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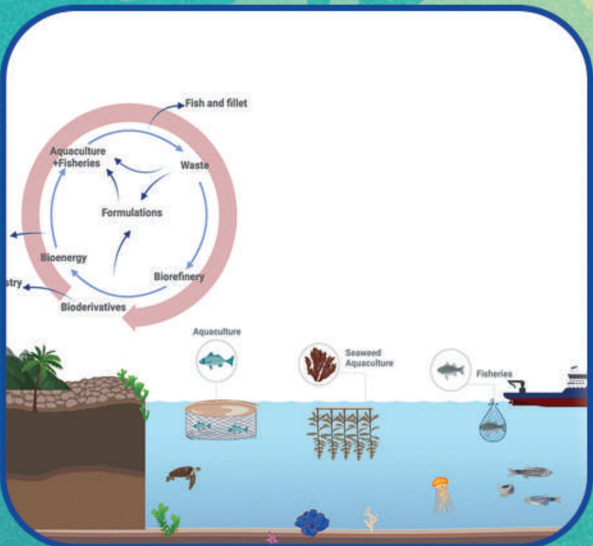

HIGHLIGHTS

- Aquaponics as a Sustainable Solution for Climate-Resilient Food Systems
- From Pond to Plate: Blockchain's Role in Traceable Aquaculture
- Microalgae – A Solution for Biological Carbon Capture in Aquaculture
- Adapting Middle Eastern Aquaculture Technologies for Water-Scarce Regions in India
- The Necessity of Species Diversification in Aquaculture
- Murrel: India's Next Aquaculture Superstar – Why Farmers Are Switching Fast

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AQUAFOCUS

Dedicated to Aquaculture Research & Development

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EDITOR'S LETTER

Dear Readers,

It gives me great pleasure to welcome you to this edition of AQUAFOCUS, where we bring together some of the most transformative ideas shaping the future of aquaculture. This issue reflects the spirit of innovation and responsibility that the sector needs as it grows to nourish a changing world.

We begin with aquaponics, a climate-smart system that blends aquaculture and hydroponics to build resilient food production models. Alongside it, we explore the advances in biomanufacturing enzymes that are helping farmers to improve feed efficiency and reduce costs.

Microalgae research highlights its dual role in carbon capture and sustainable feed production. Lessons from Middle Eastern aquaculture, particularly in water-scarce regions, offer valuable insights for strengthening India's food security strategies. At the same time we revisit the necessity of species diversification, a topic central to resilience and market stability.

This edition also covers the importance of Murrel in India as Next Aquaculture Superstar and Why Farmers Are Switching Fast in its breeding and seed production. And finally, we take you inside AquaEx India 2025, where technology, policy, and market opportunities converged to chart the next phase of industry growth.

We also proudly spotlight the IFT Expo 2025, a landmark event that unified India's fisheries and aquaculture stakeholders under one roof. From drone-assisted farming demonstrations to policy dialogues on blue financing, the expo showcased the synergy of tradition, technology, and trade.

Each feature is more than an article, it is a conversation starter, an invitation to think differently about aquaculture's role in our shared future. I hope these pages spark fresh ideas, strengthen your resolve, and reaffirm our collective responsibility to ensure that aquaculture grows in harmony with people and the planet.

With Regards,

Dr. Jesu Arockia Raj. A

Editor-in-Chief

AQUAFOCUS

Aquaponics as a Sustainable Solution for Climate-Resilient Food Systems

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Introduction

Aquaponics, the fusion of aquaculture and hydroponics, is heralded as an innovative, sustainable farming model capable of withstanding the environmental pressures exacerbated by climate change. Figure 1 shows the overview of aquaponics system function. The aquaponics system creates a closed-loop ecosystem where fish waste provides organic nutrients for plant growth, and plants help purify the water that recirculates back to the aquaculture tanks. As climate change threatens global food security, water resources, and ecosystem health, aquaponics emerges as a scalable solution for developing resilient, efficient, and eco-friendly food systems.

Principles of Aquaponics

At the heart of aquaponics lies a symbiotic relationship among fish, plants, and microorganisms. Fish excrete waste in the form of ammonia, which is converted by nitrifying bacteria Nitrosomonas and Nitrobacter into nitrites and then nitrates, a form of nitrogen that plants can absorb. The plants uptake these nutrients, thus filtering and purifying the water, which is then recirculated to the fish tanks. This process eliminates the need for chemical fertilizers and significantly reduces water consumption by up to 90% compared to traditional agriculture making it particularly valuable in arid and semi-arid regions.

Climate Change and Agriculture

Climate-resilient food systems are those that maintain productivity and food availability under changing climatic conditions. Conventional agriculture is vulnerable to erratic weather patterns, prolonged droughts, and soil degradation, which can lead to yield reductions and food shortages. Aquaponics offers protection from these variables through Controlled Environment Agriculture. These systems can be housed in greenhouses or indoors, providing consistent conditions that ensure year-round production regardless of external climate. Such insulation from weather-related disruptions ensures a reliable food supply and supports climate adaptation strategies.

Aquaponics and Climate Resilience

Aquaponics is especially beneficial for urban and peri-urban areas, where land is limited, and demand for fresh food is high. Rooftop aquaponic farms, container-based systems, and vertical farming units exemplify how urban spaces can be transformed into productive agricultural hubs. These systems not only reduce the carbon footprint associated with transporting food from rural farms to cities but also increase food access and affordability in underserved communities. In places like Singapore, Los Angeles, and Tokyo, urban aquaponic farms contribute to local food sovereignty while supporting circular economies. The dual production of fish and vegetables enhances the economic viability and nutritional value of aquaponic systems. Protein-rich species such as tilapia, catfish, and carp are commonly reared, while leafy greens, tomatoes, peppers, and herbs flourish on the hydroponic beds. This diverse output ensures dietary diversity and food security, especially in regions susceptible to malnutrition. Moreover, aquaponics can be adapted to various socio-economic settings from household-level units to commercial-scale operations making it inclusive and accessible.

Technology and Innovation in Aquaponics

From a technological perspective, modern aquaponics leverages automation, sensor-based monitoring, and data analytics to optimize system performance. Parameters such as pH, temperature, dissolved oxygen, and nutrient concentrations are continuously monitored to ensure system balance. AI and IoT technologies further improve predictive maintenance, water use efficiency, and early detection of diseases or system failures. Integration with renewable energy sources like solar and wind power makes aquaponics a truly green solution, reducing reliance on non-renewable energy and lowering greenhouse gas emissions.

Socioeconomic and Policy Dimensions

Socially, aquaponics plays a critical role in community development, education, and entrepreneurship. In developing nations, community-led aquaponics initiatives create employment, enhance food security, and empower vulnerable groups, particularly women and youth. Educational institutions incorporate aquaponics into STEM curricula, encouraging experiential learning and environmental awareness. These systems serve as live demonstration models, enabling hands-on understanding of ecology, biology, chemistry, and sustainable resource management. NGOs and development agencies have increasingly supported aquaponics in humanitarian interventions and disaster recovery programs, owing to its low-input and rapid-setup characteristics. The global recognition of aquaponics aligns with the United Nations Sustainable Development Goals (SDGs), particularly those targeting zero hunger (SDG 2), clean water and sanitation (SDG 6), responsible consumption and production (SDG 12), climate action (SDG 13), and sustainable cities and communities (SDG 11). In the context of climate policy, aquaponics can be integrated into Nationally Determined Contributions under the Paris Agreement, supporting emissions reductions in the agriculture sector while promoting food security and resilience.

Challenges and Limitations

However, aquaponics is not without challenges. High initial investment costs, especially for commercial-scale systems equipped with automation and climate control, can deter small-scale farmers. Operational complexity requires a multidisciplinary understanding of aquaculture, horticulture, and water chemistry, necessitating ongoing training and support. Furthermore, legal and regulatory frameworks are often lacking or underdeveloped, complicating licensing, marketing, and quality assurance. Consumer skepticism toward aquaponically grown food also poses a barrier, requiring targeted awareness campaigns and third-party certification schemes to ensure consumer trust. Economic viability remains a key concern, particularly in contexts where energy costs are high or market access is limited. Profitability depends on proper system design, efficient resource use, market demand, and value-added products. Studies have shown that small-scale systems can achieve financial break-even within a few years, especially when diversified with agritourism, educational workshops, or local supply chain integration. Encouraging public-private partnerships and providing subsidies, credit access, and risk insurance can help de-risk investment and promote adoption.

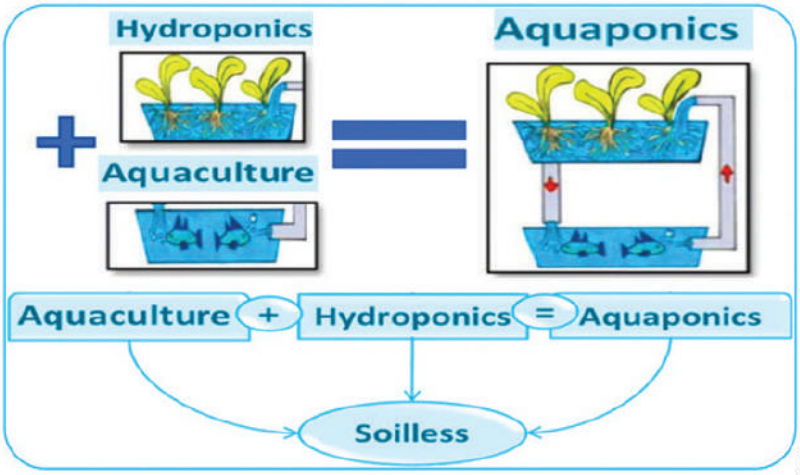

Figure 1: Aquaponics system overview, featuring the indication of water recycling direction via the red arrow. (Courtesy: Water Journal)

Case Studies

Several successful models of aquaponics illustrate its potential across diverse contexts. In the United States, companies like AeroFarms and The Plant are pioneering large-scale urban aquaponics. In India, rooftop aquaponics in cities such as Chennai and Bangalore have enabled residents to produce fresh food at home, reducing dependence on volatile markets. In Kenya, aquaponics initiatives supported by development agencies have improved rural livelihoods and reduced hunger. In Europe, the EU-funded INAPRO project demonstrated that aquaponics can operate profitably under cold-climate conditions when integrated with greenhouse technologies. Innovative designs and modular systems have made aquaponics more adaptable and cost-effective.

