POLICY BRIEF #40

THE BLUE REVOLUTION:

Aquaculture to Augment Farmers' Income

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MAY 2025

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Abstract

India’s agriculture and allied sector grew at an average annual rate of 4.6 percent in gross value added (GVA) terms from Financial Year 2010-11 (FY 11) to FY23. Interestingly, during this period, fisheries and aquaculture witnessed a much faster growth of 8.2 percent while cereals increased by just 3 percent annually in terms of gross value of output (GVO). The rapid growth in inland fisheries and the increasing global demand for Indian fisheries position this sector as a key contributor to enhancing farmers' incomes. This policy brief examines the key drivers of inland fisheries expansion in India over the last four decades and assesses its potential to strengthen rural livelihoods by diversifying income sources. Rising incomes, technological advances in seed production, strategic government support through initiatives like Pradhan Mantri Matsya Sampada Yojana (PMMSY), and export growth, particularly of *Litopenaeus Vannamei* (L. Vannamei) shrimps, have driven the growth of India’s fisheries sector, showing a significant positive impact on GVA. It also highlights some of the challenges this sector faces, especially in terms of environmental issues, access to finance, and risk coverage. But overall, the research evidence shows significantly higher profitability of aquaculture—especially shrimp farming—compared to crop agriculture. Thus, this sector has a potential to play a transformative role in promoting inclusive and sustainable rural growth in India.

Acknowledgement

We would like to express our sincere gratitude to the Kotak Karma Foundation for their generous support in facilitating this research on "The Blue Revolution: Aquaculture to Augment Farmers' Income." This work has greatly benefited from the data from multiple sources, including the Ministry of Fisheries, Animal Husbandry, and Dairying, the Marine Products Export Development Authority (MPEDA), and the National Sample Survey Office (NSSO). We also appreciate the insights from secondary case studies, field visits, and expert consultations, which have significantly contributed to this policy brief. The authors would like to express their gratitude to Rahul Arora for designing this policy brief. The authors also would like to thank Shibani Chattopadhyay, Communication Officer, ICRIER, for her comments and editing of this policy brief.

Keywords: *Aquaculture, Diversification, Fisheries, Growth, Inland, Shrimp, Income*

JEL Classification: *Q5, Q15, Q18*

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List of Abbreviations

ARDL	:	Auto Regressive Distributed Lag
BCD	:	Basic Customs Duty
FAO	:	Food and Agriculture Organization
FFPO	:	Fisheries Farmer Producer Organization
FPO	:	Farmer Producer Organization
GoI	:	Government of India
GVA	:	Gross Value Added
GVO	:	Gross Value of Output
IPCC	:	Intergovernmental Panel on Climate Change
ITA	:	International Trade Administration
KCC	:	Kisan Credit Card
LMIC	:	Low and Middle-Income Countries
MPEDA	:	Marine Products Export Development Authority
PACs	:	Primary Agriculture Cooperative Credit Societies
PM-MKSSY	:	Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana
PMMSY	:	Pradhan Mantri Matsya Sampada Yojana
RAS	:	Recirculatory Aquaculture System
SAS	:	Situation Assessment Survey

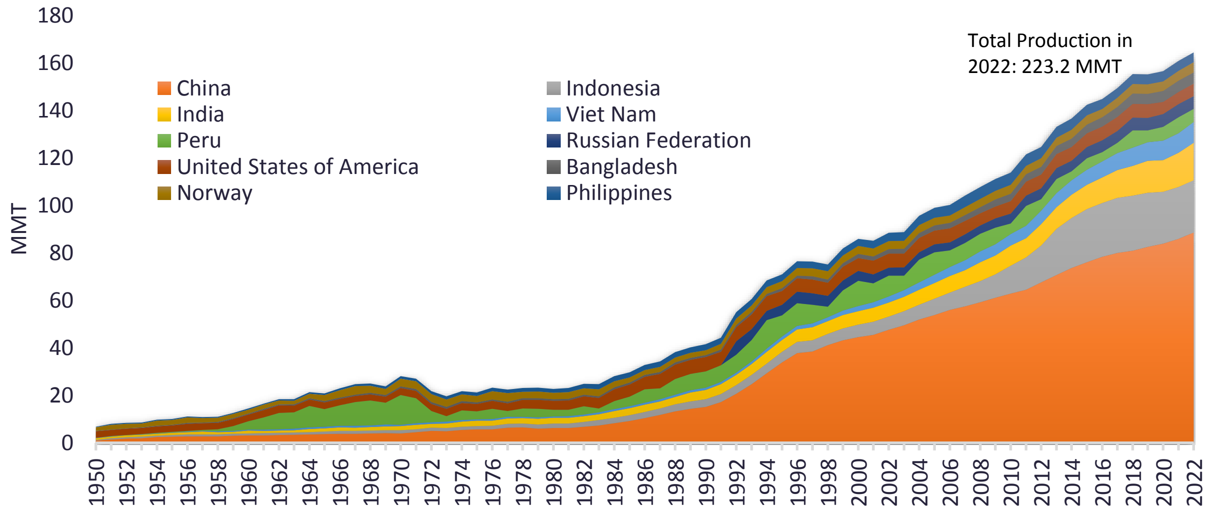
The Blue Revolution in India: Aquaculture to Augment Farmers' Income

