

# Community participation in marine ornamental aquaculture: An integral approach on livelihood empowerment of islander women and conservation of reef ecosystems at the Lakshadweep Islands, India

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Promoting and encouraging community participation in marine ornamental aquaculture presents an alternative approach to enhancing the economic status of marginalised individuals, particularly women, in the Lakshadweep islands, India. Additionally, it aids in curbing the wild capture of marine ornamental organisms, thereby relieving pressure on natural resources. This initiative is spearheaded by the ICAR-National Bureau of Fish Genetic Resources as part of a socio-economic endeavour aimed at offering nature-based solutions for conserving and managing wild ornamental organisms. The coral reef ecosystem, the largest living marine repository, harbours an incredibly diverse range of species, crucial for sustenance, income, and cultural identity. Nevertheless, this intricate and productive ecosystem faces threats from both natural occurrences and human activities, prompting concerns regarding its sustainability and resource management (Dammannagoda, 2018).

The article examines the strategy of community-based marine ornamental aquaculture and its significance in bolstering the economy of islanders, particularly women, in the Lakshadweep Sea. It seeks to investigate effective approaches to promote the sustainability of the coral reef ecosystem in the region. The initiative is guided by the following objectives: (a) conservation of marine biodiversity, (b) sustainable utilisation of biodiversity, and (c) equitable sharing of benefits arising from this initiative.

High-value marine ornamental organisms, such as fishes and shrimps, are cultivated in community aquaculture units using simplified technology. These organisms are supplied to aquarists and hobbyists, thus supplementing the income of local women islanders.

*Community aquaculture unit with beneficiaries.*





## An overview of the marine ornamental fish trade

The marine ornamental fish trade industry has generated an estimated 5.4 billion USD, with a projected compound annual growth rate (CAGR) of 8.5% from 2022 to 2023 (Market Analysis Report, 2022-2030). Globally, approximately 46 million individuals, representing 25,000 species/varieties, are traded, raising concerns about the disruptive and reckless exploitation of ornamental organisms from sensitive coral reef ecosystems for the aquarium industry (Wabnitz et al., 2003).

Marine ornamental organisms are valued at US\$1,000 per kg, significantly higher than the average price of US\$13 for food fish. The value chain for ornamentals is also shorter compared to food fishes (Cato and Brown, 2003). However, the exploitation of 20-30 million reef fishes annually for commercialisation has sparked significant concerns about their conservation status (Baquero, 1999; Wabnitz et al., 2003; Rhyne et al., 2012; Leal et al., 2015). This exploitation not only diminishes their population density to endangered levels but also damages the entire ecosystem.

Currently, approximately 50 countries participate in marine ornamental fish trading, yielding significant financial returns. For many, this trade serves as a major economic driver.

*Thor hainanensis*.



*Beneficiaries attending the animals in community aquaculture unit.*

Indonesia leads the pack, contributing 34.4% of all shipments, averaging 1,727,940 organisms annually, while Sri Lanka follows as the second leading exporter, accounting for 15.1% of shipments and 599,072 specimens. The Philippines trails behind with 12% of shipments and 309,350 specimens.

The number of species traded has seen a notable increase from 2014 to 2017, rising by 61.1% (from 47,136 specimens) to 78% (from 32,5091 specimens). However, data spanning 2014 to 2017 indicates a declining trend in the top 20 traded species, primarily due to habitat destruction (Biondo & Rainer, 2019).





## Biotope and socio-economic status of Lakshadweep

Lakshadweep is renowned for its atoll-based islands, situated within the Laccadive-Chagos ridge, an area characterised by a transition between oceanic crust to the west and continental crust to the east. This ridge comprises shoals, banks, and coral reefs stretching approximately 2,500 km, with a depth of around 1,500 m. Positioned at 8°-13° North latitude and 71°-74° East longitude in the Arabian Sea of the western Indian Ocean, Lakshadweep is located about 220-440 km off the coast of Kerala, India.

The region boasts a total lagoon area of approximately 4,200 km<sup>2</sup>, territorial waters spanning around 20,000 km<sup>2</sup>, and an Exclusive Economic Zone covering 400,000 km<sup>2</sup>. Lakshadweep consists of 36 small islands scattered across the Arabian Sea, covering a total area of about 32 km<sup>2</sup>. Among these islands, ten are inhabited, seventeen are uninhabited, and three are submerged. The capital of this Union Territory is Kavaratti, with other inhabited islands including Agatti, Andrott, Kiltan, Chetlat, Amini, Bitra, Kadamat, Kalpeni, and Minicoy. Uninhabited islands include Bangaram, Viringili, Cheriya, Kodithala, Thilakkam (1), Thilakkam (2), Thilakkam- (3), Pitti- (1), Pitti (2), Thinnakara, Parali, (1), Parali- (2), Parali -3, Kalpetti, Suheli, Valiyakkara, and Cheriya (Jose et al., 2021).

The Lakshadweep islands boast a rich diversity of species, including 114 species of seaweeds, 7 species of seagrasses, 91 species of sponges, 148 species of corals, 170 species of crustaceans, 768 species of molluscs, 78 species of echinoderms, 296 species of ornamental fishes, 603 species of fishes, 4 species of sea turtles, 80 species of birds, 12 species of cetaceans, and 3 species of mangroves (Jose et al., 2021).

