

The nets can be tied from the shore itself or it can be done within the water. The grow-out net is tied from the hand-rail so that about 1 m of the net is above water level, to prevent the stocked fish from escaping. The outer predator protection net is tied from the outer frame from outside the barrels so that adequate space is left between the inner grow-out and outer net. If the water depth is lesser than the net depth, the nets can be adjusted in depth at the top and tied to the frame.

Ballast pipe

The purpose of a ballast pipe is to keep the shape of the grow-out net intact, so that the stocked fish get adequate area to move around and to prevent entanglement or twisting of the net in water flow and tidal influx. The dimension of a ballast pipe can be fixed as 3.75 m x 3.75 m and either sand filled PVC pipe of 1.5 inches or GI pipe of 1 inch can be used to make ballast pipe. In PVC pipe intermittent holes are put for allowing flow of water through the pipe so that it does not bend and break. GI pipe is ideal due to its weight.

Mooring

Once the cage is inside water, it has to be allowed to float without getting drifted away from the site. For

this mooring has to be done. In open waters, with good water flow the best mooring is with two steel anchors of 45 kg fixed at opposite directions. In lakes where flow is slower, fixed poles can be used. Poles can be fixed at opposite directions or at all four sides. Bamboo poles or areca nut poles can be effectively used in such instances. The ropes tied from anchor to cage or from poles to cage should be long enough to allow vertical movement of the cage up to 2 m so that the cage will have least pulling on it when water level is increased up to 2m also.

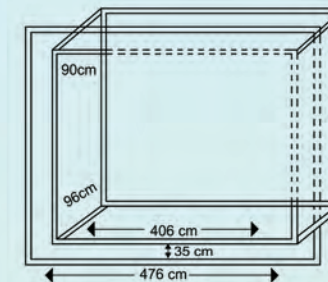
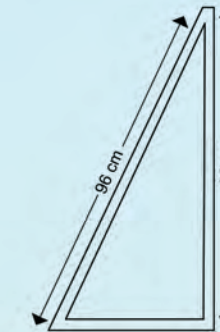
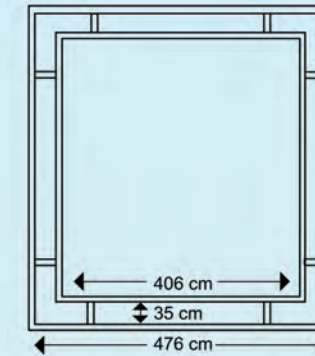
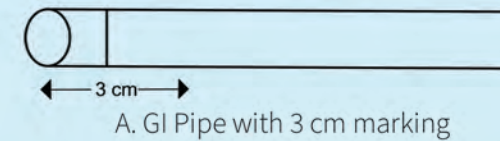
Stocking the cages

Once the cage is ready, it can be stocked with the desired fish seeds. Cobia, pompano, sea bass, grouper, red snapper, giant trevally, grey mullet, milk fish, tilapia and pearl spot have been proven successful in cage farming. In a 48 m³ volume (cage dimension of 4 m x 4 m x 4m), 35- 45 fish/ m³ can be stocked depending on the species.

Cost estimation for a 4 m x 4 m x 3 m GI cage

Sl. No.	Item	Qty. (nos.)	Cost (Rs.)
1	Cage Frame (4 m x 4 m)	1	
a	1.25 inch GI pipe (6 m)	13	14,000
b	Floats	8	5,600
c	Welding cost		5,000
d	Paint & Painting		4,000
e	Ballast pipe (GI)		2500
	Total (A)		31,100
2	Nets	3	
a	HDPE Outer net (Predator protection) 40 mm	1	8000
b	HDPE inner grow-out net	1	16000
c	Nylon Bird protection net	1	500
	Total (B)		24,500
3	Mooring		
a	Anchor	2	
b	Bamboo/ areca nut pole	4	
	Total (C)		2,000
	Grand Total (A + B + C)		57,600

