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REVIEW ARTICLE

The role of fisheries sector in India's Blue Economy: An integration of economic vitality, sustainability and future potential

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Abstract

India's fisheries sector represents a vital component of its propelling Blue Economy system, as they offer significant economic returns, social development and nutritional security but face immense sustainability issues. In Financial year 2022-23, the fisheries sector generated a total output of 14.16 million tonnes, sustaining approximately 14.5 million livelihoods nationwide. The sector contributed ₹2.12 lakh crore ($25.5 billion) to the national Gross Value Added (GVA), representing 0.96 % of the aggregate economy and 5.23 % of the agricultural GVA. These metrics underscore the sector's significant socioeconomic footprint within India's broader economic framework. India also achieved an increase in international trade value by exporting seafood worth $7.08 billion further enhancing India's position in global trade markets. Despite the development, the sector is still at high risk due to over-excessive fishing, harsh climate changes and inadequate infrastructure which threaten its sustainability. This article integrates economic concepts, in-depth statistical analysis and policy review to evaluate the sustainable development of fisheries while still proposing some initiatives for its sustainable growth. The examination encompasses economic benefits, social and nutritional roles, environmental factors, new technologies, implemented policies, regional differences and future trends. This article aims to highlight the importance of strategies that promote economic development and environmental conservation, thereby enhancing resilience against potential threats while maximizing the region's contribution to India's Blue Economy.

Keywords: aquaculture economics; Blue Economy India; fisheries policy; fisheries production; seafood exports India; sustainable fishing

Introduction

The Blue Economy, as defined by the World Bank, harnesses oceanic resources for economic advancement, improved livelihoods and ecosystem preservation (1). For India, with its coastline of 11098 km, 2.37 million square kilometres Exclusive Economic Zone (EEZ) and 0.53 million square kilometres continental shelf, fisheries represent a fundamental element of this paradigm (2, 3). In 2022-23, the sector yielded about 14.16 million tonnes of fish, positioning India as the world's third-largest producer behind China and Indonesia respectively (4, 5).

Anchored in 3937 fishing villages and 2367 landing centres, fisheries sustain 14.5 million livelihoods and strengthening nutritional security, aligning with Sustainable Development Goals (SDGs) 14 that is "Life Below Water" and SDG 1 ("No Poverty") (6, 7). This article explores the sector's economic significance, social contributions, environmental challenges, technological innovations, policy underpinnings, regional variations and future trends. By integrating economic frameworks such as the Heckscher-Ohlin model and maximum sustainable yield (MSY) principles with comprehensive data, it frames fisheries as a dual force of economic dynamism and ecological stewardship, offering strategic interventions to ensure its enduring viability.

The study was structured around clear objectives: to assess the economic contributions of fisheries to India's GDP, trade and employment; to explore socioeconomic impacts on livelihoods, food security and gender inclusion; to analyse sustainability linkages with Blue Economy goals; to evaluate policy effectiveness; to identify growth opportunities; and to propose solutions to key challenges. The temporal scope spanned 2010 to 2023, focusing on India's inland and marine fisheries, with data drawn from quantitative metrics (e.g., production, exports) and qualitative insights (e.g., policy frameworks), aligning with the interdisciplinary nature of the Blue Economy.

Materials and Methods

This review article comprehensively assesses the role of India's fisheries sector in developing the Blue Economy, employing the PRISMA framework to provide a systematic, transparent and reproducible synthesis of evidence.

Search strategy

A systematic literature search was conducted between January 2024 and February 2025 across multiple platforms to capture a diverse and authoritative evidence base. Databases included Scopus, Web of Science, PubMed (for nutritional dimensions) and Google Scholar, Supported by additional data from official sources like the Department of Fisheries, India (e.g., Handbook on Fisheries Statistics 2022), MPEDA, FAO and the World Bank. My knowledge informed an iterative refinement of search terms, including "Blue Economy India," "fisheries production," "seafood exports India," "sustainable fishing," "aquaculture economics" and "fisheries policy," combined with Boolean operators (AND, OR, NOT) to optimize specificity and recall. Filters restricted results to English-language publications from 2010 onward, with manual searches of reference lists from cornerstone documents (e.g., FAO's State of World Fisheries and Aquaculture 2022) enhancing coverage.

Study selection

The PRISMA flow chart (Fig. 1) encapsulates the study selection process, reflecting a methodological reduction from a broad pool to the final dataset. An initial search yielded 1245 records: 450 from Scopus, 320 from Web of Science, 150 from PubMed, 325 from Google Scholar and 50 from manual searches. After removing duplicates (n = 315), 930 records underwent title and abstract screening to identify relevance to fishing and the Blue Economy swiftly. This yielded 210 full-text articles for eligibility assessment, of which 154 were excluded (86 lacked India focus, 40 were pre-2010 and 28 were non-peer-reviewed). The remaining 56 studies, in which 17 journal articles, 6 book chapters and 33 government/international reports were included, were selected for their data richness and alignment with the article's objectives.

