

# Championing the blue economy: Promoting sustainable growth of the fisheries sector in India

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pwc

FICCI

# Message from FICCI

India is the world's second-largest fish-producing nation and contributes 7.56% of the global fish production. The country's fisheries sector is a source of livelihood to over 50 million people.[1] Further, the sector has grown at the rate of 7% in recent years.[2]

The total value of exports from the fisheries sector was INR 46,662.85 crore[3] in 2019–20, with scope for further growth. To realise the potential of the sector, strong financial and policy interventions are required for its sustainable growth.

Fisheries as a sector has the ability to create livelihood opportunities for millions of people, and hence has a significant role to play in the socioeconomic development of the nation.

Moreover, the revival of the blue economy can help in mitigating the climate change impacts. Given the close linkage of the blue economy with numerous sectors, the impact of any new changes in terms of economic, social and environmental growth will be far more wide ranging. The conservation and development of intangible 'blue' resources – such as preserving biodiversity, carbon sequestration, coastal resilience, sustainable fishing, lower carbon emissions at sea, efficient marine logistics, sustainable fisheries supply chain and traceability – have implications for multiple markets and user demographics.

Given India's vast fisheries resources, the blue economy can help us achieve our national goals for socioeconomic growth and also lead the way for much-needed change globally.

This report focuses on the huge potential of India's fisheries sector and why it is necessary to redraw our strategies to build a sustainable and profitable future for the sector at the earliest.



**Devleena Bhattacharjee**

Chairman, FICCI FishTech Subcommittee

1 Handbook on Fisheries Statistics: 2020
2 Ibid.
3 MPEDA website

# Message from PwC

Ensuring food security has been a challenge across the world. By 2050, about 50% more food needs to be produced globally in order to meet the demands of the increasing population. Factors such as rapid climate change and the COVID-19 pandemic have made this situation even more complex. The fisheries sector has the potential to play a significant role in meeting the growing food requirement. Fish consumption helps in attaining nutritional security, while fishing is a resilient economic activity across the globe. In India, the fisheries sector has been growing at a rate of about 5%[4] in the last 20 years and contributes to above 7% of global fish production. Although the Indian fisheries sector is flourishing steadily, there are several challenges – such as limited access to services, inputs and technologies, insufficient infrastructure, inefficient market channels, poor price discovery mechanism, post-harvest losses, and depleting fish stocks – which need to be addressed in a timely manner for the sector to expand sustainably.

The Government's focus on fisheries infrastructure development and welfare of fishers is enabling the growth and sustainability of the sector. Simultaneously, new-age production technologies are creating opportunities to enhance the yield using fewer resources. At this crucial juncture, there is a need for fast adoption and greater use of new production techniques, introduction of efficient end-to-end supply chain methods and easy access to extension services for fishers and fish farmers. Private entities can also play an effective role with the help of data-driven technologies, innovation, efficient equipment, processing and export, domestic retail market chain, and digital and physical outreach.

Considering the importance of water in sustainability, the fisheries sector plays a significant role in achieving the Sustainable Development Goals (SDGs) and solves many problems like poverty, hunger, gender disparity and conservation of water bodies. Hence, conducive policies and schemes, necessary regulations, effective support to stakeholders and uninterrupted monitoring are important for the sustainable growth of the 'blue economy' in India.

This knowledge paper presents the trends, opportunities, challenges and potential strategic interventions that can be adopted to support the blue economy in India. The need for technologies like radio frequency identification (RFID), internet of things (IoT) and blockchain for traceability or efficient production systems like recirculating aquaculture system (RAS), and mariculture is indisputable. However, successful adoption of these technologies will only be possible through awareness building among fishers and aqua farmers, coupled with the active participation of private and Government players.

India is already among the global leaders in fish production and export. Now it is time to move further ahead towards production diversification, expansion of export volumes and nutrition and economic support to all the stakeholders of the fish value chain.



**Ashok Varma**

Partner and Head, Social Sector Advisory

PwC India

[4] Handbook on Fisheries Statistics: 2020

# Executive summary

The global food demand is expected to increase rapidly due to the growing world population. Owing to the rapid depletion of land-based resources and the growing impact of climate change, attempts are being made to boost food production in order to meet this rising demand. In this situation, fish has a significant role to play as it is an affordable source of animal protein and has a lower impact on the environment. Globally, fish production has grown by 41% in the last two decades, largely due to the rise of aquaculture.[5]

India is the second-largest fish-producing country in the world and contributes about 7.56% of the global fish production.[6] Fisheries production is growing at about 11% annually since 2014–15 and contributed 1.26% to India's gross domestic product (GDP) in 2019–20.[7] The export value of fish and aqua products grew at a rate of 12.73% in the last 15 years.[8] Due to growing demand and high potential, the fisheries sector is referred to as a sunrise sector. The thrust factors for the sector include huge scope for domestic consumption (as per capita domestic consumption in India is only one-third of average global consumption), strong export potential (annual growth rate of 7%),[9] greater economic returns and strong policy support.

Despite the constant growth in production, the fisheries sector faces a diverse set of challenges based on the method of production. Most marine fishers are socioeconomically backward and operate at a smaller scale. Depleting fish stocks and lack of easy access to facilities such as credit, market and cold chain are the major issues in the case of marine fishers. Aquaculture, which contributes a major share of the total production, has to deal with poor water quality and lack of quality inputs (seed, feed etc.), extension services, credit facilities and market access. Post-harvest loss, lack of technology adoption, insufficient cold chain and a poor price discovery mechanism are a few of the common issues among marine and inland fisheries.