Raya Das, Sanchit Gupta, Ashok Gulati

1. Introduction

Fisheries and aquaculture are among the fastest-growing industries globally, playing a crucial role in economic development (Tacon, 2020). Beyond providing a vital source of protein, fish is rich in omega-3 fatty acids and bioavailable micronutrients essential for human health. Globally, fisheries and aquaculture production reached an estimated 223.21 million metric tonnes (MMT) in 2022, comprising 185.4 MMT (live weight equivalent) of aquatic animals and 37.8 MMT (wet weight) of algae (FAO, The State of World Fisheries and Aquaculture, 2024). Over the past seven decades, global aquaculture production has undergone a dramatic change. China's share in global fisheries production rose sharply from just 4.8 percent in 1950 to 39.4 percent in 2022 (**Figure *1***), reflecting a sustained policy push toward aquaculture-led rural development beginning in the 1980s. A key inflection point came in 1979, when China introduced regulatory reforms to conserve aquatic resources and simultaneously promote fish farming as a strategy for income generation and food security.

Figure 1: Trends in Global Fisheries Production by Country (1950–2022)



Source: FishStatJ, Food and Agriculture Organization of the United Nations (FAO)

India, now the world's third-largest producer of fisheries and second in aquaculture, has also witnessed remarkable progress, with production rising from 6.2 MMT in 2002–03 to 17.5 MMT in 2022–23, nearly tripling over two decades (GoI, 2023). India's agriculture and allied sector registered an average annual GVA growth of 4.6 percent between FY11 and FY23, with the fisheries and aquaculture segment expanding at a much faster pace of 8.2 percent, whereas the gross output value of cereals rose by only 3 percent per year over the same period. Given the growing potential and importance in the country's economic landscape, the sector is identified as the "sunrise sector" in India. The sector contributes significantly to food and nutritional security, national income, and livelihoods, supporting about 30 million fishers and fish farmers in India (Ministry of Fisheries and Animal Husbandry, GoI, 2023).

India has also emerged as major fish exporter, ranked seventh in fish exports, accounting for 3.77 percent of global exports (FAO, 2022). However, India's share in the global shrimp export market is far more significant, at 21 percent, making it the second-largest shrimp exporter after Ecuador. In FY24, India exported 1.78 MMT of fisheries products worth USD 7.38 billion (MPEDA, 2025), with frozen shrimp being the leading export commodity. The export of frozen shrimps during 2023-24 stood at 0.716 MMT contributing 40.2 percent of the total quantity and 66.12 percent of the total export value of fisheries from India. Hence, the fisheries sector, particularly inland fishing and aquaculture, has large potential to expand and augment farmers' income through diversification of livelihood.

In this context, the objective of this policy brief is to analyse the factors driving the growth of the fisheries sector in India, focusing on technological advancements, government policies, and institutional reforms in enhancing productivity, especially in inland fisheries. It aims to explore how these advancements and growth in export have contributed to increased productivity and market integration for farmers by improving value chain efficiencies in production, processing, and marketing. This brief will also assess how participation in inland fisheries has diversified income sources for farmers, and how this compares to traditional agricultural practices in terms of profitability and environmental sustainability. Drawing on these insights, the brief provides policy suggestions that can unlock the full growth potential of the inland fisheries sector in the country, scale its adoption across diverse geographies, and deepen its role in advancing resilient and inclusive rural livelihoods.

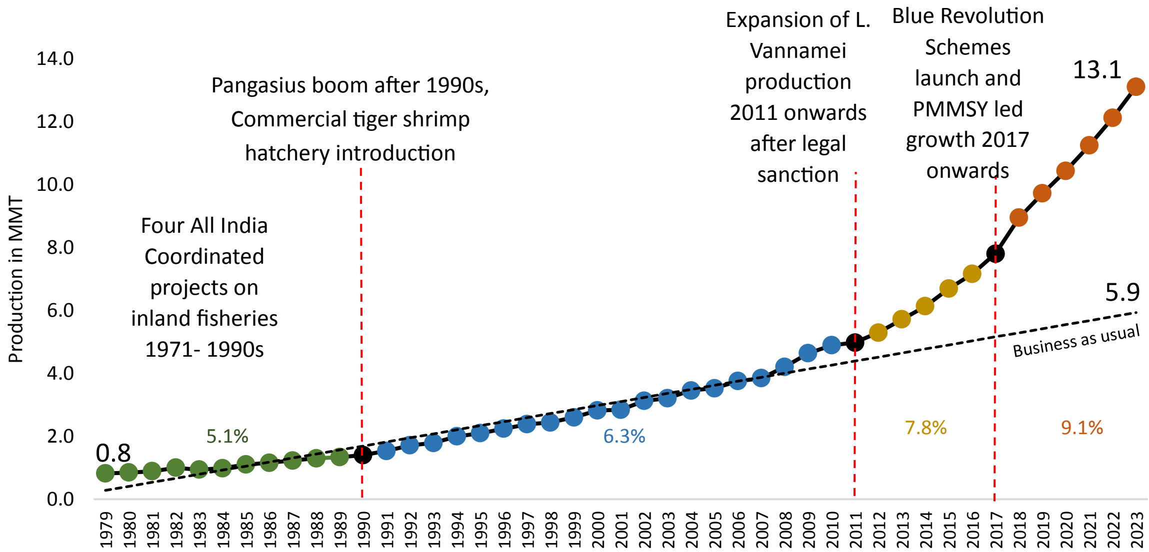
2. Unpacking the Blue Revolution: Structural Drivers of Growth