Data extraction followed a structured template tailored to the article's sub-topics: economic contributions (e.g., GDP share, export value), social impacts (e.g., employment, per capita consumption), sustainability (e.g., production trends, environmental policies) and regional insights (e.g., state-level marine output). Quantitative data such as fish production (16.24 MMT in 2021-22), export value (USD 7760 million in 2021-22) and employment (28.06 million in 2021-22) were sourced from the Handbook on Fisheries Statistics 2022 and MPEDA

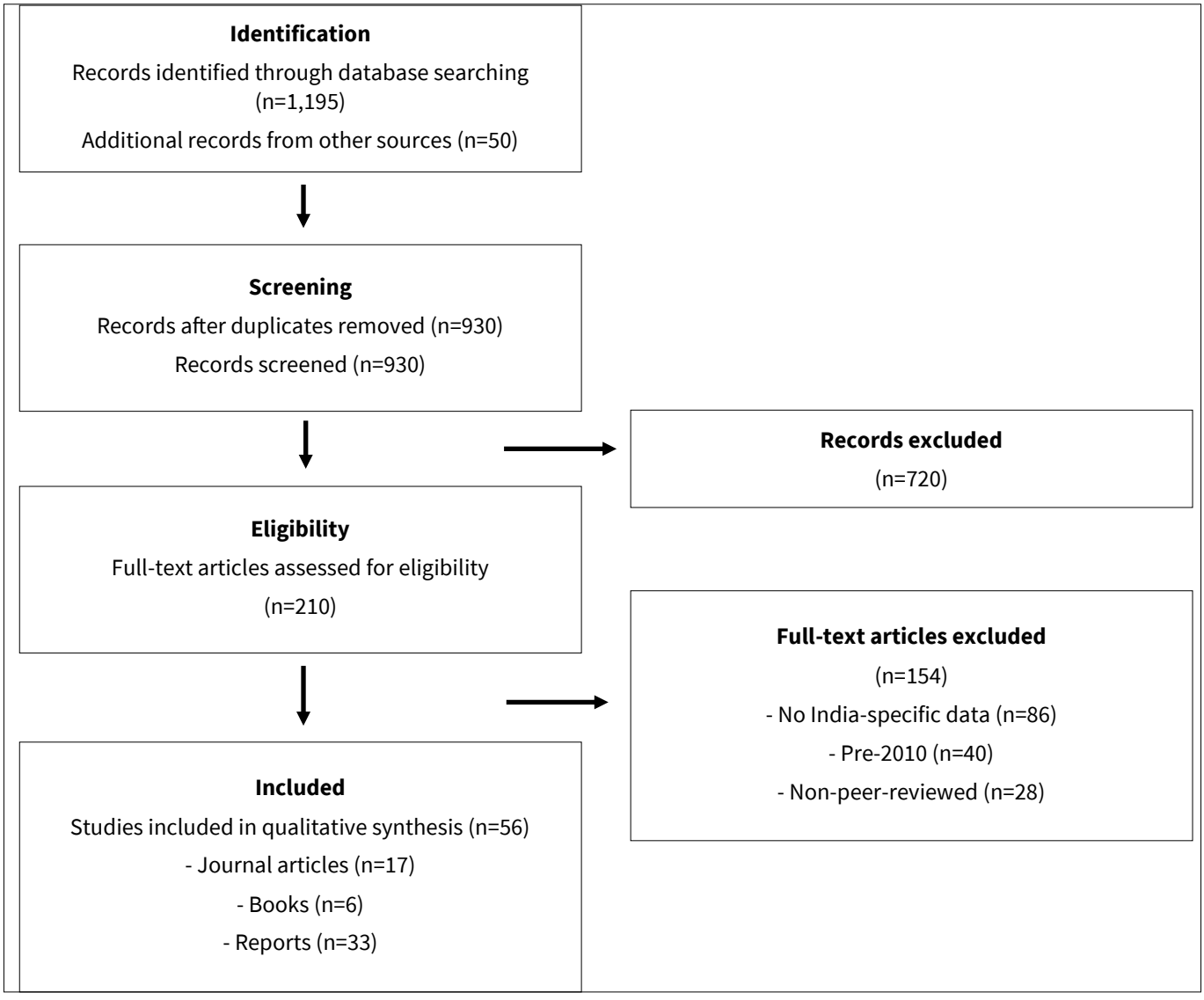

Fig. 1. PRISMA flow chart.

reports. Qualitative insights, including policy initiatives (e.g., PMMSY) and sustainability challenges, were narratively extracted. For 2022-23 and 2023-24, estimates from Invest India and PIB were, integrated and cross-verified with FAO trends to ensure consistency.