The fisheries sector has the capacity to strengthen livelihood opportunities and address nutrition and food security. However, the sector's dependency on water bodies is a challenge to its sustainability and ensuring this is key to achieving the Sustainable Development Goals (SDGs). The Food and Agriculture Organization's (FAO) 'Code of Conduct for Responsible Fisheries' has been recognised and adopted by the global community. Yet, several factors such as unscientific management practices, increasing production, increased water stress, higher disease incidence, collapsing marine stocks and distress harvesting are negatively impacting the fisheries ecosystem. Therefore, it becomes all the more important for fishers to adopt sustainable and more responsible fish farming practices. The onus also continues to remain on the demand side, and responsible consumption practices need to be promoted through consumer awareness.

A range of strategic interventions are required to realise the true potential of India's fisheries sector. Strong policy-level support from the Government can help optimise these interventions. Various measures taken by the Government such as the Pradhan Mantri Matsya Sampada Yojana (PMMSY) and Fisheries and Aquaculture Infrastructure Development Fund (FIDF) provide much-needed institutional finance and technical support to stakeholders, especially fish farmers and fishers. Also, a conducive policy environment plays a vital role in encouraging entrepreneurs and private agencies to participate in the fisheries sector's activities.

In order to fill the gaps in the fisheries value chain and strengthen stakeholder participation, collectivisation of fish farmers and fishers is considered as one of the key interventions to improve access to investments, infrastructure, technology, inputs and markets. Fish farmer producer organisations (FFPOs) help to strengthen the collectivisation efforts in the fisheries sector. These organisations can serve as an institutional platform for delivery of products and services, market linkages, and credit and capacity building for fishers and fish farmers.

5 FAO Statistical Yearbook 2021
6 Handbook on Fisheries Statistics: 2020
7 Agricultural statistics at a glance 2020
8 Ibid.
9 Ibid.

Improving production efficiency sustainably is the need of the hour. Innovative production techniques like RAS systems, biofloc technology, aquaponics, cage culture and mariculture can help in the development of a modern and efficient production ecosystem. For example, in India, mariculture has a projected annual production capacity of 4–8 million tonnes. However, the current actual production in the country is negligible.[10] Mariculture has huge potential to create sustainable livelihoods for marine fishers. Collection and analysis of data by using transponders, satellites and drones is one of the crucial aspects for managing the marine fish population, and will also help in precision fishing. Adoption of emerging technologies like big data, blockchain, automatic identification system (AIS) and IoT-based supply chain systems can help in minimising losses, improving traceability and achieving sustainability. Traceability systems can provide reliable end-to-end tracking from production to consumption, thus translating into better profit margins, enhanced customer loyalty and improved brand reputation. Moreover, FishTech companies and entrepreneurs can be encouraged to contribute to this growing sector with innovation, technology, extension services, supply chain and retail marketing. A combination of technology adoption, sustainable vision, strong policy support and inclusive participation of key stakeholders can help in achieving the sector's full potential.



[10] https://nfdb.gov.in/PDF/Fish%20&%20Fisheries%20of%20India/1.Fish%20and%20Fisheries%20of%20India.pdf

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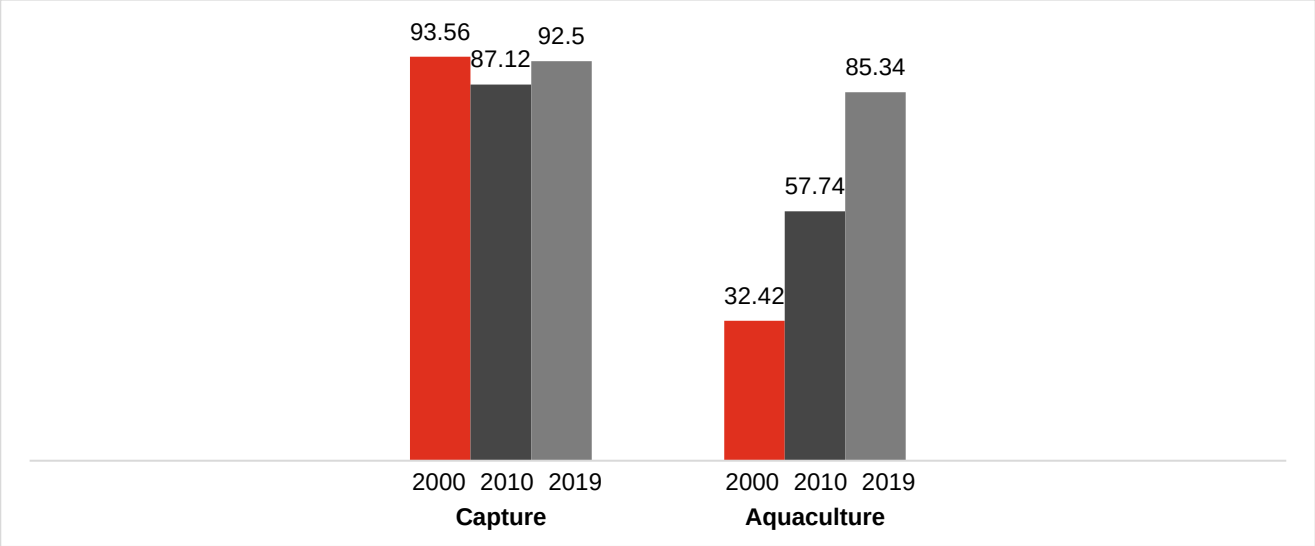



