Next-Gen Aquaculture in India: Harnessing RAS and Bio-floc Technology in the Blue Economy for the Atmanirbhar Bharat and Viksit Bharat Vision

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The fisheries and aquaculture sector has emerged as a vital pillar of India's economic growth, supporting the livelihoods of nearly three crore fishers and fish farmers while generating employment across a vast value chain spanning production, processing, marketing and exports. India today is the world's second-largest fish producer, contributing around 8 per cent of global fish production, the second-largest aquaculture producer, the largest producer and exporter of shrimp, and the second-largest producer in capture fisheries. These achievements reflect the growing strategic importance of the sector in advancing food and nutritional security, rural prosperity, export earnings and the country's blue economy aspirations.

This transformation has been underpinned by sustained policy support and unprecedented public investment. Since 2015, the Government of India has approved or announced cumulative investments exceeding ₹39,272 crore across a range of flagship schemes and initiatives aimed at the holistic development of fisheries and aquaculture. These investments have strengthened production systems, modernized infrastructure, promoted technology adoption, improved market access and enhanced global competitiveness, laying the foundation for a resilient, sustainable and globally competitive fisheries sector.

The impact of these interventions is reflected in the sector's remarkable growth trajectory over the past decade. Annual fish production has more than doubled, rising from 95.79 lakh tonnes in 2013-14 to a record 198 lakh tonnes in 2024-25. Much of this growth has been driven by the rapid expansion of inland fisheries and aquaculture, whose production increased by 147% during the same period, from 61.36 lakh tonnes to 151.60 lakh tonnes. India's seafood exports have witnessed a similar upward trajectory, more than doubling from ₹30,213 crore in 2013-14 to a record ₹73,890 crore in 2025-26. This sustained export growth, achieved amid an increasingly complex global trading environment and emerging tariff-related challenges, underscores the resilience, competitiveness and growing global acceptance of Indian seafood products.

Technology infusion has been a cornerstone of the sector's transformation, particularly in aquaculture. The adoption of advanced production systems such as Recirculatory Aquaculture Systems (RAS) and Biofloc technology under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) is enabling a transition towards more intensive, resource-efficient and commercially attractive modes of fish farming. Together with cage culture and other modern farming practices, these innovations are helping build a more productive, resilient and future-ready aquaculture ecosystem capable of meeting growing domestic and global demand for fish and fishery products.

Recirculatory Aquaculture Systems (RAS) and Biofloc technology represent a new generation of aquaculture practices that allow fish to be reared in controlled environments. While RAS relies on water treatment and recirculation systems to maintain optimal growing conditions, Biofloc technology harnesses beneficial microorganisms to improve water quality and support fish growth. Together, these technologies

are expanding the scope of aquaculture by enabling fish farming in diverse agro-climatic conditions and locations where traditional aquaculture may not be feasible. By recycling up to 90–95% of water, RAS supports resource-efficient fish production and enables the establishment of farming units closer to urban consumption centres and export hubs, contributing to a more circular and sustainable aquaculture economy.

Under Pradhan Mantri Matsya Sampada Yojna (PMMSY), 9,467 Recirculatory Aquaculture Systems (RAS) and 4,573 Biofloc units have been approved, facilitating year-round fish farming, signalling a shift towards intensive and commercially viable fish production models that are expanding aquaculture beyond traditional farming geographies. This technology infusion has been backed by investments of ₹4,120 crore under PMMSY, reflecting the Government's emphasis on modernizing fisheries production systems and accelerating the adoption of advanced aquaculture practices.

Beyond strengthening domestic production, RAS and Biofloc technologies are also supporting India's ambitions in high-value seafood exports. By enabling production in controlled farming environments, these systems help ensure consistency in quality, traceability and biosecurity—attributes that are increasingly important in global seafood markets. As the sector moves towards value addition and export-oriented production, such technology-driven aquaculture systems are expected to play an important role in enhancing the competitiveness of Indian seafood and reinforcing the country's position in international markets.

The versatility of RAS and Biofloc technologies is also enabling the expansion of specialized aquaculture segments across the country. These systems are increasingly being adopted in cold-water fisheries clusters across Jammu & Kashmir, Ladakh, Uttarakhand and Himachal Pradesh for the culture of premium-value species such as trout, while also supporting the production of export-oriented shrimp in saline and brackish-water aquaculture systems. Their application in ornamental fish rearing units is further strengthening niche markets and opening new opportunities for entrepreneurs. Together, these technologies are broadening the scope of aquaculture and creating fresh avenues for growth in high-value fisheries.

The road ahead for India's fisheries sector will be shaped by the continued integration of technology, innovation and sustainability. As the country seeks to build a resilient and globally competitive blue economy, the convergence of RAS and Biofloc systems with digital monitoring platforms, artificial intelligence, drone-enabled services and renewable energy solutions has the potential to enhance operational efficiency and reduce production costs. Equally important will be the diversification of aquaculture towards high-value species such as shrimp, trout, seabass, tilapia, murrel and pangasius, enabling greater value realisation and improved access to international markets. Supported by continuous skill development, industry partnerships and a robust policy framework, these technology-driven production systems can play a transformative role in strengthening food security, generating rural employment, expanding seafood exports and advancing the vision of a sustainable and prosperous blue economy under Viksit Bharat.

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