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National Report on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in India

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Bay of Bengal Programme Inter-Governmental Organisation
91, St. Mary's Road, Abhiramapuram
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National Report on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in India

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1. Introduction and Context

1.1. Overview of the country's demographic and economic profile (fisheries)

India possesses an extensive and diverse base of marine and freshwater resources that underpin a robust fisheries economy. With the Indian Ocean bordering its southern, eastern, and western coasts, the country commands an exclusive economic zone (EEZ) stretching 11,098.81 km and covering 2.02 million km^2 (FAO, 2020a). India's inland resources encompass an extensive network of rivers, canals, reservoirs, lakes, and floodplain wetlands that together cover more than 5.8% of India's geographical area, forming a globally significant freshwater ecosystem and supporting livelihoods, nutrition, and heritage-based fisheries practices.

The country harbours 1,035 freshwater fish species, accounting for about 3.4% of total global fish species, reflecting India's remarkable aquatic biodiversity. Inland capture fisheries contribute 2.14 million tonnes annually, which equals 21% of total fish production from inland waters, while aquaculture contributes the remaining 79%, highlighting the dominance of culture-based production systems. Among inland resources, rivers contribute 18.31%, reservoirs 20.81%, and floodplain wetlands 26.66% to inland open-water fish production, demonstrating the significant role of enhanced and culture-based fisheries in these systems. Estuaries and lagoons together contribute 16.9%, while natural lakes account for less than 2%, reflecting underutilization due to remote accessibility and ecological constraints (FAO, 2024)[1]. India ranks as the world's fourth-largest capture fisheries producer (marine and inland combined) and the second-largest aquaculture producer (FAO, 2020a[2]).

India contributes about 1.10% to the national Gross Value Added (GVA), with inland fisheries accounting for roughly 72% of total fish output and marine fisheries making up the remaining 28%. The sector sustains livelihoods for nearly 16 million people directly and nearly double that number indirectly across the wider value chain. Fish and fishery products also form a key part of India's trade profile, representing about 2.5% of total exports. Consequently, the fisheries sector serves not only as a source of nutrition and rural employment but as a strategic economic engine with the capacity to drive sustainable growth, social inclusion, and enhanced export competitiveness (Ministry of Food Processing Industries, 2025[3]).

The fisheries profile of India (Table 1[4]) indicates that the sector is distributed across 13 coastal States and UTs, supporting the nation's marine fishing activities through 1,363 landing centres and 3,477 fishing villages, which together form the structural backbone of traditional fishing communities. Notably, traditional fishermen families constitute approximately 92% of all fishermen households, while around 67% of these families fall below the poverty line, highlighting the socio-economic vulnerability within the sector. The total fisherfolk population represented here accounts for those living in coastal areas and dependent on marine resources.

Table 1. Fishing Profile of India

S. No	Category	Total No.
1.	Coastal States / UTs	13
2.	Landing Centres	1,363
3.	Fishing Villages	3, 477
4.	Fishermen Families	8,93,258
5.	Traditional Fishermen Families	8,18,491
6.	Below Poverty Line (BPL)	6,00,890

S. No	Category	Total No.
7.	Fisherfolk Population	37,74,577

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 - India

In the demographic structure (Table 2[4]), the fisherfolk population exhibits a nearly equal gender distribution, with males comprising about 52% and females 48%. Of the male population, approximately 66% are adults, while about 24% are above five years, and 10% below five years. Similarly, adult women constitute around 67% of all females, with 23% above five years and 10% below five years, indicating a demographically young population with high dependency ratios and considerable engagement in household support and fishing-related occupations.

Table 2. Population Distribution Structure

S. No	Category	Total No.
1.	**Male**	19,52,068
	Adult	12,91,640
	Above 5 yrs	4,74,674
	Below 5 yrs	1,85,754
2.	**Female**	18,22,509
	Adult	12,30,277
	Above 5 yrs	4,15,238
	Below 5 yrs	1,76,994
3.	**Total**	**37,74,577**

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

The structure of active fisherfolk participation (Table 3[4]) shows that among those directly engaged in fishing, about 81% are full-time, while 19% participate part-time, indicating high occupational dedication to marine harvesting. Within fish seed collection, a more specialized marine activity, participation reflects a notable gender dimension: females account for approximately 47% of full-time engagement and around 68% of part-time involvement, demonstrating women's key but often undervalued role in fisheries resource harvesting.

Table 3. Composition of the Active Fisherfolk

S. No	Category			Total No.
1.	Actual Fishing	Full Time		7,48,479
		Part Time		1,53,968
2.	Fish Seed Collection	Full Time	Male	6,063
			Female	5,278
		Part Time	Male	4,235
			Female	9,058
3.	**Total**			**9,27,081**

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

Membership participation in cooperatives (Table 4[4]) shows that fisheries-specific cooperatives constitute nearly 73% of all cooperative engagements among the fishing population, indicating strong reliance on fishery-dedicated community institutions for resource access, credit, market linkage, and social security, whereas 27% participate in non-fishery cooperatives, suggesting limited occupational diversification beyond fishing.

Table 4. Membership in Cooperatives

S. No	Category	Total No.
1.	Fisheries Cooperatives	7,07,833
2.	Other Cooperatives	2,56,705
3.	**Total**	**9,64,538**

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

Engagement in aquaculture (Table 5[4]) shows that households rearing prawns account for about 48% of aquaculture families, followed by fish culture at around 38%, whereas crab, mussel, and other species collectively comprise about 14%. This highlights the prominence of prawn cultivation, likely driven by higher trade value, while marine-based shellfish culture exhibits minimal household adoption.

Table 5. Fishermen Families Engaged in Aquaculture

S. No	Category	Total No.
1.	Fish	3,638
2.	Prawn	4,616
3.	Crab	876
4.	Mussel	59
5.	Others	443
6.	Total	9,632

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

The composition of the fishing craft fleet (Table 6[4]) shows that motorized crafts represent the majority at around 59%, followed by mechanized vessels at about 26%, and non-motorized crafts at 15%, reflecting a fleet structure moderately modernized yet still partially traditional. Within mechanized vessels, trawlers dominate at about 72%, while gill-netters contribute about 15%, and ring seiners and purse seiners collectively form around 5%, illustrating India's gear-based dependency on demersal trawling, a key ecological factor in stock exploitation studies. Within motorized crafts, about 32% are fitted with inboard engines, while 68% use outboard engines, indicating a preference for detachable propulsion systems that allow flexible use in shallow waters.

Table 6. Composition of Fishing Crafts

S. No	Category	No. of Crafts
1.	Mechanised	42,985
	Trawlers	30,772

S. No	Category	No. of Crafts
	Liners	49
	Gill netters	6,548
	Dolnetters & Bagnetters	3,396
	Ring Seiners	943
	Purse-Seiners	1,189
	Others	88
2.	Motorised	97,659
	Inboard Engine	31,479
	Outboard Engine	66,180
3.	Non-Motorised	25,689
4.	**Total**	**1,66,333**

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

1.2. Key nutrition challenges (e.g., undernutrition, micronutrient deficiencies, and overweight/obesity).

India faces a triple burden of malnutrition, with sustained child undernutrition, approximately one-third of children are stunted, one-fifth wasted, and nearly one-third underweight, particularly concentrated among rural and economically vulnerable populations (Singh et al., 2023[5]). Micronutrient deficiencies are widespread, with iron-deficiency anaemia affecting 57–67% of women and children, along with emerging concerns related to zinc, calcium, iodine, and vitamin B_{12} deficiencies (Let et al., 2024[6]; Byrd et al., 2022[7]). Concurrently, India is experiencing rising overweight and obesity, with recent analyses showing 24% of women aged 15–49 is overweight or obese, reflecting a dietary shift toward calorie-dense and nutrient-poor foods and the increasing prevalence of mother–child double-burden malnutrition (Singh et al., 2023[5]; Ji et al., 2024[8]).

1.3. Summary of the importance of aquatic foods in national diets and livelihoods

Fish and aquatic foods are an increasingly important component of India's national diet, with per capita fish consumption rising from 5.2 kg/year in 2010 to over 9.0–11.0 kg/year in 2023**,** reflecting growing dietary reliance on aquatic proteins and micronutrients[9]. Consumption is especially significant in coastal states such as Kerala, West Bengal, Odisha, Goa, Assam, and Tamil Nadu, where fish forms a daily or weekly dietary staple and is the primary source of animal-based nutrition for many rural and low-income households[10]. Aquatic foods provide high-quality protein, omega-3 fatty acids, vitamin B_{12}, iron, zinc, iodine, and calcium**,** thereby contributing critically to nutrition security and dietary quality, particularly for communities with limited access to land-based livestock products[11],[12].

The Indian fisheries and aquaculture sector supports more than 28 million livelihoods, including direct fishers, fish farmers, processors, vendors, transporters, and allied workers, and accounts for roughly 1.1% of national GDP and 7.5% of agricultural GDP, demonstrating its significant socio-economic role[9, 10]. The expansion of inland aquaculture, especially carp-based farming

and culture of small indigenous species, has improved local access to nutrient-dense fish, while marine capture and coastal fisheries continue to sustain employment, culture, and food systems in coastal communities[9]. With India now the 3rd largest fish-producing country globally, aquatic foods remain central not only to nutrition and household consumption but also to income generation, domestic markets, and national economic activity[9].

2. Country Snapshot Table

Table 7. Country Profile

Indicator	Value	Year	Source
Population (billions)	1,428	2023	Our World in Data[13]
GDP (INR)	330.68 lakh Crore	2024 -25	Ministry of Statistics and Programme Implementation[14]
Marine Capture Production (million tonnes)	4.49	2022	Regional Workshop on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in Asia: Dr. C. S. Shine Kumar, Director, NIFPHATT
Aquaculture Production (000 tonnes)	10,230	2022	SOFIA 2024 (FAO)[64]
Capture in Inland Waters (Million Tonnes)	13.91	2022	Regional Workshop on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in Asia: Dr. C. S. Shine Kumar, Director, NIFPHATT
Top 3 Capture Species	Indian mackerel, Oil Sardines, Ribbon fishes	Recent Years	FAO SOFIA Country Profile[56]
Top 3 Aquaculture Species	Indian Major Carps, Exotic Carps, Catfishes	Recent Years	Regional Workshop on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in Asia: Dr. C. S. Shine Kumar, Director, NIFPHATT
Employment in Fisheries Aquaculture (thousands)	14,140	2020	FAO[52]
Export (USD billion)	7.45	2023	Regional Workshop on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and

Indicator	Value	Year	Source
			Nutrition in Asia: Dr. C. S. Shine Kumar, Director, NIFPHATT
Imports (USD million)	225	2023	FAO Fishery and Aquaculture Commodity Statistics
Per capita Fish Consumption (Kg/year)	12.33	2021	Worldfish[25]
% of animal Protein from Fish	22%	2022	SOFIA 2024 (FAO)[64]
Estimated Fish Loss and Waste	25-40%	Recent	PWC[15]
Womens Participation in Post Harvest	55%	Recent	PIB[16]
Key Compliance Measures	VMS, Catch Documentation, Port State Measures, Licensing limits		
Major Climate/Environment Risks	Cyclones, Warming Seas, Habitat Degradation, Coastal Erosion		
Top Exporting item	Frozen Shrimp	2022	FAO SOFIA
Women in SSF (number) (million)	4.8	Recent	PIB[16]

3. Aquatic Food Production and Utilization

3.1. Trends in capture fisheries (inland and marine) and aquaculture

India contributes strongly to global aquaculture, producing 11.3 million tonnes, which represents 56% of Asia's aquaculture output and about 11.5% of total world aquaculture production, demonstrating India's major global role in farmed fish supply. In contrast, India's capture fisheries production, at 6.1 million tonnes, accounts for only 6.8% of the world's total capture fisheries output, reflecting a much smaller share relative to wild-caught resources. Within Asia, India contributes 12.9% of Asia's aquaculture production and 12.7% of Asia's marine capture production, indicating that India is the second-largest aquaculture producer in Asia, but not among the top contributors in marine capture fisheries. Overall, this percentage distribution clearly shows that India is primarily an aquaculture-driven fisheries economy, with farmed production far outweighing wild capture in both domestic significance and global contribution (Table 8 and 9).

Table 8. World and India: Aquaculture and Capture Fisheries Production

Country	Aquaculture Production	World Share
Total World	98.5	100%

Country	Aquaculture Production	World Share
India	11.3	56.0%
Country	**Capture Production**	**World Share**
World Total	90.4	100%
India	6.1	6.8%

Note: Data in million tonnes – live weight
Source: FAO. 2025. Fish stat.

Table 9. Asia's and India's: Aquaculture and Capture Fisheries Production

Country	Aquaculture Production	Asia's Total Share	World Share
Asia's Total	87462	100%	88.8%
India	11315	12.9%	11.5%
Country	**Capture Production**	**Asia's Total Share**	**World Share**
Asia's Total	48037	100%	53.2%
India	6106	12.7%	6.8%

Note: Data in thousand tonnes – live weight
Source: Fish stat.

Marine fish production, however, displays fluctuating patterns during the same period. Marine capture production remains relatively stable between 3.5–4.0 million tonnes from 2014 to 2019, followed by a noticeable decline in 2020, after which recovery is gradual. By 2023, marine capture levels approach 4.0 million tonnes, though still marked by year-to-year variability (Fig 1).

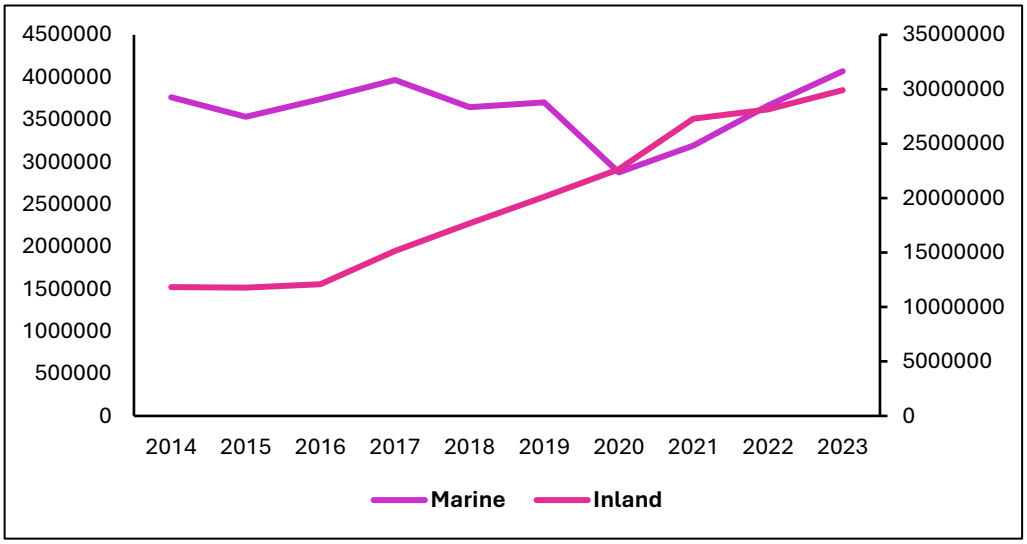

Figure 1. Trendline of the Fisheries Production

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

In the marine production breakdown, capture production dominates every year, while marine culture contributes negligible volumes, remaining close to zero throughout 2014–2023, indicating limited development of mariculture relative to inland aquaculture (Fig 2).