# 1. Fisheries: A sunrise sector



The world's population is expected to increase by two billion in the next 30 years, from the current 7.7 billion to 9.7 billion in 2050.[11] The global average per capita per day calorie intake has increased by 9% in the last two decades. This increasing volume of food requirement demands sustainable production and distribution of food items from different sources. Currently, 17% of the total animal protein consumed comes from fish. In the last 60 years, the average growth rate of total fish intake was about 3.1%, which is significantly higher than the population growth rate of 1.6%.[12]

**Global trend of fisheries production (million MT)**




Source: FAO Statistical Yearbook 2021

One of the key drivers of increasing fish consumption is the steady growth in fish production across the globe. Fisheries and aquaculture production has experienced 41% growth in the last two decades. This significant expansion came with several transformations, including substantial changes in the sources of production. Although the volume of capture fishing in the world has almost been constant, aquaculture has been the major source of increasing production, with a growth rate of 5.23%.[13]

Capture fisheries are heavily concentrated in a few major fish-producing countries. The top seven countries – China, Indonesia, Peru, India, Russia, the USA and Vietnam – contribute about 50% to the total global marine capture. Similarly, the top seven producers of inland capture – China, India, Bangladesh, Myanmar, Cambodia, Indonesia and Uganda – contribute 59% to the total inland catches. Asia and Africa contribute 66% and 25% respectively to the global inland catches.[14]

Despite continuous growth across the globe, a similar uneven distribution pattern has been observed in aquaculture production. Asia contributes 89% of the total aquaculture production of the world (China: 58%; India: 8.61%; and Indonesia: 6.61%). China is the global leader in production, with a share of nearly 30%. China, India and Indonesia collectively produce half of the world's total fish. Around 60 million people are engaged in the fisheries sector for their livelihoods across the globe. Of these, 39 million people are involved in capture fishing and 21 million people in aquaculture.[15]

11 https://www.un.org/en/global-issues/population
12 The State of World Fisheries and Aquaculture 2020; published by FAO
13 FAO Statistical Yearbook 2021
14 The State of World Fisheries and Aquaculture 2020; published by FAO
15 Ibid.

## Demand for and consumption of fish food across the globe

Globally, food demand is expected to increase in the range of 59–98% by 2050.[16] To meet this demand, the agriculture and allied sectors will be required to produce almost 50% more food in 2050 than they did in 2012. At the same time, climate change has been posing challenges to food and nutritional security. At this crucial juncture, fish and aqua products could play a pivotal role in fulfilling the food demand of the growing population, along with providing balanced protein intake across the globe.

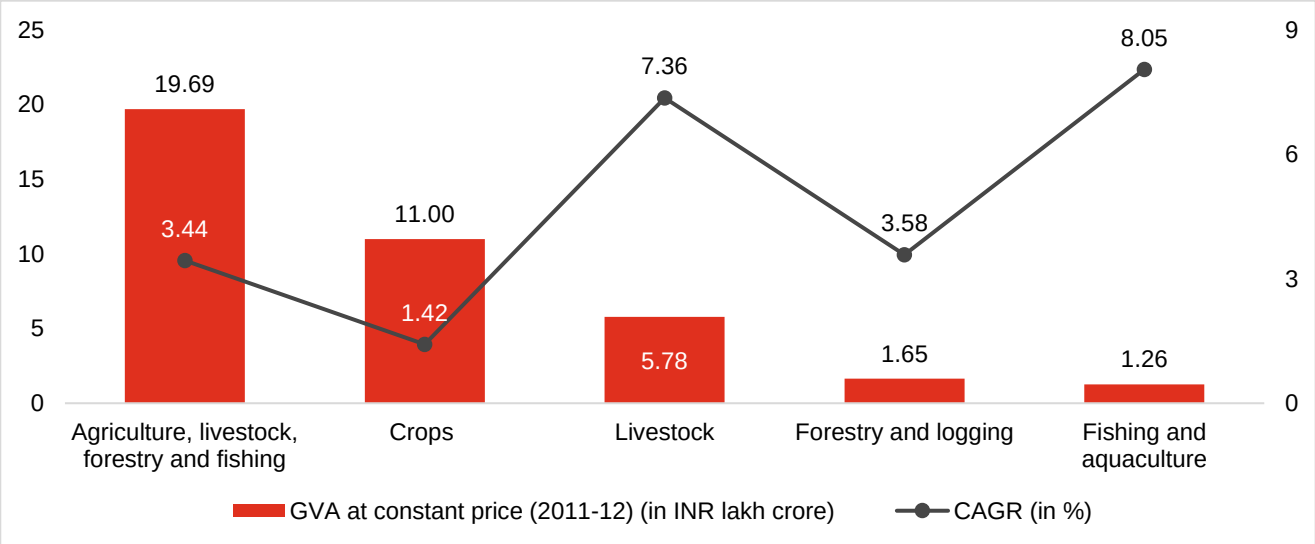
In 2018, 156 million tonnes of fish were used for human consumption and non-food usage were 22 million tonnes. The global average of annual per capita availability of fish is 20.5 kg, which has enhanced at a rate of 2.4% annually in the last six decades.[17] Mostly live, fresh or chilled fish is preferred for direct human consumption. Out of the total fish consumption, 44% is live and fresh, 35% is frozen, 11% is prepared and 10% is cured.[18] The use of seaweed and aquatic plants is gradually increasing for industrial purposes, especially in medicines, cosmetics, paint, paper and biofuels. The global production of seaweed was 32,386 thousand tonnes in 2018, and it is expected to double by 2025. Currently, China contributes around 56% of the global seaweed production.[19] The increasing demand for seaweed has created opportunities for the fishing community to diversify their livelihoods through sustainable practices. Seaweed farming has been initiated in India at a small scale in coastal areas of Tamil Nadu and Andhra Pradesh.

