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Introduction to mariculture techniques: Cage farming

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Site selection

Ideal sites for cage culture are lakes, bays, lagoons, straits and inland seas. Important criteria to be considered in site selection are water current, depth, dissolved oxygen levels, salinity, temperature, pollution etc.

A depth of >3 m is essential for effective cage culture practices. Sufficient depth is needed to maximize exchange of water, and to keep the cage bottom well above the bottom of the water body. Dissolved oxygen is required for respiration, production of energy for essential functions such as digestion and assimilation of food, maintenance of osmotic balance and activity. Oxygen requirements vary with species, stage of development, size and also influenced by environmental factors such as temperature, suspended particles etc. If the supply of oxygen deviates from the ideal; feeding, feed conversion, growth and health are adversely affected. For most fishes, a temperature of 26 - 28^{o}C with no abrupt changes is considered suitable. Preferred salinity range is from 5 – 25 ppt, in brackishwater cage culture.

Cage design and construction

A good and practical design of a cage will meet the requirements of the species farmed and the staff who will operate the system. The structure must be strong to withstand the forces of winds, waves and water currents while holding the stock securely. They must be durable and resistant to corrosion since they are exposed to highly

corrosive effects of seawater. The net bags must be strong enough to hold the stock securely and must be weather resistant. The floatation system must support the combined weights of the walkways and framing, the people working on the raft, net full of fish during harvest and fouling organisms of the net. The structure must be securely anchored to avoid being carried away by strong currents.

The low cost cage developed by CMFRI made of good quality 1.5" GI pipe (B class). The diameter of the cage is 6 m and the height is 120 cm from base to the railings. All the joints are double welded for ensuring extra strength. 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 700 kg.

Puff or foam field HDPE cage is buoyant enough to float in the water. However, metal cage needs additional floatation. Ten fiber barrels of 200 l capacity filled with 30 lb air are used for floating the cage. The cage when floated on inflated barrels provides a stable platform around the cage where fisherman can stand and safely carry out works like net clearing, net replacement etc.

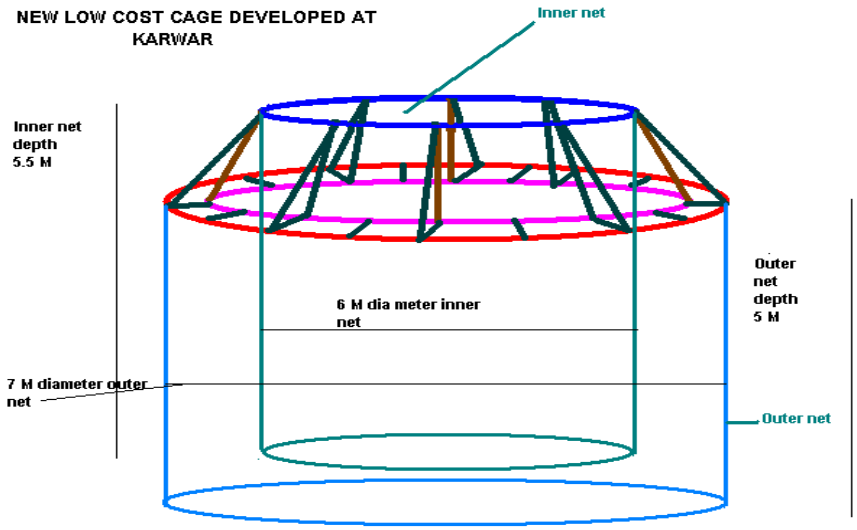
Shape: Shapes of the cages are likely influenced by the swimming behaviour of the fishes. Circular shape cage bag offers the most economical cost of netting materials of the same area and deep than the other shapes such as squares, rectangular, octagon etc. Rectangular cages have a greatest water exchange to volume ratio when the broader side is exposed to current.

Size: The common sizes used for floating net cages are 6 m and 10 m diameter and 4x4 m and 4x5 m and 5x5 m floating cages with a net deep of 3.5-5.0 m including freeboard. Larger size floating cages will require equipment and manpower for its management.

Materials: The main criteria for selecting the materials for the construction of cages are light weight, strong, weather and corrosion resistant, fouling resistant, drag free, smooth textured, easy to construct and repair, cheap and locally available. Netting materials must not be harmful or stressful to the cultured species.