As mentioned earlier, total fish production—both inland and marine—has nearly tripled, growing from 6.2 MMT in 2002–03 to 17.5 MMT in 2022–23 at a compound annual growth rate (CAGR) of 5.1 percent. But beneath this headline figure lies a structural transformation: it is inland fisheries that have powered this expansion, growing by a staggering 307 percent between 2002-03 and 2022-23, while marine fisheries increased just by 48 percent. This shift marks a fundamental change in the sector's composition (Handbook of Fisheries, 2023). In 2002–03, inland fisheries contributed 52 percent of total production; by 2022–23, their share had surged to 75 percent driven by rapid growth in aquaculture, especially shrimp and freshwater species. This inland boom is also a story of improving livelihoods. For millions of smallholders, aquaculture offers a profitable alternative to low-return crops, with potential to raise rural incomes.

3. Key drivers of inland fisheries growth in India

It is interesting to note that the structural break analysis[1] of inland fisheries production clearly reveals three significant inflection points—around 1990, 2010, and 2017—each representing a fundamental shift in the growth path (**Figure 2**). The most recent phase, 2017 to date, stands out with an average annual growth rate of 9.08 percent, showing a high momentum of the sector. The Auto Regressive Distributed Lag (ARDL) analysis of 1990–2022 highlights four long-run drivers of growth in India's fisheries GVA (Annex 1). Rising per capita income (elasticity of 0.33) has boosted fish demand fuelling the growth of the sector. Fish seed production (coefficient 0.14) has enabled a shift to scalable, commercial aquaculture with fry[2] output growing from 22 billion in 2005-06 to 359 billion in 2022-23. A government support dummy (2016–22) shows a 0.31 units structural uplift in GVA of fisheries, with key schemes like the Blue Revolution and PMMSY. Finally, export growth of L. Vannamei shrimps, shows a 0.28 percent increase in GVA per 1 percent rise in exports. Together, these findings underscore that increase in demand, technological change in seed production, strategic state support, and export competitiveness have driven the sectoral growth.

Figure 2: Drivers of Inland Fisheries Growth in India (1979-2023)



Source: FishStatJ, Food and Agriculture Organization of the United Nations (FAO), GoI. Belton et al., 2018; Rajani et al., 2023

[1] We use the Bai-Perron (1998, 2003) multiple structural breaks model for detecting unknown breakpoints in a time series or regression model where the relationship between variables changes over time.

[2] In the aquaculture production cycle, the fry stage refers to young fish seed measuring approximately 20–25 mm in length, developed after 15–20 days of nursing from the spawn stage. It is a critical transitional phase before the fish mature into fingerlings (100–150 mm), and plays a key role in determining survival and growth rates in subsequent stages of aquaculture.

To understand how India's inland fisheries sector reached this juncture—and where it might go next - it is crucial to unpack the four structurally distinct phases of its development.

Phase 1: Institutional Take-off (1979–1990)

The foundation of scientific aquaculture in India was laid through public sector- led initiatives, notably the All India Coordinated Research Projects (AICRPs). These included pioneering efforts in composite fish culture, air-breathing species, and reservoir fisheries management. A major milestone came in 1979 with the World Bank-supported Inland Fisheries Project (USD 39.7 million), leading to the establishment of 62 hatcheries across North India. Combined with NABARD-led institutional lending and state-led extension services, this phase saw a transition from capture-based fisheries to scientific aquaculture, especially in carp polyculture. Dr. Hiralal Chaudhuri and Dr. Arun Krishnan are widely regarded as the fathers of India's Blue Revolution for their pioneering contributions to the development and modernization of aquaculture. Dr. Chaudhuri, revolutionized inland fisheries by developing induced breeding techniques for carp, enabling controlled fish seed production and catalyzing large-scale freshwater aquaculture. Dr. Arun Krishnan complemented this transformation by advancing scientific fish farming practices, improving market linkages, and promoting sustainable aquaculture systems.

Key Driver: Public sector investment in hatcheries, training, and technology innovation.

Phase 2: Technological Maturation and Commercial Scale-Up (1991–2010)

This period witnessed the entry of the private sector and the commercialisation of input services. The expansion of Pangasius, a fast-growing and hardy species, alongside large adoption of artificial induced breeding techniques such as Ovaprim, accelerated fry and fingerling production—scaling up from 0.49 billion fish fry in 1973-74 to over 21 billion in 2005-06. Floating pelleted feeds, High-Density Polyethylene (HDPE) water tanks, and improved transportation systems brought down mortality and boosted productivity. The emergence of private hatcheries also expanded during this period.