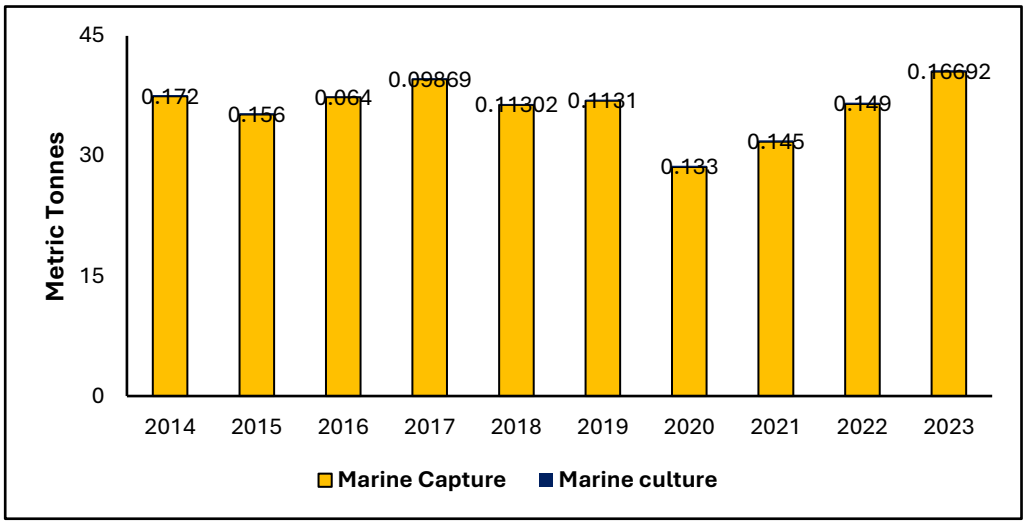

Figure 2. Marine Fisheries Production

Note: Data in metric tonnes – live weight (marine Culture values are mentioned).
Source: FAO. 2025. Fish stat.

Inland fish production exhibits a steady and sustained upward trend, rising from around 1.5 million tonnes in 2014 to nearly 4.0 million tonnes by 2023, with the most rapid growth occurring after 2017. This consistent increase highlights the strengthening of inland aquaculture and enhanced freshwater resource utilization (Fig 3).

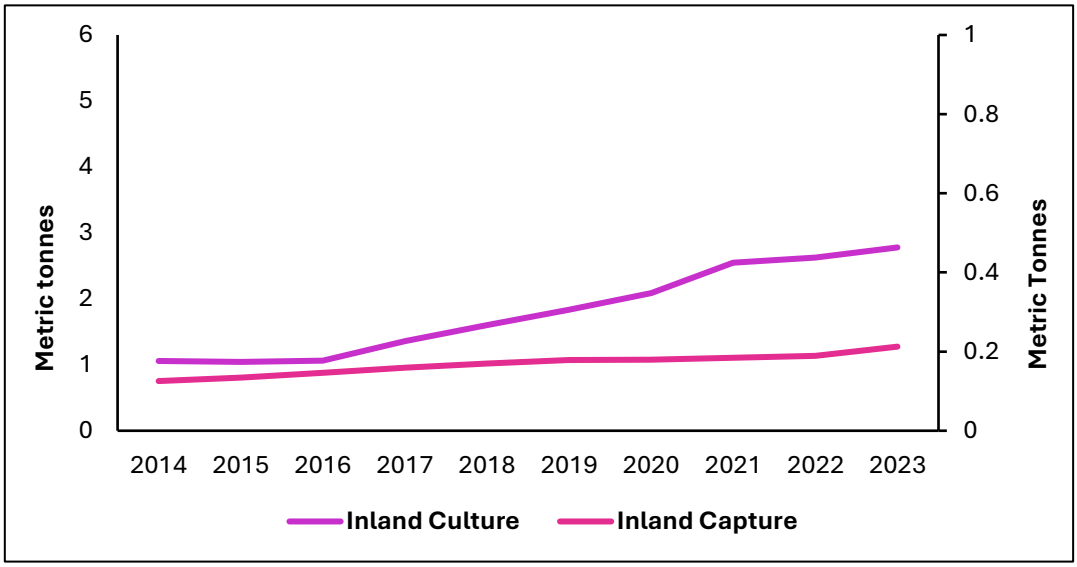

Figure 3. Trendline on the Inland Fisheries Production

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

3.2. Main species and product forms

The 2023 commercial fisheries composition reveals a clear dominance of freshwater-associated Cyprinids in the overall species production, accounting for approximately 27–28% of total recorded volume among the listed groups, while Indian mackerel contributes around 13%, followed by Clupeoids and Indian oil sardine at roughly 9% each, reflecting the strength of pelagic small-fish fisheries in coastal waters. Other marine taxa such as hairtails, scabbardfishes, marine fishes NEI, murrels, threadfin breams and decapod crustaceans each individually contribute 6–8%, collectively forming a stable secondary band of commercially important resources.

In inland systems, the dominance is far more pronounced: Catla alone represents about 39–40% of the top ten listed inland species by volume, with Rohu contributing around 18–19%, freshwater fishes NEI roughly 15–16%, and whiteleg shrimp about 11–12%, indicating the strong reliance on carp-based inland aquaculture complemented by intensification of penaeid shrimp culture. Lower-ranking species such as striped catfish (~7.5%), silver carp (~6.7%), and mrigal (~4%) remain significant but clearly secondary, while others like North African catfish and giant tiger prawn together constitute less than 3% (Fig 4 & 5).

Among marine fisheries, Indian mackerel (2.63 lakh tonnes), oil sardine (2.41 lakh tonnes), ribbonfishes (2.29 lakh tonnes), cephalopods (2.06 lakh tonnes), and non-penaeid shrimps (1.86 lakh tonnes) represent the dominant commercial species. Inland fisheries are primarily dominated by Indian major carps with a production of 67.36 lakh tonnes, followed by exotic carps (10.85 lakh tonnes), catfishes (5.69 lakh tonnes), minor carps (3.45 lakh tonnes), and murrels (2.57 lakh tonnes).

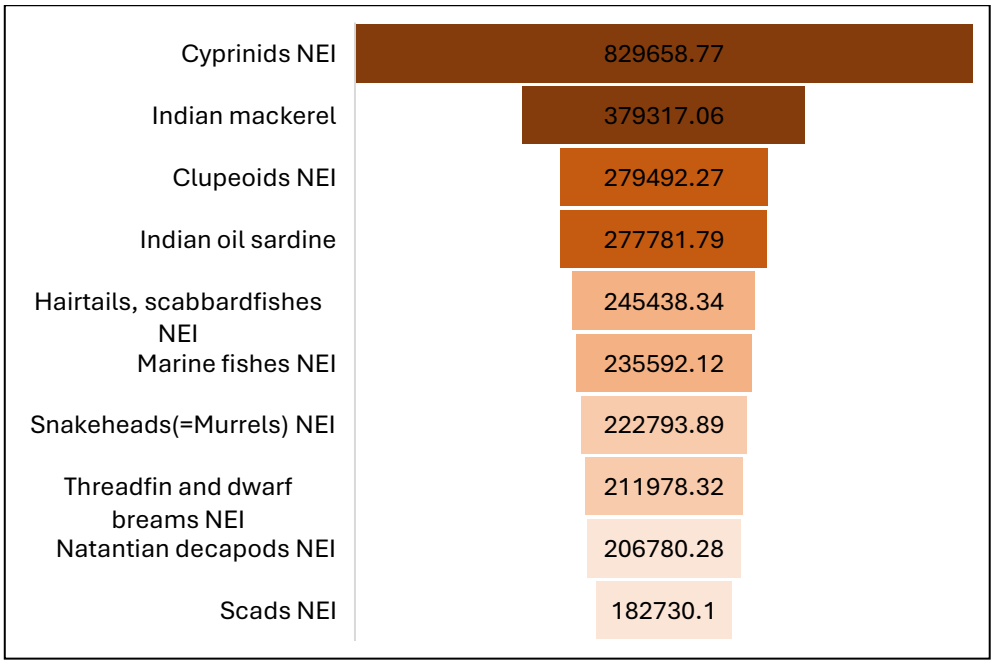

Figure 4. Top Fisheries in Marine Sector, 2023

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

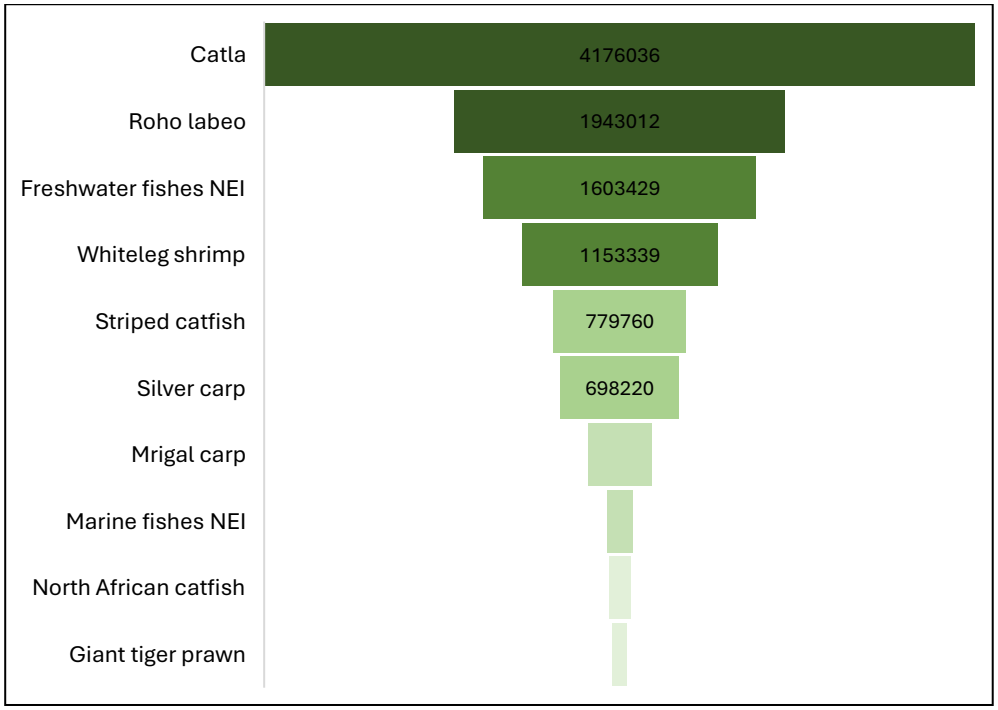

Figure 5. Top Fisheries in Inland Sector, 2023

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

3.3. Major production zones and seasonal characteristics

Marine fish production is heavily concentrated along the western and southern coasts, with Gujarat (~16.5% of total marine output), Andhra Pradesh (~14%), Kerala (~14.4%), Tamil Nadu (~14.5%), and Karnataka (~14.2%) together accounting for nearly 73% of India's marine production, whereas inland production is dominated by eastern and central states, with West Bengal (~15%), Andhra Pradesh (~35%), Odisha (~6.5%), and Uttar Pradesh (~6.5%) contributing roughly 63% of total inland output. This shows that marine fisheries are geographically coastal-dependent, while inland fisheries follow freshwater availability and aquaculture hubs concentrated in riverine and pond-based regions (Fig 6 and 7).

India's fisheries production is shaped by distinct ecological zones with strong monsoon-linked seasonality, where the south-west coast Arabian Sea margin (Kerala–Karnataka) forms one of the most productive marine regions due to monsoon-driven coastal upwelling that enhances nutrient availability and pelagic fish biomass, directly influencing sardine and mackerel yields[17], [18],[19]. The Bay of Bengal shelf, in contrast, is governed more by riverine discharge, stratification, and cyclone influence than by wind-driven upwelling, resulting in comparatively lower overall productivity but supporting valuable fisheries such as hilsa, shrimps, and ribbonfishes, with catches typically peaking during post-monsoon stabilization of salinity and fishing effort[20]. The inland floodplain systems of the Ganga–Brahmaputra basin, encompassing beels, haors, and ox-bow lakes, form India's largest inland capture fishery zone, where monsoon flooding expands habitat and enables spawning and recruitment of major carps and small indigenous species, while post-monsoon water recession concentrates stocks and increases harvest efficiency[21]. Meanwhile, the reservoir and pond-aquaculture complexes of peninsular India, notably Andhra Pradesh, West Bengal and Telangana, drive the bulk of India's farmed fish output, with controlled

stocking and feeding that partially buffer seasonal extremes, though still influenced by temperature-driven growth cycles and rainfall-related disease risk[22].

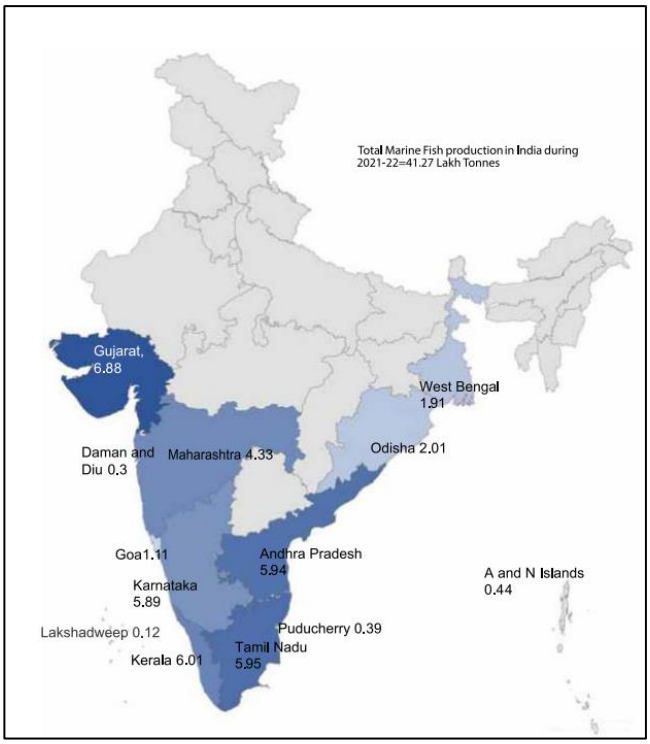

Figure 6. Marine Fisheries Production

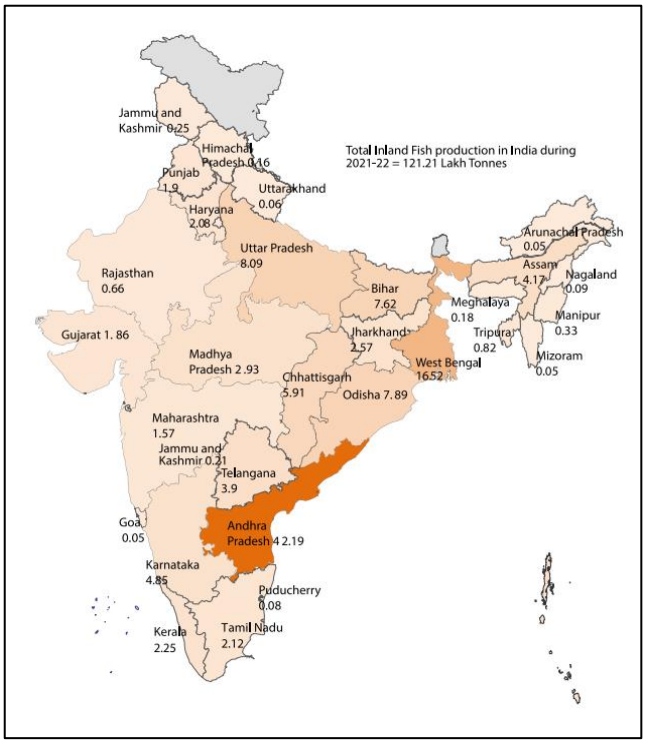

Figure 7.Inland Fisheries Production

3.4. Processing, preservation and domestic consumption practices

Processing, preservation, and domestic consumption of fish in India have undergone a significant transformation, influenced by both traditional practices and modern consumption shifts. Historically, fish preservation in India relied heavily on sun-drying and salting systems, accounting for major proportions of artisanal preservation in coastal communities[16], while fermentation practices such as *ngari*, *karuvadu*, and *lona ilish* reinforced regional nutritional traditions[23]. With modernization, India has increasingly adopted advanced methods like icing, freezing, and IQF processing[24], though still primarily for export markets. The recent *Fish consumption in India: Patterns and trends* report reveals that domestic fish consumption increased by 120% over 2005–2021, from 5.428 to 11.924 million metric tons, supported by growing population, purchasing power, and urban dietary diversification. Per capita fish consumption rose by 81.43%, from 4.9 kg to 8.89 kg, and the proportion of fish-eaters expanded to 72.1% of the national population[25]. Significantly, fresh fish remains the dominant preferred category across India, reflecting cultural emphasis on fresh consumption, while only ~15% of national fish production is processed, underscoring a cold-chain and processing capacity gap. Notably, consumption increases have been stronger in rural India, narrowing the rural-urban consumption divide[20], while northeastern, eastern, and coastal states (Tripura, Assam, Kerala, Tamil Nadu, West Bengal) consume fish at over 90–99% population prevalence.

