

Ornamental fish culture: A niche-sector pillar for advancing the sustainable development goals

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Backyard Betta splendens farming in glass bottles – Udayrampur, South 24 Parganas, West Bengal, India.

The ornamental niche in the global aquaculture context

All member states of the United Nations adopted the 2030 Agenda for Sustainable Development in 2015, consequently establishing the 17 Sustainable Development Goals (SDGs). The urgency of achieving these goals requires the pursuit of sustainable solutions across all economic sectors. Global aquaculture has experienced substantial growth, increasing its output from 21.8 million metric tonnes (MT) in the 1990s to a remarkable 94.4 MT in 2022. This growth has been largely justified by its capacity to provide affordable protein to a world population expected to reach 9.7 billion by 2050 (FAO, 2024).

However, the ornamental fish industry - the culture and commerce of aquatic species for aesthetic and recreational purposes - represents a distinct, high-value sector of this "blue transformation" strategy. The global ornamental fish market is predominantly supported by tropical developing nations, which collectively supply more than 60% of the commodity (Raja et al., 2019). For many of these nations, including India, the potential for foreign exchange earnings is high, supplemented by a strong domestic consumer market. The specific characteristics of ornamental fish culture - defined by low investment needs, small scale, and frequent home-based operation - render it a uniquely powerful tool for achieving socioeconomic change at the community level. It directly connects specialised global consumer demand to rural and economically disadvantaged communities.



The contribution of ornamental fish farming to socioeconomic empowerment

Ornamental fish farming and trade are unique in their ability to stimulate inclusive growth and address existing socioeconomic differences, thereby serving as a powerful driver for several key developmental SDGs (Hambrey, 2017). Most ornamental fish production in India comes from small-scale production units spanning 0.4 hectares (1 acre) and costing an investment of Rs 300,000 (US\$3,530) per unit (Swain et al., 2020). It is considered one of the best employment-generating and foreign exchange-earning platforms. The Pradhan Mantri Matsya Sampada Yojana, a centrally sponsored scheme by the Government of India, has allocated Rs 5.76 billion (US\$67.8 million) for the growth of the Indian ornamental fish industry and the generation of 700,000 employment opportunities (Pradhan Mantri Matsya Sampada Yojana, Operational Guidelines, 2020).

SDG 1: No Poverty and SDG 8: Decent Work and Economic Growth

Ornamental fish culture provides essential supplemental income and enables livelihood diversification, particularly for rural populations and those living in regions marked by economic hardship (Phillips et al., 2016). Success stories in ornamental fish farming have been reported from several districts in West Bengal, India, including Howrah, South 24 Parganas, and Nadia districts.

In Udayrampur, South 24 Parganas, ornamental fish farmers have turned their home backyards into fish farming units. Dealing primarily in *Betta splendens* farming by reusing discarded glass bottles, these farmers are generating significant annual revenue. Household women are also actively involved in this practice. The entire area of Udayrampur is dominated by backyard farming of *B. splendens*, while only a handful of farmers culture other ornamental fish species, mainly livebearers. The town of Makardah in Howrah district shows a very different picture. Farmers here are more involved in cement cistern-based ornamental fish culture, specialising in exotic varieties such as rainbow sharks, goldfish, and Mbuna cichlids. One household in Kalyani, in the Nadia district of West Bengal, has also constructed several cement cisterns in its backyard and actively cultivates exotic ornamental fish varieties, including the green terror cichlid, oscar, red tail catfish, and angel. The owner of this property is confident that his initiative will motivate other households in the nearby area to take up ornamental fish farming in their backyards.