Mobile units and prefabricated kits simplify installation and scalability. New developments in decoupled aquaponics, where the aquaculture and hydroponic units function semi-independently, allow for more precise control of nutrient and pH levels, enhancing productivity and reducing risk. Research is also exploring integration with algae cultivation, biogas production, and black soldier fly farming to create multifunctional agro-ecosystems with zero waste.

Conclusion and Policy Recommendations

The research landscape is evolving rapidly, with universities and institutions conducting interdisciplinary studies on nutrient cycling, fish and plant health, system optimization, and socio-economic impacts. Publications and global networks such as the Aquaponics Association and FAO's aquaponics initiatives have facilitated knowledge exchange and standard-setting. However, more long-term studies are needed to establish best practices, regional adaptations, and life-cycle assessments of aquaponic systems across agroecological zones. Policy support is crucial for scaling aquaponics. Governments should integrate aquaponics into agricultural and climate adaptation strategies, offering financial incentives, technical guidance, and inclusion in food security programs. Urban planning should accommodate aquaponics as part of green infrastructure, zoning, and public housing projects. Accreditation and labelling standards for aquaponic produce can strengthen consumer confidence and market integration. Collaborations among academia, industry, and civil society can drive innovation, dissemination, and capacity-building.

In summary, aquaponics holds tremendous promise as a resilient, efficient, and sustainable food production system for the 21st century. Its closed-loop design, minimal resource requirements, and adaptability to diverse environments make it well-suited to address the multifaceted challenges posed by climate change, urbanization, and food insecurity. To realize its full potential, coordinated efforts are needed across research, policy, industry, and grassroots levels. By embedding aquaponics in broader sustainability agendas, we can cultivate a future where food systems are not only productive but regenerative, inclusive, and climate-resilient.

References:

1. Al-Hafedh, Y. S., Alam, A., & Beltagi, M. S. (2008). Food production and water conservation in a recirculating aquaponic system in Saudi Arabia. Saudi Journal of Biological Sciences, 15(2), 225–230.

2. Bittsanszky, A., Pilinszky, K., Gyulai, G., & Komives, T. (2016). Plant growth promoting rhizobacteria in aquaponics. International Journal of Horticultural Science, 22(1), 29–33.

3. Gregory, P. J., Johnson, S. N., Newton, A. C., & Ingram, J. S. I. (2009). Integrating pests and pathogens into the climate change/food security debate. Journal of Experimental Botany, 60(10), 2827–2838.

4. Junge, R., König, B., Villarroel, M., Komives, T., & Jijakli, M. H. (2017). Strategic points in aquaponics. In Goddek, S., Joyce, A., Kotzen, B., & Burnell, G. (Eds.), Aquaponics Food Production Systems (pp. 21–44). Springer.

5. Khandaker, M. M., & Kotzen, B. (2021). Future perspectives of aquaponics systems in developing countries. Journal of Plant Biology and Crop Research, 4(1), 1031.

6. Love, D. C., Uhl, M. S., & Genello, L. (2015). Energy and water use of a small-scale raft aquaponics system in Baltimore, Maryland, United States. Aquacultural Engineering, 68, 19–27.

7. Maucieri, C., Forchino, A. A., Nicoletto, C., Junge, R., Pastres, R., Sambo, P., & Borin, M. (2018). Life cycle assessment of a micro aquaponic system for educational purposes. Environmental Science and Pollution Research, 25(34), 34015–34027.

8. Somerville, C., Cohen, M., Pantanella, E., Stankus, A., & Lovatelli, A. (2014). Small-scale aquaponic food production: Integrated fish and plant farming. FAO Fisheries and Aquaculture Technical Paper No. 589. Rome: FAO.

9. Vermeulen, S. J., Campbell, B. M., & Ingram, J. S. I. (2012). Climate change and food systems. Annual Review of Environment and Resources, 37, 195–222.

10. Yep, B., & Zheng, Y. (2019). Aquaponic trends and challenges–a review. Journal of Cleaner Production, 228, 1586–1599

From Pond to Plate: Blockchain's Role in Traceable Aquaculture

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1. Introduction

Aquaculture has emerged as one of the fastest-growing food production sectors globally, now providing over 50% of the fish consumed worldwide. This shift is driven by the increasing pressure on wild fisheries, the rising global population, and the growing demand for sustainable protein sources. Despite its growth, aquaculture faces significant scrutiny over practices such as antibiotic use, labour exploitation, and environmental degradation. In this context, ensuring traceability and transparency across the supply chain from hatcheries and farms to processors, exporters, retailers, and ultimately, consumers are more important than ever. Traceability in aquaculture involves documenting and verifying each step in the journey of aquatic products. However, traditional traceability systems are often paper-based, fragmented, and vulnerable to fraud. Blockchain technology, with its decentralized and tamper-proof attributes, offers a transformative solution to these challenges. It promises a future where every transaction and movement within the aquaculture supply chain is recorded, immutable, and accessible to all relevant stakeholders. This review article explores the application of blockchain technology in aquaculture traceability.

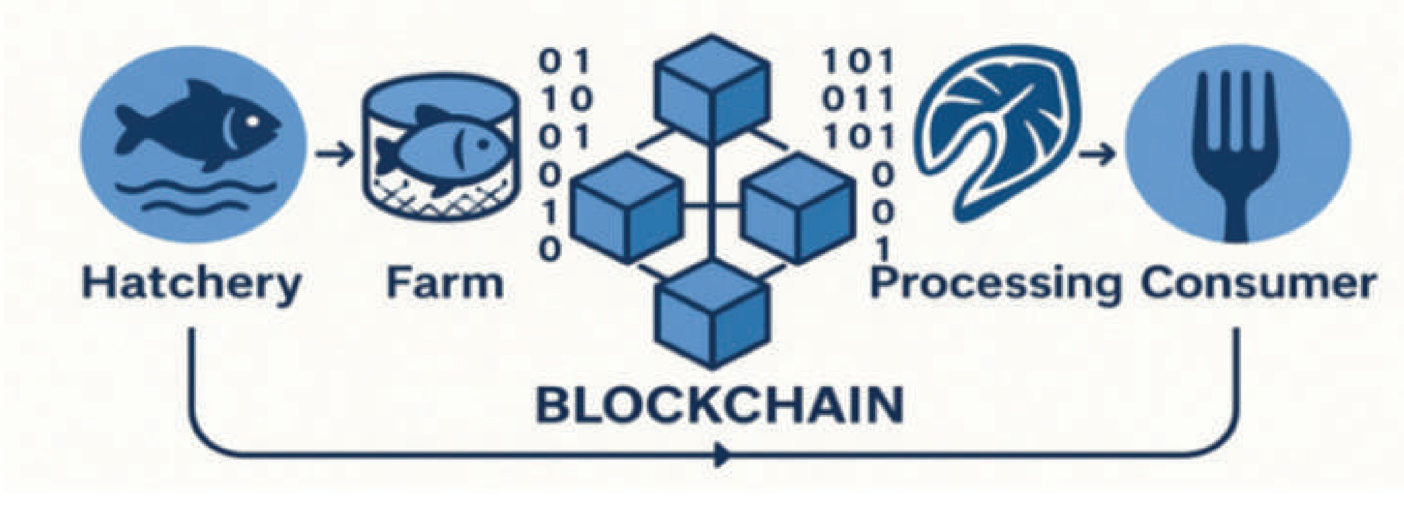

Figure 1: The Overview of blockchain role in aquaculture

2. Traceability Challenges in Aquaculture and Seafood Supply Chains

The aquaculture supply chain is complex and multi-staged. From hatchery to grow-out farm, then to processing, cold storage, distribution, and retail, several factors are involved, often across different regions and regulatory jurisdictions. This complexity makes it difficult to trace the product's journey accurately and efficiently.

Key challenges include:

- There is no universal standard for seafood traceability, leading to interoperability issues.
- In many developing regions, data is still recorded manually, making it prone to human error and tampering.
- Mislabelling of species, false origin claims, and IUU (Illegal, Unreported, and Unregulated) fishing practices are common.
- Small-scale producers often lack the technical know-how or infrastructure to implement digital systems.

• Multiple intermediaries lead to data silos and lack of accountability.

• Without effective traceability, it's difficult to verify compliance with food safety and environmental regulations.

These challenges necessitate a robust, secure, and scalable solution. Blockchain, with its immutable ledgers and transparent records, presents a compelling case for improving aquaculture traceability.

3. Overview of Blockchain Technology

Blockchain is a distributed ledger technology that allows data to be recorded across multiple nodes in a network. The data is grouped into blocks, each cryptographically linked to the previous one, forming a chain. Figure 1 shows the overview of blockchain in aquaculture. core principles of blockchain include:

• No central authority controls the ledger. All participants maintain a copy, ensuring redundancy and resilience.

• Once data is added, it cannot be altered or deleted, preventing tampering or fraud.

• All network participants can view the transaction history, promoting trust.

• These are self-executing contracts with conditions written in code, facilitating automatic or payment triggers.

