Cage Aquaculture

Boby Ignatius
Principal Scientist, MBTD, CMFRI
Email: bobycmfri@gmailcom

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Today cage culture is receiving more attention by both researchers and commercial producers. Factors such as increasing consumption of fish, some declining wild fish stocks, and a poor farm economy have produced a strong interest in fish production in cages. Many small or limited resource farmers are looking for alternatives to traditional agricultural crops. Aquaculture appears to be a rapidly expanding industry and one that may offer opportunities even on a small scale. Cage culture also offers the farmer a chance to utilize existing water resources which in most cases have only limited use for other purposes.

Key concepts

Right choice of site contributes significantly in the success of cage farm. Site selection is vitally important since it can greatly influence economic viability by determining capital outlay, by affecting running costs, rates of productions and mortality factors.

- Site selection is a key factor in any aquaculture operation, affecting both success and sustainability.
- Circular cages of different diameter ranging from 2 m to 15 m, designed for the culture of fishes such as mullet, cobia, pompano, sea bass, pearl spot, and crustacean like lobsters were experimented and demonstrated successfully in India by CMFRI.
- Stocking of right sized fish juveniles in adequate stocking density another factor determines the success of farming. The stocking density and size of stocked fishes varies with different species.
- Proper feeding the quality feeds, periodic monitoring and cleaning of cages contributes immensely to the success of cage farming.
- With proper management of cage erected at an ideal location can yield a production of 20-40kg/m^3 with various species of fishes.

Cage aquaculture involves growing fishes in existing water resources while being enclosed in a net cage which allows free flow of water. It is an aquaculture production system made of a floating frame, net materials and mooring system (with rope, buoy, anchor *etc.*)with a round or square shape floating net to hold and culture large number of fishes and can be installed in reservoir, river, lake or sea. Economically speaking, cage culture is a low impact farming practice with high returns and least carbon emission activity. Farming fish in an existing water body removes one of the biggest constraints of fish farming on land- the need for a constant flow of clean, oxygenated water. Cage farms are positioned to utilize natural currents, which provide the fish with oxygen and other appropriate natural conditions while also removing waste.

In view of the high production attainable in cage culture system, it can play a significant role in increasing the overall fish production in India. Suitable locations in

Indian's long coastline, vast brackish water areas available in coastal states and other underutilized water bodies can be better utilized by adopting cage culture. Since the investment is low and requires very little/no land area, this farming method is ideal for small scale fisher folks as an alternative income source. This can take up as an household/women activity since labour involved is minimal and can be managed by a small family. The design of the cage and its accessories can be tailor-made in accordance to the individual farmer's requirements.

As with any production scheme cage culture of fish has advantages and disadvantages that should be considered carefully before cage production becomes the chosen method.
A potential fish farmer can produce fish in an existing pond without destroying its sport fishing; does not have to invest large amounts of capital for construction or equipment; and can, therefore, try fish culture without unreasonable risks.
Advantages Cage culture does have some distinct advantages which include:

- Many types of water resources can be used, including lakes, reservoirs, ponds, strip pits, streams and rivers which could otherwise not be harvested. (Specific state laws may restrict the use of "public waters" for fish production; check with your state fish and wildlife agency.)
- A relatively low initial investment is all that is required in an existing body of water.
- Harvesting is simplified.
- Observation and sampling of fish is simplified.
- Allows the use of the pond for sport fishing or the culture of other species.
- Cage culture also has some distinct disadvantages.

These include:

- Feed must be nutritionally complete and kept fresh.
- Low Dissolved Oxygen Syndrome (LODOS) is an ever present problem and may require mechanical aeration.
- Fouling of net cage
- The incidence of disease can be high and diseases may spread rapidly.
- Vandalism or poaching is a potential problem.

Farming of fishes in cages

Site Selection

Different criteria must be addressed before site selection for cage culture The first is primarily concerned with the physicochemical conditions like temperature, salinity, oxygen, currents, pollution, algal blooms, water exchange *etc.* that determine whether a species can thrive in an environment. Other criteria that must be considered for site selection are weather conditions, shelter, depth, substrate *etc.* Finally legal aspects, access, proximity to hatcheries or fishing harbor, security, economic, social and market considerations *etc.* are to be taken care.