Key Driver: Expansion of technological innovation in breeding and feed, backed by rising private investment.

Phase 3: Shrimp Boom (2011–2017)

The third phase, from 2011 to 2017, witnessed what can be termed the 'shrimp boom'. The introduction and formal legalization of L. Vannamei (white leg shrimp) in 2009 by the Coastal Aquaculture Authority (CAA) was a turning point. Unlike the native *Penaeus monodon* (black tiger shrimp), L. Vannamei was disease-resistant, had superior feed efficiency, and offered significantly higher profitability. While the species was first imported as SPF (specific pathogen-free) brood stock in 2003, commercial cultivation only took off after legal clearance in 2009 by CAA. What followed was exponential growth, the number of registered shrimp hatcheries increased from 24 in 2009-10 to 312 by 2022-23, while post-larvae production soared from 0.62 billion to over 71 billion in the same period.

Global demand, especially from the US, EU, and China, created a strong pull factor. India's share in the US frozen shrimp market crossed 40 percent by 2022, and the country emerged as the second-largest exporter of farmed shrimp. Private investment flooded the sector, and infrastructure for cold storage, disease diagnostics, and feed mills expanded rapidly, especially in Andhra Pradesh and Tamil Nadu. Disease management protocols improved significantly, supported by biosecurity innovations and early warning systems to mitigate viral outbreaks like White Spot Syndrome Virus and Early Mortality Syndrome.

Key Drivers:

- Global demand surge (CAGR of shrimp exports at 17 percent from 2011-12 to 2017-18)
- Higher profitability: Rs. 7–9 lakh/ha/cycle vs. Rs. 1.67 lakh/ha for paddy and wheat
- Legal sanction of L. Vannamei, private players investment in value chain integration and public investment in biosecurity improvements, value-chain and extension

Phase 4: Policy-Led Expansion and Institutional Strengthening (2017–2025)

Recognising the strategic importance of fisheries, the government launched the Blue Revolution (2015-16 to 2019-20), followed by the PMMSY (2020-21 to 2024-25) with a combined investment of Rs. 23,000 crores, the focus shifted to:

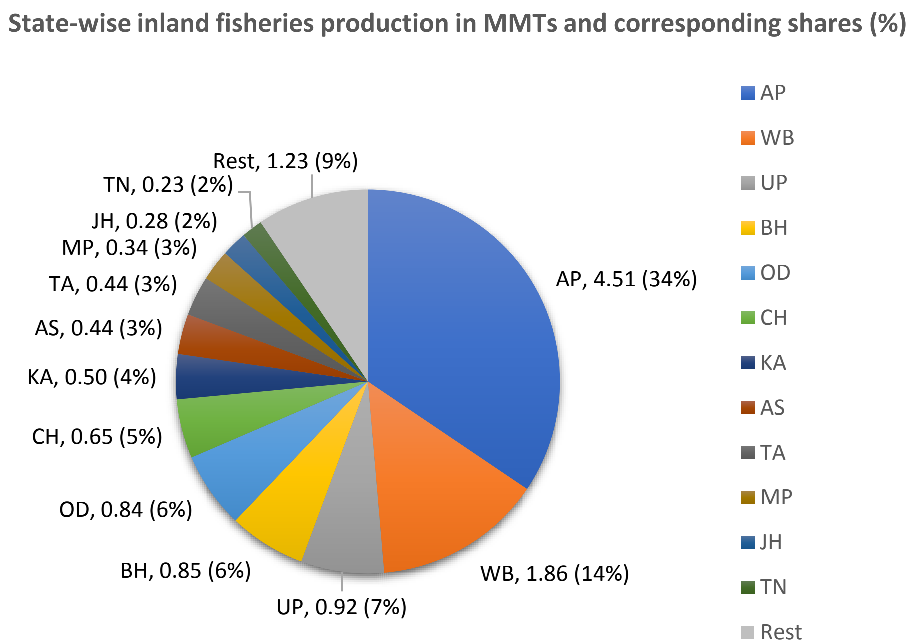
- Infrastructure upgrades (cold chains, processing plants, quality labs)
- FPO formation, cluster-based aquaculture zones, and digital traceability
- Promotion of climate-resilient and biotechnologically enhanced aquaculture

Between 2017 and 2023, inland fish production rose sharply, driven by expansion into non-traditional geographies, uptake of climate-resilient practices, and growing market linkages. Importantly, inland states like Haryana began leveraging salinity-affected lands for shrimp farming, using policy support and private entrepreneurship to drive diversification. Dr. Subbanna Ayyappan, a distinguished aquaculture scientist, has been instrumental in shaping India's Blue Revolution, over these four decades with his contributions focused on advancing sustainable inland aquaculture.

Key Drivers: State-led schemes, credit linkages, market access, private entrepreneurship models, and value chain formalisation.