Feature	Blockchain-Based System	Traditional Database
Immutability	High	Low Data can be changed
Decentralization	Yes	Centralized
Tamper Resistance	Yes	Vulnerable
Transparency	High (peer-shared)	Limited
Trust Mechanisms	Consensus-based	Administrator-based
Automation	Smart contracts for compliance	Manual/partial automation
Cost of Recalls/Fraud	Reduced	Higher
Consumer Engagement	High (verified QR codes etc.)	Low

Table 1: The Blockchain benefits compared with Traditional system of aquaculture

For aquaculture, consortium or private blockchains are more suitable due to the need for permissioned access and regulated collaboration. By integrating blockchain into aquaculture, data such as hatchery records, feed inputs, antibiotics used, harvesting date, processing time, and shipment conditions can be recorded in real-time and verified by all stakeholders.

4. IoT and Blockchain Integration for Real-Time Traceability

Blockchain by itself is powerful, but when combined with Internet of Things (IoT) technologies, its potential is multiplied. IoT devices such as GPS trackers, temperature sensors, RFID chips, and barcodes can collect and transmit data at every critical point in the aquaculture supply chain. For example, tagging fish crates or feed bags with RFID allows for automated data logging when items move across the supply chain. For cold chain logistics, continuous temperature monitoring can be logged on the blockchain to ensure freshness. Fishing vessels equipped with GPS can verify fishing locations, preventing IUU fishing. All this data can be stored on the blockchain, ensuring that it is tamper-proof and immediately available to buyers, regulators, and consumers. This real-time data exchange enhances traceability and ensures compliance with food safety standards.

5. Benefits of Blockchain in Aquaculture

Blockchain technology offers several transformative benefits for the aquaculture industry, enhancing traceability, sustainability, transparency, and operational efficiency across the value chain from hatcheries to harvest, and ultimately to consumers. Table 1 shows the Blockchain benefits compared with Traditional system of aquaculture. Below are the key benefits of blockchain in aquaculture:

• Adopting blockchain technology in aquaculture provides several benefits:

• Accurate and real-time data helps in tracing contaminated batches quickly.

• Immutable records reduce the risk of species substitution or mislabelling.

• Transparent labelling with blockchain-backed data can boost consumer confidence.

• Governments and certification agencies can verify practices through trusted data.

• Reduces paperwork and automates data entry and verification.

• Products with verified traceability can command higher prices in the market.

Ultimately, blockchain transforms traceability from a burden into a value-adding feature, making the seafood industry more resilient and responsible.

6. Barriers to Blockchain Adoption

Despite its benefits, the key barriers to blockchain adoption in aquaculture, categorized across technical, economic, social, and regulatory dimensions:

• Setting up blockchain infrastructure can be expensive for small-scale producers.

• Many fishers and farmers are not yet trained to use digital devices or applications.

• Blockchain ensures data integrity, but not data accuracy. Incorrect inputs will still yield incorrect outputs.

• Different blockchain systems may not communicate seamlessly.

• Public blockchains may face issues handling high transaction volumes.

• There are no unified global standards or legal frameworks for blockchain traceability.

To overcome these barriers, there is a need for capacity building, public-private partnerships, government incentives, and inclusive digital transformation strategies. Pilot projects, especially those involving cooperatives, SHGs, or certification schemes, can play a key role in demonstrating value and scaling adoption.

7. Conclusion

Blockchain represents a paradigm shift in how traceability and transparency can be achieved in the aquaculture industry. It transforms traditional paper-based systems into dynamic, secure, and trustworthy digital ledgers that empower all stakeholders from farmers and processors to retailers and consumers. By addressing fraud, inefficiency, and regulatory complexity, blockchain can build a more sustainable, ethical, and consumer-centric aquaculture system. The future lies in collaborative innovation, inclusive technology design, and supportive policy frameworks to ensure blockchain benefits reach even the smallest producers. Traceable aquaculture, powered by blockchain, is not just a technological upgrade it is a necessary evolution toward safer, fairer, and more resilient seafood systems.

References

1. Iftekhar, N., Cui, X., Lu, Y., & Zheng, C. (2020). Food safety traceability system based on blockchain and IoT. Journal of Food Engineering, 283, 110092.

2. Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. Trends in Food Science & Technology, 91, 640–652.

3. Wang, S., Ouyang, L., Yuan, Y., Ni, X., Han, X., & Wang, F. Y. (2019). Blockchain-enabled smart contracts: Architecture, applications, and future trends. IEEE Transactions on Systems, Man, and Cybernetics, 49(11), 2266–2277.

4. Provenance. (2018). How blockchain can transform the seafood industry.

5. Wang, Y., Han, J., & Beynon-Davies, P. (2019). Understanding blockchain technology for future supply chains: A systematic literature review and research agenda. Supply Chain Management: An International Journal, 24(1), 62–84.

6. Rejeb, A., Rejeb, K., & Keogh, J. G. (2021). Blockchain technology in the smart city: A bibliometric review. Sustainable Cities and Society, 70, 102881.

7. Fishcoin. (2019). Incentivizing seafood traceability with blockchain and mobile technology.

8. Nicola, S., & Grassi, M. (2022). Blockchain in seafood traceability: Challenges and future directions. Aquaculture Reports, 24, 101131.

9. Mousavizadeh, M., & Yang, M. (2020). Blockchain adoption in food supply chains: A review and implementation framework. Journal of Cleaner Production, 258, 120978.

Microalgae – A Solution for Biological Carbon Capture in Aquaculture

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1. Introduction

Aquaculture is the world's most rapidly developing food production industry, supplying more than 50% of global fish consumption. It serves to bring essential nutrition and economic returns, but aquaculture also affects the environment by emitting greenhouse gases mainly in the form of CO_2 and methane, and effluents that are rich in nutrients and lead to eutrophication and water body degradation (Jones et al., 2022). Conventional treatment technologies are commonly ineffective in mitigating these effects or reclaiming valuable nutrients. These emissions need to be addressed, and biological carbon capture presents a green alternative to traditional carbon capture and storage processes with greater sustainability and cost-effectiveness (Biermann et al., 2020). Biological carbon capture employing microalgae has been a prospecting solution.

2. Overview of Microalgae

Microalgae are tiny, single-celled creatures that grow quickly and have a high photosynthetic efficiency in a variety of aquatic habitats. It will fix inorganic carbon into organic biomass while detoxifying aquatic ecosystems through uptake of nitrogenous and phosphorous wastes. When introduced into aquaculture systems, they can offer several ecosystem services such as carbon sequestration, improvement of water quality, and biomass yield for feed or energy production. Microalgae fix CO2 with 10-50 times greater efficiency than land plants because they grow fast and have high photosynthetic rates. They also can be cultivated on non-cultivable lands, utilize wastewater nutrients, and generate varied biomass components like lipids, proteins, and carbohydrates. The primary components of algal biomass lipids, carbohydrates, and proteins are what enable its transformation into food, cosmetics, medications, and biofuels (Yadav et al., 2021, Zafar et al., 2021, Shahid et al., 2020). Figure 1 shows Microalgae based wastewater treatment and its uses. Because of their lipid and carbohydrate contents high energy density and proven thermochemical processing techniques, biofuels are often the most promising biofuels made from microalgae (Walsh et al., 2018).

3. Environmental Challenges in Aquaculture

3.1 Greenhouse Gas Emissions

Aquaculture faces environmental challenges such as competition for land and water, feed production impacts, and water pollution. Global aquaculture production resulted in approximately 261.3 million tonnes of greenhouse gas emissions in 2018. Greenhouse gas emissions primarily arise from feed production and aquatic nitrous oxide, with aquaculture accounting for approximately 0.49% of global anthropogenic emissions. Intensive aquaculture produces significant amounts of GHGs directly and indirectly. Fish respiration, microbial activity in sediments, and feed production contribute to CO_2, methane (CH_4), and nitrous oxide (N_2O) emissions (Li et al., 2021). Unlike terrestrial agriculture, aquaculture's aquatic environment provides opportunities for direct biological sequestration of CO_2 via aquatic plants and algae, offering a unique mitigation pathway.

3.2 Nutrient Pollution and Eutrophication

Traditional feeds enhanced with protein and carbohydrates are commonly provided to fish to increase their growth rate; nevertheless, a significant amount of the nutrients in the feed may not be used by aquatic animals, which causes feed residues to build up in the aquaculture system. Nutrient pollution in aquaculture occurs when excess nitrogen and phosphorus from uneaten feed, fish waste, and organic decomposition enter water bodies. These nutrients stimulate excessive algae growth, leading to eutrophication. This process causes harmful algal blooms, oxygen depletion, loss of biodiversity, and degradation of water quality. Ultimately, nutrient pollution disrupts aquatic ecosystems, harms fish health, and results in economic losses in fisheries and water treatment. Controlling nutrient discharge is pivotal for minimizing eutrophication and preserving aquatic ecosystem health (Chatvijitku et al., 2017).

4. Biological Carbon Capture Mechanisms

4.1 Photosynthesis and Carbon Assimilation

Photosynthesis is the fundamental natural mechanism for biological carbon capture, playing a pivotal role in the global carbon cycle by converting atmospheric carbon dioxide into organic matter. In this process the microalgae use sunlight to power the fixation of CO_2 through a complex series of biochemical reactions. The light-dependent reactions generate energy in the form of ATP

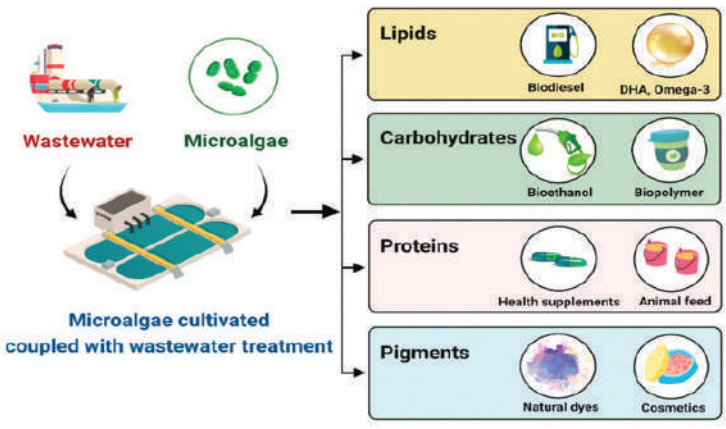

Figure 1: Microalgae based wastewater treatment and its uses

and NADPH, which drive the subsequent carbon fixation phase. The most prevalent pathway for carbon assimilation is the Calvin-Benson-Bassham (C3) cycle, where the enzyme Rubisco catalyzes the incorporation of CO_2 into ribulose-1,5-bisphosphate (RuBP), eventually producing organic compounds like sugars and starches that fuel growth and metabolic functions. The products of carbon assimilation not only form the base of food webs but also serve as renewable sources for biofuels and bioproducts, enhancing prospects for sustainable carbon management and climate mitigation strategies. (Raines 2011).