Mooring systems: Most of the mooring systems consist of lines and anchors that secure cages in a particular location. Mooring lines must withstand forces acting on the floating cage system and transmit this to anchors. The total length of mooring lines must be at least 3 times the maximum depth of the water. Depending on the set up of floating cages, mooring system can be single or multiple point. Anchors must be strong enough to resist the forces acting and to secure the floating cages system in place.

Components of a cage includes cage bag, floats, frame, service system, mooring system and anchor system.



Cage nets

Net bags fabricated with synthetic nylon or polythene netting reinforced with polythene ropes are used for farming. Recently new stronger materials from different manufactures are available in the market. Netting material is twisted, braided or even knotless.

Types of net bags are used in cage culture

Outer net or predator net for protection from competitors and predators in open waters: Braided HDPE net 3 mm/80 mm mesh (square) of required size with 14 mm PP vertical rope lining

Inner net for holding the fish: For fish Nylon / Sapphire/ HDPE net with 15 -40 mm mesh, for periodic change are used.

Bird net: Birds should be particularly prevented from cages because they prey on fish and are in many cases are carriers of disease agents and parasites. Bird nets are made with 1.25 mm/80 mm twisted HDPE, provided with rings to connect to the inner cage net, prevent birds from picking caged fish.

Service system

Service system helps the farmers for feeding, cleaning, monitoring, grading etc during cage farming. Max height of handrail should be about 100 cm.

Mooring system

Two functions of mooring line are to withstand and transmit forces. This must be powerful enough to resist the worst possible combination of forces. There are two types of mooring system exist single point & multi point mooring systems in open sea cages. Fixed mooring system is more commonly used in backwaters/ rivers etc. Different types of anchor systems are using in cage culture practices. Some common types of anchors are dead weight

anchors, block of concrete stones, gabion bags filled with stones, scrap metal etc.

Selection of species for farming

The species selected should have a ready market for local consumption or for export. The farmer should decide whether he would culture high volume, low priced species or low volume, high priced species.

Attributes for an ideal candidate species for cage culture

- Hardy species that tolerates crowding and wide physiological tolerances.
- High fecundity of female fish with plenty of material for hatchery production of seed.
- Hatchery production of seed to be relatively simple.
- Those feed well on pellet diets, and juveniles easy to wean to pellets.
- Those which grow rapidly, reaching a harvestable size (350 g – 3 kg) in six to eight months.

Potential species for India

- Marine: Cobia, Sea bass, Groupers, Snappers, Mullets, Lobsters etc.
- Inland: Carps, Pangasius, Tilapia etc.

The stocking densities for cage culture generally range from 15 to 40 no/m^3, although densities can be as high as 60 no/m^3. Cannibalistic fish should be graded into several size groups and stocked in separate cages. The stocking should be done in the early hours (06 00–08 00 hours) or late in the evening (20 00–22 00 hours) when the temperature is lower.

Two to three months thereafter, when the fish have attained a weight between 150–200 g, the stocking density can be reduced to

10–20 fish per cubic meter. Higher stocking densities require more frequent monitoring of water quality and more feeds.

Feed and feed management in cages

Main components of fish feeds are Protein, Carbohydrate, Fat, Minerals, and Vitamins etc. Deficiency of a nutritious feed leads to growth retardation and subsequent disease outbreak. Marine fish require high protein (35-40 %) for their optimal growth. Overfeeding leads to wastage and pollution. Feeding rate, frequency of feeding and time of feeding are important factors to be considered in cage farming. Feeding rate and frequencies are related to age and size of fish. Larval fish and fry need to be fed on high protein diet more frequently. As fishes grow bigger, feeding rate and frequencies can be reduced. Feeding is labour intensive, so frequency has to be adjusted to become economically viable. Growth and feed conversion increases with increase in feeding frequency. Feeding of fish also influenced by the time of the day, season, water temperature, dissolved oxygen level and other water quality parameters.

Farming details of food fishes in cages

Sl No	**Species**	**Length** (cm)	**weight** (g)	**Stocking density (nos/ m^3)**	**Culture period (months)**	**Weight** (Kg)
1	Sea bass	12	10	35	8-10	1-1.5
2	Cobia	15	15	12	6-8	3
3	Snapper	5	4	30	10-12	1.5
4	Mullet	8	5	35	8-10	1