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FRESHWATER CAGE CULTURE IN INDIA: PROSPECTS AND CONSTRAINTS

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Freshwater cage Culture in India: Prospects and Constraints

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Fish can be cultured in different culture system like ponds, pens, tanks raceways, recirculating systems, cages or in any water closed containment. India, being second topper of fish producer in the world excluding seaweed production, is planned to boost up its fish production, especially in inland fish production using the available open water resources. The current annual fisheries and aquaculture production in India is about 12 mmt. In this, a major fish production comes from inland fisheries sector which alone contributes around 66.81% in the total fish production of the country. In freshwater aquaculture, rearing of fish in freshwater, a major share of up to about 80% in recent years, especially with the contribution from Indian Major Carps (IMC). India has projected to produce 5.92 lakh tonnes of fish in the upcoming years which is three times more than the country's current fish production. Hence, there is a growing interest in developing commercial inland aquaculture activities to meet the projected fish production of the country. Therefore, there is a need to develop and adapt the efficient eco-friendly farming practices which can support diversified species culture to sustain the valuable fish production of inland sector.

The on-growing and production of farmed aquatic organisms using cage enclosures have been a relatively recent aquaculture innovation, especially in freshwater resources such as reservoirs, river and other freshwater bodies. Freshwater cage culture is a developing and high-tech technology throughout the world in which fish were grown from fry to fingerling, fingerling to table size or table size to marketable size in a captive-enclosed space that maintains free exchange of water with the surrounding water bodies. Initially the cages were used to hold the fish temporarily during transportation and marketing. Presently, it is used for commercial rearing purpose. The first cage, used for producing fish, was developed in Southeast Asia around the end of 19th century. Wood or bamboos were used to construct those ancient cages and the fish were fed with trash fish and food scraps. In Japan, modern cage culture technology was initiated in 1950's with an introduction of synthetic materials for cage construction. In the past 20 years, freshwater cage culture has grown tremendously and

Fabrication of cages using locally available low cost materials in Andur reservoirs at Kolhapur

presently it is used at commercial level for fish production in developed as well as developing countries. In the mean time,

Floating cages installed in Andur reservoirs at Kolhapur (Maharashtra)

consumption pattern of fish is increased day by day and it has been estimated that 57% and 4% increase in fish consumption at developing and developed countries, respectively. On the other hand, cage culture is considered as an opportunity to utilize existing open-water resources to enhance fish production from inland open waters which is also looked as an answer for the increased demand of animal protein in the world.

FRESHWATER CAGE CULTURE

A cage is an intensive fish rearing system that confines the fish in a mesh net enclosure. Generally, cage is surrounded completely in four sides using synthetic netting materials which can withstand longer period of time in water. The term "cage" is often used inter unsteadily. Cage culture utilize the existing open water resources but confines the fish movement inside the cages using some type of mesh enclosure. The mesh allows free flow of the water between the fish culture unit and surrounding water resource, which also helps to maintain the water quality needed for the fish culture.

Freshwater cage culture is very popular aquaculture production system where fish are reared in the floating net enclosures supported by the pole and other materials like bamboo, pipe and metal steel, etc.

Cage culture in freshwater bodies is proven to be a successful technology, due to higher production of biomass per unit area, which is providing the income generation and economic benefits to the fisherfolk. Cage culture technology can also be adopted in various agro-climatic conditions which are having freshwater resources.

STATUS OF FRESHWATER CAGE FARMING

The practice of cage aquaculture was originated around 200 years ago in Cambodia, where fish, especially catfish (Clarias sp.), were held in cages with a primary objective of keeping them alive until

