3. OPEN SEA CAGE CULTURE FOR MARINE FINFISH AND SHELL FISHES

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Capture fisheries is undergoing tremendous changes either due to increased fishing pressure or due to decrease in the production of certain groups due to fishery dependent or fishery independent factors. In spite of increasing effort the catch of almost all commercially important fin fishes and shell fishes is on the decline and results in severe resource depletion and unemployment. Fishermen community solely depending on fishing for their livelihood is facing an uncertain future. Decline in marine capture fishery also affects the availability of cheap protein for the masses and also affects the GDP growth of the country. It was in this context cage farming of fin fishes and shell fishes assume importance. Since cage farming is done in open waters where wave action and current takes care of the day to day maintenance of the cage cultured fishes and unlike pond cultured fishes the carbon foot print in cage culture is relatively low and therefore more eco friendly. Cage culture of high value marine fin fishes was initiated in Norway during 1970's and has been developed as a major industry all over the world. Most of the countries where the cage culture has been commercialized are having calm and well protected areas in seas to accommodate cages safely against any unfavorable weather conditions. India, with a vast coast line of 8000 km has an immense potential for the development of mariculture. Central Marine Fisheries Research Institute has initiated cage culture in India for the first time and marine cage was successfully launched at Visakhapatnam, in east coast of India in 2007 (Rao 2009). Later, cage culture was extended to 14 other locations and demonstrated successful culture of Sea bass, *Lates calcarifer,* Cobia *Rachycentron canadum*, Pompano, *Trachinotus blochii.* CMFRI had achieved tremendous success in cage farming at Karwar. At Karwar CMFRI made a production of 2.5 tonnes of Sea bass in 6 meter cages.

The concept of sea cage farm involving a number of cages and number of species was first tried and successfully perfected at Karwar. The Cage farm of CMFRI now has 20 cages culturing five species of marine fin fishes viz., sea bass, cobia, pompano, snappers and sea breams. In order to meet the rising requirement of fish in the domestic as well as international market there is an urgent need to increase the production of food fishes through marine and coastal cage culture. Although we have achieved remarkable success lot more issues are to be researched in order to develop a healthy and environment friendly cage culture technology. The experimental culture of pompano in coastal water bodies in west Godavari district of Andhra Pradesh had opened a new vista for mariculture development. High saline waters in these areas offer immense opportunities to cultivate not only euryhaline species but also marine food fishes. More studies are required to understand issues like growth, salinity tolerance, stocking density, health issues, carrying capacity etc. Development of sustainable Mariculture in India

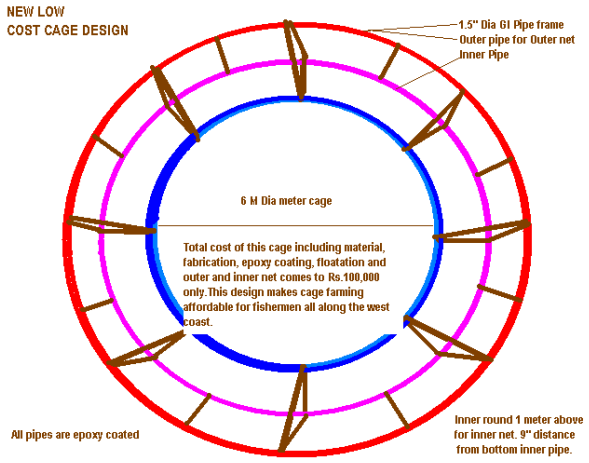
is the need of the day to promote the propagation of high-value marine fish species like sea bass, cobia, pompano, snappers, shellfishes and seaweeds. This will enhance the competitive advantage of the country's fishery sector globally as well as to increase the overall sustainability and productivity of fish farming communities. Since mariculture has been identified as a thrust area of development recently it is essential to undertake focused research on various issues to establish a sustainable mariculture system in India.

Objectives

1. Development of R&D based fish farms for demonstration
2. Demonstrate viability, profitability and environmental compatibility of cage farming in Indian waters
3. Field testing suitability and compatibility of Indian species for age farming
4. Development of field tested package of practices for entrepreneurs/farmers
5. Training and HRD for local fishers/ entrepreneurs/farmers in various aspects of cage farming
6. R&D on scientific aspects of feeding, growth, survival, disease control, husbandry, harvesting, holding, marketing etc.