While national-level trends reflect the rapid expansion of fisheries in India, the regional distribution of this growth remains highly concentrated. Andhra Pradesh alone accounts for 34 percent of the country's total inland fish production far surpassing other major states such as West Bengal (1.86 MMT) and Uttar Pradesh (0.92 MMT) (**Figure 3**). While Andhra Pradesh's share has jumped nearly 16 percentage points over two decades in 2002-03 to 2022-23, West Bengal has seen notable decline of 15 percentage points. These regional disparities underscore the need for targeted investments, standardized power tariff for farmers, institutional support, and infrastructure development in lagging states to ensure that the sustainable growth of inland fisheries translates into equitable income gains for farmers across the country.

Figure 3: Domestic landscape of inland fisheries (2022-23)



Source: Handbook on Fisheries Statistics, GoI.

4. Value Chain of Inland Fisheries in India

The value chain of inland fisheries in India has variations depending upon the cultured species. It is fragmented and underdeveloped in case of carps for example and more organized in case of shrimps which are mostly exported from India. Some of the key stakeholders in inland fisheries value chain include farmers, seed providers (hatcheries and nurseries), feed plants, traders, local intermediaries, processors and exporters. Government support has been significant in the past two decades for its development which includes setting up organizations like Marine Products Export Development Authority (MPEDA), CAA, National Centre for Sustainable Aquaculture (NaCSA) among others which have played important role in value chain development of this sector.

A significant portion of India's aquaculture sector is dominated by small and medium-scale farmers, many of whom lack direct access to high-value markets. Particularly the carp value-chain comprising 72 percent of aquaculture is fragmented, multi-tiered, and often inefficient, leading to price distortions and income disparities among stakeholders. Farmers face many challenges in aquaculture practice. Access to finance, technical know-how, access to markets, price information asymmetry, storage infrastructure, risk in production system[3], lack of processing units, etc. are some of the factors restricting its take-up. For aquaculture to scale up, the value chains need to be regionally spread and diversified across species. The central government has taken a right step in this direction by announcing the plan for developing 17 dedicated fisheries clusters across multiple states ensuring some regional specialization according to the aqua-climatic zones for various species. Further, sustainable and cooperative business models need to be fostered that are also inclusive taking into account India’s small average agricultural operational holding size.

In the case of shrimps, the value chain is regionally concentrated in the eastern coastal belt specifically in Andhra Pradesh and characterised by hub and spoke model. The natural comparative advantage of access to sea and brackish waters along with a history of aquaculture entrepreneurship in the Godavari and Krishna deltas provide Andhra Pradesh an edge over other states. The state has now graduated to industrial aquaculture with firms which have vertically integrated the value chains from seed hatcheries up to export zones, specifically for shrimps. This kind of integration brings costs down and solidifies traceability, a key for competing in export markets. India’s shrimps have remained highly competitive over time in the export market. The unit value of exports (UVE) and global prices have stayed in the range of USD 6-9 per kg from 1995-96 to 2023-24 with the exception of 2013-15 when UVE was above USD 10 per kg. However, changes in trade policies impact the aquaculture export and the competitiveness of India. The effective duty on Indian shrimp exports to the United States is set to increase from 7.7 percent to 17.7 percent, including a countervailing

[3] Authors’ field visits and stakeholder consultations indicate that shrimp farmers typically face losses in at least one out of every four production cycles, primarily due to disease outbreaks, input cost volatility, or market fluctuations. This inherent risk makes access to affordable finance critical, yet remains a major constraint for small and medium-scale farmers.

duty (CVD) of 5.8 percent and anti-dumping duty of 1.8 percent[4]. This increase may affect the competitiveness of Indian shrimp in its largest export market, comprising 40 percent of India's shrimp export (MPEDA, 2025). India needs to diversify its shrimp export destinations to reduce overdependence on specific markets. Currently, only 17 percent of the produce is exported to China and 13 percent to EU countries, both of which have growing demand and offer significant potential for expansion. Strengthening exports to these regions can enhance market stability and boost export earnings.

5. Role of fisheries in augmenting farmers' income

Aquaculture—particularly at small and medium scales—has demonstrated a stronger impact on rural income generation and job creation than traditional crop farming. Studies across developing countries show that fish farming is not just an alternative but a viable pathway to rural economic transformation. Research by Ahmed, Belton, and Murshed-e-Jahan (2015) highlights how aquaculture contributes directly and indirectly to rural growth, offering both employment and market opportunities. Practices like polyculture—raising multiple fish species in a single pond—have proven to be both resource-efficient and economically rewarding, yielding high cost-benefit ratios (Purcell et al., 2006). In the Indian context, where marginal and smallholder farmers dominate the agricultural landscape, these insights make a compelling case for integrating aquaculture more centrally into rural development policy.