Both fish and meat exports account for approximately 11% of the total food export value each, globally.[20] The total annual fish export volume was 67.1 million tonnes in 2018, which is around 38% of the total production value of USD 164 billion.[21] Asian countries – China, Vietnam, India, Thailand – and Norway and Chile are the global leaders in fish exports.

## A sunrise sector

The fisheries sector is recognised as a high-potential sector in India, considering its impact on the socioeconomic development of the country. Fish is an inexpensive and nutritious food with high protein content. Moreover, it provides livelihoods to 28 million people in India, including a large economically disadvantaged population.

**Sector-wise gross value added (GVA) in 2019–20 and compound annual growth rate (CAGR) between 2011–12 and 2019–20**




Source: Agricultural statistics at a glance 2020

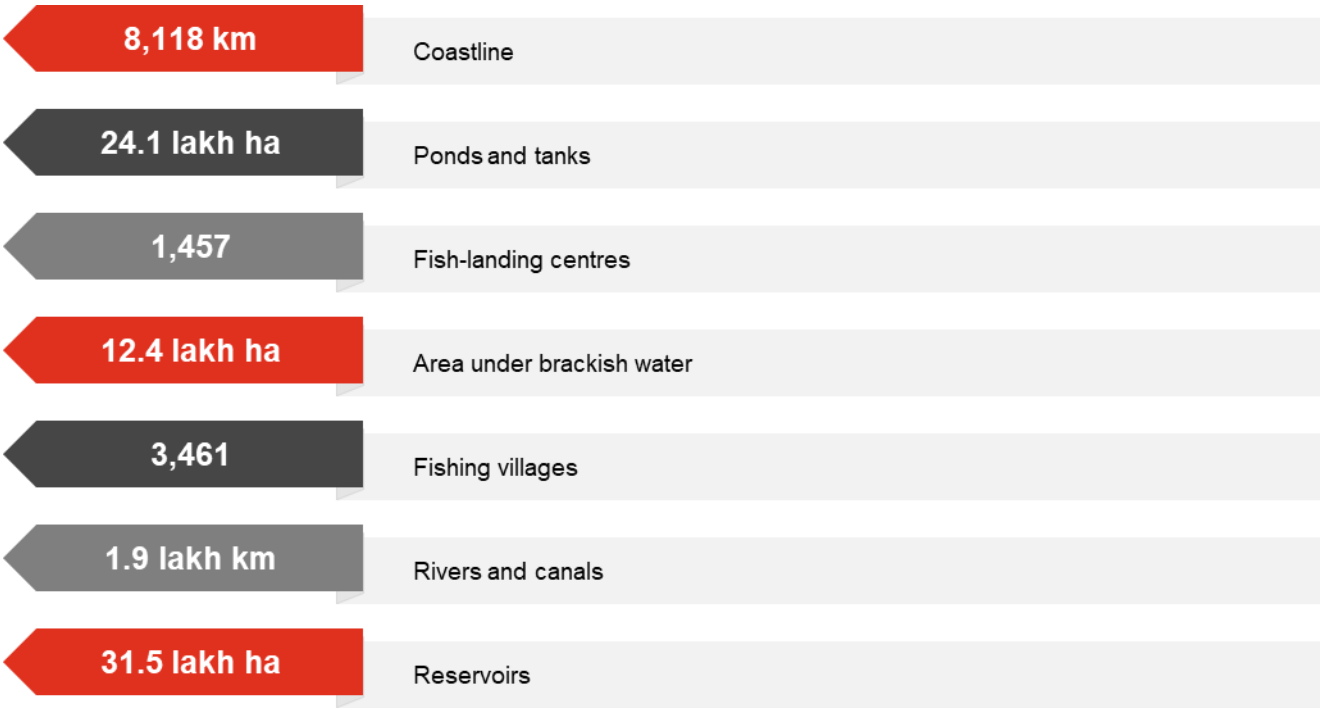
16 World Fisheries and Aquaculture, FAO 2020
17 The State of World Fisheries and Aquaculture 2020 (FAO)
18 Ibid.
19 Ibid.
20 FAO Statistical Yearbook 2021
21 The State of World Fisheries and Aquaculture 2020 (FAO)

India is the second-largest fish-producing country in the world and contributes 7.56% of the global fish production. Compared to the other agriculture and allied sectors, the gross value added (GVA) contribution of fishing and aquaculture is lower. However, the growth rate of this sector in the last one decade has been significantly higher than that of other sectors. Fishing and aquaculture contributed to 1.26% of India's gross domestic product (GDP) in 2019–20. However, the sector shows huge potential with a compound annual growth rate (CAGR) of 8% in the last decade and 10.87% since 2014–15.[22] Increasing domestic demand and high export potential make fishing and aquaculture a sunrise sector which can be a key driver in doubling the income of aqua farmers.

Culture-based fisheries are adopted in tanks and ponds across India, covering an area of 24.1 lakh ha. These favourable conditions provide a promising opportunity for India to grow as one of the leading fish-producing countries in the world.