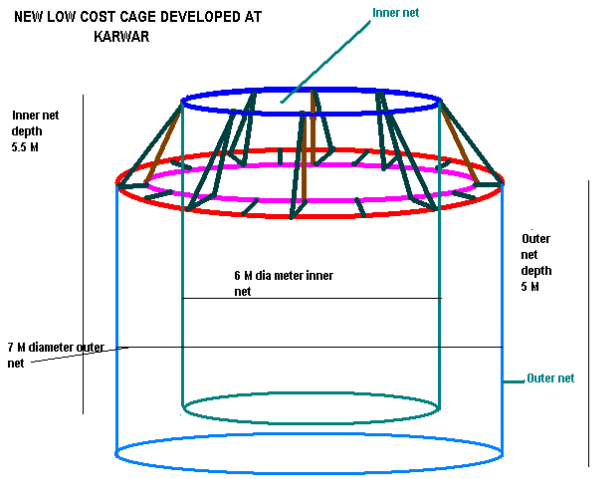
Development of innovative low cost cages for promoting Open Sea Cage Culture along the Indian coast

Central Marine Fisheries Research Institute being the pioneer to the initiate open sea cage culture in Indian waters has been striving hard to promote open sea cage culture at selected locations in all the Maritime states with the involvement of the fisherman community.Cage design and mooring technology has been undergoing refinement through the dedicated and committed efforts of the scientist of CMFRI. Efforts were continuously made to reduce the cost of the cage and mooring systems so as to make it affordable for the fisherman and also to help them to take it up as a lively hood alternative.



Design details of the low cost cage

The present HDPE Cage alone costs about Rs.4,00,000/- Per Cage and together with the mooring systems and net, the cost increase to about Rs.5,50,000/- making it unaffordable to the fisherman. While interacting with the fisherman they expressed their desire to have cage costing less then Rs. 1,00,000/- and lasting at least for 5 years to make it sustainable and economical in the long run. It was with their interest in mind the Karwar Research Centre has looked for alternatives for HDPE cages for promoting Cage Culture in the coastal waters and developed this fifth generation cage.



Technical details of the low cost cage

Design

The low cost cage developed at Karwar is made of good quality 1.5" GI pipe (B class). The diameter of the cage was 6 meter and the height was 120 cm from Base to the railings. All the joints are double welded for ensuring extra strength. Fig (4). After fabrication the structure was provided with single coat epoxy primer and double coat epoxy grey paint to prevent rusting. The total weight of the cage is about 300 kg only.

Low cost cage before epoxy coating

Floatation

Puff or foam field HDPE cage is buoyant enough to float in the water however, metal cage needs additional floatation. Eight fiber barrels of 200 lit. Capacity filed with 30 lb air was used for floating the cage. One of the cap of the barrel is fitted with a valve tube for inflating with air and both the caps are

then sealed with M'Seal to prevent air leakage. The cage when floated on inflated barrels provides a stable platform around the cage where fisherman can stand and safely attend work like net cleaning, net exchange etc.

Advantage of the low cost cage

The HDPE cages floats on water surface hence the outer net is always in the water level and predatory fishes enters into the area in between outer and inner net. In the case of low cost cage the outer net is 60cm above water level and provides no chance for predatory fishes to enter in the middle space.

HDPE cage sinks if more than three person climb on the side frame where as the low cost cage can take the weight of as many as 20-25 persons on the platform safely. The cost of 1 HDPE cage including netting, mooring etc, together costs about Rs. 5,50,000, whereas the low cost cage including netting, mooring all together cost only Rs. 1,00,000. The HDPE cage may take a minimum 4 to 5 Crops to recover the input cost whereas low cost cage can recover the investment in a single crop itself. The diameter of the HDPE cage and low cost cage is 6 meters and Depth of the net also is 6 meters. Hence area wise both the cage gives the same performance.