If we assess annual profitability of crop agriculture vis-à-vis. aquaculture the data clearly demonstrates that aquaculture—whether carp or shrimp farming—offers significantly higher returns per hectare per cycle compared to traditional crop cultivation. In Haryana, carp-based aquaculture yields Rs. 3.50 lakh/ha, compared to just Rs. 1.67 lakh/ha from paddy and wheat, while shrimp farming pushes income further to Rs. 6.57 lakh/ha, four times the combined returns from wheat and paddy (**Figure 4**). Similar patterns are observed in Odisha, Telangana, West Bengal, where aquaculture returns range between Rs. 2.36 lakh/ha. to Rs. 4.17 lakh/ha. per year, higher than the crop income. Andhra Pradesh, leveraging shrimp farming, records the highest profitability at Rs. 7.82 lakh/crop/ha. which extends to Rs. 14.5 lakh/ha/year with two cycles[5] underscoring the economic incentives of transitioning from paddy to high-value aquaculture.

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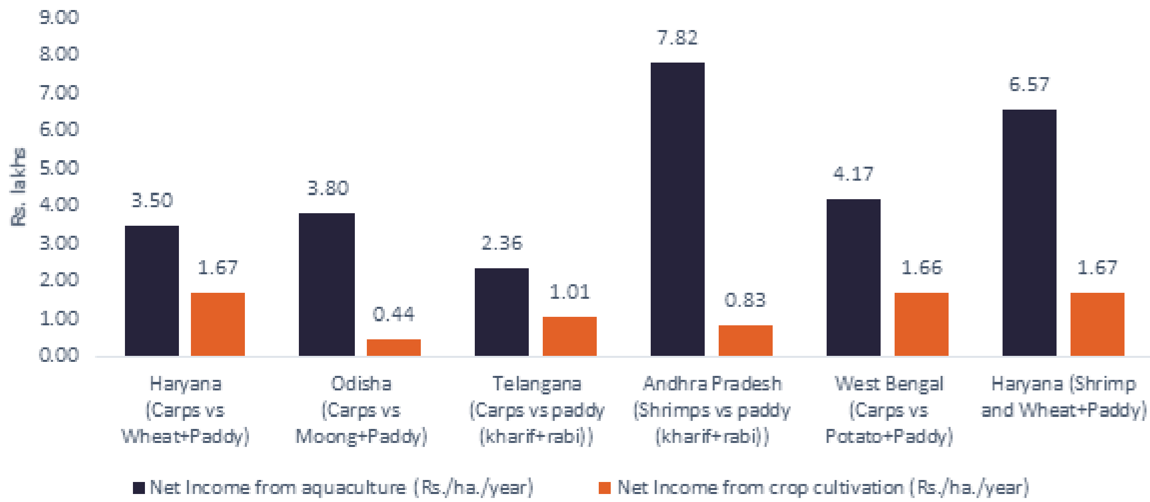
[4] The U.S. imposed an anti-dumping duty on Indian frozen shrimp in 2004, following the International Trade Commission's finding that imports were harming the US shrimp industry. This duty has undergone periodic reviews and currently stands at 1.8 percent. In October 2024, a CVD of 5.8 percent was added by the US on grounds of export subsidies by India, which is 3.57 percent for Ecuador (ITA, 2025). Unlike India, Ecuador does not import SPF brood stock giving them advantage in export market.

[5] The farmers in the state generally practice two cycles with stocking at February-March and stocking at September-October with a culture period 90-120 days (Srinivas and Venkatrayulu, 2019)

Figure 4: Profitability in crop agriculture vis-à-vis aquaculture Rs./ha./year



Source: Various studies have been used for costs of fish culture. Santosh et al. (2024) for carps in Haryana; Das et al. (2024) (surveyed 2021-22) for carps in Odisha; Sindhu et al. (2023) (surveyed 2019-20) for Telangana; Dhande et al. (2024) (surveyed 2021-22) for shrimps in Andhra Pradesh; Beg et al. (2024) (2022-23) for West Bengal; data for shrimps in Haryana has been collected from authors' own field visit to Sirsa district in April 2025 (for 2022-23) and verified through key stakeholders. For crops, cost of cultivation data from Directorate of Economics and Statistics, MoAFW, GoI (latest year) has been used.

Note: 1. Data from the above-mentioned studies has been used to calculate paid-out A2 cost (CACP methodology) for consistency in comparisons across states and crops, some assumptions were taken. These are: (i) Interest of working capital assumed at 6 percent across studies, (ii) Depreciation, if not explicitly mentioned, has been calculated through a straight-line approach, (iii) Input subsidy to the farmer has been assumed at 40 percent of the total variable costs as per PMMSY guidelines. 2. One cycle of fish cultivation is compared with state-specific dominant double crop combination over one crop year. For Andhra Pradesh, we have also calculated net returns with two shrimp cycles in one year which is Rs. 14.5 lakhs/year/ha.