Schematic drawing of Cage frame fabrication



B. Inner and Outer Frame D. Diagonal & Vertical support

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Design & Fabrication of Open Water Cages for Fish Farming



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Materials required for fabricating and installing a 4 m x 4 m x 3 m (length x breadth x cage depth) cage for farming

Sl. No	Item with specifications	Qty. (nos.)
1.	Galvanized Iron (GI) Pipe (1.25 inch) 6 m length (B Class quality)	13
2.	PVC Barrel (Used/New)	8
3.	Grow-out Net (HDPE twisted twine of 1.25mm; square mesh) 4 m x 4 m x 4 m	2
4.	Outer Net (predator protection net HDPE twisted/braided twine of >1.25 mm) 4.7 m x 4.7 m x 3 m	2
5.	HDPE Rope (4 mm; 6 mm, 10 mm & 12 mm) as per requirement	1
6.	Bird protection net (80-100 mm Nylon) 6 m x 6 m	1
7.	Ballast pipe (GI, 3.7 m x 3.7 m; 1.25 inch)	
8.	Mooring materials (Anchor/ bamboo pole/Areca nut stem) depending on site	

Cage culture is coming up as a promising venture and offers the fishers a chance for optimally utilizing the existing water resource which in most cases has limited use for other purposes. It is a low impact farming practice with high economic returns. There are wide prospects of culturing different species of finfishes in cages. In India cage culture was initiated by CMFRI since 2005 and within a decade and half, the technology has been standardized and widely accepted by fishers and farmers along the coastal districts of Kerala.

ICAR-CMFRI has developed cost-effective design for cages in open waters (rivers, lakes, quarries) with many years of innovations and inputs from technical experts and has been simplified and popularized among farmers. Square shape cages have been advised widely for open waters other than sea.

Cage Frame Fabrication

Mark 406 cm (or 159.843 inch; 13.32 feet) on 08 nos. of full length (6 m) GI pipes. Before cutting mark 3 cm from edge (all around) at both ends on each pipe. Then cut all the 08 pipes at 45 inch length from edge leaving the marked 3 cm.

From the five remaining full length pipes mark 3 cm at edges and cut four pipes into 476 cm (or 187.402 inch; 15.62 feet). Then, weld the pieces into three square frames (two 406 cm² and one 476 cm²). The marked 3 cm portion at edges is used for welding joints. Keep one 406 cm² as inner frame and another 476 cm² as outer frame of the cage in plane area. Connect the inner and outer frames using 35 cm pipes (12 nos.) at regular intervals by normal welding. While welding, the edges of these connecting pipes can be flattened for better attachment.

The 90 cm long, pipe pieces with flattened edges are then vertically connected from the inner frame (406 cm²) at four corners as well as at the center of all the four sides. On top of these vertical supports (8 nos.) the third square frame measuring 406 cm² is placed and jointed by welding. After this, diagonal supports using remaining GI pipes and pieces (about 96 cm) have to be welded from the outer frame corners to the top frame (hand rail) corners. It is always better to measure and cut these pieces because slight length variation also will cause difficulty in connecting with the frames.

Painting

Once the cage frame is fabricated, all the joints have to be sealed using M-seal and allowed to dry. After a day or two one or two coats of epoxy primer is applied on the frame. After the primer is properly dried water proof epoxy paint is applied on the cage frame. This will increase the longevity of the frame even to more than 10 years with regular maintenance.

Fixing of Floats

Eight numbers of 200 L barrels (PVC/ Styrofoam) are required to keep the cages floating in the water. Used barrels are available in plenty locally. The barrels are filled with air and sealed prior to tying on the frame. Two floats are tied on each side of the cage frame in such a way that it exactly fits in between the inner and outer frame.

Nets

Two types of nets are essential while rearing fishes in cage. In the open water cage culture, nets of two dimensions are recommended. The inner grow-out net used for stocking the fish are of 4 m x 4 m x 4 m (length x breadth x depth) dimension; while, the outer predator protection net is 4.7 m x 4.7 m x 3 m (length x breadth x depth).