Disadvantages

Unlike HDPE cage wind action is more on metal cage as it is floated on barrels. Hence it will be difficult to float in open sea condition from June to August unless Heavy duty mooring is provided. Except for this the metal cage performance is far superior to HDPE cage. For fabrication of HDPE cage costly parts and specially trained persons are required. Hence fabrication charges are very high. Whereas for GI cage once the design is provided any small scale workshop can make it. HDPE cage once abandoned is an environmental hazard whereas GI cages once abandoned can be recycled.

Low cost cage in the farm

Open sea Cage Culture in India is promoted by the government of India in a big way to increase fish production from coastal waters and to provide livelihood option to the fishermen. In this context CMFRI's initiative to reduce the cost of the cage to make it affordable to the common fishermen, will go a long way in resource and employment generation.

GI cage Provides an excellent working Platform for the farmers

Dismantling type 10 meter cage in the sea

Dismantling type Cages

GI cages reduce the cost of the cage by almost one fifth of the HDPE cage and increase the profitability of the operation. The whole concept of developing the low cost cage was to reduce the input cost and increase the profitability. The earlier GI cages were designed as fused cages where all the joints are welded. In such cages transportation of the cage was a problem and once the cage is welded it cannot be transported from one place to another by road. Another issue was that for the final welding of the cage power was not available at many places and hiring generator works out very costly. Another issue was that the water volume available inside the cage decides the number of fishes that we can grow in that. A six meter dia cage gives 141 M^3 water for rearing so providing more cultivable area in a single cage is very important. Another important observation was that all other expenses like mooring materials; floatation materials etc remain more or less same. Considering all this an attempt was made first to make the cage a dismantling type without affecting its strength.

Initially a 6 meter cage was designed and fabricated as dismantling type and tested it for strength, transportation efficiency and cost difference. When we found the design strong as a next step we designed a 10 meter circular dismantling type GI cage and later a 12 meter circular dismantling type GI cage. The water volume of the 10 meter cage is 392 M^3 and that of the 12 meter cage 565 M^3. This innovation has increased the cage volume by 4 times and the production per cage to 21.6 tonnes (Table-2). Another advantage is that cages can be fabricated in small scale industries units where they get subsidized power and transport it anywhere by road. Similarly after the harvest the cage can be dismantled, serviced and stored in a shed and used again for the next faming when climate is favourable. 6 meter cage can be managed by 6 persons where as for the 12 meter cage 10 persons are required. In short having one 12 meter cage is like having 4 cages of 6 meter diameter. So this path breaking design is going to make cage farming very profitable.

Cage Cost

Sl.No	Material	Cost-6 meter cage	Cost-10 meter cage	Cost-12 meter cage
1	GI Pipe	18900	37400	45900
2	Welding Charges	10000	20000	24500
5	Epoxy Paint	1600	2600	3600
6	Labour charges	1000	1500	2500
7	Floatation	7500	12000	13500
8	HDPE Rope	1000	1500	2000
	Total	**40,000**	**75000**	**92000**

Cost estimates of the GI Cages

Cage Production

Sl.No	Details	Cost-6 meter cage	Cost-10 meter cage	Cost-12 meter cage
1	Cultivable Water Volume (M^3)	141 M^3	392 M^3	565 M^3
2	Stocking Density	5000	15000	20000
3	Sea Bass Production capacity in Kg. (60% survival rate and average weight 1.8 Kg weight after 8 months grow out (October – May)	5400	16200	21600
4	Gross Revenue (Without deducing expenses) assuming that Sea bass fetches an average price of Rs.250/Kg	Rs.13,50,000	Rs.40,50,000	Rs.54,00,000

Production Capacity of GI cages

Cage frame is only a structure to hold the cage net safely throughout the culture operation in the sea. Since the cost of the cage nets mooring etc are same for any type of cages it is advantageous to go for a cost effective structure so that the input cost for the farming greatly decreases and profitability of the cage farming increases.GI cages are being used in Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu effectively. Low cost GI cages are playing a major role in popularizing open sea cage farming among the farmers and fishermen along the Indian coast catalyzing the growth of the blue revolution in the country.