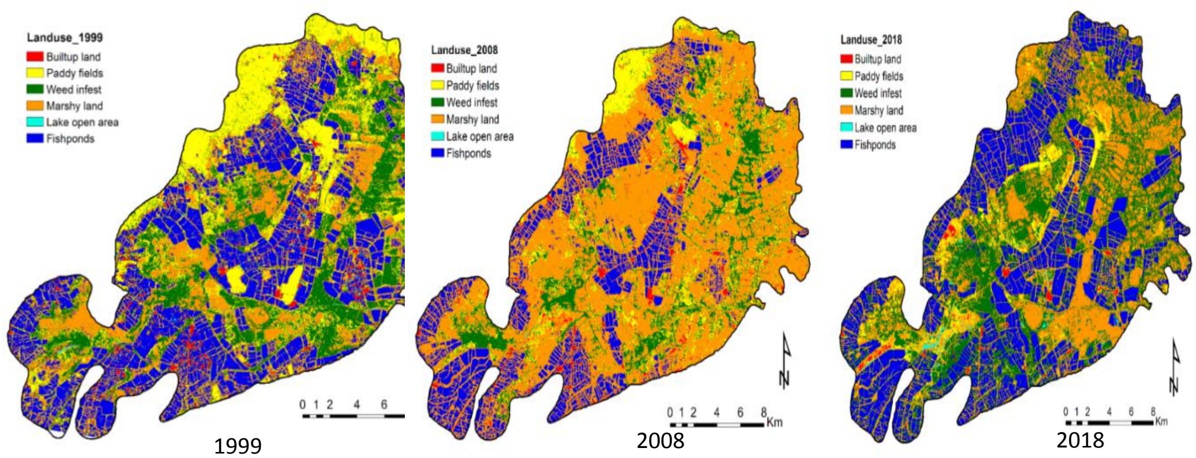
These trends make a compelling case for scaling up aquaculture as a key strategy for enhancing farm incomes and rural livelihoods. Despite schemes like PMMSY, many regions still lack adequate extension services, hatchery access, or training in best practices, which restricts adoption among traditional crop farmers. Profitability in aquaculture varies across states based on biological cycle of the crops, types of aquaculture crop, cropping practices, and access to working capital. For instance, the capital cost of shrimp farming in Haryana is estimated at Rs. 15–16 lakh/ha., of which about 40 percent is subsidized under PMMSY. Many districts in Haryana, particularly Sirsa, and parts of Punjab like Mansa and Fazilka are witnessing a rapid rise in shrimp cultivation, driven by the adversity of salinity-affected soils negatively affecting crop productivity and availability of saline groundwater which is otherwise unsuitable for traditional crops. Salinity affects paddy cultivation adversely, but shrimp cultivation in such places can convert adversity into an opportunity for income augmentation. These trends make a strong case for promoting aquaculture as a strategic pathway for increasing farm incomes, provided that access to finance, risk mitigation, and infrastructure support are simultaneously strengthened.

6. Environmental sustainability of aquaculture

As India increases its shift toward aquaculture to boost rural incomes, environmental sustainability must also be central to the conversation. According to the Blue Food Assessment (Gephart et al., 2021), fish farming emits only 5.1 kg CO_2 equivalent per kg of edible fish, compared to 8.4 kg for poultry, 12.2 kg for pork, and 39 kg for beef. Even within Indian systems, carp aquaculture in ponds generates just 3.1 tonnes of CO_2 equivalent per hectare annually—substantially lower than emissions from rice cultivation, which can exceed 5 tonnes per hectare (Robb et al., 2017; Gulati & Singh, 2023). Yet, poorly managed intensification—through nutrient loading, antibiotic misuse, or saline water seepage—can impact the environmental sustainability.

For instance, in Andhra Pradesh's Kolleru Lake region, where the rapid expansion of shrimp farming—driven by higher profitability—led to saline water seepage into adjacent agricultural fields, rendering soil unsuitable for crop cultivation. Satellite analysis by Rao et al. (2004) found that by 2001, 42 percent of Kolleru Lake's 245 km² area had been converted to aquaculture, while only 8.5 percent remained under agriculture. Alongside effluent discharge and unchecked encroachments, these practices triggered ecosystem degradation, prompting judicial intervention and a rollback of shrimp ponds. However, the high economic incentives have led to the resurgence of saline water aquaculture in the region (**Figure 5**). As the GoI scales up investments under schemes like the PMMSY, ecological safeguards must be institutionalized. This includes enforcing water treatment standards, zoning aquaculture activity, aquifer mapping, monitoring salinity impacts, and integrating environmental assessment into subsidy-linked production incentives.

Figure 5: Land-use map of Kolleru Lake Wetland (1999, 2008 and 2018)



Source: Kolli et al. (2020)

Note: Blue area is fish ponds

7. Policy Implications - Towards a Resilient and Inclusive Aquaculture Economy

i. Diversifying from Traditional Cultivation to High-Value Aquaculture

Aquaculture, particularly carp and shrimp farming, offers significantly higher profitability compared to traditional crop cultivation, making it a strong incentive case for diversification. Based on our secondary data-based case study analysis and field visits, we estimate that the net returns from aquaculture range from Rs. 2.36 lakh/ha. to Rs. 7.82 lakh/ha. far surpassing the paddy-wheat cropping systems across states. However, the major barriers of diversification are access to working capital, risk averse strategy of farmers, and access to markets. Carp culture is less capital intensive compared to shrimp farming, scaling it up through integrated farming systems such as rice–fish and makhana–air-breathing fish cultivation can increase profitability for smallholders in India. Aquaponics is also a key way for diversification which is an integrated farming system that combines fish farming with hydroponic vegetable cultivation, where nutrient-rich fish waste supports plant growth, and the plants, in turn, help purify the water.