4.2 Carbon Sequestration Pathways

Carbon sequestration refers to the process by which carbon dioxide is captured from the atmosphere and stored in various natural reservoirs, effectively reducing its concentration and helping to mitigate climate change. Key biological sequestration pathways include the use of plant biomass to capture CO_2 through photosynthesis, incorporation of organic carbon into soils and sediments, and the export of organic matter to the deep sea via the biological pump. Biomass can be utilized directly as a renewable resource or processed for long-term storage, while sediment burial isolates carbon for centuries to millennia by trapping it in low-oxygen environments where decomposition is slow. Export to the deep sea, largely driven by the sinking of organic particles and marine snow, sequesters carbon in ocean depths for extended periods, playing a crucial role in regulating the Earth's carbon cycle and climate. These pathways make biological carbon capture in aquaculture a viable climate mitigation strategy (Rani et al., 2021).

5. Algal-Based Treatment Technologies in Aquaculture

5.1 Microalgae Cultivation Systems

Microalgae like Chlorella, Nannochloropsis and Scenedesmus grow rapidly and exhibit high CO_2 fixation efficiencies. Algal-based treatment technologies have gained prominence in aquaculture for their ability to address nutrient pollution and promote sustainable water management. Microalgae can assimilate inorganic nutrients such as nitrogen and phosphorus from aquaculture effluent, thereby reducing the potential for eutrophication and supporting water quality improvement. This approach not only maintains a healthier setting for cultured organisms but also converts waste nutrients into valuable algal biomass, fostering circular resource use. Integrating microalgae cultivation with aquaculture wastewater treatment offers synergistic benefits (Singh et al., 2019). Beyond water remediation the captured carbon will be stored it as organic matter within their cells. This biomass can be harvested for use as feed additives, biofuels, or other value-added bioproducts, converting a waste stream into an economic resource and closing nutrient and carbon loops (Anikuttan et al., 2016).

5.1.1 High-Rate Algal Ponds (HRAPs)

High-Rate Algal Ponds (HRAPs) are engineered, shallow raceway-type ponds designed for efficient aquaculture wastewater treatment through the cultivation of algal-bacterial consortia. HRAPs harness sunlight and CO_2 to promote rapid algae growth, which assimilates nutrients like nitrogen and phosphorus from wastewater, effectively reducing nutrient pollution and eutrophication risks.

They typically have short hydraulic retention times, making them much faster than conventional stabilization ponds, while using minimal mechanical energy, thus offering a sustainable and low-cost wastewater treatment option (Ramli et al., 2020). Benefits of HRAPs include high nutrient removal efficiency, low energy requirements compared to mechanical treatments, and simultaneous CO_2 capture via photosynthesis, functioning as a natural carbon sink. Additionally, the system yields valuable biomass and reduces the overall carbon footprint of wastewater treatment. Overall, HRAPs represent a promising integrated approach to wastewater remediation, nutrient recycling, and carbon sequestration.

5.1.2 Photobioreactors

Photobioreactors are specialized closed systems designed for the controlled cultivation of microalgae by optimizing light exposure, gas exchange, nutrient supply, and environmental conditions to maximize biomass productivity and quality. Unlike open pond systems, photobioreactors allow precise control over light intensity and duration, temperature, pH, and carbon dioxide concentration, reducing contamination risks and improving photosynthetic efficiency. They are used both at lab scale and industrial scale for producing biomass for biofuels, aquaculture feed, pharmaceuticals, and wastewater treatment (Shaikh Abdur Razzak et al., 2024).

6. Performance and Efficiency of Algal Carbon Capture

6.1 Carbon Fixation Rates

Microalgae's ability to biofix CO2 is largely dependent on the carbon sources and growth substrates used in the growing system. Apart from inorganic carbon sources like bicarbonate (HCO3-) and CO2 (33), microalgae like Chlorella can also use organic carbon sources like glucose and acetate. Microalgae need sufficient amounts of both macronutrients and micronutrients to grow and fix CO2. While micronutrients like vitamins and trace metals are needed in lesser amounts but are just as crucial for the best growth and CO2 fixation of microalgae, macronutrients like nitrogen and phosphorus are necessary for the general growth and development of microalgae. Microalgae systems can fix carbon at highly variable rates depending on species, cultivation conditions, and CO_2 availability. Generally, microalgae have CO_2 fixation rates that can range roughly from 250 to 500 mg CO_2 per litre per day (mg L^{-1} day^{-1}) in controlled cultivation settings. For example, Botryococcus braunii has demonstrated the highest CO_2 fixation among studied species, with rates around 497 mg L^{-1} day^{-1}, followed by Spirulina platensis (~319 mg L^{-1} day^{-1}), Dunaliella tertiolecta (~272 mg L^{-1} day^{-1}), and Chlorella vulgaris (~252 mg L^{-1} day^{-1}) under laboratory conditions.

6.2 Nutrient Removal Efficiencies

Studies show that microalgae grown in membrane photobioreactors or integrated cultivation systems can achieve nitrogen removal efficiencies of about 76.7% to 94% and phosphorus removal efficiencies between 66.2% and 80%. Co-cultivation with bacteria can enhance these performances further by promoting symbiotic nutrient cycling and reducing operational energy costs. Light cycles and hydraulic retention times (HRT) also significantly influence nutrient uptake rates, with continuous light and longer HRTs generally supporting better removal efficiencies. For instance, ammoniacal nitrogen removal of 94% and soluble phosphorus removal about 67.6% were observed in a system combining microalgae with constructed wetlands over a 24-hour light cycle (Goh et al., 2022).

6.3 Water Quality Improvements

Studies show that increasing microalgal species diversity correlates with enhanced nitrogen removal efficiencies; richer microalgal communities can remove nitrogen more effectively due to complementary nutrient uptake strategies among species, which improves water purification outcomes in eutrophic systems. Specific species like Tetradesmus obliquus have demonstrated phosphorus and nitrogen removal rates up to 98% and 100% respectively, within a few days during batch cultivation in urban wastewater. Furthermore, microalgae contribute to reducing biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS), with removal efficiencies varying depending on the algal biomass density and system design (Songlin et al., 2023).

8. Conclusion

Biological carbon capture in aquaculture using microalgae offers a promising, sustainable approach to mitigate CO_2 emissions and improve water quality. Microalgae exhibit highly efficient photosynthesis processes, enabling rapid assimilation of carbon while simultaneously removing excess nutrients from aquaculture effluents. This dual function not only reduces eutrophication risks but also contributes to biomass production that can be utilized for biofuels, animal feed, or fertilizers, closing nutrient and carbon cycles within aquaculture systems. This approach not only addresses environmental challenges but also offers economic benefits through biomass valorization, positioning microalgae as integral players in the future of sustainable aquaculture and carbon management.

References

1. Jones AR, Alleway HK, McAfee D, Reis-Santos P, Theuerkauf SJ, Jones RC. (2022) Climate-Friendly Seafood: The Potential for Emissions Reduction and Carbon Capture in Marine Aquaculture. Bioscience. 72(2):123-143.

2. Biermann, F., Kim, R.E., (2020). The boundaries of the planetary boundary frame- work: a critical appraisal of approaches to define a “safe operating space” for humanity. Annual Rev of Environs and Res 45, 497–521.

3. Yadav, D.K.; Singh, A.; Agrawal, V.; Yadav, N. (2021) Algal Biomass. In Bioprospecting of Plant Biodiversity for Industrial Molecules; Wiley: Hoboken, NJ, pp. 303–334.

4. Zafar, A.M.; Javed, M.A.; Aly Hassan, A.; Mehmood, K.; Sahle-Demessie, E.(2021) Recent Updates on Ions and Nutrients Uptake by Halotolerant Freshwater and Marine Microalgae in Conditions of High Salinity. J. Water Process, 44, 102382.

5. Shahid, A.; Malik, S.; Zhu, H.; Xu, J.; Nawaz, M.Z.; Nawaz, S.; Asraful Alam, M.; Mehmood, M.A. (2020) Cultivating Microalgae in Wastewater for Biomass Production, Pollutant Removal, and Atmospheric Carbon Mitigation; a Review. Sci. Total Environ. 704

6. Walsh, M.J.; Van Doren, L.G.; Shete, N.; Prakash, A.; Salim, U. (2018) Financial Tradeoffs of Energy and Food Uses of Algal Biomass under Stochastic Conditions. Appl. Energy, 210, 591–603.

7. Li, Huankai, Chen, Sihua, Liao, Kang, Lu, Qian, Zhou, Wenguang (2021) Microalgae biotechnology as a promising pathway to ecofriendly aquaculture: a state-of-the-art review J Chem Technol Biotechnol; 96: 837–852

8. Chatvijitkul S, Boyd CE, Davis DA and McNevin AA, (2017) Pollution potential indicators for feed-based fish and shrimp culture. Aquaculture 477: 43–49.

9. Raines CA. (2011) Increasing photosynthetic carbon assimilation in C3 plants to improve crop yield: current and future strategies. Plant Physiol;155(1):36-42.

10. Rani, V., Nandan, S. B., & Schwing, P. (2021). Carbon source characterisation and historical carbon burial in three mangrove ecosystems on the South West coast of India. Catena, 197.

