Fig.6. Floats using PVC pipes

Fig.7. Floats using plastic cans

Cage mooring:

Successful mooring of the cages in water is an important aspect in the cage culture. The mooring process takes into account the depth, substratum and the current speed at the culture site. The fabricated cages which are to be moored can be gently slipped into water with a simple lever mechanism using iron rods, pipes or wooden logs (fig. 8). This process avoids any damage to the shape and structure of the cage which could be caused due to abrasion and also reduces the number of manpower required to launch the cage into water. Nylon/polyethylene ropes of 18mm dia. are tied to sand filled bags which act as anchors. This keeps the cage stable and secure in coastal waters with strong currents (fig. 9).

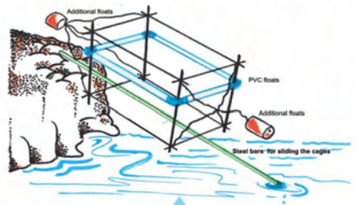

Fig. 8a. Illustration of cage shifting to water surface.

Fig. 8b. Cage shifting to water surface.

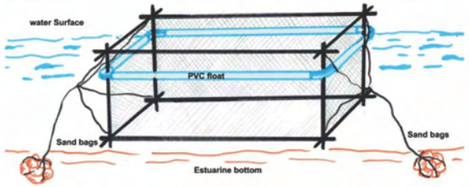

Fig. 9a. Illustration of Cage mooring with sand bags.

Fig. 9b. Cage mooring with sand bags.

Sl. No	Items	Rs.
1	GI pipe frames (6 m) 1.5 inch dia 10 bars	20,000
2	25 m Netlon roll material for outer cage wall	15,000
3	Inner net (12 kg)	10,000
4	Ropes	5,000
5	Fabrication and mooring cost (labour)	15,000
6	Floats	5,000
7	Total cost for construction and mooring	70,000
8	Fish Production in 1 year (kg)	1,000
9	Average revenue in one year (Rs) @ Rs 400/kg	4,00,000
10	Net profit in one year (Rs)	2,50,000
11	Production in cages reared for two years (kg)	3,20,000
12	Average revenue in two years (Rs) @ Rs 400/kg	12,80,000
13	Net profit if cultured fortwo years (Rs)	7,68,000

**Price provided are as per 2018*

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Customized indigenous finfish cages developed for fish farmers of coastal Karnataka

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Cages for small scale fish farmers

Karnataka State possesses coast line of 300 km and has pristine unpolluted saline creek and estuarine areas of about 8000 ha. These coastal water bodies have high potential for aquaculture, especially cage culture of finfishes. The water current speed in these water bodies is high and ranged from 30 to 42 cm/sec. Therefore, the cages deployed for finfish culture has to be sturdy and firm to withstand the hydrographic conditions prevailing here.Taking into consideration the dynamic seasonal hydrographic conditions in the creeks and estuaries of coastal Karnataka as well as with an aim to provide the coastal fisher families an alternate year-round profitable livelihood option, research on cage designs for culturing finfishes was initiated by ICAR-CMFRI, Mangalore Research Centre in 2008.The important criteria considered while planning and designing the cages were its stability in fast moving waters, ease of operation, capacity to sustain high production, use of locally available fabrication materials, skill of local fishers in handling objects and mooring it in water, affordability and ease of accessibility to all family members. Customized all weather cages were designed and fabricated with locally available material for coastal waters of Karnataka. Techniques under "hard cage concept" in Auburn University, Alabama, USA were followed with suitable modifications to design customized indigenous cages for Karnataka. This design can be adopted in other parts of the country also, where the water current speed of the water body is more than 20 cm/sec.The basic cage design was tested and modified to improve its stability, durability and optimize the use of locally available fabrication materials. Basically the cage consist of a rectangular frame, an inner net to hold the fish, an outer protective net and bird net on the top.

Initial Cage Designs - Cage prototype -I and II

Prototype-I cages were developed in 2008. It had a dimension of 2.5 m x 2.5 m x 2 m and the frames were made with bamboo poles. Netlon, which were commonly used as fencing material in farm land was selected for making the outer protective net for the cages and nylon nets for inner as well as bird net (fig.1). PVC pipes were used for keeping the cages afloat.