Fish production in India has grown from 56 lakh tonnes in 2000 to 141 lakh tonnes in 2020. The major driver for this growth has been aquaculture, which is contributing 85 lakh tonnes of fish per year.[23] Although India has observed around 2.12% annual growth in capture fishing in the last two decades, aquaculture production has grown at a substantial rate of 7.59% annually, which is higher than the global average of 5.23%. In 2020, India produced 104 lakh tonnes of inland fish and 37 lakh tonnes of marine fish.[24]

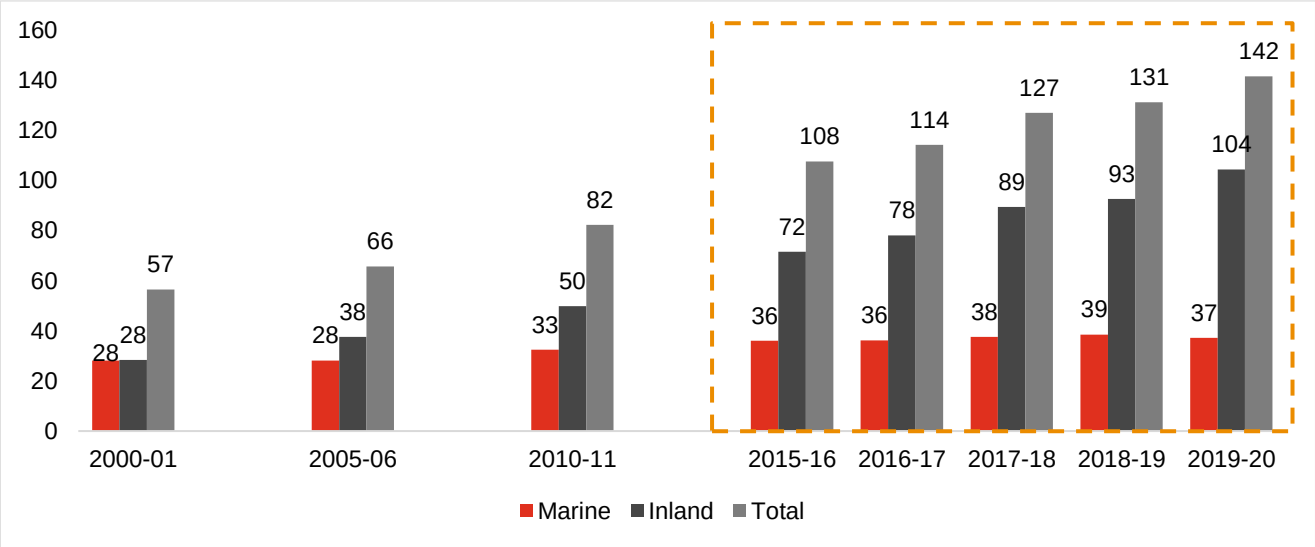
**Favourable conditions for India's fishing industry**




Source: Department of Fisheries, Annual Report 2021–22

22 Agricultural statistics at a glance 2020
23 https://dof.gov.in/inland-fisheries
24 Handbook on Fisheries Statistics: 2020, GoI

## Trends in fish production in India (in lakh MT)




Source: Handbook on Fisheries Statistics: 2020

Andhra Pradesh, Odisha, Uttar Pradesh, Bihar, Chhattisgarh, Telangana have shown rapid progress in aquaculture and achieved more than 6% growth in total fish production in the last five years.

## Leading fish-producing states and their growth rate

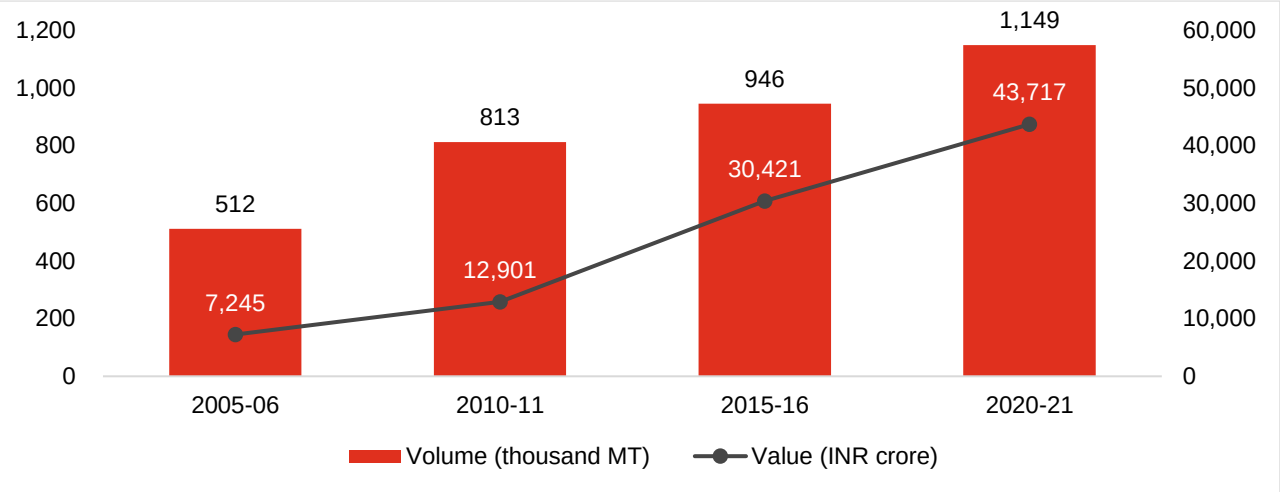
| State | Inland production (lakh MT, 2020) | Marine catch (lakh MT, 2020) | Total production (lakh MT, 2020) | CAGR in the last five years (in %) |
|---|---|---|---|---|
| **Andhra Pradesh** | 36.1 | 5.64 | 41.74 | 15.4 |
| **West Bengal** | 16.19 | 1.63 | 17.82 | 1.6 |
| **Gujarat** | 1.58 | 7.01 | 8.59 | 1.5 |
| **Odisha** | 6.6 | 1.58 | 8.18 | 11.9 |
| **Tamil Nadu** | 1.74 | 5.83 | 7.57 | 1.6 |
| **Uttar Pradesh** | 6.99 | 0 | 6.99 | 8.5 |
| **Kerala** | 2.05 | 4.75 | 6.8 | -1.7 |
| **Bihar** | 6.41 | 0 | 6.41 | 6.0 |
| **Karnataka** | 2.29 | 4.03 | 6.32 | 2.1 |
| **Chhattisgarh** | 5.72 | 0 | 5.72 | 13.7 |
| **Maharashtra** | 1.18 | 4.43 | 5.61 | -0.8 |
| **Telangana** | 3.00 | 0 | 3.00 | 6.1 |