11. Singh, J., & Dhar, D. W. (2019). Overview of Carbon Capture Technology: Microalgal Biorefinery Concept and State-of-the-Art. Frontiers in Marine Science, 6.

12. K K, Anikuttan and Adhikari, Subhendu and Kavitha, M. and Jayasankar, P (2016). Carbon sequestration capacity of sediments, algae, and zooplankton from fresh water aquaculture ponds. Environmental Monitoring and Assessment. 188-06

13. Ramli NM, Verreth JAJ, Yusoff FM, Nurulhuda K, Nagao N, Verdegem MCJ.(2020) Integration of Algae to Improve Nitrogenous Waste Management in Recirculating Aquaculture Systems: A Review. Front Bioeng Biotechnol;8:1004.

14. Shaikh Abdur Razzak, Khairul Bahar, K.M. Oajedul Islam, Abdul Khaleel Haniffa, Mohammed Omar Faruque, S.M. Zakir Hossain, Mohammad M. Hossain (2024). Microalgae cultivation in photobioreactors: sustainable solutions for a greener future. Green Chemical Engineering, Volume 5, Issue 4

15. Nagao, N. (2019) “Bioreactor for Microalgal Cultivation Systems: Strategy and Development,” Biofuel and Biorefinery Technologies. Springer International Publishing.

16. Politaeva, N., Ilin, I., Velmozhina, K., and Shinkevich, P. (2023). Carbon dioxide utilization using chlorella microalgae. Environments 10, 109

17. Goh, Pei Sean, Nor Akalili Ahmad, Jun Wei Lim, Yong Yeow Liang, Hooi Siang Kang, Ahmad Fauzi Ismail, and Gangasalam Arthanareeswaran. (2022). “Microalgae-Enabled Wastewater Remediation and Nutrient Recovery through Membrane Photobioreactors: Recent Achievements and Future Perspective” Membranes 12, no. 11: 1094

18. Songlin Zhou, Wei Li, Shuqiang He (2023) Microalgal diversity enhances water purification efficiency in experimental microcosms. Front. Ecol. Evol., Volume 11

Adapting Middle Eastern Aquaculture Technologies for Water-Scarce Regions in India: A Sustainable Approach to Food Security

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Introduction

Water scarcity is emerging as one of the defining environmental challenges of the 21st century, particularly in arid and semi-arid regions. With the twin pressures of climate change and growing food demand, traditional freshwater-intensive farming practices are becoming increasingly unsustainable. Globally, agriculture consumes over 70% of available freshwater, and aquaculture while more water-efficient than land-based protein systems is still constrained by water availability and quality. In India, the crisis is acute: nearly 54% of the country faces high to extremely high water stress, while over 6.7 million hectares of land are affected by salinity and alkalinity, rendering them marginal or unproductive under conventional farming systems. These environmental constraints necessitate a shift toward resource-smart, climate-resilient production systems that can thrive in degraded and saline environments. Aquaculture offers a promising avenue, especially when integrated with agricultural components in synergistic models. However, for aquaculture to be truly transformative in such ecologies, it must adopt innovative system designs that minimize freshwater use, optimize nutrient recycling, and convert saline or waste resources into productive outputs. For India, which shares similar climatic and soil salinity challenges across vast tracts of Gujarat, Rajasthan, Haryana, and coastal Tamil Nadu, adapting such models represents a promising solution. By leveraging both global innovation and local knowledge, India can explore sustainable aquaculture pathways that enhance rural livelihoods, strengthen food security, and restore ecological balance in its most water-stressed regions.

Integrated Agri-Aquaculture Systems (IAAS) and Brine Reuse: A Middle Eastern Innovation

The Middle East has pioneered aquaculture methods tailored to extreme environmental constraints, such as scarce freshwater and high salinity. One of the most remarkable innovations emerging from this region is the development of Integrated Agri-Aquaculture Systems (IAAS) that harness reverse osmosis (RO) brine a by-product typically considered environmental waste. In such systems, RO reject brine is routed through fish ponds, enriching the water with nutrients from fish excretion. This nutrient-rich effluent is then employed to irrigate halophytic crops like Salicornia bigelovii and Distichlis spicata. Figure 1 shows Overview of Integrated Agri-Aquaculture Systems (IAAS). One study revealed that Salicornia yield tripled up to 23.7 t/ha when irri-

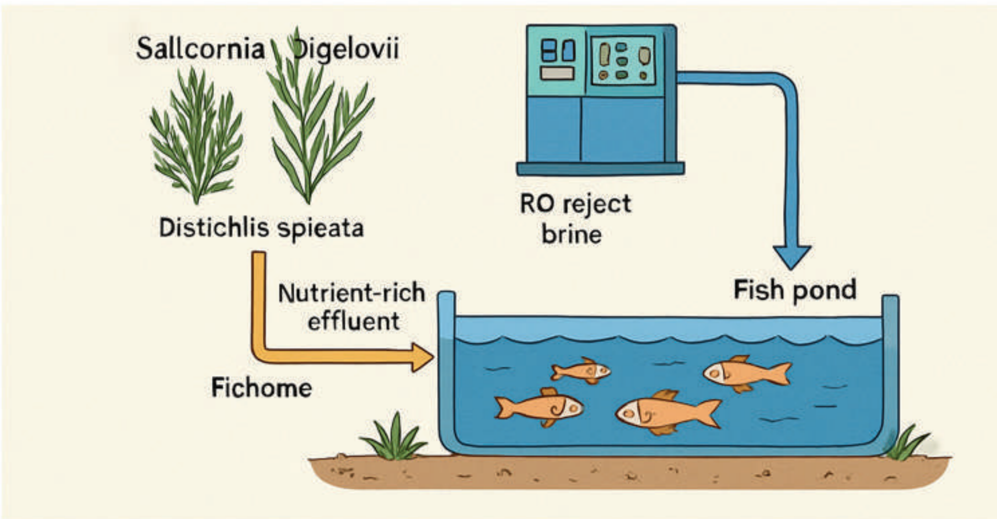

Figure 1: Overview of Integrated Agri-Aquaculture Systems (IAAS)

gated using aquaculture-enhanced brine, resulting in net returns of around US $76,000 per hectare, compared to significantly lower yields and returns when plain brine was used directly (Lyra et al., 2019). The International Center for Biosaline Agriculture (ICBA), headquartered in the UAE, has been instrumental in scaling up such integrated systems. Through collaboration with local and global partners including ADAFSA, EAD, Global Food Industries LLC, and the Max Planck Institute, ICBA has successfully introduced Salicornia and fish into desert farms across multiple sites in the UAE, cultivating value chains from “desert farm to fork” (ICBA, 2020).

India’s Inland Saline Aquaculture Landscape: Potential and Progress

India’s arid regions such as parts of Gujarat, Rajasthan, and coastal Tamil Nadu mirror the ecological challenges found in the Middle East, making the adaptation of such systems both logical and potentially transformative. The successful implementation of IAAS in India requires careful contextualization: selecting appropriate saline-tolerant fish species, pairing them with suitable halophytes, ensuring nutrient management through biofiltration, and designing infrastructure that makes efficient use of brine and groundwater.

Looking specifically toward India’s inland saline and brackishwater system, the developments in Punjab, Haryana, and Rajasthan offer compelling real-world models. In Punjab’s Fazilka district, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) introduced carp culture in low-salinity (≤5 ppt) waters. What began as a one-hectare pilot in 2014 expanded to over 30 hectares by 2018, yielding approximately INR 150,000 per hectare annually (Ansal & Singh, 2019). More notably, northern India’s inland saline zones have supported commercial-scale cultivation of Pacific whiteleg shrimp (Litopenaeus vannamei), with yield potentials reaching 8–10 t/ha per crop, translating to annual net profits of around US $14,345–17,216 (INR 1–1.2 million) from two cropping cycles (90 to 120-day cycles), despite cold winters limiting culture seasons (Rao et al., 2023).

Haryana, for instance, has leveraged inland saline groundwater to produce L. vannamei, a species highly valued for its fast growth, disease resistance, and adaptability. However, farmers have reported challenges such as water quality fluctuations, disease outbreaks, and the absence of tailored feed. Experts emphasize the importance of proactive water testing, rigorous biosecurity practices, and probiotic feed formulations to sustain productivity (Ragunathan et al., 2024).

Bridging the Gap: Constraints and Solutions in Indian Saline Aquaculture

Despite the technological promise, uptake of saline aquaculture in India remains constrained. A media report underscores that, while northern states have identified over 58,000 hectares suitable for saline aquaculture, only around 2,600 hectares are currently under cultivation. Barriers include high setup costs, limited subsidy structures, restrictive land use norms (e.g., 2-hectare caps), volatile salinity levels, lack of quality seed supply, and inadequate post-harvest infrastructure (such as cold storage and markets). Policy proposals from farmers and stakeholders include increasing subsidy limits, raising permitted land size to 5 hectares, and establishing integrated aqua parks and marketing systems for aggregation and value addition. This environment makes the Middle East’s integrated systems compelling models for India. Adopting IAAS using desalinization brine whether from RO units or saline groundwater paired with halophytes and fish culture, can transform marginal lands into productive landscapes. India could pilot such systems in coastal saline belts, peri-urban areas facing water scarcity, and saline desert fringes, adapting the technologies to suit local species and socioeconomic contexts.

