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Cage Fish Farming in Indian Reservoirs: Balancing Production with Ecosystem Health

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Cage culture is emerging as a promising way to increase fish production from India's large reservoirs while supporting rural livelihoods. Fish are grown in floating net cages placed in open water, making use of unused water areas without needing extra land. The method offers good income opportunities for farmers and fishermen. However, waste from uneaten feed and fish excreta settles on the reservoir bottom. This can reduce oxygen levels, enrich nutrients, and change the communities of small bottom-living organisms. If not managed carefully, these changes may disturb the ecological balance of the reservoir. This article explains the benefits of cage fish farming, its effects on sediments and aquatic life, and practical steps that farmers and managers can take to keep the practice sustainable for the long term.

Introduction

India's demand for fish is rising steadily because of a growing population and the need for affordable protein. Traditional capture fisheries in rivers and reservoirs are under pressure due to overfishing and environmental changes. In this situation, cage culture has become an important option for increasing fish production from existing water bodies. In cage culture, fish are reared inside floating net enclosures fixed in open water such as reservoirs, lakes or large ponds. The cages are usually made of strong materials like high-density polyethylene (HDPE) and are designed to stay stable in varying water conditions. Popular species grown in cages include Pangasius, Tilapia and Indian major carps such as Catla, Rohu and Mrigal. These species grow fast and fetch good market prices. The biggest advantage is that cage culture uses the unused water area of reservoirs. Farmers do not need additional land or large amounts of new water. Government schemes that provide subsidies, training and technical support have encouraged many small and marginal fishermen to adopt this method. While the economic benefits are clear, the environmental effects on water quality, bottom sediments and aquatic life also need careful attention so that the practice remains sustainable.

Figure 1. Floating net cages used for fish farming in an Indian reservoir

How Cage Culture Affects Reservoir Ecosystems

Reservoirs are living systems where physical, chemical and biological processes work together. The bottom layer, called the benthic zone, contains sediments and many small organisms such as worms, molluscs, insect larvae and tiny crustaceans. These organisms help

recycle nutrients and also serve as food for fish. When cage culture is practised intensively, waste materials settle under the cages and can disturb this natural balance.

1. Organic Loading and Eutrophication: During feeding, a portion of the feed (often 20–30 percent) is not eaten by the fish. This uneaten feed, along with fish faeces, settles on the reservoir bottom. The accumulated organic matter decomposes and releases nutrients such as nitrogen and phosphorus into the sediment. This process is known as eutrophication. Decomposition increases the demand for oxygen in the bottom layer. When oxygen becomes low, harmful gases such as hydrogen sulphide, ammonia and methane are produced. These gases are toxic to many aquatic organisms. As a result, sensitive species disappear, and only pollution-tolerant organisms such as Tubifex worms and Chironomus larvae survive. This reduction in biodiversity is a clear sign of environmental stress.

2. Changes in Sediment Chemistry: Studies conducted in reservoirs such as Indirasagar, Sardar Sarovar and Gangrel have shown that cage culture changes the chemical nature of the sediment. Organic carbon levels under cages often become two to three times higher than in areas without cages. Nitrogen compounds (ammonia and nitrate) and phosphorus also increase because of the continuous input of feed and waste. The pH of the sediment may decrease, making conditions more acidic. These chemical changes affect the organisms living in the sediment. When water movement or drawdown occurs, the stored nutrients can be released back into the water column and trigger algal blooms, which further reduce water quality.

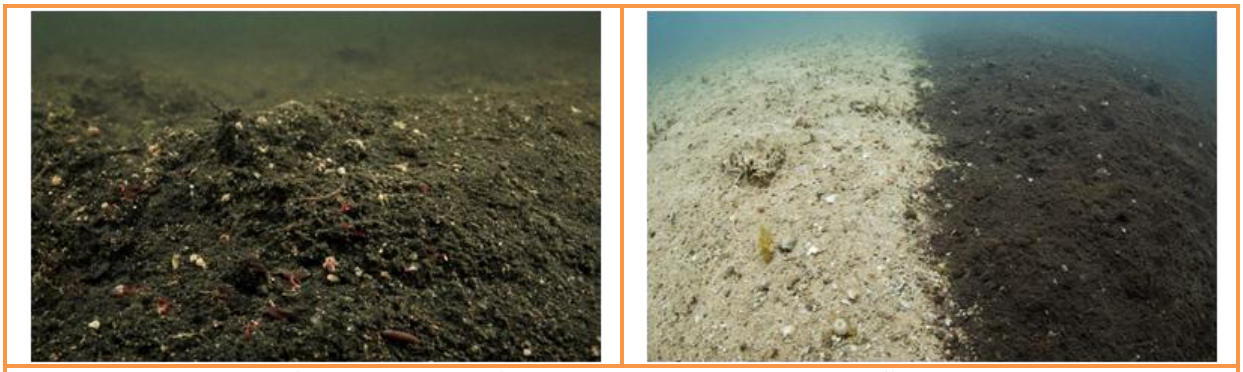

Figure 2. Accumulation of organic waste under fish cages can alter sediment quality and affect bottom-dwelling organisms.