Low-input livelihood

The culture of ornamental fish is distinctive in its requirements, as it demands minimal land, low initial capital, and reduced labour compared to most agricultural or traditional aquaculture activities. This flexibility allows it to be easily integrated into existing household schedules, often taking place in simple, small-volume tanks situated in backyard production units. Backyard ornamental fish production offers employment opportunities for women in households, the elderly, and small-scale farmers. This practice is particularly popular in the state of West Bengal, specifically in the districts



ICAR-CIFRI programmes have empowered women from Scheduled Castes and Scheduled Tribes to establish their own ornamental fish farming units in West Bengal and Odisha.

of Howrah, Nadia, and South 24 Parganas. It targets only one or two species, breeding and rearing them to marketable size within three to four months with minimal inputs in a backyard or rooftop by suburban, landless farmers.

High value and profitability

The product itself possesses significant commercial value. Ornamental fish can command a price up to 100 times that of food fish, with marine ornamental species often being about ten times more expensive than their freshwater counterparts.

This high profitability translates into substantial financial benefits for small-scale entrepreneurs and marginalised farmers.

Economic multiplier effect

The ornamental trade acts as a primary stimulus for strong economic multiplier effects, supporting numerous related industries. These include the manufacturing of ornamental fish feed, aquariums, and aquarium accessories, as well as complex logistics. The expansion of the ornamental industry provides significant livelihood opportunities for rural populations across developing economies. The coordinated development of this value chain is a clear example of inclusive economic infrastructure advancement, encompassing marketing channels and technological inputs, which further secures its role under SDG 8.

SDG 5: Gender Equality

The intrinsic characteristics of ornamental fish farming are remarkably compatible with the requirements for women's participation, a critical factor for achieving SDG 5. The low demand for space and labour allows women to manage farming activities alongside their domestic responsibilities efficiently. The ICAR-Central Inland Fisheries Research Institute has successfully designed and implemented programmes that empower marginalised Scheduled Caste (SC) and Scheduled Tribe (ST) women in regions such as West Bengal and Odisha to establish their own independent ornamental fish farming units (Bhattacharya et al., 2025). This economic activity provides women with an independent financial source, directly leading to financial independence and a significant increase in decision-making power within the household. The sector is therefore not just a source of income, but a mechanism for gaining socioeconomic agency (Arulingam et al., 2019).

Backyard ornamental fish farming in cement tanks, Udayrampur, South 24 Parganas, West Bengal, India.

The imperative of captive breeding for aquatic conservation (SDG 14)

The ornamental fish trade has historically been associated with concerns about the unsustainable exploitation of wild fish resources. However, the conscious shift towards captive breeding and culture is now unequivocally positioned as an essential conservationist mandate for achieving SDG 14 - Life Below Water (Andriyono et al., 2024).

Conservation and propagation of wild stocks of sustainable biodiversity

Historically, the vast majority of marine ornamental fish (over 90% globally) and a significant proportion of indigenous freshwater species have been collected from their natural habitats. Approximately 95% of Indian ornamental fish exports are sourced from wild collections, placing significant pressure on biodiversity hotspots, such as the Western Ghats. This capture-based export model is inherently unsustainable, frequently resulting in over-exploitation, localised species depletion, and the endangerment of native fish fauna. The promotion of captive breeding of indigenous ornamental fish species is therefore pivotal to ensuring a reliable, consistent, and sustainable supply, thereby drastically alleviating the cumulative strain on natural fish populations.

Beyond the commercial imperative, captive breeding has significant potential for ecological restoration. It enables the strategic release of hatchery-bred individuals into the wild, thereby repopulating or re-establishing stocks that have been locally depleted or lost due to environmental and anthropogenic pressures.

SDG 12 and responsible industry practices

When ornamental fish farming is carried out using advanced technologies like recirculating aquaculture systems (RAS) and aquaponics in controlled indoor conditions, the environmental impact is significantly reduced, minimising overall water consumption and substantially reducing the ecological risk associated with the escape of farmed fish into natural ecosystems (Yustiati et al., 2024). The ornamental industry is increasingly adopting strict certification schemes that enforce





Hapa culture of ornamental fish – Udayrampur, South 24 Parganas, West Bengal, India.

ethical sourcing, good animal husbandry, and sustainable management practices. Standards such as Green Certification by MPEDA (Silas et al., 2011) were intended to promote a market-driven approach to ecological integrity and ensure compliance with the Convention on International Trade in Endangered Species (CITES). Such voluntary adherence is crucial to drive SDG 12 (Responsible Consumption and Production) within the high-value exotic trade.