Toward a Resilient Future: Innovative Alternatives and the Way Forward

Another promising alternative is saltwater or marine aquaponics, where saline-based fish farming is coupled with halophyte cultivation or seaweed-based biofilters, mimicking ecosystems like sea forests. These systems foster nutrient recycling, improved water quality, and diversified yields in forms of vegetation and marine crops (Takeuchi, 2017) but require further adaptation for Indian climates and crop preferences. While technological adaptation is vital, social and institutional frameworks are equally important. Models in the Sundarbans highlight risks associated with monoculture shrimp farming namely inequitable benefit distribution, environmental degradation, and external investor dominance (Stockholm Resilience Centre, 2022). To counter these, India should promote inclusive models that prioritize smallholder integration, community ownership, equitable revenues, environmental safeguards, and local capacity building. Emerging innovations such as floating cage aquageoponics from Bangladesh where floating rafts combine fish rearing with vegetable cultivation offer contextually relevant analogues for flood-prone or waterlogged landscapes (Haque, 2013). Trial deployments of similar technology in Indian reservoirs, coastal wetlands, or inundated farmlands could expand aquaculture footprint while optimizing vertical space and reducing freshwater reliance.

Furthermore, technological innovations motivated by Middle Eastern approaches to resource scarcity such as flow-electrode capacitive deionization (FCDI) to concentrate brines efficiently with reduced energy input can support brine reuse in integrated systems (Rommerskirchen et al., 2022).

Conclusion

In summary, India's water-stressed and saline-prone regions are ripe for receiving the lessons and technologies developed in the Middle East. If implemented judiciously, these systems can rejuvenate degraded landscapes, promote food security, diversify incomes, and enhance climate resilience. Key policy enablers include:

1. Revising subsidy frameworks extending land ceilings, incentivizing brine reuse systems, and covering infrastructure costs for integrated operations.

2. Establishing pilot demonstration clusters for IAAS in coastal and arid zones via collaboration between ICAR, GADVASU, ICBA, and state fisheries departments.

3. Strengthening farmer access to technical training, quality seed/seedlings, and marketing infrastructure through KVKs, aqua parks, and cooperative platforms.

4. Encouraging research on system combinations salinity-appropriate species, halophyte-crop pairings, and solar/brine purification technologies.

By synthesizing Middle Eastern IAAS and India's inland saline aquaculture potential into a cohesive, locally adapted strategy, India could transform the challenge of salinity into a resilient and profitable future for its farmers.

References

1. Ansal, M. D., & Singh, K. (2019). Utilization of inland saline groundwater for aquaculture in India: A success story from Punjab. Aquaculture Asia, 24(1), 21–25.

2. Haque, M. E. (2013). Floating agriculture: A potential cleaner production technique for climate change adaptation and sustainable community development in Bangladesh. Journal of Cleaner Production, 60, 120–123.

3. ICBA (International Center for Biosaline Agriculture). (2020). Annual Report 2020: Innovation in Biosaline Agriculture. ICBA Publications.

4. Krishi Jagran via PWonlyIAS. (2025). Saline aquaculture potential in India: Opportunities and policy gaps.

5. Lyra, D. A., Shahid, S. A., & Elouafi, I. (2019). Sustainable use of desalination brine in integrated agri-aquaculture systems. Agricultural Water Management, 223, 105695.

6. Ragunathan, R., Senthil Kumar, D., & Kalaimani, N. (2024). Challenges and solutions in inland saline shrimp farming in Haryana. Journal of Aquaculture Research and Development, 15(2), 77–85.

7. Rao, R. J., Rajendran, S., & Velmurugan, P. (2023). Prospects and constraints of inland saline aquaculture in northern India. Indian Journal of Fisheries, 70(1), 51–59.

8. Rommerskirchen, F., Ratajczak, P., Porada, S., & Presser, V. (2022). Flow-electrode capacitive deionization for brine concentration: A low-energy approach to water reuse. Desalination, 540, 115989.

9. Stockholm Resilience Centre. (2022). Unequal benefits in aquaculture and shrimp monoculture in the Indian Sundarbans.

10. Takeuchi, T. (2017). Aquaponics in marine environments: A potential future food system. Aquaculture International, 25(3), 1039–1047.

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The Necessity of Species Diversification in Aquaculture

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Introduction

Aquaculture has grown from a traditional subsistence activity into a technologically advanced global industry. The aquaculture sector contributes significantly to global food security, providing nearly half of all fish consumed by humans. Aquaculture also plays a pivotal role in employment and livelihoods, especially in rural and coastal communities across Asia, Africa, and Latin America. Despite these achievements, the current aquaculture model faces pressing challenges. A striking feature of modern aquaculture is the heavy dependence on a narrow set of species. Globally, fewer than 20 species account for the vast majority of production. This concentration on species such as Nile tilapia (Oreochromis niloticus), Whiteleg shrimp (Litopenaeus vannamei), and various carp species has been driven by market demand, ease of breeding, and production efficiency. However, such specialization has created systemic vulnerabilities.

Monoculture systems lack ecological complexity. They rely heavily on formulated feeds, antibiotics, and chemical inputs. The absence of ecological checks and balances makes these systems prone to disease outbreaks, which can devastate entire harvests. The global shrimp industry, for example, has suffered massive losses due to Early Mortality Syndrome (EMS) and White Spot Syndrome Virus (WSSV), highlighting the fragility of single-species farming. Additionally, monocultures contribute significantly to environmental degradation through nutrient pollution, habitat destruction, and genetic homogenization. In contrast, diversified systems draw on ecological principles to build resilience and reduce dependency on intensive inputs. The idea is not new. Traditional polyculture practices in Asia such as rice fish farming have sustained communities for centuries. What's different today is the scientific understanding and technological capability to optimize these systems for modern production scales.

Still, evidence suggests that diversified systems are more productive per unit area when appropriately managed. More importantly, species diversification aligns with the United Nations Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). It supports circular economy principles by closing nutrient loops, minimizes waste, and reduces the need for synthetic inputs. By framing diversification as a necessity rather than a choice, this paper aims to reshape how the industry and research community envision the future of sustainable aquaculture.

2. Types of Species Diversification

Species diversification in aquaculture can be categorized by function, space, time, trophic level, and production system design. Here we explore key types:

2.1. Polyculture Systems

Polyculture involves culturing two or more aquatic species in the same water body or production unit. Indian farmers raise a mix of catla, rohu, mrigal, and common carp in the same pond. These fish occupy different niches surface, column, and bottom layers and utilize feeds differently, improving feed conversion efficiency. The advantages include better resource utilization, Higher yield per hectare, Reduced environmental load and Improved disease management.

2.2. Integrated Multi-Trophic Aquaculture (IMTA)

IMTA refers to a system in which species from different trophic levels are cultivated together so that the waste produced by one becomes input (nutrients) for another. In Canada, salmon farms integrate kelp and blue mussels downstream from net pens. This model has significantly reduced nutrient discharge into coastal ecosystems and improved the public image of salmon aquaculture. The benefits include circular nutrient economy, reduced feed costs, environmental compliance and multiple product streams.

2.3. Integrated Agriculture–Aquaculture Systems (IAA)

In IAA systems, aquaculture is linked with agriculture (crops or livestock) to create a holistic production environment. In Rice–fish culture, Fish are stocked in flooded rice fields. Their movement aerates water and reduces pests. The Benefits include Enhanced farm productivity, Efficient land use, Higher total income and Sustainable nutrient management

2.4. Temporal Diversification

Temporal diversification involves rotating different species in the same system across time, usually aligning with seasonal changes or market demands. The farmers in southern India stock milkfish in summer and switch to shrimp in monsoon due to salinity changes. The advantages include Flexibility in water use and market targeting, breaks disease cycles and Optimizes labour and input costs.

2.5. Diversification Across Environments

Some farmers diversify by using different environments on their farms like freshwater ponds for carp, brackish water tanks for shrimp and sea cages for cobia. Such landscape-based diversification spreads environmental risk and allows targeting of different markets.

3. Ecological Benefits of Species Diversification

3.1. Enhanced Ecosystem Functioning

Diversification in aquaculture mimics the complexity of natural ecosystems, which results in more stable and efficient functioning. By integrating species with different ecological roles such as grazers, filter feeders, scavengers, and producers diversified systems utilize energy and nutrients more effectively, reducing waste and pollution.

3.2. Improved Nutrient Cycling and Waste Management

Aquaculture systems typically accumulate waste products such as uneaten feed and excreta. In monocultures, these accumulate and degrade water quality. However, diversified systems utilize waste as input for other species.

3.3. Reduction of Disease Risk

Monocultures are highly susceptible to disease outbreaks due to high stocking density and genetic uniformity. Species diversification disrupts disease transmission pathways and reduces the buildup of pathogens.

3.4. Water Quality Improvement

Water quality is a critical limiting factor in intensive aquaculture. Species diversification improves water parameters by controlling nutrient loading and biological oxygen demand (BOD).

3.5. Habitat Structuring and Biodiversity Enhancement

Diversified aquaculture contributes to on-farm biodiversity and enhances habitat complexity. Different species create or modify niches, leading to secondary colonization by other organisms.

3.6. Mitigation of Invasive Species Impact

Invasive species are a growing concern in global aquaculture. Diversification can act as a natural buffer by stabilizing ecosystems and reducing resource availability for invaders.

3.7. Carbon Sequestration and Climate Benefits

Some diversified systems contribute to blue carbon storage. For example: Seaweeds and seagrasses absorb atmospheric CO_2 and can be harvested without releasing stored carbon.

4. Economic and Social Benefits

4.1. Income Diversification and Risk Reduction

Just as in investment portfolios, diversification in aquaculture reduces economic volatility. Relying on a single species exposes farmers to price crashes, disease losses, and seasonal fluctuations. Multiple species Ensure stable cash flow throughout the year, allow price hedging by targeting different consumer segments and Offer resilience to market disruptions or regulatory changes.

4.2. Employment Generation and Livelihood Support

Diversified aquaculture systems are labour-intensive and generate jobs across the value chain by hatchery management, pond preparation, species-specific feeding and harvesting and post-harvest processing. Especially in coastal and rural areas, such operations engage women in seaweed farming, mussel collection, and feed preparation, provide youth employment in logistics, retailing, and cold chain services.