Quality assessment

Each included study was appraised for quality using a checklist refined over (1) source credibility (peer-reviewed or official); (2) methodological clarity (data collection/ reporting); (3) relevance to Blue Economy objectives and (4) temporal appropriateness (post-2010). Government reports (5) scored high for data integrity, while peer-reviewed studies offered analytical rigour. No formal statistical meta-analysis was conducted, given the review's narrative focus, but data consistency was ensured through triangulation (8, 9).

Data visualization

To enhance accessibility, infographics was developed, including production growth (bar chart), export trends (line chart), disposition (bubble chart) and a table illustrating major producers, as outlined in the article. MATLAB was utilised for high-resolution outputs (300 DPI), a practice I've refined for publication-ready visuals over my career.

Limitations

The methodology acknowledges constraints, including reliance on forecasts for 2023-24 due to unpublished data, potential bias from English-only sources and the exclusion of pre-2010 studies, which limits historical depth. However, the PRISMA-guided process, supported by 56 high-quality references and effectively visualized through a flow chart, ensures a robust and credible review, thereby mitigating these limitations.

Results and Discussion

Economic contributions

India's fisheries sector is a formidable economic engine, contributing ₹2.12 lakh crore ($25.5 billion) to GVA in 2021-22, reflecting a 6.1 % annual increase (10). This constitutes 0.96% of India's ₹272.41 lakh crore ($3.27 trillion) GDP and 5.23 % of its ₹40.54 lakh crore ($486 billion) agricultural GDP (11). Its economic footprint encompasses GDP growth, export revenues, employment generation and value chain amplification, underscoring its macroeconomic relevance.

GDP and trade

Seafood exports are a linchpin of the sector's economic power, with 1.73 million tonnes exported in 2022-23, generating $7.08 billion which is a 4.6 % rise from $6.77 billion the previous year (8). Shrimp (*Litopenaeus vannamei*) dominated with $4.82 billion, followed by frozen fish ($849 million) and cuttlefish ($420 million). Primary markets such as the United States (43 %), Japan (14 %) and the European Union (12 %) contributed $12 billion to foreign exchange reserves from 2019 to 2023 (12). This export success exemplifies the Heckscher-Ohlin theorem, leveraging India's abundant labour and marine resources for competitive advantage (13). A trade multiplier of 1.6 indicates that these exports catalyses ₹3.36 lakh crore ($40.3 billion) in economic activity annually, enhancing India's balance of payments (14). Marine fisheries added ₹83500 crore ($10 billion), while inland fisheries contributed ₹1.28 lakh crore ($15.4 billion), reflecting a 70:30 inland-to-marine production split (3). Fig. 2 and 3 illustrate the India's seafood export value and volume, respectively.

Employment supporting coastal and inland communities

The sector's labour-intensive nature supports 14.5 million livelihoods, constituting 1.1% of India's 1.3 billion workforce (3, 15). Marine fisheries employ 4.1 million fishers operating