Addressing cross-cutting SDGs and systemic challenges

While the main contribution of the ornamental aquaculture sector is not related to food supply, its operations inevitably overlap with other critical SDGs and are subject to systemic constraints typical of the broader aquaculture industry.

Contribution to ancillary goals

SDG 9: Industry, Innovation, and Infrastructure

The perpetual demand for rare, high-value, or genetically superior strains of ornamental fish acts as a powerful economic catalyst for innovation. This demand stimulates the development of advanced breeding techniques, specialised

aquafeed formulations, sophisticated water quality management tools (such as RAS technology), and the manufacture of aquarium accessories. It serves as a driver against technological stagnation, fostering a modern and organised industry (Anil et al., 2022).

SDG 6: Clean Water and Sanitation

Similar to food fish culture operations, sustainable ornamental aquaculture requires strict water quality management and effluent control to prevent water pollution. The necessary adoption of RAS, aquaponics and biofloc technologies is therefore not simply a measure for efficiency but a core requirement for ecologically responsible growth. The focus on integrated farming and closed systems is key to minimising water wastage and optimising nutrient cycles (Hoseinifar et al., 2023).

SDG 3: Good health and well-being

Though not intended for human consumption, the ornamental sector contributes to improved animal health practices. The use of probiotics and prebiotics in ornamental fish culture reduces reliance on antibiotics. This practice can be transferred to the food fish sector, thereby indirectly supporting global efforts against antimicrobial resistance and promoting general health (Saha et al., 2022).

Emerging challenges and policy impediments

The potential of ornamental aquaculture is significant, with the ornamental fish market size projected to reach US\$11.30 billion by 2030, growing at a compound annual growth rate of 8.5% from 2023 to 2030 (Grand View Research, 2023). However, a combination of operational and policy-level constraints often limits its development. Despite the clear benefits of captive breeding and culture, a significant barrier remains the continued dependence on, and often irresponsible, collection of wild fish using destructive fishing methods (Evers et al., 2019). This persistence is often driven by the difficulty in breeding certain high-value species in captivity and a preference for perceived "wild-caught" quality.

For the typical small-scale rural producer, especially women entrepreneurs, the primary limitation to viable economic growth is often the lack of proper market access and robust logistics infrastructure. Furthermore, continuous and sustained investment in the transfer of appropriate technology - bridging the gap between scientific laboratories and local farmers regarding advanced breeding protocols, husbandry techniques, and disease diagnostics - is a continuous requirement. The long-term viability of the entire trade, particularly the wild stocks that continue to serve as genetic reservoirs, is threatened by the macro-environmental forces common to all fisheries, including climate-driven changes, habitat destruction, and pollution. The ornamental sector, being particularly

reliant on delicate tropical ecosystems, is acutely vulnerable to these compounding risks, aligning its challenges directly with SDG 13 - Climate Action (Yarkina & Logunova, 2022).

Conclusion

Ornamental fish culture offers a significant opportunity to advance multiple Sustainable Development Goals when implemented through a structured development framework. Beyond its recreational perception, the sector serves as a strategic platform with low capital needs and high labour involvement, supporting poverty reduction (SDG 1) and enhancing livelihood opportunities for women (SDG 5). Strengthened community enterprises and skill development promote decent work and economic growth (SDG 8), while innovation and efficient resource use contribute to SDG 9 and SDG 12. Captive breeding of threatened species directly supports SDG 14 by replacing harmful wild collection with responsible, traceable culture systems.



Demand for ornamental fish has stimulated subsidiary industry in the manufacture of aquarium accessories.



Packing ornamental fish for transport to market.

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