Source: Handbook on Fisheries Statistics: 2020

## Export of aqua products from India

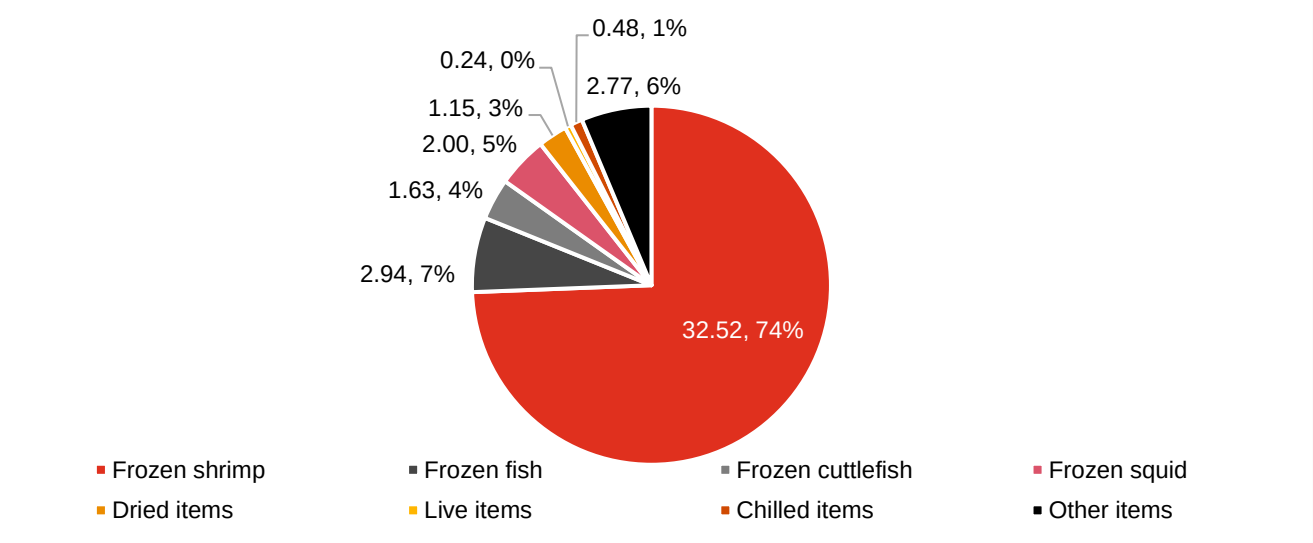
India has emerged as a fish surplus country and has increased its export of fish and fish products consistently over the years. The country's fish export value has increased from INR 7,245 crore to INR 43,717 crore in the last 15 years, with a CAGR of 12.73%.