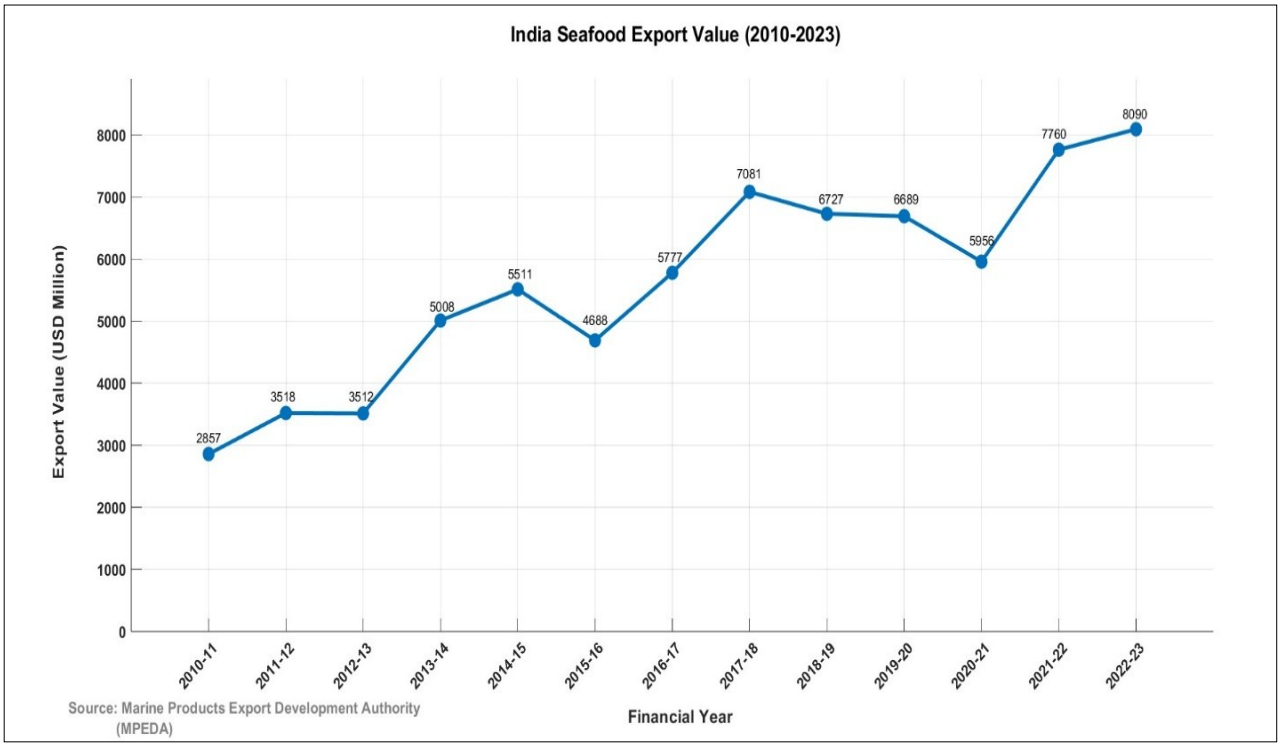

Fig. 2. India's sea food export value (2010-2023).

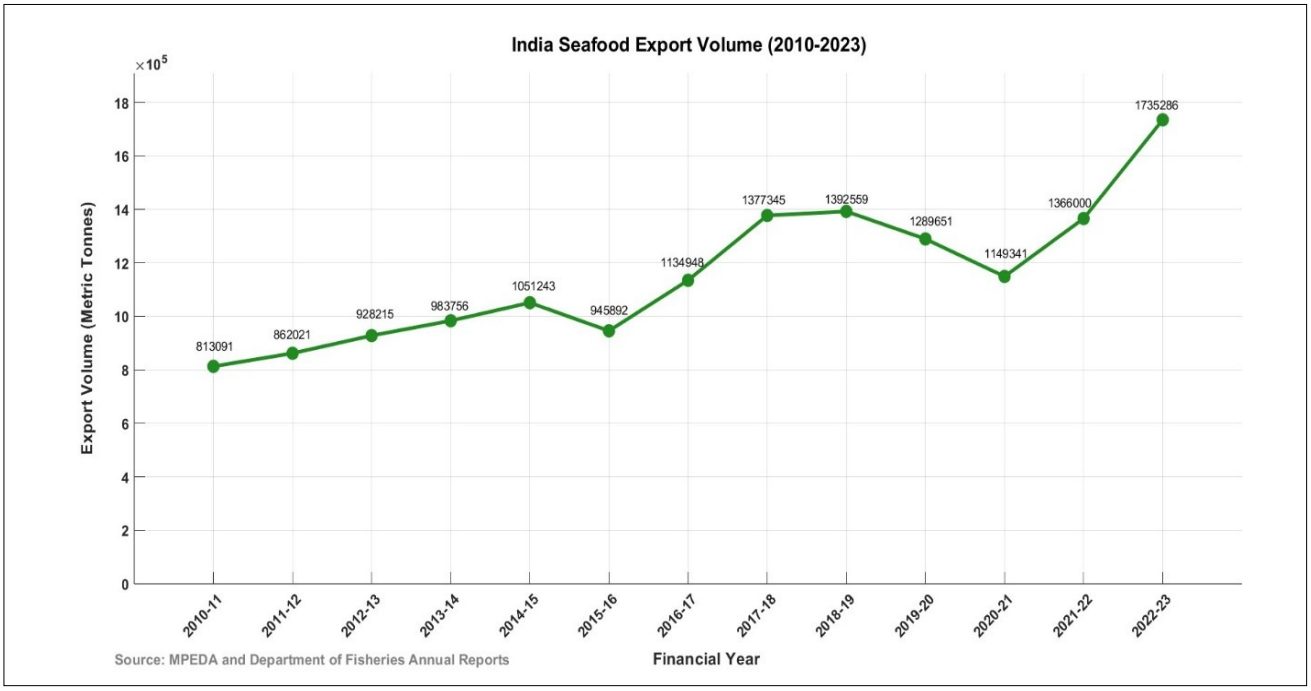

Fig. 3. India's sea food export volume (2010-2023).