4.3. Food and Nutritional Security

Different aquatic species provide different nutritional profiles like fish are rich in omega-3 fatty acids and protein, shellfish offer iron, zinc, and selenium and seaweed is high in iodine, fiber, and vitamins. When families or communities practice diversified aquaculture, they improve both dietary diversity and nutrient availability, especially in malnutrition-prone areas.

4.4. Market Expansion and Product Differentiation

Species diversification allows farms to cater to niche gourmet markets (e.g., oysters, trout), herbal/nutraceutical sectors (e.g., seaweed extracts), export markets with premium pricing and domestic retail chains requiring year-round supplies. Farmers who diversify are more likely to participate in value-added production, such as smoked fish, dried shrimp, pickled seaweed and fish sausages. These products fetch higher margins and support brand development.

4.5. Institutional Support and Access to Finance

Governments and international organizations increasingly support diversified aquaculture through subsidies for integrated systems, skill training for handling multi-species, low-interest loans for innovative farms and certification schemes (e.g., organic aquaculture). Diversified farms are viewed as climate-smart investments, helping secure funding from green finance, CSR funds, and multilateral donors. For example, India's PMMSY (Pradhan Mantri Matsya Sampada Yojana) includes incentives for polyculture and seaweed farming under climate adaptation funds.

5. Conclusion

The aquaculture industry's historical reliance on monocultures has delivered significant short-term gains but has also exposed the system to a range of long-term vulnerabilities including ecological degradation, economic fragility, and heightened disease susceptibility. In this context, species diversification is not merely an option; it is an imperative for sustainable, resilient, and equitable aquaculture development. Species diversification strengthens ecological stability by mimicking natural ecosystems, improving nutrient cycling, reducing waste, and lowering the incidence of disease. Integrated systems such as polyculture, integrated multi-trophic aquaculture (IMTA), and rotational farming demonstrate that it is possible to increase productivity while minimizing environmental impact. In summary, the necessity of aquaculture species diversification is underscored by its multifaceted benefits across ecological, economic, and societal domains. It represents the evolution of aquaculture from high-risk, input-heavy systems to adaptive, inclusive, and regenerative models. As nations seek to build sustainable aquaculture futures, diversification must become a foundational pillar driving both innovation and equity in the aquatic food landscape.

References

1. Lokesh Pawar, Mayuri Nag & M. Junaid Sidiq (2020). Integrated Multi-Trophic Aquaculture Systems (IMTA): A Sustainable Approach for Better Resource Utilization. Journal of Aquaculture, Vol. 28, pp. 19–26.

2. G. Biswas, P. Kumar, T. K. Ghoshal, M. Kailasam, D. De, A. Bera, B. Mandal, K. Sukumaran & K. K. Vijayan (2020). Integrated multi-trophic aquaculture (IMTA) outperforms conventional polyculture with respect to environmental remediation, productivity and economic return in brackishwater ponds. Aquaculture, Vol. 516, 734626.

3. Alokesh Kumar Ghosh, A. F. M. Hasanuzzaman, S. S. Islam, Md Golam Sarower, Shaikh Tareq Arafat & Khandaker Anisul Huq (2025). Integrated multi-trophic aquaculture (IMTA): enhancing growth, production, immunological responses, and environmental management in aquaculture. Aquaculture International, 33, 336.

4. Hariom Bohare, Soumya Rai, R. P. Singh, Akshay Garg & Poonam Shakya (2025). Review on Integrated Multi-Trophic Aquaculture System (IMTA). Veterinary Research (Vol. 10, Special Issue 3).

5. Jumah Yashier Upling (2020). A review on waste absorption efficiency of different extractive integrated multi-trophic aquaculture (IMTA) species: Implications in coastal and offshore aquaculture waste management. GSC Biological and Pharmaceutical Sciences, 11(02), 257–264.

6. Muhammad Hanif (2022). Development of the Integrated multi-trophic aquaculture (IMTA) System in the World; Article Review. Journal of Aquaculture Science, Vol. 7 No. 2.

7. Rosamond L. Naylor, Rebecca J. Goldburg, Jurgenne H. Primavera, Nils Kautsky & Malcolm C. M. Beveridge (2000). Effect of aquaculture on world fish supplies. Nature. Naylor and colleagues continue influential work, such as A 20 year retrospective review of global aquaculture.


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Introduction

Murrel (Channa striatus), a native freshwater carnivorous fish widely distributed across India and Southeast Asia, has rapidly emerged as a high-value candidate species for freshwater aquaculture. Traditionally harvested from wild sources, murrel has long been regarded as a premium table fish due to its firm flesh, rich taste, and widely acknowledged medicinal properties. Over the past decade, however, murrel has transitioned from a niche species to a mainstream aquaculture commodity. Farmers across Tamil Nadu, Andhra Pradesh, Telangana, and Kerala are adopting murrel as an alternative or complementary species to carp, driven by price stability, strong market demand, biological resilience, and recent technological breakthroughs in seed production and feed formulation.

Figure 1: Image of Murrel

The rise of murrel is aligned with India's broader push for species diversification, a key component of sustainable aquaculture development. As climate variability, disease challenges, and market saturation increasingly affect monoculture systems, species like murrel offer resilience, profitability, and biological adaptability. Its ability to thrive in low-oxygen waters, withstand handling stress, and grow in diverse culture systems positions it at the center of India's next phase of aquaculture expansion.

The Economic Advantage: Why Markets Favor Murrel

One of the strongest drivers behind murrel's surge in popularity is its exceptional and consistent market value. Unlike carp species, whose prices fluctuate depending on seasonal supply and festival demand, murrel enjoys year-round premium pricing. Retail prices commonly range from ₹450 to ₹700 per kilogram, with live murrel or large-sized fish fetching even higher rates in urban markets and specialty restaurants. Murrel's high consumer preference is rooted in cultural, culinary, and medicinal beliefs. In South India, murrel is perceived as a "strengthening" fish, often recommended in post-operative diets due to the presence of bioactive peptides linked to wound healing and tissue regeneration. This contributes to sustained demand across both rural and urban populations.

From an economic standpoint, farmers report 2–3 times higher net profit margins from murrel compared to carp, even in small production systems. The species' shorter culture cycle (6–8 months to market size), lower disease incidence, and high survival rates collectively enhance profitability. Live trade networks, especially in Tamil Nadu and Andhra Pradesh, further ensure strong farm-gate connectivity and rapid cash flow for farmers.

Biological Strengths and Climate Resilience

Murrel's physiological traits make it uniquely suited to

India's climatic and water-resource conditions. As an air-breathing fish, murrel possesses suprabranchial organs that allow it to survive and grow in oxygen-depleted environments where other freshwater species struggle. This adaptation enables murrel culture in:

• Seasonal ponds

• Irrigation tanks

• Low-water or neglected ponds

• Rural farm reservoirs

• Biofloc and zero-exchange systems

Fig 2: Grading of Murrel

This climate resilience is particularly valuable as India experiences irregular rainfall patterns and increasing incidences of water stress. Murrel's tolerance to suboptimal water quality, handling, and crowding makes it suitable for small and marginal farmers who rely on limited water resources. Figure 1 and 2 shows the Murrel and its grading used in farming. Murrel also demonstrates strong disease resistance. While susceptible to certain ectoparasites and bacterial infections, properly managed murrel ponds report survival rates above 85%, significantly higher than carp systems. Its carnivorous nature and aggressive feeding behaviour support fast growth when provided with nutritionally adequate feed.

Technological Breakthroughs: Seed Production and Feed Innovation

Seed Production Advances

One of the historical bottlenecks in murrel aquaculture was the limited availability of quality seed. Earlier reliance on wild-caught fry led to inconsistent growth, poor survival, and irregular supply. However, research institutions and private hatcheries have significantly improved induced breeding and larval rearing technologies.

Key developments include:

• Hormone-induced spawning using Ovatide, HCG, and improved broodstock management

• Larval rearing in FRP tanks with enriched live feed

• Transition protocols from live feed to formulated diets

• Standardized nursery stocking density and cannibalism control techniques

Today, hatcheries in Andhra Pradesh, Tamil Nadu, and West Bengal are capable of producing millions of fry per season, ensuring reliable supply for commercial farms.

Feed Innovations Driving Scalability

Feeding used to be another constraint due to murrel's carnivorous nature. Farmers traditionally depended on trash fish or live feed, which was costly, inconsistent, and unhygienic. Recent advancements have revolutionized murrel nutrition:

• Formulated floating and sinking pellets for all life stages

• Black Soldier Fly (BSF) larvae–based protein feeds, reducing dependence on fishmeal

• Seaweed-based immunostimulant feeds to improve disease resistance

• Carrageenan-coated slow-release pellets enhancing stability and reducing wastage

• Probiotic and phytogenic feed additives improving gut health and growth

As a result, murrel farming is becoming more standardized, scalable, and economically viable.

Social and Rural Impact: A Livelihood Transformer

Murrel's robust economics and low resource requirements are transforming rural livelihoods. Small farmers with 0.5–1 acre ponds find murrel ideal because of its low input cost and strong market linkages. Self-Help Groups (SHGs), particularly women-led coastal and inland groups, are adopting murrel as a reliable income-generating activity.

Youth entrepreneurs are entering the sector by establishing:

• Small-scale murrel hatcheries

• Live-fish transport units

• Value-added murrel processing businesses

• Integrated murrel-biofloc farms

The species' premium pricing ensures steady revenue, enabling financial stability for rural households. Furthermore, murrel aligns with the national objective of species diversification, reducing overdependence on carp and contributing to ecological balance by minimizing pressure on wild fish stocks.

Challenges and the Road Ahead

Despite strong prospects, murrel aquaculture faces a few constraints:

• Variation in seed quality across unregulated hatcheries

• Cannibalism during early nursery stages

• Limited farmer training on feeding and water quality

• Lack of standardized disease surveillance programs

However, current innovations are rapidly addressing these issues. With proper extension services, scientific support, and feed standardization, murrel has the potential to scale nationwide. As government policies promote diversification, murrel is prepared to lead India's next Blue Transformation phase.