Fig.1. Cage frame with bamboo poles 2.5 m x 2.5 m x 2 m dimension

Fig. 2. Cage frame with GI pipes poles 4 m x 2 m x 2 m dimension

The limited durability of the bamboo frame and carrying capacity of the prototype-I cages led to the development of prototype-II cages in 2009. GI pipes of one inch diameter with better durability replaced the bamboo for the frames. The cage size was also increased to 4 x 2 x 2 m (fig. 2). The volume of the Prototype-I and Prototype-II cages were 12.5 t and 16 t respectively and there commended stocking rate was 50 nos./m^3. Seabass/red snapper fingerlings stocked in these cages reached a weight of 800g at the end of 8 months (one season). With a survival of 90%, the production from these two proto-types in one season was around 0.4 and 0.5 t respectively. The GI frame cages were sturdy and could withstand the high current prevailing in the estuaries. Sturdy, stable and easy to handle cage model made of GI frames with a durability of three years was found to be the best suited cage for installation in estuaries with heavy tidal influx.

Cage prototype –III, final design.

Cage prototype-III was developed in 2011. This cage is bigger and was designed to optimally use the standard length of GI pipes (6m) and Netlon roll available in the market. The cage dimension is 6 m x 2 m x 2 m with a water holding capacity of approximately 24 t. Recommended stocking was 1,200 fish finger lings/cage at the rate of 50 nos./m^3. As the prototype-III cages were bigger, GI pipes of higher density (1.5 inch) was used for the main frame and additional support in the form of one or two GI cross bars of similar dimension was provided at the base. This ensured the stability and shape of the cage in water (fig. 3).This sturdy easy to handle most cost effective cage model with a durability of five years is recommended to all aquafarmers engaged in cage farming of finfishes in open waters. Since its introduction, this model has wide acceptance and ready adoption by aquafarmers in coastal Karnataka.

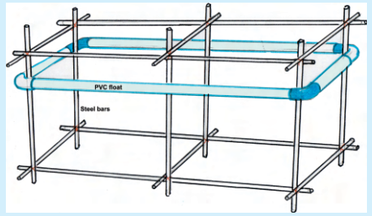

Fig. 3. Pictorial representation of GI cage frame (6 m x 2 m x 2 m) with PVC pipe.

Features of the recommended (Prototype – III) cage model

- Corners and joints of the GI frames are secured with ropes or old net pieces rather than welding as it provided flexibility and reduced pressure caused by currents at joints and the frame continued to maintain shape and support to the cage.
- The Netlon roll marketed has a length and width of 25 m and 2 m respectively. The entire roll can be optimally utilized to fabricate one Prototype-III cage (6 m x 2 m x 2 m). One Netlon roll can be cut into three equal pieces (fig. 4) and wrapped around the GI frame and secured tightly with ropes or old net pieces.
- The inner cage made of nylon net material with a mesh size of 18-23 mm. If the seeds stocked are very small (⩽ 2 cm) then hapas made of mosquito net are kept afloat within the main cage till they attain stockable size (⩾ 3 cm) (fig. 5).
- The PVC pipe provided at the top of the cages provides ample floatation and designed in such a way that the cage moves vertically up and down along with the tide, ensuring enough water in the cage even during lowest low tide. However, the PVC pipes are prone to damage due to fouling and result in seeping of water into the pipe. This reduces floatation ability. This can be solved by providing alternate, additional easily available items like used empty plastic cans.
- The cage becomes heavier as the culture period progresses and hence to keep the cages afloat, additional floats (Plastic cans) are attached (fig. 7).
- The prototype-III cage is expected to yield 0.8 to 1.0 t fish at the end of 8-10 months with a stocking rate of 50 no./m^3 and 90% survival.
- The noticeable advantage of Prototype-III cage made of GI pipe frame is that it can be retained for over three seasons in coastal waters. The fish attained 3-5 kg in 18-20 months when the culture period is extended for 2 years yielding an average production of 3.2 t per cages.
- The 6 m x 2 m x 2 m prototype-III cage model is most suitable for culture of finfishes in coastal open-waters of Karnataka as it is cost effective, durable and easy to handle with a production of 1 t of fish at the end of a culture period of 8-10 months and 3.2 t at the end of 20 months. Further, this is the only model developed which can be used in shallow areas (where the water depth is around 1.5 m).

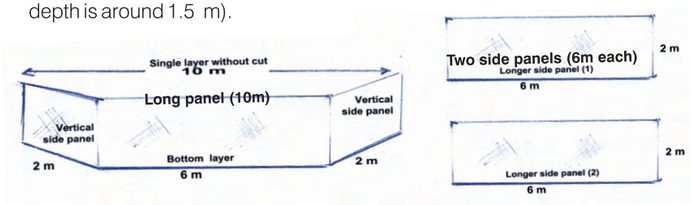

Fig. 4. Outer net fabrication using Netlon material

NETLON

Fig. 5. View of inner cage and hapa fabrication