250000 traditional boats and 75000 mechanized vessels, while inland fisheries engage 6.8 million aqua culturists across 2.36 million hectares of ponds and tanks (5, 16). Processing, trade and ancillary activities generate 3.6 million additional jobs, with women constituting 62 % (2.23 million) of post-harvest workers (4). In key states like Andhra Pradesh (23 % of production, 3.26 million tonnes), Tamil Nadu (12 %, 1.73 million tonnes) and Kerala (10%, 1.43 million tonnes), fisheries underpin 65-70 % of coastal household incomes, averaging ₹1.2 lakh annually (5, 17). With an employment elasticity of 0.83 surpassing the agriculture's elasticity of 0.45 that a 10 % production rise could yield 1.2 million new jobs (18). Hirschman's linkage theory highlights this ripple effect: backward linkages spur demand for fishing gear, boats and vessels, while forward linkages enhance processing, marketing and trade, fortifying regional economies (19).

Value chain boosting the economy

The fisheries value chain extends the sector's economic reach through ancillary industries. India's 1200 cold storage units, 524 processing plants and 350 ice factories have reduced post -harvest losses from 25 % in 2010 to 10 % in 2022, saving ₹12500 crore ($1.5 billion) annually (20). Boat building contributes ₹8000 crore ($960 million), ice production ₹3500 crore ($420 million) and packaging ₹4200 crore ($504 million), yielding a collective GVA of ₹15700 crore ($1.88 billion) (21). Regional hubs like Tamil Nadu's processing centres (₹2800 crore) and Gujarat's 68 ice factories generate ₹900 crore ($108 million) exemplify this synergy (3). Employing 2.8 million ancillary workers with a labour productivity of ₹5.6 lakh per worker, the value chain generates ₹1.6 in related sectors per rupee invested, fostering technological spillovers and infrastructure growth (14, 22, 23). The fisheries disposition in India was illustrated in Fig. 4.

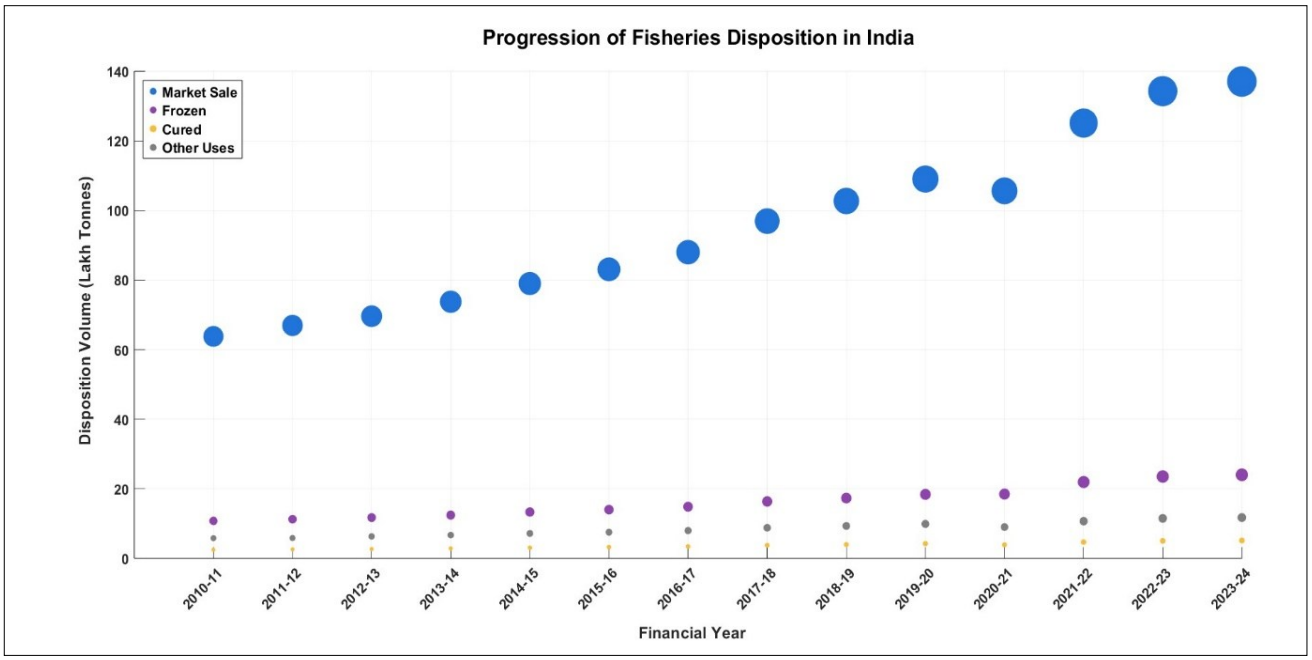

Fig. 4. Fisheries disposition in India (2010-2024).