The shrimp & prawn frozen account for about 27.07% of total volume, nearly equal to the miscellaneous category at 27.55%, meaning these two segments together constitute over 54% of total seafood by volume. The next major contributors are fish dried, unsalted at 15.56%, followed by marine fish frozen at 12.81%, and fish dried & salted or smoked at 9.28%, together representing around 38% of the category. All other listed items contribute individually at less than 2% each, with specialty products like lobster, cuttlefish fillets, fish meal, shark fins, and various

tunas collectively making up only about 5–6% of total volume. This indicates that Indian seafood composition is dominated by shrimp/prawn, dried fish, frozen marine fish, and an unspecified miscellaneous class, whereas premium/specialty items make up a very minor proportion below 2% (Fig 8[26]).

The shrimp value chain from capture fisheries consists of pre-harvest inputs, harvesting through trawling and gillnetting, onboard handling, auctioning and primary handling at landing centres, secondary processing including freezing and value addition, followed by packaging, cold-chain transport, and distribution across domestic and export markets (Fig 25).

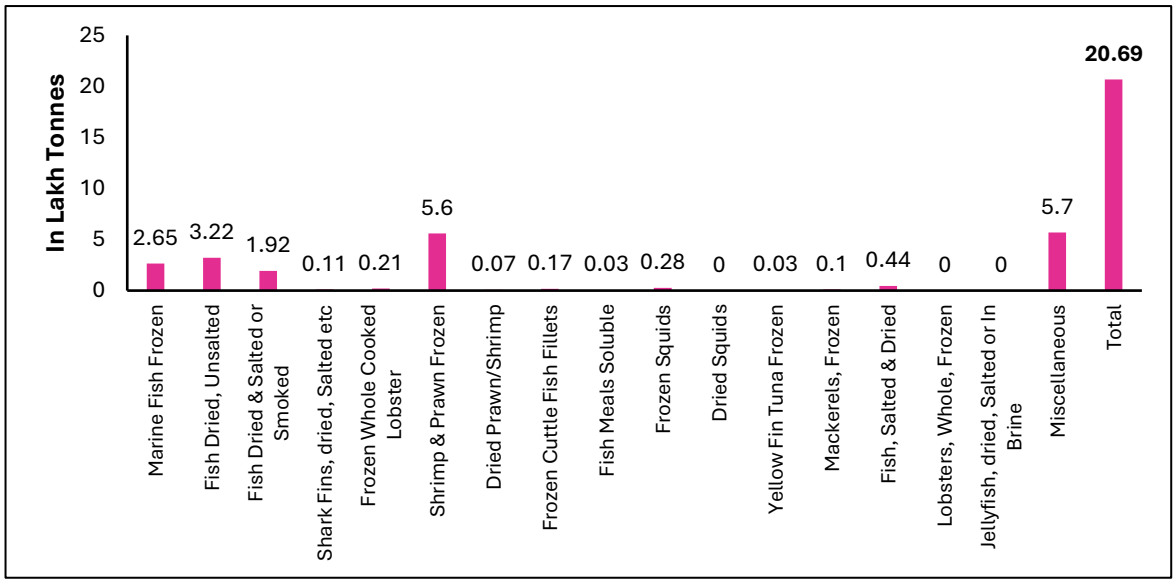

Figure 8. Preserved and Processed Commodities by India: 2020 -21

Note: Data in lakh tonnes
Source: Handbook of Fisheries Statistics: 2022

A clear upward trend in fish consumption in India, both at the population level and among those who regularly consume fish. Between 2005–06 and 2019–20, India's total population increased by 21%, while total fish production rose by 115%, meaning fish supply expanded more than five times faster than population growth. Domestic use of fish (excluding exports) increased from 5.428 to 11.924 million tonnes, a 120% rise, indicating that most of the production growth was absorbed for domestic consumption. Import dependency also increased by over 440%, from 14,000 to 76,000 tonnes, although imports still accounted for less than 1% of total domestic fish availability. Consequently, annual per capita fish consumption for the entire Indian population rose by 81.4%, from 4.9 kg to 8.89 kg, reflecting significant dietary diversification toward aquatic foods. Within the fish-consuming segment of the population, the shift is even more prominent: the proportion of fish consumers grew from 66% to 72.1%, equal to a 32% increase in the fish-eating population (from 730.6 to 966.9 million individuals), and per-capita consumption within this group increased from 7.43 kg to 12.33 kg, a 66% rise (Table 10 & 11).

Table 10. Per Capita Fish Consumption in India

Year	Total Population (Billion)	Total Fish Production (Million Mt. Tonnes)	Domestic Fish Consumption from Domestic Production (Million Mt. Tonnes)	Domestic fish Consumption from Imports at Pre-Processing Weight (t)	Total Fish Consumed (Million Mt. Tonnes)	Annual Per Capita Fish Consumption (Kg)
2005-2006	1.107	6.577	5.415	14,000	5.428	4.9
2015-2016	1.283	10.762	9.277	52,000	9.328	7.27
2019-2020	1.341	14.164	11.848	76,000	11.924	8.89

Source: WorldFish

Table 11. Per Capita Fish Consumption Among People Eating Fish in India

Year	Total Population (Billion)	Fish Consuming Population (%)	Fish Consuming Population (Million)	Total Fish Consumed in Domestic Market (Million Mt. Tonnes)	Annual Per Capita Fish Consumption among Fish Consuming Population (Kg)
2005-2006	1.107	66%	730.6	5.428	7.43
2015-2016	1.283	68.8%	882.7	9.328	10.57
2019-2020	1.341	72.1%	966.9	11.924	12.33

Source: WorldFish

4. Trade and Market Dynamics

4.1. Overview of fish exports (species, value, markets)

The seafood exports increased by roughly 30–35% between 2014 and 2023, while imports rose even faster, by approximately 70–75% over the same period, showing a substantial acceleration around 2018–2021 where import growth briefly exceeded export levels before both stabilized with exports maintaining a higher volume overall (Fig 9). The shrimps and prawns dominate overwhelmingly, accounting for approximately 82–85% of total quantity, while the next category (cuttlefish and squid) represents only about 12–13%, followed by fishmeals and other categories each contributing around 9–11%, with the remaining listed products individually constituting less than 5% each (Fig 10).

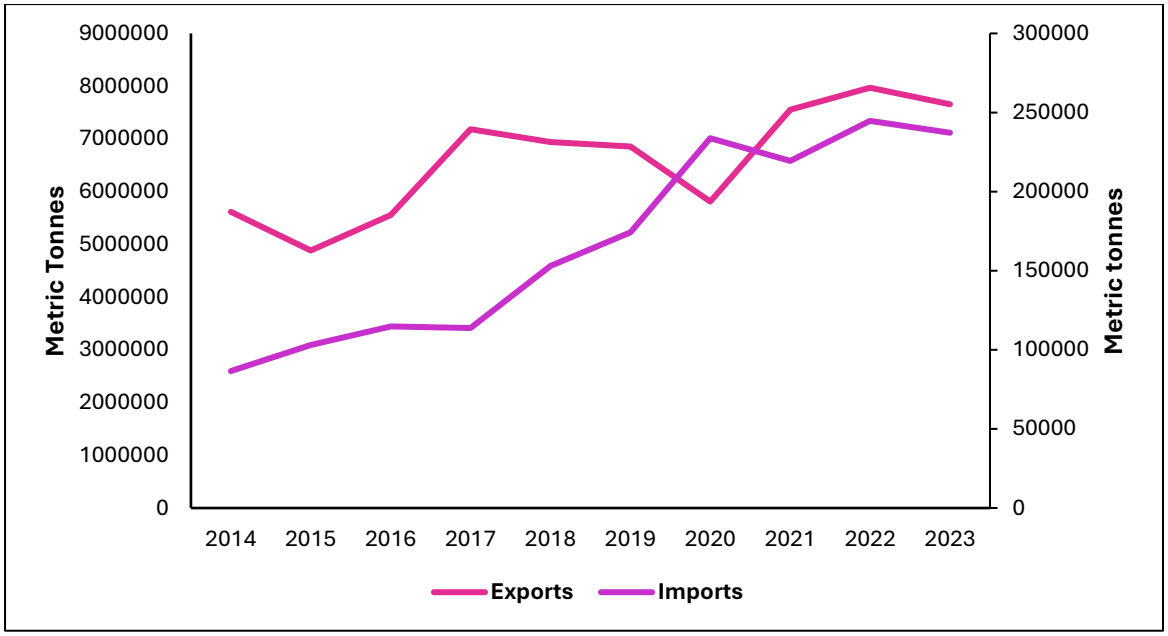

Figure 9. Trendline in Seafood Trade

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

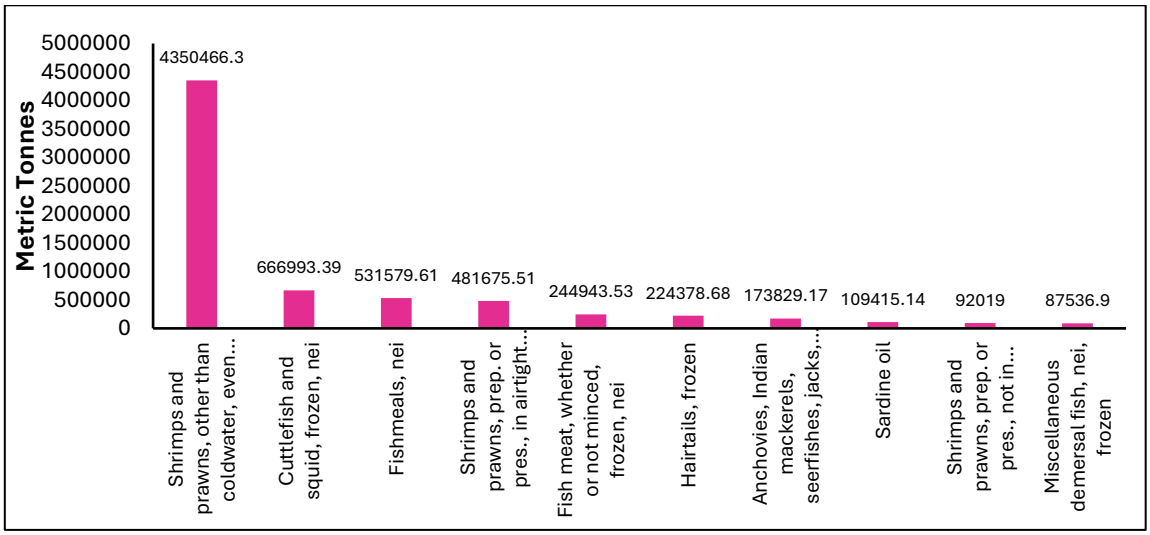

Figure 10. Top Commodities in Trade, 2023

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

4.2. Key import flows and their drivers

In exports, shrimps and prawns alone contribute an overwhelming 83–85% of the total volume, far exceeding all other categories combined, indicating an extremely concentrated export structure (Fig 11). By contrast, the import profile is more dispersed: while shrimps and prawns still lead at about 30–35%, a variety of other species such as miscellaneous diadromous fish (~22%), catfish (~18%), carp (~15%), and fishmeals (~12%) share the remaining volume comparatively evenly (Fig 12). This suggests that exports are driven by a single dominant high-

value commodity, whereas imports are influenced by domestic supply gaps across many species. Additionally, the presence of categories like fish body oils, agar agar, and fish waste at <5% each indicates a secondary but consistent demand for specialized input materials and derivative products. Frozen shrimp alone contributes 66% of total export value and 40% of export quantity, followed by frozen fish (9% value, 21% quantity), fish and shrimp meal and feed (6% value, 16% quantity), frozen squid (5% value, 5% quantity), surimi products (4% value, 8% quantity), and frozen cuttlefish (3.7% value, 3% quantity) (Table 12).

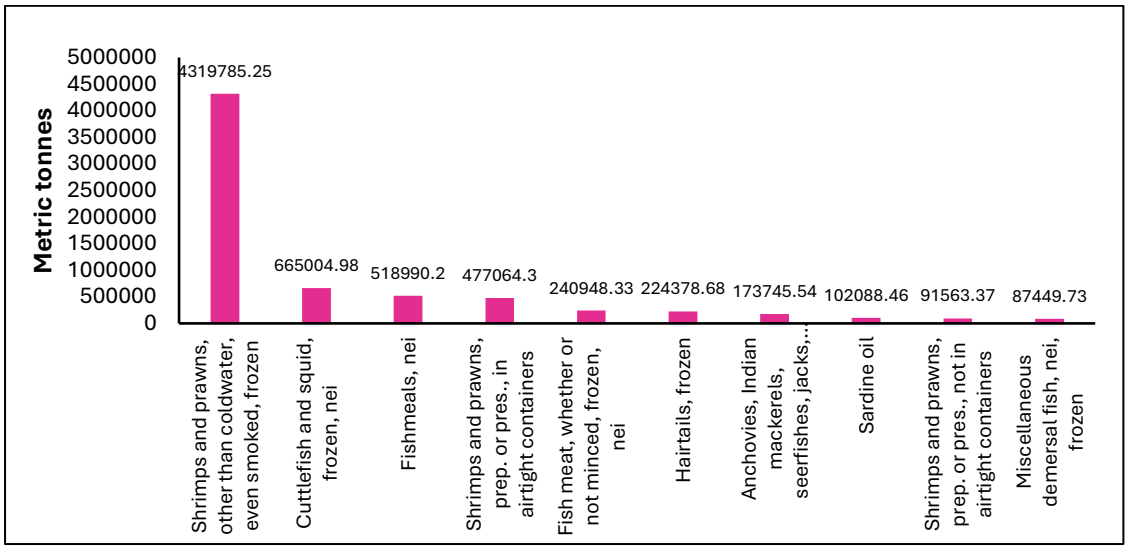

Figure 11. Top Export Commodities, 2023

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

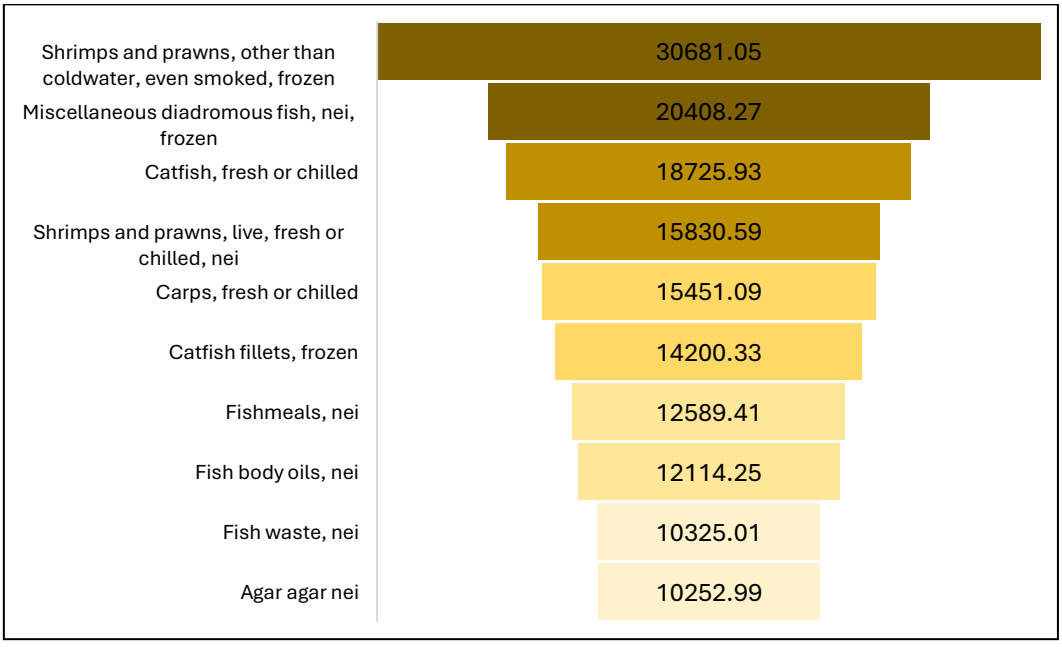

Figure 12. Top Import Commodities, 2023

Note: Data in metric tonnes – live weight
Source: FAO. 2025. Fish stat.