ii. Cooperative and FFPO models expansion

As our study shows the GoI schemes of Blue Revolution and PMMSY have significantly boosted the growth of the sector. Working capital access via adapted Kisan Credit Card (KCC) models, and group lending through Fish Farmer Producer Organizations (FFPOs) can ease the financial entry barriers particularly for small farmers. Digitisation of community ponds and unified land and water lease policy can increase access to resource particularly for small farmers. Recognizing the success of the NDDB-led dairy cooperative model, the GoI is now seeking to replicate similar frameworks in the fisheries and aquaculture sectors, through expansion of Primary Agriculture Cooperative Credit Societies (PACs). Currently, there are 25,660 Fisheries Cooperatives operating across India. Notably, Andhra Pradesh and Telangana together account for 27 percent of these cooperatives. The cooperative network needs to be expanded and functioning for facilitating input access, credit support, and market linkages for the aquaculture development across states.

iii. Technological Innovations for Sustainable Intensification

As inland fisheries now account for over 75 percent of India's total fish output, the transition must focus on ecological sustainability of farming practices while improving technical efficiency. Promoting farming practices like polyculture, aquaponics, and techniques like poly-lined shrimp ponds, application of biochar in pond preparation through targeted extension and financial support will help balance productivity with environmental sustainability. Climate-smart technologies such as Biofloc and Recirculating Aquaculture Systems (RAS) can improve water-use efficiency and reduce nutrient loading. At the same time, digital innovations like Narrow Band IoT (NB-IoT) in pond systems and can optimize feed usage, enable real-time water quality monitoring, and reduce operational costs. The integration of aquavoltaics—floating solar panels on aquaculture ponds—offers significant potential to reduce electricity costs, which constitute a major share of operational expenses in fish farming.

iv. Investment in Value-chain Infrastructure and Export Boost

Expanding investment across the fisheries value chain is essential to replicate successful models like Andhra Pradesh's integrated aquaculture system, which links hatcheries, feed suppliers, and processing facilities to support large-scale, high-quality production. The GoI has taken steps to address these needs through schemes such as PMMSY (FY20-FY25), extended through FY26, which supports infrastructure like ponds, hatcheries, and high-density systems (RAS, Biofloc, cage culture). Additionally, the newly launched PM-MKSSY (FY23-FY27) allocates an outlay of Rs. 6,000 crores to support fisheries-based microenterprises through performance-based grants, and enterprise development. The 17 designated clusters developed for aquaculture and inland fisheries under PMMSY, can be developed as export hubs through expansion of processing centres, and integrated hub-spoke value-chain like Andhra Pradesh. In addition to frozen shrimp, promoting high-potential species such as tilapia, pangasius and carp, supported by targeted investments in processing infrastructure, can enhance value chain efficiency, improve price realization and significantly augment farmer incomes.

In conclusion, it is clear that fishery sector growth over the last decade or so has been very promising, and there is still lot of potential to tap. Within fishery sector, shrimp cultivation has been most remunerative. Coastal areas of Andhra Pradesh have shown a transformative path towards prosperity of peasants, as also production of more nutritious food. The key challenge lies in scaling aquaculture sustainably to other states where significant untapped potential exists, while ensuring environmental balance, institutional support, and market connectivity.

For aquaculture to scale up sustainably, value chains must be regionally distributed, diversified across species, and supported by varied export destinations to enhance resilience and long-term growth. Access to lucrative markets like the US, EU, China, Japan, UAE can help build efficient value chains in India that are compliant with food safety, Best Aquaculture Practices (BAPs) as well as environmental standards. Ensuring affordable finance for small-scale fish ponds through fishery cooperatives and FPOs can further enhance inclusivity and broaden the benefits of sectoral growth.

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Annexure

Annex 1: Drivers of growth of fisheries sector in India 1990-2023

ARDL (1,0,0,0,0) regression				
Sample: 1991-2022				
Number of observations = 32				
R-squared = 0.62				
Adj R-squared = 0.56				
Root MSE = 0.02				
First difference of ln GVA	Coefficient	Std. Err.	t	p value
ADJ				
ln_GVA				
Lag 1	-0.34***	0.07	-4.98	0.000
LR				
ln_GDP per capita	0.33**	0.15	2.08	0.047
ln_Fish seed production	0.14***	0.03	4.34	0.000
BR and PMMSY dummy	0.31***	0.05	5.72	0.000
ln_Export	0.28***	0.09	2.85	0.008
SR				
Constant	1.38***	0.31	4.42	0.000
Pesaran, Shin and Smith bound test significant at 1 percent level				
Breusch-Godfrey LM test for autocorrelation p value = 0.89				
Portmanteau test for white noise statistic = 0.0168 p value = 0.89				

*Note: *** 1 percent significance level, **5 percent significance level*

BR and PMMSY dummy variable is for years 2015 to 2023

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