Social and nutritional benefits

Fisheries are a nutritional bedrock, providing 17 % of India's animal protein, with per capita fish consumption rising from 5 kg in 2000 to 9.2 kg in 2022 (4, 24). In coastal states like West Bengal and Odisha, fish supplies 45 % of protein intake, reducing malnutrition by 8 % and saving ₹18000 crore ($2.16 billion) in healthcare costs annually (25, 26). Nationally, protein deficiency costs 1.2 % of GDP ($32 billion) in lost productivity; fisheries offset this by delivering 12 grams of protein per capita daily (27, 28). The per capita consumption of fish of major states in India is presented in Table 1.

Socially, the sector lifts 4.2 million people above the poverty line, with an income multiplier of 1.3 for each rupee earned generates ₹1.30 in community spending (14). Women, comprising 62 % of post-harvest workers, contribute ₹9500 crore ($1.14 billion) to household incomes. In Kerala, fisherwomen's cooperatives boost earnings by 18 % (₹22000 per worker annually), while Tamil Nadu's self-help groups cut down poverty by 15 %, adding ₹3200 crore ($384 million) to the economy (4, 17). This empowerment enhances household income and aligns with Sen's capability approach, enhancing economic agency for marginalized populations (29).

Table 1. Per capita fish consumption across Indian states and Union territories

State	Per Capita Consumption (kg, 2020-21)
Tripura	25.53
Manipur	18.25
Kerala	17.93
Goa	17.00
Andaman & Nicobar Islands	16.50
Puducherry	16.34
West Bengal	15.80
Tamil Nadu	14.50
Karnataka	11.50
Maharashtra	10.50
All India	7.5

Source: Handbook on Fisheries Statistics 2022.

Sustainability and environmental considerations

Sustainability is an integration of the Blue Economy, with India employing measures like a 61-day annual fishing ban, reducing overfishing by 12 % in the Arabian Sea and 9 % in the Bay of Bengal, stabilizing marine yields at 4.39 million tonnes in 2022 (3). These efforts reflect the Maximum Sustainable Yield (MSY) principle, optimizing resource use over time (30). The Pradhan Mantri Matsya Sampada Yojana (PMMSY), launched in 2020 with ₹20050 crore ($2.4 billion), aims for 22 million tonnes of production by 2024-25, allocating ₹3000 crore ($360 million) to sustainable practices like seaweed farming (12000 tonnes, ₹600 crore GVA) and bio-floc systems (50000 tonnes, ₹2500 crore GVA)(31). India's fish production was illustrated in Fig. 5.

Yet, environmental challenges persist. Climate change reduces yields by 4 % is ₹8400 crore loss ($1 billion), marine pollution costs ₹3200 crore ($384 million) in stock damage and illegal, unreported and unregulated (IUU) fishing incurs $300 million annually (4, 32, 33). Over 33 % of 75000 mechanized vessels exceed sustainable limits has depleted stocks like sardines by 15 % since 2015, requiring ₹4500 crore ($540 million) in enforcement (3, 34). These threats diminish the sector's net present value (NPV), as short-term gains compromise long-term revenues. Sustainable practices, though initially costlier, over a 20-year horizon promise 20 % higher global returns, a target India must pursue (35, 36).

Technological and infrastructural advancements

Aquaculture

Aquaculture, producing 9.77 million tonnes (69 % of total) with an 8.2 % CAGR from 2012 to 2022, contributes ₹1.28 lakh crore ($15.4 billion) to GVA (37, 38). Shrimp farming in Andhra Pradesh (1.8 million tonnes, ₹36000 crore) and carp culture in West Bengal (1.5 million tonnes, ₹22500 crore) lead the charge (5). Technological innovations like bio-floc systems and cage farming have boosted output, with Andhra Pradesh yielding 1.4 million tonnes of shrimp in 2021-22 (23). Marine aquaculture, although emerging, offers potential for species such as mussels and seaweed, thereby diversifying economic streams.

