supports – 8 nos. (to connects the base supports to the circular top handrail) • Diagonal Supports – 8 nos. (to connect the catwalk ring to the circular top handrail with T-joints) **ii. Handrail** • 6 m ø (HDPE, 90 mm ø pipe), fitted about 1 m above the inner Collar Ring and connected by vertical as well as diagonal supports with the Base Collar Rings.

<table>
<tr><th>Sl. No</th><th>Component</th><th colspan="5">Salient Feature</th></tr>
<tr><td></td><td></td><td colspan="5">iii. Mooring System
• Anchors/ Gabion Boxes
• D-Shackles
• Mooring Chains
• Buoys
• Anchor Marker Line
• Mooring Rope</td></tr>
<tr><td>2</td><td>Outer Predator Net Cage</td><td colspan="5">i. Braided UV treated HDPE netting of 3 mm thickness and 80 mm mesh size is very effective and recommended.
ii. Dimensions of Predator Net Cage – 7 m diameter and 5 m depth (entirely submerged).</td></tr>
<tr><td>3</td><td>Inner Fish Rearing / Grow-out Net Cage</td><td colspan="5">i. Twisted HDPE netting of 0.75-1.5 mm thickness and 16 – 40 mm mesh size is selected depending on the size of cultivable species.
ii. Dimensions of Fish Rearing Net Cage – 6 m diameter and 5 m depth (4.0 m submerged and 1.0 m up to the handrail; volume 113 cubic metres)</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">3-4 Sets of Inner Fish Rearing / Grow-out Net Cages Required as Culture Progresses</td><td>Species</td><td>18 mm Mesh For Fish Size (mm/ g)</td><td>25 mm Mesh For Fish Size (mm/ g)</td><td>40 mm Mesh Fish Fish Size (mm/ g)</td><td>60 mm Mesh For Fish Size (cm/ kg)</td></tr>
<tr><td>Cobia</td><td>100-200 / 10-70</td><td>200-450 / 70-1100</td><td>460-750 / 1100-4000</td><td>75-100 / 4-7</td></tr>
<tr><td>Pompano</td><td>20-30/ 2</td><td>40-100/ 35</td><td>100-200/ 500</td><td>--</td></tr>
<tr><td>Seabass</td><td>20-100/ 15</td><td>40-200/ 300</td><td>200-400/ 1500</td><td>--</td></tr>
<tr><td>Grouper</td><td>20-100/ 15</td><td>40-200/ 300</td><td>300-400/ 1000</td><td>--</td></tr>
<tr><td>5</td><td>Bird Net</td><td colspan="5">i Twisted HDPE and UV treated 1.25 mm twine and 60 – 80 mm mesh size will be ideal.</td></tr>
<tr><td>6</td><td>Ballast</td><td colspan="5">i. To maintain the cylindrical shape of the net cages, concrete blocks of appropriate weight are tied at suitable intervals.
ii. Alternately, HDPE pipe of 1.5 inch (38 mm) diameter, with MS chain or wire rope of 10 mm thickness inserted in it, can be used as ballast.</td></tr>
</table>

6. Integrated Project Components and Unit Costs

Sl. No.	Component	Unit Cost (Rs. in Lakh)
1	Sea Cage Unit - Circular (6 m ø x 4 m depth = 113 m^3) or Rectangular (6 x 4 x 4 m = 96 m^3) and Inputs	5.0
2	Hatchery (10 million fry / year)	25.0
3	Feed Mill (10 tonne / day)	200.00
4	Ice Plant (40 tonne)	2.5 lakh/tonne
5	Cold Storage (40 tonne)	2.5 lakh/tonne
6	Transportation Facility (Refrigerated Vehicle 10-tonne capacity)	25.00
7	Aqua One Center	20.00

7. Estimated Project Costs & Returns

Sl. No.	Item	Amount / Quantity
1	*Setup Cost*: Circular Cage Unit (6 m ø x 4 m depth = 113 m^3); Rectangular Cage Unit (6 x 4 x 4 m = 96 m^3); *Inputs Cost*: Fish Seed, Feed, etc.	Rs. 5,00,000
2	Stocking Density/ Cage	1000 nos.
3	Culture/ Grow-out Duration	7 months
4	Weight of Fish at Harvest (Cobia, average)	3.0 kg
5	Expected Yield/Cage/7 months	2,400 kg
6	Estimated Returns/Cage/7 months (Sale Price Cobia @ Rs. 300/kg)	Rs. 7,20,000
7	Estimated Total Costs/Cage/7 months	Rs. 5,00,000
8	Net Returns/Cage/7 months	Rs. 2,20,000

8. Project Monitoring Unit (PMU)

The Technology Partner ICAR-CMFRI would constitute a PMU, and the Project Monitoring Indicators would broadly include:

- Installing & Stocking Cages in time so as to synchronize harvesting with marine fishing ban period and thereby realize higher market price.
- Fish-escape prevention structure to be in place.
- Ensuring predator and bird nets are secured and in place.
- Formation of local level people-institutions (Cooperatives, SHGs, etc.).
- Creation of Sustainability Fund Account.

9. Governance and Socio-Economics

The routine activity of an FCS/ SHGs is managed through an executive committee under the command of the President and Secretary. Functional linkages among Fishers/ Fish Farmer Interest Groups (FIGs)/ Self Help Groups (SHGs), line departments, technology partner, input suppliers and marketing agencies will be established for the sustainability of the Group as well as for the Project Development. Workshops, capacity building, forward & backward linkages (fish seed hatcheries, feed mill, post-harvest handling and marketing) and sustainability fund will ensure continuity and adoption of the technological intervention.

10. Further Reading

Philipose, K.K., 2013. *Development of innovative low cost cages for promoting open*

sea cage culture along the Indian coast. pp. 127-132. Customized Training in Mariculture. Course Manuel, CMFRI, Kochi, Kerala.

NFDB, 2018. *Guidelines for Sea Cage Farming in India*. Published by NFDB, January 2018, pp. 32. [http://nfdb.gov.in/guidelines.htm]