3. Alteration in Benthic Biodiversity: Benthic organisms are good indicators of environmental health because they respond quickly to changes in water and sediment quality. In a healthy reservoir, many different species of worms, molluscs and insect larvae (such as mayflies and caddisflies) are present. They help maintain nutrient cycling and form an important part of the food web. Continuous cage culture reduces this diversity. Sensitive species that need clean, oxygen-rich conditions gradually disappear. Pollution-tolerant species become dominant. The ecosystem becomes simpler and less able to recover from stress. Over time, this can lower the overall productivity and stability of the reservoir.

4. Risk of Sediment Toxicity and Resuspension: Sediments under cages can also accumulate heavy metals from feed additives and residues of medicines or antibiotics used in fish farming. During storms, strong water currents or reservoir drawdown, these sediments may be stirred up and mixed back into the water. The sudden release of nutrients and toxins can cause algal blooms, fish disease outbreaks or even fish mortality, affecting both wild fish and the cultured stock.

Benefits of Cage Culture

Despite the environmental concerns, cage culture offers several important advantages:

- Higher fish production from existing water bodies without requiring extra land.
- Additional income and employment for small and marginal fishermen and rural youth.
- Better utilisation of under-used reservoir water resources.
- Opportunity to culture fast-growing and high-value fish species.
- Support for national goals of food security and blue economy development.

Practical Measures for Sustainable Cage Culture

Cage culture can remain productive and environmentally friendly if proper management practices are followed. The following steps are recommended for farmers, cooperatives and fishery departments:

- ✓ **Assess carrying capacity**: Before installing cages, estimate how much fish biomass the reservoir can support based on its water volume, depth and existing nutrient levels.
- ✓ **Select suitable sites**: Place cages in deeper areas with good water flow and higher dissolved oxygen. Avoid shallow, stagnant or already nutrient-rich zones.
- ✓ **Control stocking density and feeding**: Avoid overcrowding and overfeeding. Efficient feeding reduces the amount of waste that reaches the bottom.
- ✓ **Rotate cage locations**: Periodically move cages to new sites so that the sediment under previous locations can recover naturally.
- ✓ **Monitor regularly:** Check water quality, sediment condition and the presence of benthic organisms at intervals. Early detection of problems allows timely corrective action.
- ✓ **Adopt integrated approaches**: Growing filter-feeding organisms (such as mussels) or aquatic plants near cages can help absorb excess nutrients and improve overall water quality. This practice is known as integrated multi-trophic aquaculture.

Figure 3. Regular monitoring of fish health and water quality is essential for sustainable cage culture.

Conclusion

Cage fish farming is a valuable method for increasing fish production and improving livelihoods by making better use of India's reservoir resources. It contributes to food security and supports the rural economy. However, its long-term success depends on maintaining ecological balance. The health of a reservoir is judged not only by the quantity of fish harvested but also by the condition of its sediments and the diversity of organisms living at the bottom. If these are damaged, the productivity of the entire system can decline over time. Therefore, scientific site selection, controlled stocking and feeding, periodic cage rotation, and regular environmental monitoring are essential. When these practices are followed, cage culture can develop as an eco-friendly and productive system that supports both economic growth and environmental conservation. A balanced approach will ensure that the benefits of cage farming continue for future generations of farmers and fishermen.

References

1. Ali, M. and Rehman, M. (2020). Environmental impacts of cage culture in freshwater reservoirs. *Aquaculture Research*, 51(6): 2451–2461.
2. Gupta, S. and Kumar, A. (2023). Environmental sustainability of cage culture in Indian reservoirs: Challenges and solutions. *Journal of Fisheries and Aquatic Sciences*, 56(5): 112–119.
3. Hassan, M. and Mondal, P. (2022). Impact of cage culture on benthic biodiversity: A case study from Bangladesh. *Environmental Science and Pollution Research*, 29(8): 11899–11908.
4. Sharma, P. and Soni, A. (2019). Cage fish farming: Its potential and environmental concerns in India. *Aquaculture Asia*, 24(2): 39–45.
5. Thakur, P. and Yadav, S. (2021). Organic enrichment and sediment quality in reservoirs under cage culture practices. *Journal of Aquatic Ecosystem Stress and Recovery*, 10(4): 210–220.