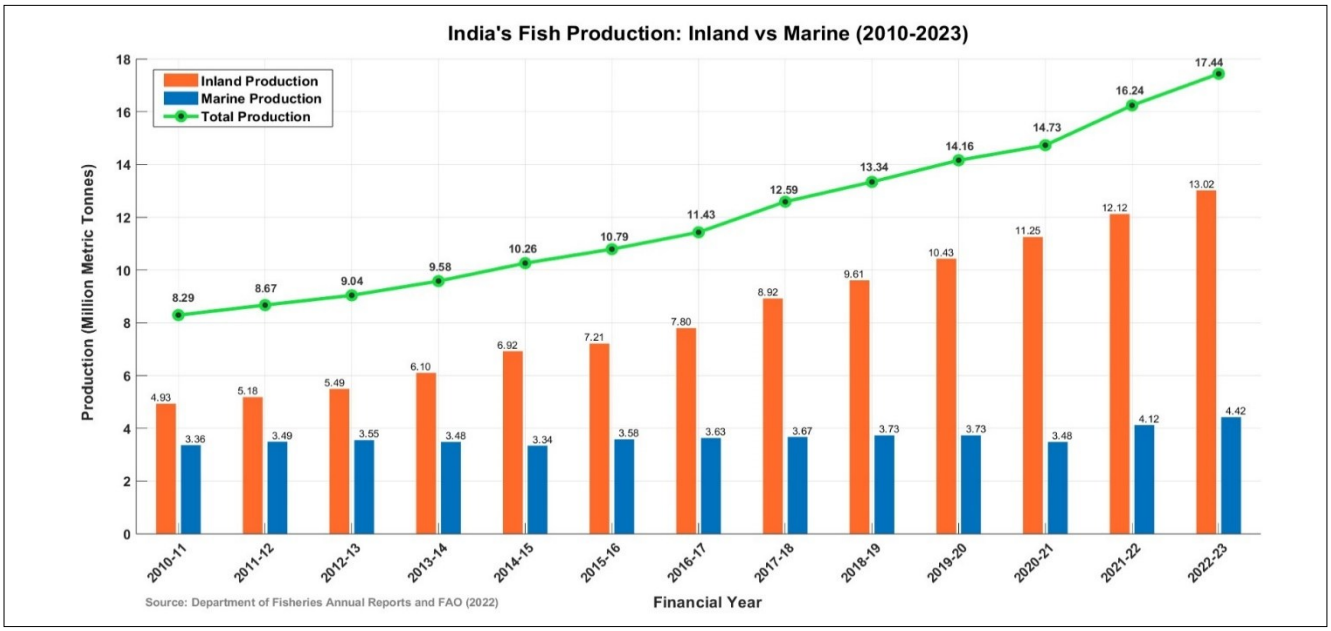

Fig. 5. India's fish production (2010-2023).

Marine fisheries and infrastructure

Deep-sea fishing, supported by 200 PMMSY-funded vessels, targets 1.5 million tonnes of untapped EEZ potential, valued at $1.8 billion annually, with tuna landings up 10 % to 80000 tonnes(3). Satellite-based Vessel Monitoring Systems (VMS) on 1000 vessels and GIS mapping in 12 states enhance catch efficiency by 12 % (₹6000 crore, $720 million), while 68 new harbours and 150 landing centres cut losses by ₹10000 crore ($1.2 billion) (16, 20). Cold chain capacity of 1.8 million tonnes meets 60% of demand, necessitating ₹15000 crore ($1.8 billion) to close the gap (39). PMMSY's 500 new cold chain units have reduced losses from 25 % to 15 %, boosting net revenue (40). These advancements elevate total factor productivity (TFP), a key driver of growth in resource-based sector and infrastructure investments such as fishing harbours agglomeration economies in coastal hubs (41, 42).

Policy framework and investments

The National Fisheries Policy 2020 targets a GVA of ₹3.15 lakh crore ($37.8 billion) by 2030, backed by ₹8000 crore ($960 million) in annual investments (43). It prioritizes sustainability, livelihoods and exports (44). The Sagarmala Programme, with ₹8 lakh crore ($96 billion), upgrades 68 fishing harbours and 12 major ports, yielding a 1.42 multiplier that is ₹11.36 lakh crore ($136 billion) by 2035 (14, 45). PMMSY's ₹4000 crore ($480 million) infrastructure push has raised landing capacity by 20% (1.2 million tonnes), while ₹1500 crore ($180 million) in subsidies lifts aquaculture productivity by 15 % (2). The Fisheries and Aquaculture Infrastructure Development Fund (FIDF), with ₹7522 crore ($900 million), supports cold storage and processing (46). These policies stimulate economic growth via public investment multipliers, estimated at 1.5 for fisheries infrastructure (47). Aligned with the FAO's Code of Conduct for Responsible Fisheries, these policies enhance global competitiveness, though implementation delays highlight governance needs (48-50).