Particulars	Value ($)	Quantity
Frozen Shrimp	66%	40%
Frozen Fish	9%	21%
Fish & Shrimp Meal & Feed	6%	16%
Frozen Squid	5%	5%
Surimi & Surimi Analogue	4%	8%
Frozen Cuttle Fish	3.7%	3%

Table 12. Item-wise export in terms of quantity and value

Source: Regional Workshop on Strengthening Sustainable Aquatic Food Value Chains for Enhanced Food Security and Nutrition in Asia: Dr. C. S. Shine Kumar, Director, NIFPHATT

4.3. The role of domestic markets in providing affordable fish to households

Domestic markets play a central role in ensuring that fish remains an accessible and affordable food source for Indian households, particularly among low- and middle-income populations. Over 70% of the Indian population relies on fish as a nutritious and affordable source of food, especially in coastal and riverine regions where traditional market systems enable decentralized distribution and access to fresh fish close to consumersc[25]. More than three-fourths of all fish produced in India is sold in fresh form, and about 82% of total production remains within the domestic market[9].

India's domestic fish consumption rose sharply between 2005 and 2021, increasing by 120%, from 5.428 to 11.924 million tonnes, indicating a strong expansion in internal demand and availability. During the same period, the reliance on imported fish for domestic consumption increased by 543%, though imports still represent less than 1% of total domestic supply, showing that most domestic consumption is fulfilled by internal production. The national per capita fish consumption increased by 81.43%, from 4.9 to 8.89 kg, demonstrating an upward shift in fish as a dietary protein source across the country (Table 13[25]).

Table 13. Key Demographic, Economic and Fish Consumption Trends in India

Category	Indicator	2005	2021
Population & Economy	Population (billion)	1.11	1.34
	Per capita GDP (INR, constant terms)	53,478	108,645
	PFCE – Per capita final consumption expenditure (INR)	18,584	61,594
Fish Production	Total fish production (million tons)	6.577	14.164
	Domestic consumption (million tons)	5.415 (2005–06)	11.848 (2019–20)
	Imported fish for domestic market (tons)	14,000	76,000
	Total fish consumed domestically incl. imports (million tons)	5.428	11.924

Category	Indicator	2005	2021
Per Capita Fish Consumption	Per capita annual consumption, national (kg)	4.9	8.89
	Per capita consumption among fish-eaters (kg)	7.43	12.33
	Per capita consumption growth vs LMIC average	India: 60%	LMIC avg: 45%

Source: World Fish

The utilization pattern of fish in India shows that fresh-marketed fish consistently dominates, increasing from 66.96% in 1991–92 to over 77% in 2020–21, highlighting strong consumer preference for fresh fish. Frozen fish utilization rose from 6.56% to 13.49%, reflecting expanding cold-chain storage and urban market demand. Meanwhile, curing dropped sharply from 15.17% to 2.86%, and reduction (fishmeal) declined from 8.24% to around 2–3%, indicating a shift away from traditional preservation and industrial processing. Minor categories such as canning (<1%), offal use (<1%), and unspecified uses (<1%) remained minimal throughout, confirming that India's fisheries sector has moved toward direct human consumption in fresh or frozen formats, driven by rising incomes and changing dietary expectations (Fig 13).

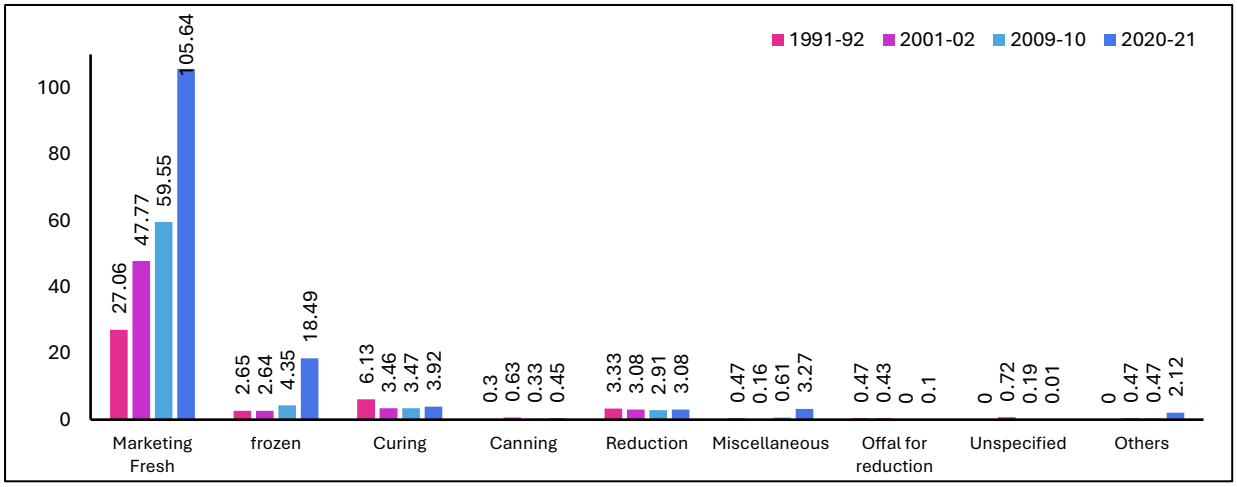

Figure 13. Trends in utilisation pattern of fish in India

Note: Data in lakh tonnes – live weight
Source: Fish stat.

India's domestic fish supply is predominantly contributed by freshwater fish, making up about 72.3% of total domestic availability, highlighting the dominance of inland aquaculture in national consumption. This is followed by pelagic fish, which account for approximately 10.2%, demersal fish at 9.7%, and crustaceans (shrimp and prawn) at 9.7%, showing that while crustaceans dominate export markets, they represent a smaller portion of domestic use. Cephalopods (squid, cuttlefish, octopus) contribute only about 0.63% to domestic consumption while marine fish overall represent around 11.9% of domestic supply. These percentages demonstrate that India's consumption pattern is heavily reliant on farmed freshwater species, with marine and deep-sea species making up a much smaller share (Fig 14-21).

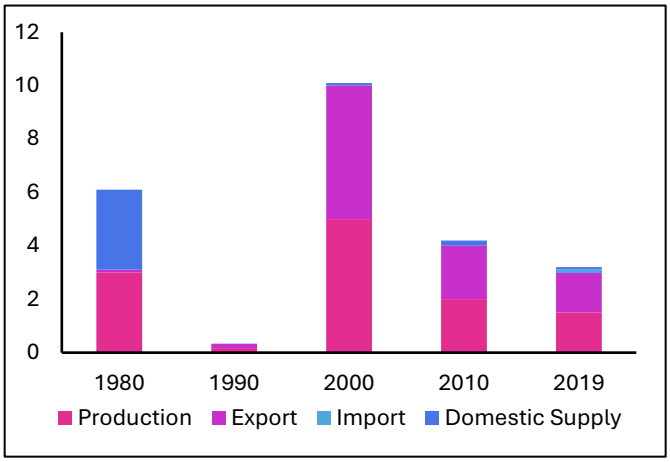

Figure 14. Trends of Production, Export, Import and Domestic Supply in Aquatic Animals (Not included in Others)

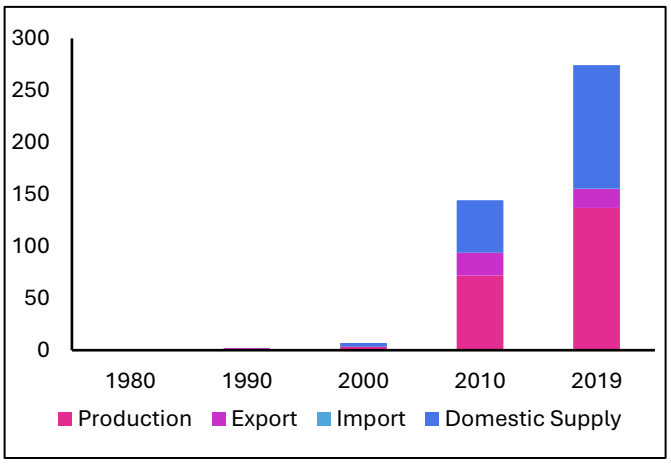

Figure 15. Trends of Production, Export, Import and Domestic Supply in Molluscs excl Cephalopods

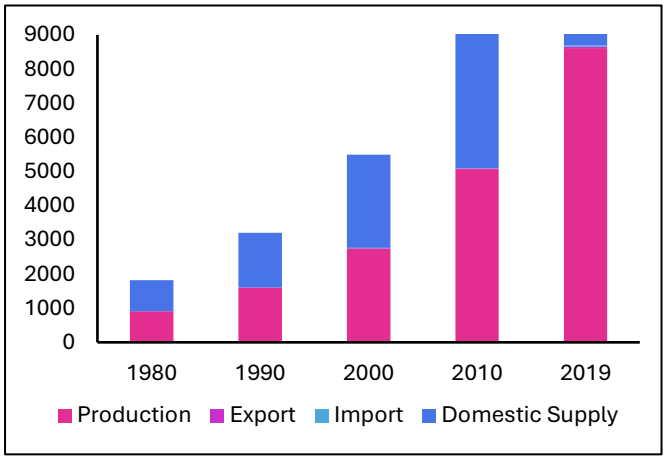

Figure 17. Trends of Production, Export, Import and Domestic Supply in Freshwater Fish

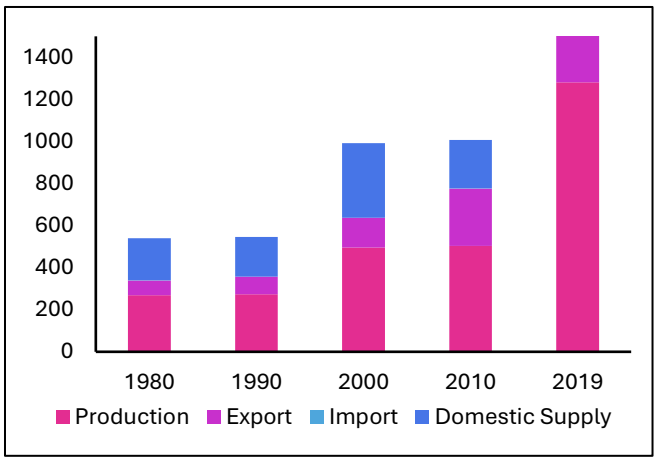

Figure 16. Trends of Production, Export, Import and Domestic Supply in Crustaceans

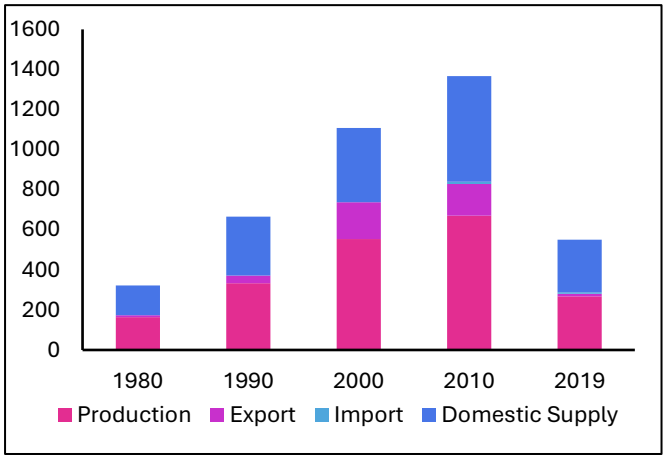

Figure 18. Trends of Production, Export, Import and Domestic Supply in Marine Fish

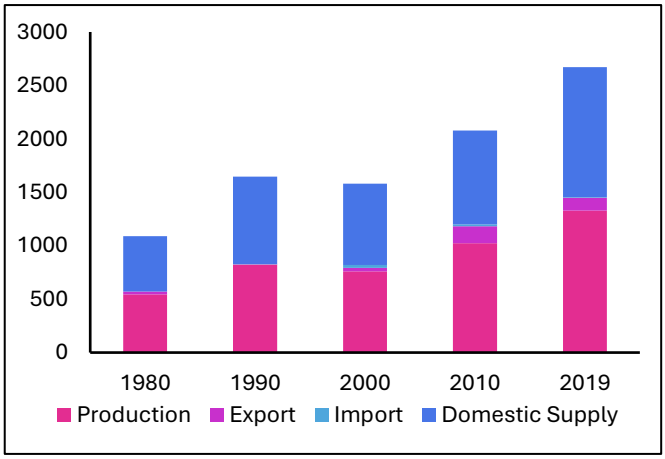

Figure 19. Trends of Production, Export, Import and Domestic Supply in Pelagic Fish

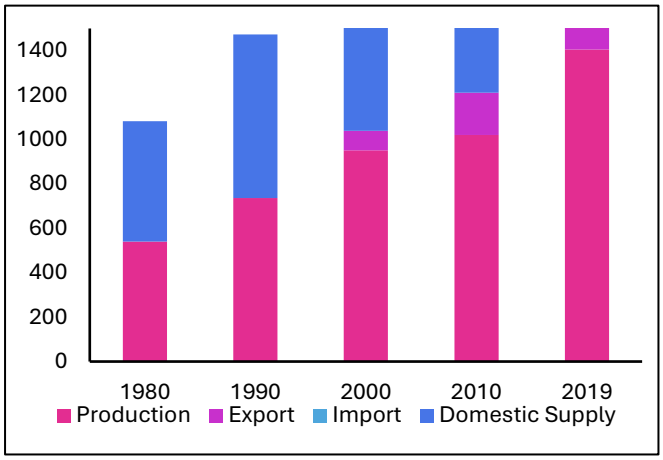

Figure 20. Trends of Production, Export, Import and Domestic Supply in Demersal Fish

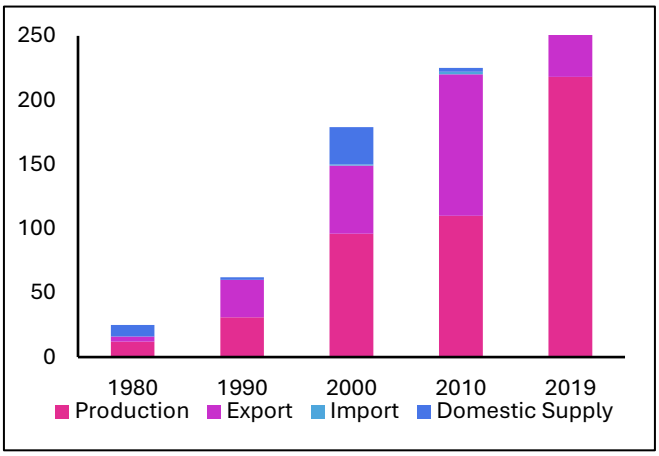

Figure 21. Trends of Production, Export, Import and Domestic Supply in Cephalopods

Note: Data in thousand tonnes – live weight
Source: Fish stat.

4.4. Barriers and opportunities (tariffs, non-tariff measures, certification, and traceability).

Barriers and opportunities in India's fish trade are shaped by a combination of tariff and non-tariff measures, as well as evolving certification and traceability requirements. FAO notes that India historically applied relatively high border protection to agricultural commodities, including fisheries, through quantitative restrictions, licensing, and high tariffs, with subsequent trade reforms progressively reducing such barriers and aligning policies with multilateral commitments[27]. Most fisheries and aquaculture products imported into India from EFTA countries were previously subject to import tariffs close to 30 percent, and that the agreement introduces schedules for either immediate elimination, phased reductions over 5–10 years, or 50 percent cuts in duties for selected tariff lines, with the stated objective of facilitating trade and improving market access[28]. FAO jointly with UNCTAD, compiles data on sanitary and phytosanitary (SPS) requirements, technical regulations, private standards and "non-traditional" barriers applied by major importing markets, and documents existing Indian export-control mechanisms, patterns of border rejections and associated estimated trade losses for Indian fish and aquaculture exports[29].