Cage installed in Monali Reservoir at Maharashtra

Cage installed in Kaneri Reservoir at Maharashtra

sold. Later, it has become a common technology in South-east Asian countries such as China, Philippines, Indonesia and Thailand. A wide range of freshwater species are cultured in cages such as tilapia (Oreochromis spp.) Pangasius, Grass carp (Ctenopharyngodon idella) and many other species. Modern cage culture practice differs from traditional cage culture by its construction material and level of inputs used. In traditional cage culture, people used locally available material for cage construction and feeding practices. However, in modern cage culture, people started using a synthetic material with high shelf life for cage construction and commercial feed inputs for feeding the fish. The modern practices were initiated in Japan during 1950's for rearing of yellowtail (Seriolaquinquer adiata). Later, the same was adopted in Norway for culturing of Atlantic salmon (Salmo salar). In USA, a decade later, tilapia cage culture was originated during the late 1960's (Beveridge, 1996). Presently, China contributes around 68.4% of the global freshwater cage culture, followed by Vietnam (12.2%), Indonesia (6.6%) and the Philippines (5.9%). Around 72 fish species are cultured in freshwater cages, at global level, with Pangasius being the leading species followed by Nile tilapia, Oreochromis niloticus, common carp, Cyprinus carpio, Oreochromis spp, rainbow trout, Oncorhynchus mykiss and salmon, Salmo sp .

India has huge resource of inland open water bodies such as the availability of 2.25 million hectares of pond and tanks, 3.5 million hectares of reservoirs, 29000 km rivers and 0.78 million hectares of swamps, beels, and other water bodies, which can be effectively used for inland cage culture activities. In India, the first attempt on freshwater cage culture was initiated in swamps and in the Yamuna and Ganga rivers using air breathing catfishes and Indian major carps, respectively. Later, the Central Institute of Fisheries Education, Mumbai, conducted cage culture experiments for rearing of fingerlings and table sized fishes in the Powai, Govindsagar, Halali, Tandula and Dimbe reservoirs. Presently, different fish species like Indian major carp, tilapia, pangasius, exotic carp, snakehead, and catfishes have been reared in freshwater cages (Radhakrishnan, et al. 2019).

Cages installed at Waki Reservoir (Maharashtra)

In the recent past, the trends and regulation on establishing the cage culture in freshwater bodies have been improved by Government agencies. NFDB has made guidelines for cage culture and it also promoting the cage culture in rural areas by providing financial assistance to improve the socio - economic status of rural people. Most of the Indian states which are having freshwater open resources such as lake, reservoirs and check dams started utilizing those water bodies for cage culture to boost up the fish production.

Recently, Govt. of India has taken a decision to increase the fish production through technological up-gradation of cage culture which has been effectively promoted

by various state government funded schemes such as the National Mission for Protein Supplements in Tamil Nadu and Jharkhand. Currently there are about 6000 cages, with different dimensions, installed in different wetlands of India. States like Jharkhand, Chhattisgarh, Odisha, Telangana, Maharashtra and Madhya Pradesh have made significant progress in cage culture using reservoirs water resources. The predominant species being used in cage culture is Pangasius (Pangasiondon hypophthalmus) or GIFT Tilapia. Trials have been made with genetically improved variety of rohu called "Jayanti Rohu", Puntius javanicus, Labeo rohita, Lates calcarifer, Macrobrachium rosenbergii. In addition to this, air breathing fishes, ornamental fishes and Murrels are also being cultured in cages.

However, cage culture is a relatively new aquaculture technique in India, skills in cage culture need to be disseminated to farmers. Unplanned expansion of cage culture can lead to undesirable environmental impacts and therefore there is also a need for proper guidelines to be established to ensure sustainable growth of this sector. Following are the freshwater species cultured in cages at global level.

SPECIES	PERCENTAGE
Pangasius	41.1%
Nile tilapia	26.7%
Common carp	6.6%
Rainbow trout	4.1%
Salmon sp.	3.7%

CLASSIFICATION OF FRESHWATER CAGE FARMING

Cage culture can be done in extensive, semi-intensive and intensive modes in selected water bodies. The method of cage culture can be practiced in open water bodies is mostly decided by the productivity of water. In low productive open water bodies more input and management activities are needed. In contrast, water bodies with high productivity require lower feed inputs and management activities. In extensive method of cage culture, feed is not required; phytoplankton and zooplankton from the