### Export volumes and value of aqua products from India over the years




Source: https://mpeda.gov.in/

### Item-wise value of India's fish exports in 2020–21 (INR thousand crore)

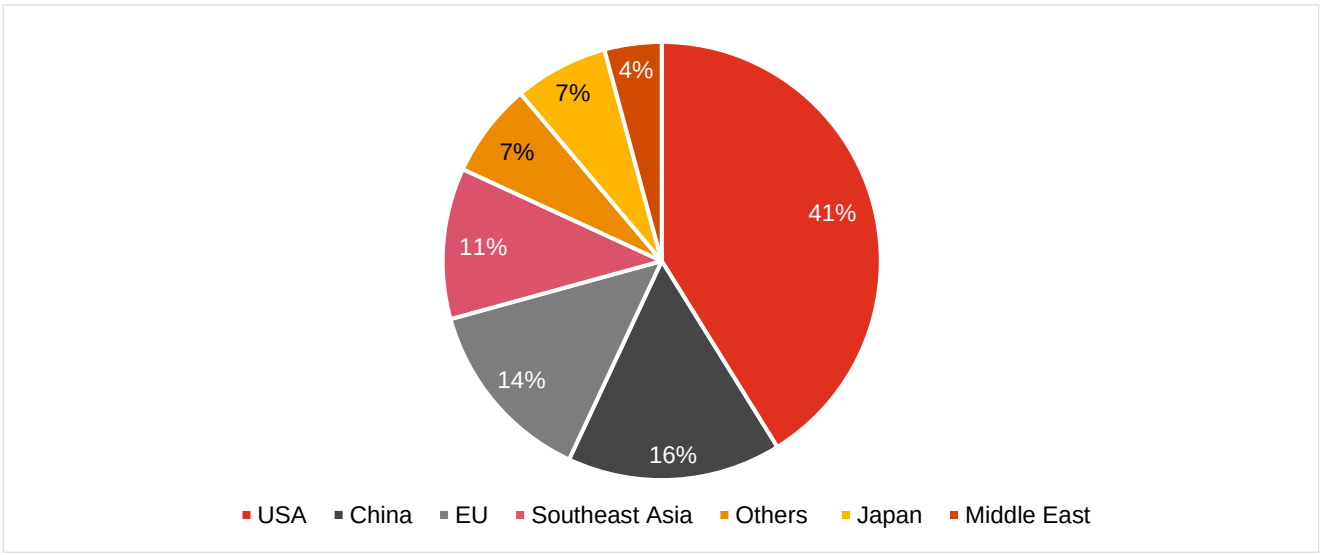



Source: Handbook on Fisheries Statistics: 2020

Considering the high value of shrimp and the increasing export demand, India has rapidly increased its shrimp production. Frozen shrimp is now the leading export product in terms of quantity and value, accounting for 51.36% of the quantity and 74.31% of the total value of exports.[25] This is followed by frozen fish, which accounts for 16.37% of the export volumes and 7% of the total value.[26] Other products such as frozen, chilled and dried fish products contribute less than 20% of the export value.

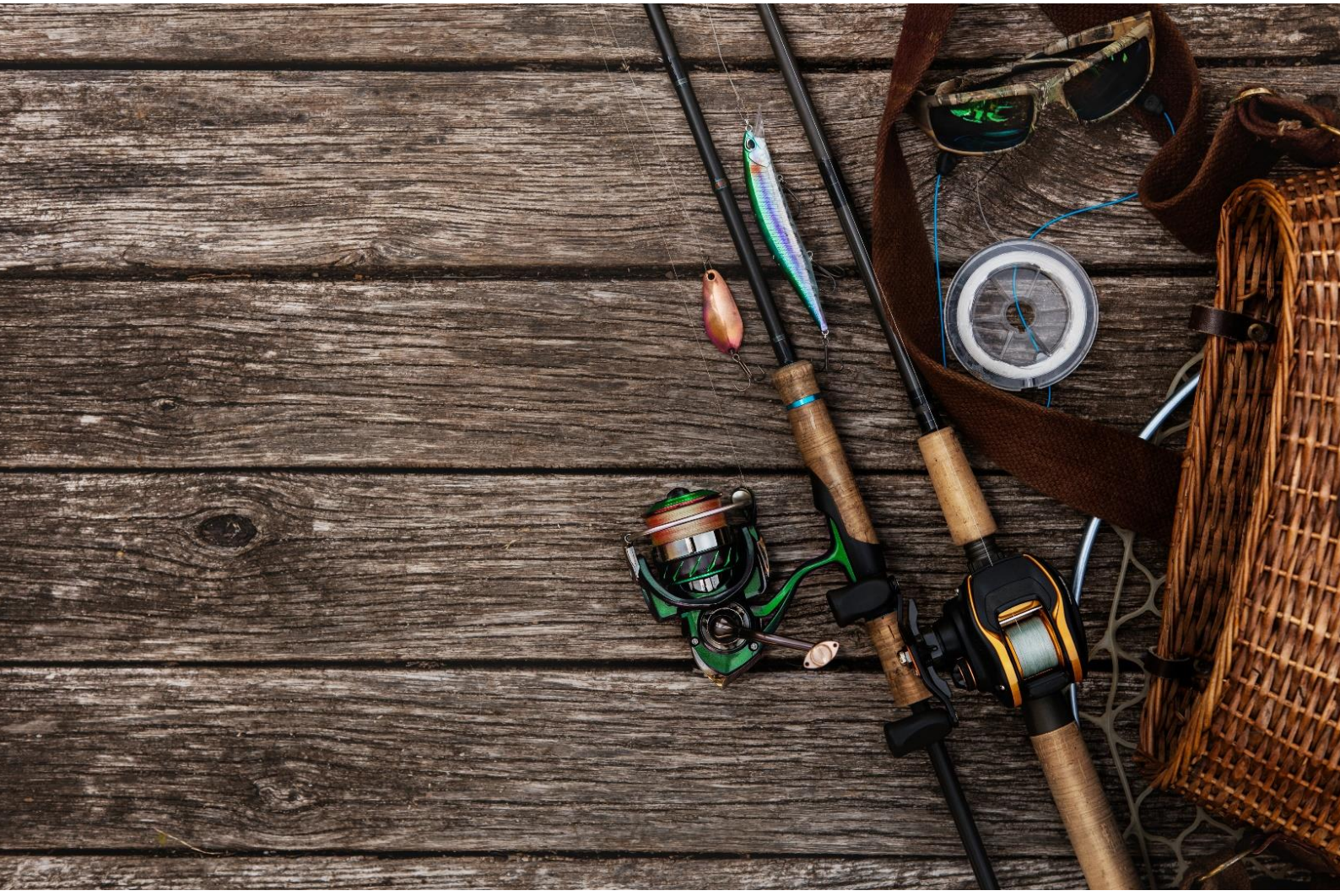
[25] MPEDA website
[26] Ibid.