5. Nutritional Contribution of Fish

5.1. Fish's share in total protein intake

The protein supply from aquatic foods in India increased by approximately 50% between 2014 and 2023**,** rising from 3.38 to around 5.05–5.08 million tonnes. Per-capita availability followed a similar trend, increasing by nearly 48%, from about 3.38 g/day to just over 5 g/day. The largest annual jump occurred between 2018 and 2019, representing a ~7% rise in one year, followed by another ~4% increase from 2019 to 2020. After reaching its peak in 2021, the supply stabilized within a narrow range of ±1%, indicating a saturation plateau in overall protein contribution from aquatic foods (Fig 22).

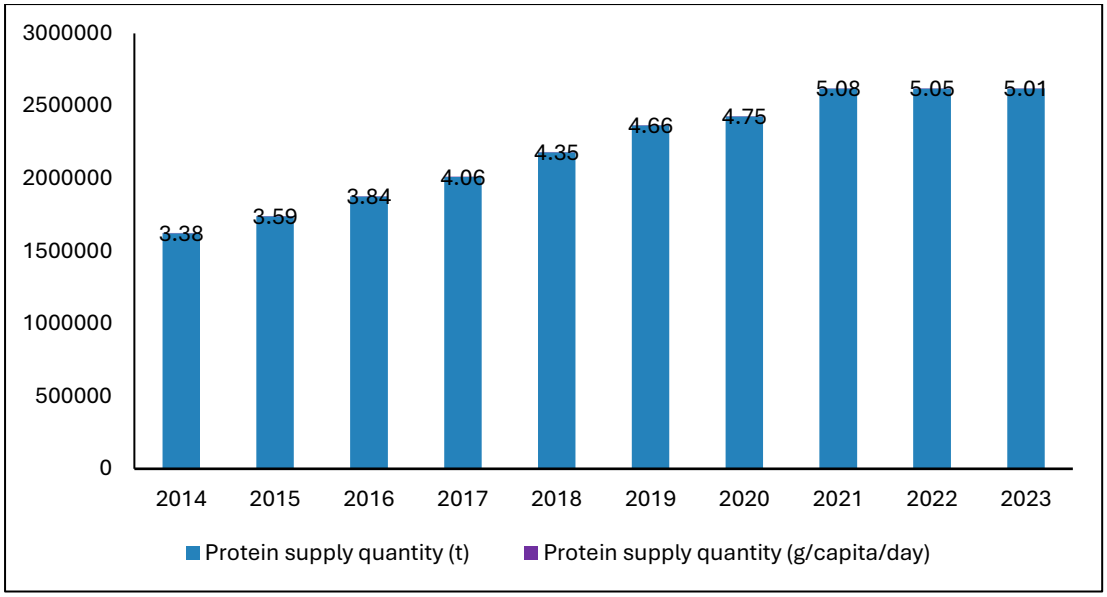

Figure 22. Trends in Protein Supply and Consumption

Note: Data of supply: thousand tonnes; consumption: g/capita/day (mentioned as labels)
Source: Fish stat.

5.2. Key micronutrients supplied (Ca, Fe, Zn, I, Se, Vitamin A, Vitamin B12, DHA/EPA)

The small pelagic marine fish and small indigenous freshwater species (SIS) in India serve as dense sources of key micronutrients, particularly calcium, vitamin B12, and DHA/EPA, capable of meeting or even exceeding nutritional requirements during early life stages[30],[31]. This conceptual framing aligns strongly with Indian nutrient composition studies showing that species eaten whole, such as *Amblypharyngodon mola*, *Puntius sophore* and *Gudusia chapra*, provide exceptionally high calcium (often 800–5,000 mg/100 g), iron (up to ~36 mg/100 g), zinc, selenium and fat-soluble vitamins including vitamin A[29]. Marine fish additionally supply vital iodine, with classic Indian analyses reporting mean iodine concentrations of ~193 µg/100 g in marine fish and higher values in shellfish[32].

Marine fish exhibit generally higher potassium concentrations, with species such as *Nemipterus japonicus* and *Stolephorus spp.* showing around 2,200–2,300 mg, which is nearly 2–3× higher than the potassium levels seen in common freshwater species like *Catla* or *Rohu*. Freshwater species excel in calcium content, with *Ailia coila*, *Gudusia chapra*, and *Xenentodon cancila* containing 3–5× more calcium than most marine fishes, making them significant contributors to dietary calcium intake. In terms of phosphorus and iron, *Gudusia chapra* in freshwater provides exceptionally high levels of phosphorus (~2490 mg) and iron (~36.5 mg), which is 10–15× higher than typical marine fish values, highlighting small indigenous freshwater species as micronutrient-dense. Meanwhile, prawns (*Penaeus monodon*, *F. indicus*) show 2–4× higher sodium, zinc, and copper content compared to many finfish, indicating that shrimp consumption provides a comparatively dense mineral profile per unit weight (Table 13[33]).

5.3. Role of small fish species consumed whole

Small fish species that are consumed whole: such as *Amblypharyngodon mola*, *Puntius sophore*, *Gudusia chapra*, anchovies (*Stolephorus* spp.), and small mullets, play a critical nutritional and socio-economic role in Indian fisheries. Their whole-body consumption (including head, bones

and viscera) provides high bioavailable concentrations of calcium, iron, zinc, vitamin A and essential fatty acids that are often deficient in cereal-based diets[29]. These species are typically harvested by traditional small-scale fishers using low-impact gear, contributing significantly to local livelihoods and food security while exerting less ecological pressure than larger, commercially targeted species[26]. Because of their accessibility, affordability, and micronutrient density, small fish are particularly important for vulnerable populations including children, pregnant women, and low-income households in riverine, inland and coastal communities across India[31, 34].

Table 14. Nutrient Richness of Selected Small Fish Species Consumed Whole

Species	Consumption form	Key micronutrients (mg/100 g or µg/100 g)
Amblypharyngodon mola	Whole	High Ca, Vit A, Fe
Puntius sophore	Whole	Ca, Fe, Zn
Gudusia chapra	Whole	Ca, Fe extremely high (~36 mg Fe/100 g)
Stolephorus waitei	Whole	High Zn, DHA/EPA
Xenentodon cancila	Whole	High Ca

Source: Mohanty B.P et al., 2016[33]

5.4. Evidence from national nutrition surveys or literature

Evidence from national dietary sources in India demonstrates that fish consumption, particularly small indigenous species, substantially contributes to improving nutrient adequacy and combating micronutrient deficiencies. The *Indian National Family Health Survey (NFHS-5)* highlights persistent deficiencies in iron, vitamin A and anaemia in many states, particularly those relying heavily on cereal-based diets, thereby underscoring the importance of nutrient-dense animal-source foods such as small fish[35]. The IFCT, 2017[34] provide detailed biochemical data confirming that commonly consumed Indian fish (e.g., sardine, mackerel, anchovy, hilsa, mullet) contain high levels of vitamin B12, DHA/EPA, selenium, and bioavailable iron, supporting their role as strategic nutrition inputs. Studies by Mohanty et al. (2016)[33] further demonstrate that small fish consumed whole provide high calcium, zinc and iron levels due to the inclusion of bones and organs. Complementing this, Thilsted (2012)[30] have shown in regional South Asian households that integrating small fish species significantly improves vitamin A and mineral intakes among children and women. Together, this body of national and scientific nutritional evidence reinforces the role of small fish as a realistic, culturally acceptable, affordable and locally available solution for addressing hidden hunger in India.

6. Fish Loss and Waste (FLW)

6.1. The main points along the chain where losses occur (landing, transport, processing, retail)

Post-harvest fish loss in India is reported across all key stages of the value chain, beginning at landing, where inadequate onboard icing, poor handling during unloading, physical damage, and discarding of low-value species contribute to both quantitative and quality loss[36]. During transport within India, losses are attributed to non-refrigerated or poorly insulated movement of fish, temperature fluctuations, extended transit times, and manual handling practices, all of which lead to microbial spoilage and physical degradation of fish quality[37]. In pre-processing and processing operations, losses arise from downgrading of material, trimming and rejection, and

deterioration caused by delays before chilling or processing, indicating inefficiencies in standardized quality control and cold-chain continuity at industrial and artisanal processing levels[32]. At the commercial distribution and retail stages across India, significant losses result from fish being displayed without adequate cooling, exposure to ambient temperatures for extended durations, repeated handling, and inadequate hygiene and sanitation standards, leading to visible spoilage, consumer rejection, and final-stage discard[38]. At the global analytical level, FAO notes that losses in fish value chains in developing countries are predominantly concentrated during early and middle supply chain stages, where inadequate infrastructure, insufficient cold-chain management, and climatic challenges lead to accelerated deterioration and post-harvest waste[39].

6.2. Available estimates of quantity and value lost

India's food loss dynamics differ significantly between inland and marine systems and across post-harvest stages: inland fisheries improved with losses declining from 6.92% to 5.23%, while marine fisheries losses surged from 2.78% to 10.52%, reflecting a severe decline in post-harvest quality control (Table 15). The single most loss-intensive stage is dry fish production at 36.97%, while mid-chain stages such as wholesale, retail, and pre-processing contribute around 8–9% each, and final-market losses remain moderate to low, ranging from 5.43% for local market to just 0.38% for local market (dry) (Fig 23). Recent post-harvest loss estimates indicate that inland fisheries losses declined from 5.23% in 2015 to 4.86% in 2022, while marine fisheries losses reduced from 10.52% to 8.76% during the same period, reflecting gradual improvements in handling and infrastructure.

Table 15.Food Loss Estimates

Commodity	2005-07	2013-14
Inland Fishery	6.92	5.23
Marine Fishery	2.78	10.52

Data: Percentage of Production
Source: WRI-India[40]

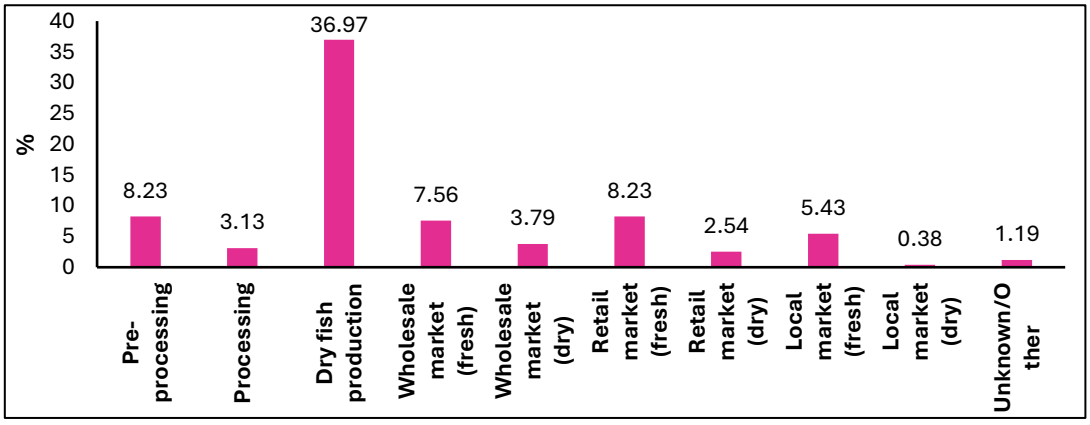

Figure 23. Percentage of Loss in various Stages of Post-Harvest

Data: Loss (%)
Source: Fisheries Journal[41]

6.3. Causes (infrastructure, handling, storage)

In India, available studies consistently show that fish loss and waste (FLW) arise from a combination of infrastructural gaps, poor handling, and inadequate storage/cold chain along the value chain from on-board to retail. A national assessment for the Department of Fisheries (NPC study, 2023–24) found that high losses occur specifically during handling and transport because of inadequate cold-chain infrastructure, lack of hygienic handling practices, and delays in market access[42]. Earlier economic evaluations of inadequate post-harvest infrastructure facilities in Indian marine fisheries highlight shortages and congestion of fishing harbours and landing centres, insufficient auction halls, ice plants, processing and transport facilities, and poor road connectivity, all of which lead to physical and quality losses during landing, auction and onward movement[43]. The NFDB's report on Cold Chain & Post-Harvest Infrastructure Development further identifies premature harvesting, poor storage facilities, lack of infrastructure and processing facilities, and inadequate market facilities as major reasons for waste of fish and fishery by-products, with specific node-level problems such as lack of on-board icing and storage space, physical damage during fishing and unloading, open-air auctioning, insufficient potable water and ice at landing centres, lack of chilled storage, and insufficient transport facilities[44]. Scientific articles reviewing Indian post-harvest losses report that the large monetary losses (₹15,000–61,000 crore annually) are "generally the result of unhygienic handling and processing, inadequate preservation and packaging, lack of storage systems and marketing manipulations", echoing earlier CIFT studies that documented inadequate icing, rough handling, and exposure of fish at ambient temperatures during auction and retail[41]. The inland fisheries, experienced a 5.23% loss, reflecting the larger production base and economic weight. For marine fisheries, it had a much higher 10.52% loss (Table 16).

Table 16. Estimate of the Monitory Value of Harvest and Post-harvest Losses

Commodity	Production (million tonnes) (2012-13)	Price (Rs/tonne) (2013)	Overall Total Loss (%)	Monitory Value of the Losses (Rs. Crore)
Inland Fish	5.74	125306	5.23	4315
Marine Fish	3.28	125306	10.52	1235

Source: ICAR-CIPHET[45]

India's fisheries infrastructure is dominated by transportation facilities, which account for about 79% of the total, while fish retail markets and kiosks together contribute around 15%, showing a strong emphasis on distribution and end-point selling. Ice plants/cold storages and feed mills together make up less than 3%, indicating very limited upstream preservation and processing support. Within transportation, small-scale units are predominant, motorcycles (48%), bicycles with ice boxes (29%), and auto-rickshaws (16%), whereas refrigerated trucks represent only 0.9% and insulated trucks 3%, reflecting insufficient cold-chain capacity (Table 17).

Table 17. Fisheries Infrastructure Existing

Particulars	Nos.
Ice Plant/Cold Storages	70
Fish Feed Mill/Plants	127
Fish Transportation Facilities	6288

Particulars	Nos.
Refrigerated	58
Insulated Trucks	187
Auto Rickshaws	986
Motor Cycles	3036
Bicycles with Ice Box	1831
Fish Retail markets	606
Fish Kiosks including ornamental Kiosks	563
Value Added Enterprises	41

Source: Ministry of Fisheries, Animal Husbandry & Dairying[46]

The sector-supporting infrastructure (Table 18[4]) shows that ice factories constitute about 41% of fishery-related facilities, followed by curing yards (about 11%), peeling sheds (12%), and cold storage facilities (8%), while boat yards represent around 14% of infrastructure capacity. Industrial processing, through freezing and processing plants, accounts for about 11%, highlighting that the cold-chain and post-harvest preservation facilities are oriented more towards initial preservation (ice) than high-value processing and storage.