Cage Size

It is a fact that costs per unit volume decrease with increasing cage size, within the limits of the materials and construction methods used. CMFRI has developed open sea cages of 6 m dia and 15 m dia for grow out fish culture and 2 m dia HDPE cages

for seed rearing. Ideal size for grow out cage is 6 m due to its easy maneuvering and reduced labour. For fingerling 2 m cages can be used.

Cage frames and nets

Different cage materials can be used for cage farmes. Materials commonly used are High Density Poly Ethylene (HDPE), Galvanised iron (GI) pipes, PVC pipes etc. HDPE frames are expensive, but long lasting. Cost effective epoxy coated Galvanized Iron (GI) frames are recommended for Small groups and fishermen. GI frames have less life span compared to HDPE frames.

Nets of varying dimensions and materials were tested for cage culture in India. CMFRI has used braided and twisted HDPE nets for grow out purpose. It can last for two or more seasons. Nylon net can be used economically, but since it is light weight, to hold the shape intact more weight has to be loaded in the ballast pipe. Cost factor has to be taken care while using new netting materials like sapphire or dyneema materials for net cage. The depth of net ranging from 2 to 5 m is ideal. For open sea cage culture, predator net to prevent attack by predatory organisms is essential.

Potential species and criteria for selection of species for cage culture

The selection of species for cage culture should be based on a number of biological criteria like omnivore or carnivore, hardiness, fast growing, efficient food conversion ability, availability of eggs and juveniles, and disease resistance. Economic market ability and demand are also taken into consideration.

Stocking

Although stocking densities should be determined by species requirements and operational considerations, the influence of stocking densities on growth and production has been determined empirically. The stocking density depends also on the carrying capacity of the cages and the feeding habits of the cultured species. Optimal stocking density varies with species and size of fish.

Feeds and feed management

Fresh or frozen trash fish, moist pellet (MP) and floating dry pellets are the common feed for growing fish in cages. Feeding in cages is quite easy compared to that in ponds. The ration can be divided into equal portions and supplied at regular intervals. Feeding can be done either by broadcasting or using feeding trays. Feeds must be complete and provide all the necessary proteins, carbohydrates, fats, vitamins and minerals needed for growth and health. Feeds cannot be allowed to deteriorate during storage.

Harvest

Harvest of fish in cages is less labour intensive compared to that in ponds. Cages can be towed to a convenient place and harvest can be carried out. Also based on demand, partial or full harvest can be done. Marketing of fishes in live conditions as a value addition can also be done.

Cage management

Cage culture management must result in optimizing production at minimum cost. The management should be so efficient that the cultured fish should grow at the expected rate with respect to feeding rate and stocking density, minimize losses due to disease and predators, monitor environmental parameters and maintain efficiency of the technical facilities. Physical maintenance of cage structures is also of vital importance. The raft and net-cages must be routinely inspected. Necessary repairs and adjustments to anchor ropes and net-cages should be carried out without any delay. Monthly exchange of net should also be considered, as this ensures a good water exchange in the net, thereby washing away feces, uneaten food and to a certain extent reduce the impact of fouling.

Fouling of cage net

Fouling of cage nets and other structures has been observed at many instances of cage farming. Nets get covered with biofoulers. Fouling by molluscs, especially edible oyster sand barnacles have to be checked before its growth advancement. Algal mats and other periphytons can be removed by introduction of omnivorous grazers in cages. A fouled net will be heavier, thereby increasing drag, and this result in loss of nets and fish.

To avoid/ reduce fouling, net should be changed as and when required, which may vary from 2 to 4 weeks depending on the intensity of fouling. During oyster fouling, net exchange has to be done immediately after the seasonal spat fall. Herbivorous fish such as rabbit fish (*Siganus*spp.), pearl spots (*Etroplus*spp.) and scat (*Scatophagus*sp.) can be used to control biofoulers, but their application on a large scale needs to be assessed.

Disease monitoring

Monitoring of fish stock health is essential and early indications can often be observed from changes in behavior, especially during feeding.

Summary

- Cage culture is the most efficient way of raising fish
- Cage can erected in various suitable water bodies in various sizes and shapes
- Stocking density of fishes in cage depends on the species cultured and growth rate of fishes
- A production of 20-40kg/m^3 can achieved in normal conditions from cages
- Identification of ideal site for vital for cage farming
- Proper feeding with quality feeds in of paramount importance for a successful cage farming
- Regular monitoring of net cages and fishes ensures a good harvest from cages.