*Ancylocaris brevicarpalis*.

Islanders primarily rely on fishing, particularly tuna, for their livelihoods. The production of value-added products from tuna fishes (MASMIN) is a major occupation. Additionally, revenue is generated through the production of coconut oil, coconut powder, vinegar, jaggery, and crafting handicrafts from dead shells.

## Women in community aquaculture

Women are receiving training to set up aquaculture units, mainly focusing on ornamental species, to improve their social and economic status (Allison, 2011; Beveridge et al., 2013; Ajith Kumar et al., 2020). Marine ornamental aquaculture has the potential to attract determined women to engage successfully in blue ventures (Pandey & Mandal, 2017). By making the most of blue bio-resources, women's economic status can be improved, especially as the rearing unit is often considered a 'work from home' model. As a result, women on the islands are actively involved in various ornamental aquaculture activities, including breeding, rearing, value addition, and marketing. The trade in marine ornamentals offers a valuable opportunity to promote gender equality and boost household income, providing a wide range of employment opportunities for women through self-help groups (SHGs) and cooperatives.

The promotion of technology for breeding and rearing marine ornamentals has been actively encouraged among coastal communities (Ajith Kumar et al., 2020). Selecting the Lakshadweep islands as the site for this venture is highly suitable due to several factors: (a) easy accessibility to a variety of colourful ornamental organisms, (b) availability of quality seawater, (c) provision of favourable conditions consistently, and (d) availability of live feeds. Cultivating marine ornamentals in the Lakshadweep islands is both feasible and effective, and it can be planned in a coherent manner to safeguard natural marine ornamental resources.





Additionally, efforts are underway to maintain genetic diversity, which is crucial for the thriving variety of marine ornamentals to adapt to captivity, develop resistance, and remain attractive. Consequently, the development of the marine aquarium trade enhances the living standards of island communities.

In aquariums, marine ornamental crustaceans have gained prominence due to their symbiotic behaviour with fish and other invertebrates (Calado, 2008). The symbiotic relationship of ornamental shrimps with other organisms simplifies rearing, especially in small “nano-tanks”. The propagation of marine ornamental shrimps is facilitated by the ICAR - NBFGR, focusing on two species, namely, *Thor hainanensis* and *Ancyllocaris brevicarpalis*, which are provided to women islanders for further rearing in community aquaculture units (ICAR - NBFGR, 2020).

## Supply and value chain for sustainability: A successful model

The loss of coral reef inhabitants due to unstructured collection and harvesting of living jewels is disrupting the habitat balance, as each individual plays a unique role in their environment, essential for biosphere sustainability. To mitigate this pressure on the ecosystem, promoting marine ornamental aquaculture is crucial, as it can contribute to sustainable aquarium trade and encourage environmentally friendly practices.

In this context, the establishment of a live germplasm resource centre on Agatti Island, Lakshadweep by the ICAR-NBFGR is noteworthy. This centre disseminates rearing technology and supplies captive propagated animals (F2 generation of shrimps and fishes) to women islanders for further rearing in community aquaculture units, which are

*Inner view of the germplasm centre.*

constructed using locally available indigenous materials. This eco-friendly approach enables the production of high-quality marine ornamentals, mainly pathogen-free, fetching attractive prices for the beneficiaries.

The demand for small-sized species suitable for nano-tanks is increasing, as they are easy to transport and maintain, satisfying hobbyists (Olivotto et al., 2011). A significant advantage of marine ornamental aquaculture is that it can be conducted year-round, even during the off-season period when the Arabian Sea is rough. Moreover, cultured ornamentals often fetch market prices equal to or even higher than those of food fishes, providing an added advantage to this venture.

## Opportunities

The potential of ocean resources is vast and needs to be brought to the forefront. It is crucial to raise awareness among people and educate them about the benefits and drawbacks. The success of our mission lies in convincing people to seize the opportunities and reap the real benefits. The ICAR-NBFGR is effectively achieving this by harnessing the potential resources of the Lakshadweep Sea through new initiatives.

This goal is being realised through community-based aquaculture for marine ornamentals, utilising locally available facilities. Currently, women on Agatti Island are actively involved and have begun establishing community aquaculture units to breed and supply marine ornamentals for sustainable aquarium trade.

In conclusion, our vision to explore native marine ornamentals suitable for community-based aquaculture has been successfully realised, aiming to improve the economic status of marginalised people in Lakshadweep. The island community, particularly women, has been convinced and trained to



establish backyard aquaculture units using available facilities. This approach allows for the amicable and effective utilisation of native bio-resources from the coral reef ecosystem, adopting a “work from home” model.

As a result, women actively participate in various community-based aquaculture activities, including breeding, raising, value addition, and marketing. The initiatives led by ICAR-NBFGR in Lakshadweep have been embraced by women islanders and have garnered appreciation from the scientific community for their dual role in promoting this rearing technology among islanders and conserving biodiversity meticulously.

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