Table 18. Infrastructure – Fishery Related

Category	No. of Crafts
Boat Yards	402
Cold Storages	228
Ice Factories	1,210
Freezing plants	175
Processing Plants	160
Curing Yards	330
Peeling Sheds	352
Extraction Plants	44
Fish Meal Plants	44
Total	**2,945**

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

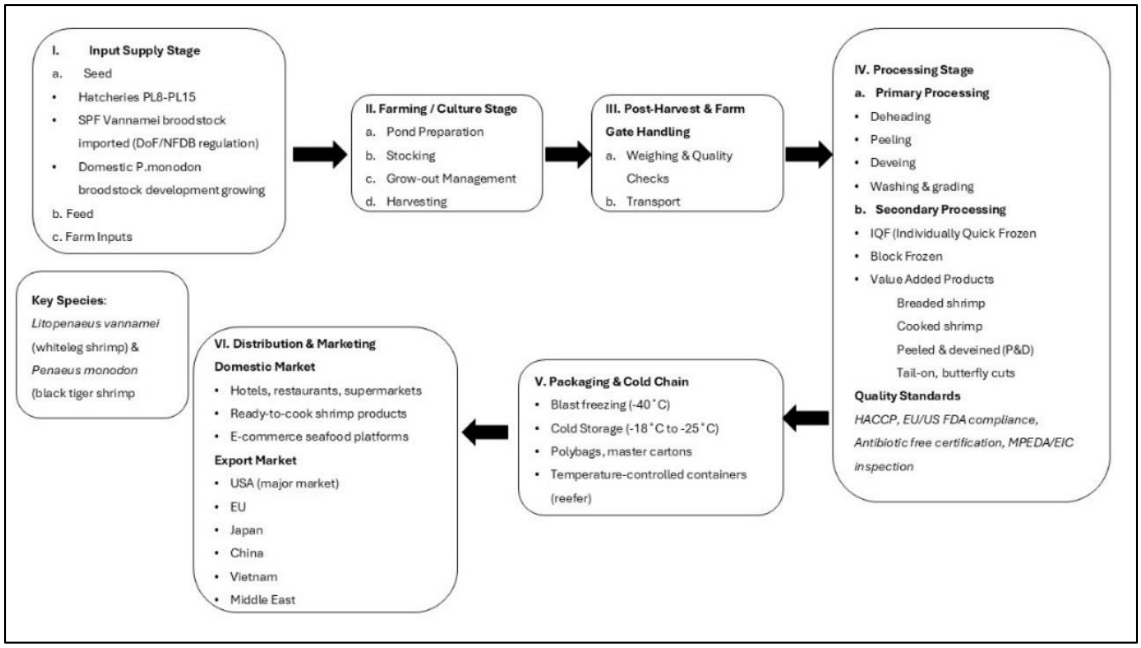

Figure 24. Shrimp Value Chain from Aquaculture

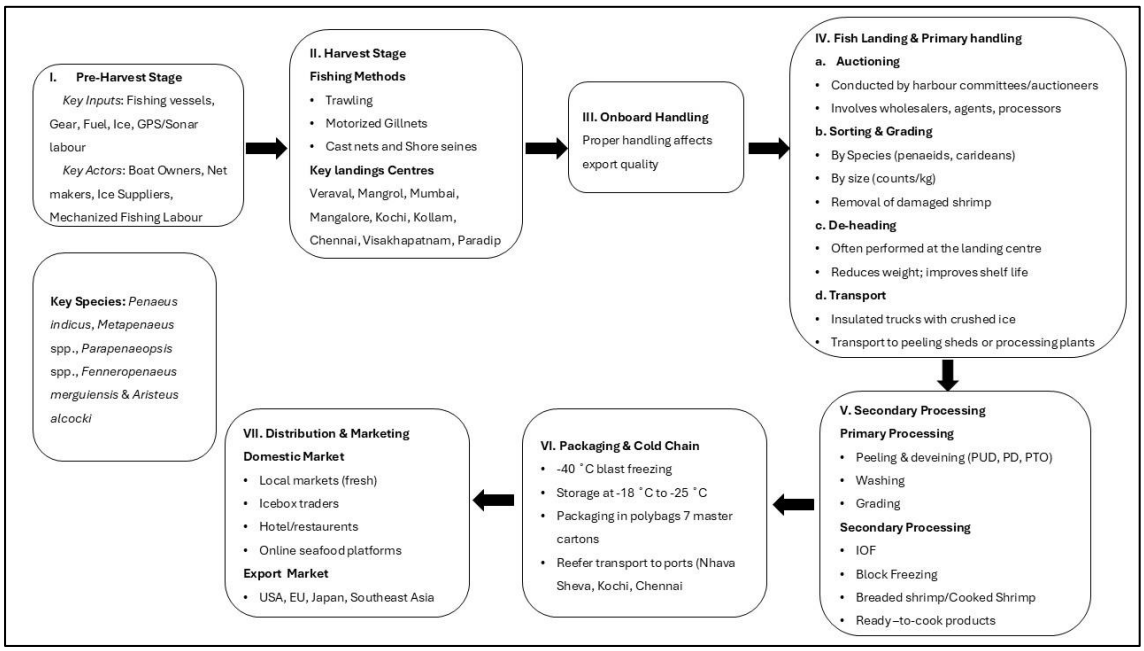

Figure 25. Shrimp Value Chain from Capture Fisheries

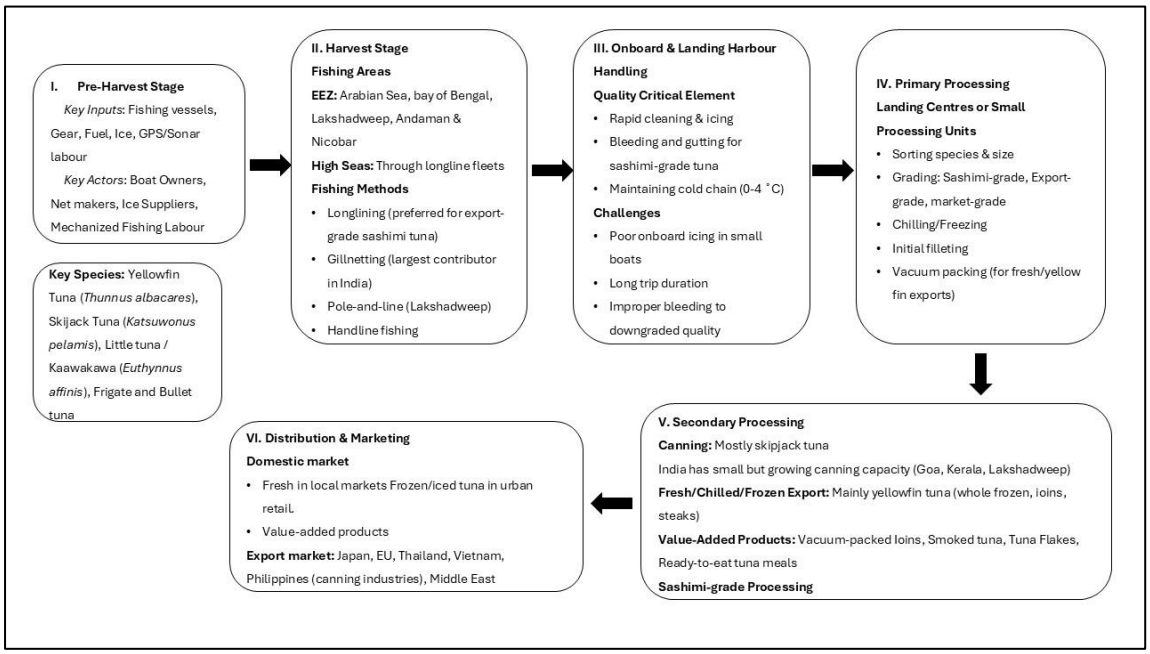

Figure 26. Tuna Value Chain from Capture Fisheries

Fig 24 depicts a shrimp aquaculture value chain, beginning with an Input Supply Stage that includes hatchery seed (PL8–PL15), SPF *Litopenaeus vannamei* broodstock under DoF/NFDB regulation, domestic *Penaeus monodon* broodstock development, feed, and farm inputs, followed by Farming/Culture, Post-Harvest & Farm Gate Handling, Processing (Primary and Secondary), Packaging & Cold Chain, and Distribution & Marketing stages, with domestic and export markets explicitly listed and quality standards such as HACCP, EU/US FDA compliance, and MPEDA/EIC inspection shown; key species are visually identified as *L. vannamei* and *P. monodon*. Fig 25 presents a wild-caught shrimp value chain, starting with a Pre-Harvest Stage showing fishing vessels, gear, fuel, ice, GPS/sonar and labour, followed by a Harvest Stage that lists trawling, motorized gillnets, cast nets, and shore seines across multiple landing centres including Veraval, Mumbai, Kochi, Chennai, and Visakhapatnam, then Onboard Handling, Fish Landing & Primary Handling with auctioning, sorting, grading, de-heading, and iced transport, moving into Secondary Processing (including PUD, PD, PTO products, IOF and block freezing), Packaging & Cold Chain, and Distribution & Marketing for both domestic and export markets; the key species box lists multiple shrimp taxa such as *Penaeus indicus*, *Metapenaeus* spp., and *Fenneropenaeus merguiensis*. Fig 26 displays a tuna capture fisheries value chain, beginning with Pre-Harvest inputs and actors similar in structure to Fig 25, followed by a Harvest Stage specifying fishing zones (Arabian Sea, Bay of Bengal, Lakshadweep, Andaman & Nicobar, and High Seas) and methods such as longlining, gillnetting, pole-and-line, and handline fishing, then Onboard & Landing Harbour Handling highlighting rapid cleaning, icing, bleeding, and cold-chain maintenance at 0–4°C, along with listed operational challenges, progressing to Primary Processing (sorting, grading, chilling/freezing, filleting, vacuum packing), Secondary Processing including canning, fresh/chilled/frozen exports, and value-added products, and finally Distribution & Marketing for domestic and export markets; the key species listed are yellowfin, skipjack, little tuna, frigate tuna, and bullet tuna. Collectively, the three images show visually comparable sequential stages from pre-production or harvest through processing, cold chain,

and marketing, while differing clearly in species groups, inclusion of aquaculture in Fig 24, auction-based landing systems in Fig 25, and sashimi-grade and canning-related processing elements specific to tuna in Fig 26.

6.4. Mitigation practices or innovations

Mitigation of fish loss and waste (FLW) in India has focused on improvements in onboard and onshore icing, hygienic handling, and development of cold-chain infrastructure, along with technology-led solutions. The expansion of insulated fish boxes, flake ice systems, and chilled seawater systems has shown reductions in microbial spoilage and quality loss onboard small-scale vessels[47], [48]. The introduction of low-cost solar-powered cold storage in coastal landing centres and village markets has demonstrated post-harvest lifespan extension of 2–4 days for fresh fish, significantly reducing waste for short-distance market chains[49]&[50]. Infrastructure upgrades for landing sites: such as sanitary auction halls, potable water access, concrete flooring, and structured auctioning procedures, have also improved hygiene outcomes and reduced physical damage during sorting and transport[51]. Packaging innovations, including MAP (Modified Atmosphere Packaging) and vacuum packing, have improved shelf-life and export quality of pelagic fish such as mackerel and sardines[52],[53]. Further, the NFDB-backed initiatives on cold-chain expansion, reefer van deployment, and fish retail kiosks have been reported to lower spoilage in high-volume urban markets[54]. Digital innovations such as traceability systems and mobile-based fish price dissemination have improved market efficiency, reduced time-to-sale, and indirectly mitigated quality losses[55].

7. Socio-economic and Gender Dimensions

7.1. Employment generated by the sector (fisheries, aquaculture, post-harvest)

Employment statistics over time show that aquaculture employment rose steadily from 17% in 1995 to about 40% in 2020 of total fisheries employment. In contrast, capture employment declined from over 81% in 1995 to about 58% by 2020, reflecting decreasing reliance on wild fisheries due to stock pressures and regulations. Within capture, inland capture employment dropped from 64% to 44%, while marine capture employment declined from around 17% to about 12%, demonstrating a gradual contraction of labour in direct fishing activities. Notably, subsistence fishing increased from 0.8% to around 1.8%, suggesting more households engaging in small-scale survival-oriented fishing, while unspecified employment categories remained below 2–3% across the period, contributing minimally to labour shifts (Table 19).

Table 19. Employment Statistics

	1995	2000	2005	2010	2013	2020
Aquaculture	1,400	1,900	2,723	4,190	4,284	5,716
Capture	**6,615**	**6,615**	9,467	9,439	8,168	**8,168**
Inland	**5,181**	**5,181**	8,492	7,775	6,255	**6,255**
Marine	**1,366**	**1,366**	**858**	1,569	1,658	**1,658**
Subsistence	**68**	**68**	116	95	255	**255**
Unspecified	**135**	**135**	7	193	256	**256**
Total	**8,150**	**8,650**	**12,196**	**13,822**	**12,707**	**14,140**

Data: Thousands; Source: FAO[56] (Bold are estimated but not verified)

7.2. The role of women in processing, trading, and marketing

According to the recent release by Press Information Bureau (citing the Illuminating Hidden Harvests (IHH) study by FAO, women play a central role in processing, trading and marketing in India's SSF. A total of 4.8 million women are engaged in SSF in India, representing roughly 40% of all persons involved in the sector. When breaking down their involvement by segment of the value chain, the study estimates that 55% of women in small-scale fisheries are involved in post-harvest handling, processing, and trade / marketing**,** substantially more than their share in pre-harvest (27%) or harvesting (18%) activities[16].

Occupational diversification beyond direct fishing (Table 20[4]) illustrates wide gender-differentiated fishery-allied engagement. In fish marketing, women constitute about 86% of those involved, and in curing/processing and peeling, women make up approximately 90% and 95%, respectively. This highlights that while men dominate active fishing segments, women are significantly more represented in the post-harvest sector. Labour activities are more evenly balanced, with about 54% women and 46% men, and other miscellaneous categories show around 57% women participation. These gender trends reflect traditional labour divisions within fisheries value chains.

Table 20. Occupation Profile and Gender-wise Fishing Allied Activities

S. No	Category	Gender		Total No.
		Male	Female	
1.	Active Fishermen			9,27,081
2.	Members involved in fishing allied activities			
	Marketing of Fish	28,551	1,81,686	2,10,237
	Marketing / Repairing Net	26,135	28,528	54,663
	Curing / Processing	4,669	43,623	48,292
	Peeling	2,514	43,643	46,158
	Labourer	53,971	62,512	1,16,481
	Other	19,726	26,187	45,914
	Other than Fishing			79,583
	Total Occupied			15,28,409

Source: CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 – India

7.3. Constraints faced by small-scale actors (e.g. access to finance, Technology)

Small-scale fishers, aquaculture farmers, and post-harvest workers in India face persistent structural constraints that limit their economic mobility despite the sector's contribution to livelihoods. A recurrent barrier is limited access to affordable credit and formal banking, with many fishers depending on informal moneylenders charging high interest rates[57], [58]. Access to technology and modern infrastructure, including insulated fish boxes, cold chains, hygienic landing facilities, GPS, and modern craft, is uneven and largely absent in small-scale fleets, especially in inland and artisanal marine fisheries[59]. Lack of secure tenure and rights of access to fishing areas, particularly for traditional coastal communities, restricts sustainable livelihood

planning and increases vulnerability to displacement by mechanised fleets[60], [61]. Further, market access constraints, including dependence on intermediaries, price volatility, and weak bargaining power, limit value capture by small-scale actors, disproportionately affecting women fish sellers and processors[62]. Seasonal fluctuations, climate variability, and extreme weather events exacerbate income instability, while limited formal social protection coverage means that most artisanal fishers operate with minimal insurance against shocks.

8. Sustainability and Resilience

8.1. Summary of stock status where available (overfishing, recovery, habitat pressures)

The stock status data indicate that in the 57-stock assessment, 72.7% of stocks are sustainable and 27.3% are unsustainable, whereas in the 51-stock assessment, sustainable stocks decline to 63% and unsustainable stocks rise to 37%, showing a worsening trend in stock health. Underfished stocks slightly decline from 23.4% to 22.1%, while maximally sustainably fished stocks decrease from 49.4% to 40.9%, indicating reduced sustainable exploitation levels. Conversely, overfished stocks increase from 27.3% to 37%, and in numerical terms, unsustainable stocks rise from 36.8% to 45.8%, demonstrating increasing pressure on fish populations. Overall, these percentages highlight a clear shift toward greater overexploitation and decreasing sustainability in stock utilization over time (Table 21&22).

Table 21. State of the Stocks: 2025

Particulars	**57 (%)**	**51 (%)**
No. of Stocks	308	470
Underfished	23.4	22.1
Maximally Sustainably Fished	49.4	40.9
Overfished	27.3	37.0
Sustainable	72.7	63.0
Unsustainable	27.3	37.0

Source: FAO[63]

Table 22. Number of Stocks in regard to their State: 2025

Particulars	**57**	**51**
No. of Stocks	193	153
No. of ASFIS Species	109	76
No. of ISSCAAP Groups	15	11
Underfished	71	39
Maximally Sustainably Fished	51	44
Overfished	71	70
Sustainable	63.2%	54.2%
Unsustainable	36.8%	45.8%

Source: FAO: SOFIA[63]

For Area 51, the updated SoSI shows a decline in underfished stocks from 3.1% to 22.5%, and maximally sustainably fished stocks from 59.4% to 47.3%, while overfished stocks decreased from 37.5% to 30.2%, resulting in sustainable stocks rising from 62.5% to 69.8%. For Area 57, the updated SoSI indicates that underfished stocks increased sharply from 11.6% to 33.5%, while maximally sustainably fished stocks declined from 51.9% to 37.6%, and overfished stocks reduced from 36.5% to 28.9%, improving the sustainable share from 63.5% to 71.1% (Table 23).