FACTORS / PARAMETER	TILAPIA	CARPS	CATFISHES	
Species	GIFT tilapia and Red tilapia	Indian major carp, Exotic carp	Striped catfish Murrels and	Butter catfish
Place of culture	Cochin (Kerala) Pune (Maharashtra)	Pune (Maharashtra)	Chandil (Jharkhand)	Maithon (Jharkhand)
Size of cages	4 x 4 x 2.5 m	5 x 5 x 2.5 m	5 x 5 x 2.5 m	4m x 4m x 2m
Cage depth	0.9 to 1.6 m	0.9 to 1.6 m	0.9 to 1.6 m	1 to 1.5 m
Size of stocking	25-30g	15-35g	10-25g	8-10g
Stocking density	150 kg/m3	80 fish/m3	60 to 100 nos/m^3	15 to 35Nos/m3
Feed	Floating pellets	Floating pellets	Floating pellets	Floating pellets
Feeding ration	3 to 5% body weight	3 to 5% body weight	3 to 5% body weight	3 to 5% body weight
Types of culture	Floating cage	Floating cage	Floating cage	Floating cage
Culture duration	5-6 months	12 months	6 – 8 months	7 months
Harvesting size	500-600 g	900-1000 g	800-1000 g	50-62g
Production per crop	5 tons /crop	2-5 tons/crop	5 tons/crop	200-600kg/crop

water bodies can be utilized as natural food sources. Cage culture as a semi-intensive practice requires a low protein supplementary diet (<30%) and if feed exceeds 30 percent of protein content, the practice can be considered to as intensive method.

SELECTION OF SPECIES

- Considering the consistent demand of fish in market, culture species for cage culture will be selected based on the following three major criteria;
- Economic value: it should be high to meet the profit in cage culture by farmers.
- Nutritional value: the emerging health conscious people are highly worried about what kind of fish they eat. So it has been advised to choose the fish which are having high nutritional profile for cage culture.
- Regional preference: important factor in cage culture. Mostly in freshwater cage culture, fish will be produced for local market. Hence, rearing of fish which is having greater local consumption will be good for cage culture.
- The following indigenous species need to be inducted into the cage culture domain: Labeo bata, L. rohita (Jayanti rohu), Osteobrama belangeri (pengba), Ompok bimaculatus (pabda), Anabas testudineus (Climbing perch), Pangasius pangasius, Puntius sarana, Chitala chitala (featherback), Channa striatus, C. marulius, (Murrels) Wallago attu and Shellfish Macrobrachium rosenbergii.

CRITERIA SITE SELECTION

- The cage installation site need /to have average water depth of at least 5-10 metres.
- Water quality should be good and free from local and industrial effluent pollution. Better avoid the sites which nearer to industry area.
- In small reservoir, avoid site near to sluice gates and irrigation channel which may damage the cages during its operation.
- There should be a convenient transportation facility from land to the cage culture site at water.
- Sites with algal blooms need to be avoided. Otherwise it may easily attracts the fouling organism.
- The site should be free of aquatic weed and high inhabitants of wild fish, otherwise which may cause oxygen stress.
- Cages need to be placed in such a way that it will not hinder navigational activity of the water body.
- The site should be away from bathing and burning ghats.
- Avoid areas of fish nursery and breeding grounds of fishes and other animal like wildlife habitat including birds nesting, socio-culturally important areas public use like drinking water, etc.

ADVANTAGES

- Different types of open water resources such as reservoirs, lakes, ponds, streams and rivers, etc., can be used to enhance the fish production.
- The capital investment is low as compared to other culture system, especially pond culture system. In cage culture no earthwork involved while constructing the cages.
- Since it is an open water culture system, there is no need to find suitable land site with good soil quality.

- Open water bodies can be used for multipurpose without creating much conflicts over one another like irrigation, drinking, electricity generation, fishing, etc.
- Harvesting is simplified.
- Easy way of observation, handling, feeding, and sampling of fish.
- Less manpower requirement for cage farming.
- Job opportunities for rural, local community, unemployed youth and women.
- Additional income to fishers during closed seasons.