Conclusion

Murrel has evolved from a traditional wild delicacy to a modern aquaculture success story. Its premium market value, strong biological resilience, rapid growth cycle, and suitability for small-scale farming make it one of India's most commercially promising freshwater species. With technological breakthroughs in hatchery, feed, and production systems, murrel is set to take center stage in India's freshwater aquaculture landscape. As climate uncertainty and market pressures reshape fisheries, murrel stands out as a reliable, profitable, and sustainable choice truly India's next aquaculture superstar.

References

1. Haniffa, M. A., et al. (2004). "Induced Spawning of Striped Murrel (Channa striatus)." Indian Journal of Fisheries.

2. Marimuthu, K., & Haniffa, M. (2007). "Larval Rearing Techniques for Murrel." Asian Fisheries Science.

3. NBFGR (2020). Priority Fish Species for Aquaculture Diversification in India. ICAR-NBFGR, Lucknow.

4. Kumar, D., & Gupta, S. (2019). "Advances in Murrel Feed Formulation." Journal of Aquaculture Research & Development.

5. Department of Fisheries, Govt. of India (2022). Handbook on Freshwater Aquaculture Diversification.

6. Vijayakumar, R., et al. (2021). "Nutritional Evaluation of BSF Meal for Carnivorous Freshwater Fish." Aquaculture International.

7. Pandian, T. J. (2011). Fish Reproductive Biology: Murrel Species. CRC Press.

8. Gupta, S. K. & Rathore, V. (2019). "Market Trends and Economics of Murrel Farming." Fishery Technology.

9. FAO (2023). Freshwater Fish Production Outlook in South Asia.

Shrimp-a-thon 2025: An initiative to raise domestic shrimp consumption in India
Bhavana Reddy, Strategic Marketing Lead, Skretting India

Shrimp-a-thon 2025 concluded successfully marking a significant step in promoting domestic shrimp consumption and highlighted shrimp's role in nutrition and India's aquaculture sector. Held in the heart of India's aquaculture belt Bhimavaram, Andhra Pradesh on May 4, 2025 the event brought together a diverse group of over 500 participants, including farmers, dealers, fisheries students, health professionals, chefs, policymakers, opinion makers and educators showcased the importance of supporting local shrimp consumption and embracing a healthier lifestyle through **# Shrimp For Health** campaign.

The morning kicked off with energizing 3km and 5km runs, which saw strong participation and high spirits. The run symbolized a collective stride toward nutritional awareness, sustainable food choices and a stronger domestic aquaculture ecosystem.Event concluded with delicious shrimps dishes sponsored by farmers turning the experience into a celebration of both health and locally produced superfood.

The event highlighted a critical paradox: while India is one of the world's leading shrimp producers, more than 90% of its shrimp is exported, even as protein deficiency continues to affect a large portion of the population. This became the central theme of the event emphasizing the urgent need to bridge the gap between production and consumption locally.

Dr. Saurabh Shekhar, General Manager, Nutreco South Asia, addressed the audience and debunked common myths surrounding shrimp consumption. He emphasized shrimp's nutritional profile high-quality protein, low fat, and essential micronutrients and stressed its potential to become a mainstream protein source for Indian households. Initiatives like this acts as a trigger for a sustained, concentrated effort to build long-term awareness and boost domestic consumption.

Mr. Ravi Kumar Yellanki, President of the All India Shrimp Hatcheries Association, cited the opportunity to grow local consumption, comparing India's potential to China's 25-fold growth in 15 years. **Dr. Manoj Sharma** of Zhingalala emphasized shrimp's nutritional value and supported efforts to promote locally produced protein. Chandrasekar S of USSEC and Right To Protein aid shrimp is important to India's economy and protein goals.

Beyond the run, the event featured interactive stalls such as the Protein-o-Meter and Live Shrimp Counter, enriching the experience. It not only positioned shrimp as a powerful superfood but also showcased the strength of collaboration within the aquaculture industry.

A collective effort: Thanks to our valued co-sponsors

The success of Shrimp-A-Thon 2025 was made possible by the strong support of more than 17 co-sponsors and partners, all integral to the aquaculture value chain. United by a common goal, we worked together to promote a healthier, protein-rich India and a more sustainable aquaculture industry. Their commitment to the cause played a vital role in making the event a remarkable success.

A strong foundation for the future

Shrimp-A-Thon 2025 was more than just a run it was a powerful initiative to change perceptions, encourage local shrimp consumption, and create a lasting impact. With exceptional participation and collective support, this initiative has set a strong foundation for future campaigns focused on raising awareness about domestic shrimp, enhancing food security for sustainably **feeding the future.**

As we move forward, the momentum created here will continue to build bridges between **producers and consumers,** inspire more informed dietary choices, and strengthen India's position as not just a leading shrimp exporter but also a nation that values and consumes what it grows.

Tamil Nadu Fish Food Festival 2025: A Celebration of Seafood, Sustainability and Community

The Tamil Nadu Fish Food Festival 2025 was inaugurated by Thiru Udhayanidhi Stalin, Hon'ble Deputy Chief Minister of Tamil Nadu, at Island Grounds, Chennai, and was held from May 30 to June 1, 2025. Organized by the Department of Fisheries and Fishermen Welfare, the festival aimed to raise public awareness about the nutritional value of seafood and to spotlight the state's rich marine heritage.

Held inside a sprawling 1,00,000 sq. ft. air-conditioned pavilion, the event featured over 50 stalls from Chennai-based seafood brands, 15 stalls displaying aquaculture and ornamental fish, and 20 stalls focused on value-added fish products. The venue became a vibrant hub for seafood lovers, culinary enthusiasts, and aquaculture stakeholders from across the region.

One of the major highlights was the live cooking counters, where professional chefs and women from fishing communities prepared a variety of traditional and contemporary seafood dishes, creating an engaging and interactive culinary experience. Beyond the gastronomic showcase, the festival hosted a comprehensive seafood exhibition, spotlighting the latest advancements in aquaculture technologies and seafood processing innovations.

Visitors also explored informative exhibits and live cooking demonstrations that emphasized the nutritional benefits of seafood, particularly its high content of Omega-3 fatty acids, iodine, essential minerals, and vitamins A, D, and K nutrients known to be especially beneficial for children and senior citizens.

A standout attraction was the "Prawnathon", a lively mini-marathon aimed at promoting public awareness around the health benefits and sustainability of prawns. The event also featured expert talks and panel discussions on topics such as sustainable fishing practices, emerging aquaculture trends, and seafood export opportunities, adding an educational dimension to the festival.

The Tamil Nadu Fish Food Festival 2025 concluded on a successful note, leaving behind fond memories, increased nutritional literacy, and a deeper appreciation for the state's seafood traditions and the coastal communities that sustain them.

IFT Expo 2025: Catalyzing India's Blue Economy Through Innovation and Sustainability

The International Fishery Tech Expo (IFT Expo) 2025 marked a defining moment for India's fisheries and aquaculture sectors by hosting the nation's first-ever dedicated fishery technology showcase inaugurated by Maharashtra Ports Development Minister Nitesh Narayan Rane. Held from June 12 to 13, 2025, at the Bombay Exhibition Center in Mumbai, the two-day event symbolized India's strong commitment to building a future-ready, technology-driven Blue Economy.

IFT Expo 2025 served as a convergence point for a diverse array of stakeholders across the fisheries value chain, including fish producers, aquaculture entrepreneurs, seafood processors, exporters, importers, research institutions, investors, and technology providers. This landmark expo aimed to drive innovation, encourage investment, and promote sustainable practices in marine and inland fisheries.

The exhibition showcased a broad spectrum of products, services, and technological innovations under key categories such as fishing vessels and modern equipment, advanced aquaculture technologies, seafood processing and value addition, packaging solutions, cold chain and storage systems, logistics, and digital tools for fisheries management.

Live demonstrations were a key attraction, offering attendees an interactive experience with the latest advancements in automation, drone-based aquaculture monitoring, IoT-driven water quality management, and smart feed delivery systems. The expo provided exhibitors a platform to highlight not only product innovation but also integrated solu-

tions aimed at improving efficiency, traceability, environmental compliance, and profitability within the sector.

One of the standout themes of IFT Expo 2025 was its focus on sustainability and responsible fisheries development. The event spotlighted various government initiatives and policy interventions aimed at conserving marine biodiversity while enhancing livelihoods.

This aligned with India's broader marine conservation goals and reflected a balanced approach to increasing productivity without compromising ecological integrity.

Exhibitors also showcased climate-resilient aquaculture models, organic feed alternatives, and eco-friendly processing systems that support low-carbon growth in fisheries.

Complementing the exhibition was the Knowledge Symposium, a high-level forum that featured expert talks, panel discussions, and roundtables involving national and international thought leaders.

Topics included sustainable aquaculture practices, fishery digitization, post-harvest innovation, global seafood market trends, blue financing mechanisms, and the role of artificial intelligence in fisheries resource management.

These sessions fostered collaborative dialogue between policymakers, industry leaders, researchers, and coastal community representatives. Importantly, the expo's timing coincided with the announcement of the Union Budget 2025–26, which earmarked a significant financial allocation to the fisheries sector, underlining the government's prioritization of the industry.

IFT Expo 2025 was supported by key government departments and leading industry associations, making it a flagship event for accelerating India's position in the global seafood industry.

With seafood exports already exceeding Rs.64,000 crore in FY2023–24, the expo aimed to further strengthen India's export competitiveness, promote domestic entrepreneurship, and encourage the adoption of sustainable technologies across coastal and inland fisheries.

By bridging innovation, investment, and policy, IFT Expo 2025 set the stage for the next era of smart, inclusive, and sustainable growth in India's fisheries sector, firmly positioning the country as a rising global hub in marine and aquaculture innovation.

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