Table 23. Comparison of FAO State of Stock Indexes: Current Vs Updated for Major Fishing Areas: 2024

Area	No. of Stock Examined		Current SoSI Categories					Updated SoSI Categories				
	Current SoSI	Updates SoSI	Underfished (%)	Maximally Sustainably Fished (%)	Overfished (%)	Sustainable (%)	Unsustainable (%)	Underfished (%)	Maximally Sustainably Fished (%)	Overfished (%)	Sustainable (%)	Unsustainable (%)
51	30	298	3.1	59.4	37.5	62.5	37.5	22.5	47.3	30.2	69.8	30.2
57	39	335	11.6	51.9	36.5	63.5	36.5	33.5	37.6	28.9	71.1	28.9

Source: FAO[64]

8.2. Environmental risks (pollution, waste, carbon intensity)

India's fisheries sector is increasingly affected by interconnected environmental risks that threaten stock productivity and ecosystem stability. Pollution and anthropogenic contamination are major concerns in coastal and inland waters: industrial effluents, agricultural run-off, domestic sewage and plastic waste have contributed to declining water quality, eutrophication, heavy-metal accumulation in fish tissue, and habitat degradation in estuarine and near-shore ecosystems[65, 66, 67].

Several studies highlight that microplastic pollution has reached measurable concentrations in Indian coastal waters, including documented ingestion by commercial fish species, posing risks to food safety and consumer health[68].

Fishery-related waste, especially post-harvest discards, spoiled fish due to inadequate cold-chain management, and processing by-products, contributes to resource inefficiencies and localized organic pollution. The absence of robust recycling systems for fish offal and market waste results in improper disposal in and around landing areas and fish markets, affecting sanitation, attracting pests, and creating health risks.

Carbon intensity varies by fleet type: small-scale artisanal craft remain relatively low-carbon, whereas mechanized trawlers, purse seiners and long-range fuel-intensive fleets exhibit significantly higher CO_2[69].

8.3. Climate risks and adaptation measures

India's fisheries are increasingly vulnerable to climate-driven oceanographic and hydrological shifts, including warming sea surface temperatures, altered monsoon patterns, intensification

of cyclones, and changes in current systems. These factors affect fish distribution, spawning cycles, and migration patterns. Studies report that warming trends in the Indian Ocean have resulted in latitudinal and depth-wise shifts of pelagic species such as oil sardine and Indian mackerel, altering catch composition and availability for small-scale fleets that cannot follow shifting stocks[66, 70]. In riverine systems, altered flows due to climate variability and upstream water demand have impacted migratory fish such as hilsa, exacerbating recruitment stress[60]. Climate change also increases frequency of extreme weather events, imposing direct risks to fisher safety and operational days at sea[71].

Adaptation measures are emerging at varying scales. Government-implemented seasonal fishing bans, mesh-size regulations, and area closures help reduce biological pressure during vulnerable life-cycle stages[72]. Investments in community-scale adaptation include early weather-warning systems, GPS & VMS-enabled navigation support, and marine safety initiatives[73]. At the ecosystem level, restoration of mangroves, seagrass, and estuarine habitats enhances natural climate buffering and recruitment support[74]. Diversification into aquaculture, including brackishwater and mariculture, offers livelihood buffering against climate-related harvest volatility, though care must be taken to prevent ecological trade-offs. Adoption of lower-carbon gears, improved vessel efficiency, and fuel-optimized operational practices represent mitigation-linked adaptation strategies[Error! Bookmark not defined.]

8.4. Resilience factors (diversification, community practices, and early warning systems).

Resilience within India's fisheries sector is underpinned by multiple social, ecological, and institutional mechanisms that help buffer climate and economic shocks. Livelihood diversification, including seasonal shifts between fishing and wage labour, engagement in aquaculture, mariculture (e.g., mussel and seaweed farming), and small enterprise trading, provides adaptive flexibility and helps reduce dependency on a single fishery[64,70&75]. Many coastal communities also possess embedded traditional knowledge of sea conditions, lunar cycles, species distribution, and weather prediction, forming a foundation of community-based adaptive practices. In regions such as Kerala, Tamil Nadu, Odisha, and Gujarat, cooperative institutions play a role in resource sharing, mutual aid, and local enforcement of fishing norms, reflecting a level of community-led self-regulation[60,Error! Bookmark not defined.,76]. India has also significantly strengthened early warning and information systems, improved fisher safety and reducing operational risk. Real-time advisories from the Indian National Centre for Ocean Information Services (INCOIS), combined with state-level weather services have enhanced the accuracy and penetration of forecasts delivered to fishers through SMS, VHF radio, mobile apps, and community alert networks[71,72].

9. Governance and Policy Framework

The term value chain governance denotes the rules, actor constellations, processes and structures shaping interactions, decision-making and practices across the VC, making it possible to bring a commodity from primary production to end use. VC governance is a process of negotiation among diverse stakeholders with asymmetric power, different images about what is needed in the VC, incompatible expectations, and conflicting demands. VC governance involves the range of social processes and practices involved in solving VC problems and creating opportunities through interactions among civil, public and private VC actors

9.1. Overview of national fisheries and aquaculture policies

India's fisheries and aquaculture sector governance at the national level is anchored primarily in the National Policy on Marine Fisheries, 2017, and supported legally by national-level fisheries legislation and regulatory mandates. The National Policy on Marine Fisheries, 2017 sets the central direction for marine fisheries development, management, fleet operations, fisher welfare, stock sustainability, scientific integration, and institutional governance under the authority of the Union Government. It establishes the role of the Government in scientific management, data-based resource assessment, vessel monitoring, stakeholder consultation, and regional coordination of shared marine resources. The legislative backbone of fisheries governance includes foundational statutes enacted by the Union Government such as the Marine Products Export Development Authority Act, 1972, which creates MPEDA and empowers it to regulate marine product processing, exports, licensing of fishing vessels, and inspection mechanisms; the Territorial Waters, Continental Shelf, EEZ and Maritime Zones Act, 1976, which establishes India's sovereign rights for conservation and management of natural marine resources within national maritime zones; the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981, which regulates fishing access by foreign vessels through licensing and enforcement provisions; and the Coastal Aquaculture Authority Act, 2005, which governs aquaculture impacts, environmental regulation of coastal farms, licensing, species restrictions, and compliance of aquaculture activities with the national mandate. In addition, national-level governance of coastal marine fisheries is linked to the State-level Marine Fishing Regulation Acts (MFRAs), which each coastal state and Union Territory enacts to regulate vessel size, gear types, mesh size, seasonal closures, and fishing zones within territorial waters. While these MFRAs are sub-national instruments, their uniform structure and alignment to national legislation make them part of the broader governance framework. India's aquatic food systems are supported by key national policy instruments including the Pradhan Mantri Matsya Sampada Yojana (PMMSY, 2020–25), the National Policy on Marine Fisheries (2017), the Coastal Regulation Zone (CRZ) Notification (2011, amended 2018), national aquaculture guidelines, and the Marine Fisheries Regulation Acts implemented across coastal States.

Together, these national policies and legal statutes form the central governance architecture that regulates India's marine fisheries and aquaculture sector, including administrative authority, licensing, enforcement powers, aquaculture oversight, stock protection, maritime jurisdiction, and fisher-related regulations, with implementation coordinated by the Department of Fisheries under the Ministry of Fisheries, Animal Husbandry and Dairying.

9.2. Food safety and quality assurance systems

In India, the Marine Products Export Development Authority (MPEDA), established under the Marine Products Export Development Authority Act (1972), oversees quality control for marine product exports, regulating registration, inspection, and operational compliance of fishing vessels, processing plants, cold storage, and seafood handling facilities, including onboard conditions for catch preservation. MPEDA is authorised to carry out inspections of marine products in any fishing vessel or processing facility and ensure adherence to safety, sanitary, and contaminant standards required for export markets. Food safety governance is further supported by the Coastal Aquaculture Authority (CAA) under the Coastal Aquaculture Authority Act (2005),

mandating assessment of aquaculture units for environmental impact, species management, and effluent discharge, enabling the Authority to require environmental inspections or demolition of aquaculture units that cause pollution or chemical risk to seafood safety. Quality assurance for seafood is complemented by India's Environment (Protection) Act (1986), which empowers the Central Government to regulate and restrict industrial discharges and pollutants that may contaminate fishery resources, and establishes procedures for environmental monitoring and dissemination of pollution-related information, thereby contributing to seafood quality assurance. Many Indian seafood exporters, particularly in high-value tuna, shrimp, cephalopods, and pelagic fisheries, operate with internationally recognised food safety certification systems including HACCP, ISO 22000, GMP and SSOP, and maintain in-house or third-party accredited laboratory facilities for testing microbial loads, heavy metals, histamine, veterinary drug residues, and other safety parameters, as required under export inspection protocols administered through MPEDA and relevant agencies. Additionally, regulatory measures such as seasonal fisheries closures and restrictions on gear (as per EEZ Orders of 2017 and seasonal ban notices) also indirectly contribute to safer seafood production by improving stock condition, reducing stress spoilage, preventing illegal fishing practices, and preserving catch quality from sea to landing site[77].

9.3. Participation in international agreements (e.g., WTO fisheries subsidies, PSMA, CITES)

India's participation in international agreements shapes its fisheries governance through commitments under UNCLOS, implemented domestically via the Maritime Zones Act (1976) granting jurisdiction over marine resource management in the EEZ, and through CITES (1973), operationalized under the Wildlife Protection Act (1972) to regulate trade of endangered marine species including corals, sea cucumbers and sharks. India is a WTO member and engages in the WTO fisheries subsidies negotiations under GATT (1994), with relevance to subsidy disciplines and export frameworks, while climate and biodiversity-related commitments through CBD and UNFCCC translate into national legislation such as the Biological Diversity Act (2002) and the National Biodiversity Action Plan for habitat protection and climate resilience. India is Party to the UN Fish Stocks Agreement (UNFSA). It has not ratified ILO Convention 188, and similarly has not acceded to the FAO Port State Measures Agreement (PSMA), meaning international compliance on shared and migratory stock management and port-based IUU enforcement is addressed through national laws including the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act (1981) and State MFRAs rather than multilateral treaty obligations.

India is party to the following international conventions:

- Convention on Biological Diversity (CBD)
- Nagoya Protocol on Access to Genetic Resources and their Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar)
- United Nations Framework Convention on Climate Change (UNFCCC)

- Kyoto Protocol to the United Nations Framework Convention on Climate Change
- Paris Agreement
- United Nations Convention on the Law of the Sea (UNCLOS)
- United Nations Fish Stocks Agreement (UNFSA)

International conventions influencing fisheries domestic value chains:

- FAO Code of Conduct for Responsible Fisheries (CCRF) & Related Instruments
- WTO Agreement on Fisheries Subsidies (AFS)
- UN Convention on the Law of the Sea (UNCLOS):
- Agreement on Port State Measures (PSMA):

Related Initiatives & Standards

- FAO Voluntary Guidelines: Frameworks like the FAO's Voluntary Guidelines for Catch Documentation Schemes (VGCDS) (related to traceability) and Flag State Performance (VGFSP) support better governance and supply chain integrity.
- International Maritime Organization (IMO) Conventions: The Torremolinos Convention addresses the safety of fishing vessels, impacting infrastructure and operations within the domestic sector.
- Regional Fisheries Management Organizations (RFMOs): Regional bodies implement specific rules for shared stocks, influencing domestic fleets and market access

9.4. Institutional arrangements for managing value chains

In India, institutional arrangements for managing fisheries and aquaculture value chains span policy, statutory authorities, infrastructure funds, research institutions and collective organisations. At the apex, the Department of Fisheries (DoF), Ministry of Fisheries, Animal Husbandry & Dairying is mandated to promote and develop inland and marine fisheries "including infrastructure development, marketing, exports and institutional arrangements," and implements national schemes that explicitly target gaps along the value chain[78]. The flagship Pradhan Mantri Matsya Sampada Yojana (PMMSY) and related initiatives (e.g. Blue Revolution, FIDF, and the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana, PM-MKSSY) are designed to strengthen value chains from production to retail through investments in harbours, landing centres, cold storages, ice plants, modern fish markets, transport facilities, processing and traceability systems, and to integrate and consolidate fisheries value chains via performance-linked grants to micro and small enterprises, cooperatives, SHGs and Fish Farmer Producer Organisations (FFPOs)[79].

On the post-harvest and export side, the MPEDA, a statutory body under the MPEDA Act, 1972 – plays a central role in organising the marine products value chain for export through schemes on market promotion, capture and culture fisheries, processing infrastructure and value addition, and quality control. MPEDA's registration and inspection powers over vessels, processing plants and cold storages link harvesting, handling, processing and export certification into a single regulatory chain. Parallelly, the Coastal Aquaculture Authority (CAA) regulates coastal aquaculture siting, species and effluents, thereby shaping upstream farm-level practices and environmental performance that feed into domestic and export value chains[76]. The FIDF further

finances large value-chain assets such as harbours, landing centres, ice plants, cold storages, transport and modern fish markets across States[76].

India has introduced a National Digital Traceability Framework (2025) aimed at enabling end-to-end “net-to-plate” tracking of seafood products, supported under the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY), to strengthen compliance, transparency, and international market access.

ICAR-CIBA has developed "Design and implementation of IoT with block chain based traceability system for shrimp supply chain management (Patent 202541070414)". This is a prototype developed and field tested for shrimp end to end value chain with feedback mechanism. This QR code based system is open platform and amenable for customization to any fish and fishery products[80].

Research and technical backstopping for value-chain management are provided by ICAR fisheries institutes, notably CMFRI (capture fisheries, market and supply-chain analysis), CIFT (fishing and processing technology), and other ICAR institutes for inland and aquaculture systems. CMFRI’s work on marine fish marketing and supply chains documents how improvements in cold chains, processing and organised marketing have transformed marine fish value chains, while also highlighting persistent inefficiencies, multi-layered intermediation and price spreads[81]. Studies of market supply chains in Odisha and other coastal regions likewise underline the critical role of middlemen, credit–market linkages, and weak collective marketing arrangements in shaping value distribution along the chain. At the same time, a National Framework on Traceability in Fisheries and Aquaculture, spearheaded by NFDB/DoF, maps value-chain actors and prescribes institutional arrangements for catch documentation, batch-wise tracking and digital records from harvesting through processing and export. National Fisheries Development Board Downstream, state fisheries departments, cooperatives, FFPOs/producer companies, women’s SHGs, and market committees manage local landing centres, auctions, retail markets and small-scale processing, often supported by PMMSY and state schemes for ice plants, cold storage, retail kiosks and mobile fish vending units. Empirical reviews of government support measures show that subsidies and public investment now extend across almost every stage of the marine fisheries value chain, from inputs and harbour infrastructure to storage, retail, processing and social protection, highlighting the importance of aligning these interventions with efficiency, equity and sustainability objectives.

10. Key Challenges and Opportunities

India is a fisheries-rich nation, yet our value chain knowledge and research remain fragmented and location-specific. The existing literature and technical assessments are primarily generated by specialized institutions such as ICAR–CIFT, NIFPHATT, and fisheries universities, along with scattered project-based studies. However, there is no nation-wide coordinated programme for assessing the fish value chain and other aspects, which results in uneven data, regional blind spots, and sub-optimal national planning.

10.1. Most pressing constraints (production, markets, nutrition, gender, governance)

Production

- **Rising pressure on fish stocks**, with unsustainable stocks increasing to 37–45.8%, indicating overfishing and weak enforcement of science-based management.

- **High post-harvest losses**, especially in marine fisheries (up to 10.52%), driven by inadequate onboard handling, poor icing, and infrastructural gaps at landing centres.
- **Uneven access to modern technology and infrastructure** among small-scale and inland fishers, including limited cold-chain facilities, insulated boxes, and climate-resilient vessels.
- **Climate variability and extreme weather events** affecting production stability, fishing days, and fisher safety.