DISADVANTAGES

- Feed must be completely balanced for cage farming.
- Water quality management is quite difficult.
- Fouling organism's attachment over cage culture unit.
- Risk of disease in cage culture.
- Poaching is a potential problem.
- Water pollution as well as eutrophication.

PROSPECTS OF THE FRESHWATER CAGE FARMING

The commercial cage farming is beneficial to the India cage culture farmer because Indian freshwater bodies are highly suitable for cage culture of many freshwater fish species. In addition to this, there is a huge demand in local market, especially in lake and reservoir areas, for nutritionally superior quality product i.e. live fish. It is easy to catch and sell the fish in live condition at nearby cage culture sites. The other positive prospects of freshwater cage culture are as follows;

- The availability of various state and central sponsored schemes and financial assistance for implementing the cage culture in Indian open water bodies.
- Availability of need based training programme for entrepreneurship development through demonstration trainings, exposure visits to the successful farms, etc.
- The availability of unexploited and high market value fishes like minor carps, murrels, pengba, freshwater prawn, etc.
- The availability of skilled human resources who can work in any kind of fields.
- In aquaculture industry, words like "double the production" and "annual growth rate" are the key for expansion of future cage culture.

CONSTRAINTS OF FRESHWATER CAGE CULTURE

- Poorly placed cages may alter current flows and worsen the sedimentation.
- Improper management of cage culture activity may pollute the environment with uneaten feed and fish faecal waste, causing eutrophication.
- The dependency on completely balanced commercial feed may reduce the profit of cage culture.
- During sampling time, fishes in the cages will be crowded in one place which may cause stress to the fish and led to secondary infections.
- Human errors- Poor construction of cages, poor quality of seed (fry, fingerlings), high stocking density and poor quality of feed, improper feeding methods, ignoring regular monitoring of fish, fish handling, site selection and cage maintenance can be considered as human errors.

CONCLUSION

Cage culture in freshwater open water bodies is the most effective and advanced technology practiced in the world. The demand for inland fish production is placing greater pressure over reservoirs fishery resources. It has been projected that reservoirs of India can produce much more fish than its current production level. To boost the reservoir production, governments has made more policies and schemes for supporting the local people. State and central government have announced many financial assistance and subsidy schemes to undertake cage culture activity more effectively in open water bodies by local people to improve their


Feeding in cages

social status and livelihood. In addition to this, intervention in cage culture technology, at large scale through public private partnership (PPP) mode in these reservoirs, can further boost the fish production which helps to fulfil the expected production potential of nearly 1 million tonnes.

REFERENCES

1. Bhowmick, U., & Das, A. K. (2011). Cage and Pen culture. Handbook of fisheries and aquaculture. ICAR, New Delhi.
2. Beveridge MCM, Stewart J.A. (1998) Cage culture: limitations in lakes and reservoirs. In: Peter T (ed) Inland Fishery Enhancements, FAO Technical Paper 374, FAO, Rome, 263-279
3. Das A.K., Vass K.K., Shrivastava N.P., Katiha. P.K. 2009. Cage Culture in Reservoirs in India. (A Handbook) World Fish Center Technical Manual No. 1948. The World Fish Center, Penang, Malaysia. 24 pp.
4. Das, M. K. (1999). Impact of habitat quality and disease on fish production in inland water bodies. J. Inland Fish. Soc. India, 31, 28-30.
5. Mishra, S. S., Das, R., Choudhary, P., Debbarma, J., & Sahoo, S. N. (2017). Present status of Fisheries and Impact of Emerging Diseases of Fish and Shellfish in Indian Aquaculture. J Aquat Res Mar Sci.5-26.
6. Radhakrishnan,K. Samraj,A. Padmavathy,P. Biswas,I. (2019). Current status of freshwater cage aquaculture in India: Towards blue revolution. Volume 23No.1.1-5pp
7. Tacon, A. G., & Halwart, M. (2007). Cage aquaculture: a global overview. FAO Fisheries Technical Paper, 498, 3.