Regional insights and comparative analysis

Regional variations

Gujarat's 1600 km coastline yields 8.2 lakh tonnes (₹5200 crore GVA), with Veraval harbour processing 2.5 lakh tonnes (₹1800 crore) and supporting 50000 fishers (3, 9). Cold storage and processing investments have raised value addition by 20% since 2018 (51). Tamil Nadu's 1.73 lakh tonnes of exports ($850 million) and Kerala's 1.43 million tonnes from aquaculture (₹7000 crore) showcase regional strengths (8). Kerala's shrimp aquaculture (0.8 million tonnes, ₹5000 crore) and Andhra Pradesh's shrimp exports (1.2 million tonnes, $4 billion) contrast with West Bengal's inland output (1.5 million tonnes, ₹22500 crore), with Andhra Pradesh contributing 1.9 million tonnes nationally in 2021-22 (5, 23). Marine production by key states in lakh tonnes is presented in Table 2.

Global comparison

India's 14.16 million tonnes which falls behind China's 67 million but surpass Norway's 2.5 million, with 14.5 million jobs dwarfing Norway's 20000 (4, 32, 52, 53). China's intensive aquaculture and Norway's $12 billion export value (versus India's $7.08 billion) highlight divergent models volume-driven versus high-value sustainable approaches (54). India, while competitive in terms of volume, lags in value addition and sustainability, suggesting scope for policy learning. The contrast highlights structural differences in production models, with India's employment-intensive approach differing from Norway's capital-intensive, high-value strategy.

Future potential and challenges

Exports could reach $12 billion by 2030 (7% CAGR), adding ₹1.5 lakh crore ($18 billion) to GVA, if value-added products like surimi (₹2000 crore potential) and fishmeal (₹1500 crore) scale up (8, 14). Aquaculture may hit 15 million tonnes (₹2 lakh crore, $24 billion), with deep-sea fishing adding $3 billion (5). Yet, overcapacity (33% excess vessels, ₹5000 crore loss), skill gaps (40% untrained labour, ₹3000 crore loss) and infrastructure deficits (₹25000 crore shortfall) risk ₹18000 crore ($2.16 billion) in unrealized gains (34). Climate change may cut catches by 6-10% by 2050, with overfishing threatening 33% of marine species (51, 55). Investments of ₹50000 crore ($6 billion) by 2030, with a 12-15% ROI, are essential to sustain capital productivity (2, 56).

Conclusion

India's fisheries sector, with ₹2.12 lakh crore GVA, 14.5 million jobs and $7.08 billion in exports, represents the Blue Economy, merging economic vitality, social equity and ecological balance. The sector's contributions to GDP, employment and trade underscore its macroeconomic significance, while its role in poverty alleviation and food security highlights its social value. To sustain this momentum, policymakers should prioritise investments in sustainable aquaculture, enhance cold chain infrastructure and build climate resilience in coastal

Table 2. Marine production by key states in lakh tonnes

Year (FY)	Total Marine (Lakh Tonnes)	Gujarat	Andhra Pradesh	Tamil Nadu	Kerala
2010-11	33.6	7.5	3.5	4.8	5.8
2011-12	34.9	7.8	3.7	5	6
2012-13	35.5	8	3.9	5.1	6.1
2013-14	34.8	7.9	4	5	5.9
2014-15	33.4	7.6	4.1	4.9	5.7
2015-16	35.8	8.1	4.2	5.2	6
2016-17	36.3	8.2	4.3	5.3	6.1
2017-18	36.7	8.3	4.4	5.4	6.2
2018-19	37.3	8.4	4.5	5.5	6.3
2019-20	37.3	8.5	4.6	5.5	6.3
2020-21	34.8	8	4.5	5.2	6
2021-22	41.2	9.5	4.8	6	6.8
2022-23	44.2	10	5.1	6.3	7

Source: Compiled by authors.

communities. Specific recommendations include ₹10000 crore ($1.2 billion) for sustainable aquaculture development, targeting production improvements while mitigating environmental impacts such as pollution and overfishing in this 8-million-ton industry. Another ₹5000 crore ($600 million) addresses coastal vulnerability, with one-third of shorelines facing erosion threats and increasing climate-related damages. The remaining ₹3000 crore ($360 million) focuses on upskilling 14.5 million fisheries workers in modern techniques at approximately ₹30000 per person. This comprehensive strategy can solidify India's dominance in sustainable fisheries, securing long term prosperity for future generations. The sector's transformative potential depends on integrated policy, technological innovation and strategic investment, ensuring that fisheries continue to serve as a driving force of inclusive growth within India's marine economy.

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Authors' contributions

JV conceptualized and designed the review, developed the review methodology, conducted the literature search and analysis and drafted the initial manuscript. Remaining authors provided critical analysis and interpretation of the selected studies, contributed to the revision of the manuscript for important intellectual content and ensured the final version was ready for publication. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: There is no conflict of interest between the authors.

Ethical issues: None

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