Markets

- **Fragmented and intermediary-dominated market structures**, leading to weak bargaining power and price volatility for small-scale producers.
- **Inadequate cold-chain and transport infrastructure**, constraining quality preservation and access to distant or higher-value markets.
- **Uneven compliance capacity** with food safety, quality standards, and traceability requirements, excluding many small producers from premium domestic and export markets.
- **Limited collective marketing arrangements**, especially for artisanal fishers and women vendors.

Nutrition

- **Persistent triple burden of malnutrition**, with high levels of child undernutrition, widespread micronutrient deficiencies (iron, calcium, iodine, vitamin B_{12}), and rising overweight/obesity.
- **Underutilisation of nutrient-dense small indigenous fish species** in public nutrition and social protection programmes.
- **Weak nutrition surveillance**, as national nutrition surveys do not track species-level fish consumption, limiting evidence-based planning.

Gender

- **High female participation but low empowerment**, with women constituting 86–95% of post-harvest roles (processing, curing, peeling, marketing) but remaining largely informal.
- **Limited access for women to institutional credit, assets, and infrastructure**, constraining enterprise growth and income security.
- **Under-representation of women in cooperatives, leadership, and decision-making**, despite their central role in value chains

Governance

- **Fragmented value-chain data and research**, with no nationwide coordinated assessment system, leading to regional blind spots and sub-optimal planning.
- **Uneven implementation and enforcement** of fisheries regulations across states, particularly Marine Fishing Regulation Acts (MFRAs).

- **Gaps in international alignment**, including non-accession to PSMA and UNFSA, limiting transparency and coordination on IUU fishing and shared stocks.
- **Institutional complexity and coordination challenges** across multiple agencies managing production, markets, nutrition, and sustainability objectives.

10.2. Promising opportunities or best practices that could be scaled up

Production

- **Scaling climate-resilient aquaculture systems**, including low-impact inland and coastal aquaculture, to stabilise production and reduce pressure on overfished marine stocks.
- **Expansion of ecosystem-based fisheries management**, using CMFRI stock assessments to guide gear restrictions, seasonal bans, and effort regulation.
- **Upgrading onboard handling and post-harvest practices**, including improved icing, insulated fish boxes, and crew training, to reduce losses and enhance quality.
- **Leveraging early warning and safety-at-sea systems** (INCOIS advisories, weather alerts) to reduce climate-related production risks.

Markets

- **Strengthening cold-chain and market infrastructure** (landing centres, ice plants, cold storages, reefer transport, modern fish markets) through PMMSY and FIDF investments.
- **Scaling digital traceability systems** under the national "net-to-plate" framework to improve transparency, compliance, and market access for small-scale producers.
- **Promoting collective marketing models**, including cooperatives, FFPOs, and SHGs, to improve bargaining power and reduce dependence on intermediaries.
- **Expanding value addition and processing**, including dried, frozen, packaged, and ready-to-cook products, to capture higher domestic and export value.

Nutrition

- **Mainstreaming small, nutrient-dense fish species** into national food, nutrition, and social protection programmes (school meals, maternal nutrition, safety nets).
- **Developing affordable fish-based nutrition products** (dried, powdered, smoked fish) suitable for rural and low-income households.
- **Improving nutrition evidence and planning** by integrating species-level fish consumption into national dietary and nutrition surveys.
- **Leveraging rising domestic fish consumption trends** to promote healthier dietary shifts away from calorie-dense, nutrient-poor foods.

Gender

- **Formalising women's roles in value chains** through stronger inclusion in cooperatives, FFPOs, and SHGs to improve access to credit, assets, and markets.

- **Scaling women-led enterprises** in fish processing, curing, peeling, retailing, and value-added products through targeted financial and enterprise support.
- **Expanding skill development for women**, particularly in quality handling, packaging, cold-chain operations, and business management.
- **Using women-dominated post-harvest segments** as entry points for inclusive value-chain upgrading and income diversification.

Governance

- **Leveraging strong national policy frameworks and schemes** (PMMSY, National Marine Fisheries Policy, FIDF, PM-MKSSY) to align production, markets, nutrition, and sustainability objectives.
- **Strengthening inter-institutional coordination** across DoF, MPEDA, CAA, NFDB, and state departments for end-to-end value-chain governance.
- **Scaling national digital systems** for traceability, data collection, and monitoring to address fragmentation and improve evidence-based planning.
- **Building on community institutions and cooperatives**, especially in coastal states, to support co-management, compliance, and local enforcement.

11. Priority Policy Recommendations

11.1. Key actionable policy recommendations linking aquatic foods, value chains and Food Security and Nutrition (FSN - six dimensions)

S. No	FSN Dimension	Policy Recommendation	Rationale	Supporting evidence
1	**Fish Loss & Waste (FLW)**	Launch a national FLW reduction and cold-chain strengthening programme through modernization of fish landing centres, expansion of cold storage, ice plants, insulated and refrigerated transport, and standardized hygiene infrastructure across the post-harvest value chain.	Marine post-harvest losses are high, reaching 10.52%, particularly due to cold-chain gaps.	Marine fisheries losses increased from 2.78% to 10.52%; Table 14 shows quantitative evidence of high post-harvest losses
		Expand cold storage, ice plants, refrigerated and insulated transport, and standardised auction and landing centre	Only a small share of infrastructure supports cold storage; heavy reliance remains on ice-only storage..	Table 17 & Table 16 show only 228 cold storages vs 1,210 ice factories & low

S. No	FSN Dimension	Policy Recommendation	Rationale	Supporting evidence
		hygiene facilities to ensure cold-chain continuity from harvest to market.		refrigerated transport capacity.
		Strengthen on-board handling, icing, and hygienic fish handling through structured capacity-building and certification-based training programmes for vessel crews and landing-centre workers.	Vessel/landing centre handling is a major point of quality decline and physical loss.	Causes of fish loss include poor onboard icing, physical damage, and exposure at landing (NPC study and NFDB findings).
2	**Gender Inclusion**	Support women-led enterprises in curing, peeling, processing and marketing through targeted financial inclusion, enterprise development schemes, and preferential access to infrastructure and markets.	Women comprise 86–95% of these roles but lack financial/enterprise support.	Table 19 shows women constitute 86% in marketing, 90% in curing/processing, and 95% in peeling.
		Formalise women's inclusion in cooperatives, FFPOs & SHGs to improve access to institutional credit, decision-making, and value-chain integration.	Entry into formal institutions increases access to credit and bargaining power.	Table 4 shows 73% of cooperative membership in fisheries-specific cooperatives.
		Provide women-focused skill development for value-added packaging, cold-chain operations, and value-added fish processing to strengthen income security and leadership in post-harvest value chains.	Skill upgrading increases income through improved product quality and market access.	Evidence of women dominating post-harvest occupations shown in occupation profile.

S. No	FSN Dimension	Policy Recommendation	Rationale	Supporting evidence
3	**Compliance & Trade Readiness**	Strengthen food safety regulation and quality control from harvest to export through harmonised inspection, certification, and compliance enforcement across domestic and international markets.	Export markets demand strict compliance; small producers often excluded due to weak systems.	MPEDA governs inspection & export-quality compliance
		Implement decentralized traceability systems for small-scale producers under the national net-to-plate framework to enable access to premium domestic and export markets.	Allows small operators to meet certification and access premium markets.	National traceability framework in development under DoF/NFDB
		Harmonise domestic rules with WTO trade disciplines & species trade rules international SPS standards, and species trade provisions.	Facilitates global access & prevents export blockages.	India's engagement with WTO/CITES/CBD documented
4	**Environmental Sustainability**	Strengthen habitat protection and ecosystem-based fisheries and management, and science-based fishing effort regulation to restore depleted marine and inland fish stocks.	Overfished stocks increased to 37–45.8% unsustainable harvest pressure.	Table 20 & 21 show rising unsustainable stock status from 36.8% to 45.8%.
		Promote low-impact climate-resilient aquaculture systems and strictly & enforce effluent treatment and biosecurity compliance	Expanding aquaculture must avoid habitat degradation	Aquaculture dominates 72% of production
		Promote offal utilisation, by-product recovery, and fishmeal	Addresses ecological waste and economic	Processing by-products currently poorly utilized

S. No	FSN Dimension	Policy Recommendation	Rationale	Supporting evidence
		conversion to reduce ecological waste and improve resource efficiency.	inefficiency in processing systems.	
5	**Nutrition Contribution**	Promote small-nutrient-dense fish in national species through national food, nutrition, and social protection programmes to address calcium, iron, iodine, and vitamin B12 deficiencies.	Small fish supply Ca, Fe, I, B12, essential for combating malnutrition	India shows widespread micronutrient deficiencies & potential from SIS
		Develop affordable fish-based nutrition products for rural households, school feeding, and maternal nutrition programmes.	Addresses child & maternal nutrient gaps using locally available foods.	Per capita fish intake increased by 81.43%, indicating demand acceptance
		Integrate species-level fish consumption tracking into national nutrition and dietary surveys.	Enables evidence-based nutrition planning	Current NFHS does not track fish species intake
6	**Climate Resilience & Readiness**	Expand climate-resilient aquaculture & systems, early warning services, and safety-at-sea infrastructure to address climate-driven variability and extreme weather risks.	Rising climate-driven variability affects stock access, production stability, and fisher safety	Fisheries face climate risks & shifting species distributions
		Upgrade fishing harbours, vessels, and nearshore infrastructure for cyclone, storm surge, and rough-sea resilience.	Small-scale fishers most vulnerable to climate-related loss fishing days	Infrastructure modernization needed for climate events
		Introduce micro-insurance & livelihood diversification, and shock-buffering social protection schemes for small-scale fishers.	Reduces crisis-induced poverty risk among fishers	Most artisanal fishers lack social protection & insurance coverage

11.2. Recommendations (specific, feasible, and linked to national priorities)

Dimension	Policy Action(s)	Linked National Policy / Strategy
1. Fish Loss & Waste (FLW)	1. Implement national FLW reduction plan across landing, transport, processing & retail, prioritising marine fisheries where losses reach 10.52%	Pradhan Mantri Matsya Sampada Yojana (PMMSY); National Fisheries Policy (Draft 2020); Fisheries Infrastructure Development Fund (FIDF)
	2. Expand cold storage, ice plants, refrigerated transport & auction hall hygiene upgrades	PMMSY; FIDF; Ministry of Fisheries Infrastructure Investments; NFDB Cold-Chain Modernization Plan
	3. Strengthen on-board handling, icing practices, and scientific quality control training	CIFT post-harvest technology initiatives; MPEDA quality compliance directives; DoF skill-development frameworks
2. Gender Inclusion	1. Support women-led fish retailing & processing enterprises through SHGs, FFPOs & women cooperatives	National Fisheries Policy (2017–draft); PMMSY women-led entrepreneurship schemes; NRLM SHG strengthening
	2. Expand women's access to formal cooperative membership, credit, fleet equipment, and retail spaces	Cooperative Development Framework; State Fisheries Cooperative Acts; PM–MKSSY value-chain microenterprise support
	3. Provide targeted training for women in handling, packaging, processing, and fish marketing	Skill India; ICAR–CIFT women training programmes; PMMSY manpower capacity initiative
3. Compliance & Trade Readiness	1. Strengthen HACCP/ISO and domestic food safety standards for fish supply chains	MPEDA Act 1972; FSSAI seafood standards; MPEDA export-quality mandates
	2. Deploy traceability systems for small fishers and small aquaculture producers	National Framework on Traceability (NFDB/DoF); Digital fisheries database initiatives
	3. Align India's marine governance and inspection standards with WTO trade frameworks	WTO Seafood Subsidy Negotiations; Export Promotion Schemes; MPEDA export regulatory compliance
4. Environmental Sustainability	1. Restore estuarine/river habitats and protect marine spawning grounds	National Biodiversity Act (2002); National Marine Fisheries Policy; Coastal Regulation Zone (CRZ) notifications
	2. Expand ecosystem-based fisheries management, gear restrictions & fishing bans where stocks are overfished	State MFRAs; National Marine Fisheries Policy; CMFRI stock assessment–based management

Dimension	Policy Action(s)	Linked National Policy / Strategy
	3. Promote low-impact aquaculture and reduce harmful effluents	Coastal Aquaculture Authority Act (2005); National Aquaculture Guidelines; Environment Protection Act (1986)
5. Nutrition Contribution	1. Promote consumption of small indigenous fish species through public health nutrition messaging	NFHS nutrition framework; National Food Security Act; Poshan Abhiyaan nutrition mission
	2. Support development of low-cost dried, powdered, smoked fish products for low-income households	PMMSY value-addition investments; MPEDA value-added seafood development
	3. Include species-level fish intake in nutrition surveys and dietary surveillance	NFHS surveys; ICMR dietary guidelines; IFCT 2017 nutrient characterisation for fish
6. Climate Resilience & Readiness	1. Integrate climate early-warning, INCOIS advisories & safety-at-sea systems	INCOIS advisories; National Disaster Management Authority; Ministry of Earth Sciences forecasting systems
	2. Modernise fishing vessels & harbours for extreme weather durability	PMMSY harbour modernization; FIDF fleet reinforcement funding; State fisheries infrastructure programmes
	3. Expand fishers' micro-insurance, risk-transfer & livelihood diversification	PMMSY insurance support schemes; Pradhan Mantri Jeevan Jyoti & Suraksha Bima Yojana integration; State fisher welfare schemes

12. Provide the traffic-light scoring for the six key dimensions

Dimension	Score (1–5)	Colour	Key Notes
Fish Loss & Waste	**2**		India's marine post-harvest losses are significant, reaching 10.52%, mainly due to inadequate icing, rough handling, infrastructural gaps at landing centres, and limited cold-chain distribution. Inland losses are somewhat lower (5.23%) but still material. **Explanation: The score reflects moderate progress but large remaining losses that reduce quality, value, and nutrition access.**
Gender Inclusion	**2**		Women dominate post-harvest roles, making up 86–95% in processing, peeling, and marketing, yet their roles remain informal and under-recognised. Limited access to finance, cooperative leadership, bargaining capacity, and formal credit mechanisms restrict empowerment and income security. **Explanation: Score reflects high female participation but low empowerment and institutional inclusion.**

Dimension	Score (1–5)	Colour	Key Notes
Compliance & Trade Readiness	**3**		India maintains strong export-quality frameworks through MPEDA inspections, HACCP compliance, ISO standards, and regulatory oversight. However, readiness is uneven among small-scale suppliers, limited traceability, variable quality handling, and differential compliance capacity create internal disparities. India is engaged in WTO seafood commitments but not a PSMA party, which limits IUU alignment transparency. **Explanation: Score indicates strong export compliance but incomplete international enforcement coverage**
Environmental Sustainability	**2**		Stock assessments show concerning decline trends, with unsustainable stocks rising from 27.3% to 37–45.8% depending on dataset, revealing growing pressure on fish populations. Ecosystem restoration, gear regulations, and fishing bans exist but require stronger implementation and ecological enforcement, especially regarding trawling and habitat degradation. **Explanation: Score based on stock degradation trends and limited effective ecosystem enforcement.**
Nutrition Contribution	**3**		Fish consumption in India rose by ~120%, and per-capita annual fish consumption increased nearly 81%, demonstrating strong protein contribution from aquatic foods. Small fish species provide critical micronutrients (Ca, Fe, I, B12), yet national nutrition systems do not fully integrate species-level intake tracking. Micronutrient deficiencies remain high among women and children, indicating partial fisheries nutrition capture. **Explanation: Score reflects strong contribution to dietary protein but incomplete micronutrient correction at population scale.**
Climate Resilience & Readiness	**3**		India has strong climate-readiness measures including INCOIS real-time forecasts, early warning dissemination, and diversification of income through aquaculture expansion. However, climate risks, warming waters, shifting species distributions, and extreme weather, still significantly impact small-scale fishers who lack widespread insurance and adaptive fleet capability. **Explanation: Score based on robust progress in climate services, but incomplete capacity at community level.**

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