## Major destinations for fish exports from India

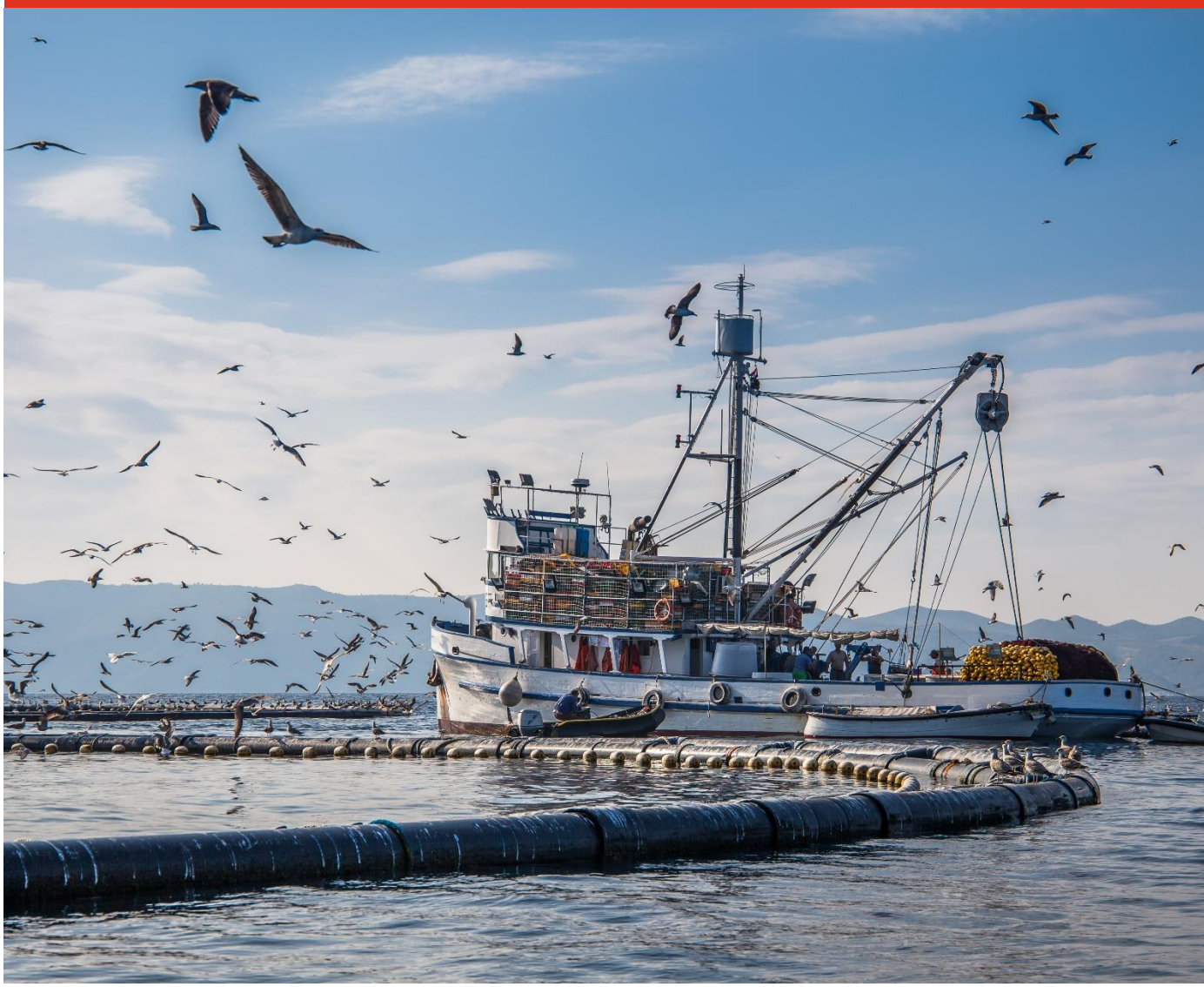



Source: https://mpeda.gov.in/

Diverse aqua products from India are exported to several countries across the globe. Of these, the USA is the leading export destination and contributes 41% of the fish export revenue, followed by China and the European Union.



# 2. Key factors driving the fisheries sector in India



India is historically known for its family farming approach due to small and marginal farm holdings. This approach is also widespread in the fisheries sector, although large-scale captive cultivation of aquatic species in man-made tanks has increased in the last three decades. Freshwater culture has been successful in areas with available groundwater, rivers, creeks and irrigation tanks. There has also been a sharp increase in the cultivation of shrimp species in man-made tanks, which require saline water. To enhance production and diversify, aqua farmers and entrepreneurs have adopted suitable technologies and aquaculture practices, especially in the coastal wetlands and salt-resistant patches. A few dominant shrimp species that are widely cultivated in India are *Tiger* and *Vannamei*, which have expanded the prospects of aquaculture in the country. Some of the key factors driving investments by farmers and entrepreneurs in the fisheries sector are discussed below.

## 2.1. Rising demand for aqua products in the domestic market

The increase in fish production is fuelled by an increase in fish consumption. As fish costs less than meat, it is considered as a poor man's source of protein. The average national per capita consumption of aqua products in India is 7.5–10 kg annually, which is significantly lower than the global average of 20–30 kg annually.[27] Rapid urbanisation and fast-paced lifestyles are influencing many people to look for quick and easy-to-prepare healthy food options. Aqua products meet these requirements because of their high protein and low fat content. Moreover, increasing accessibility, affordability, awareness of benefits and continual growth in population are enhancing fish consumption in the country. Hence, along with common species of fish such as *rohu* and *catla*, high-value species such as shrimp, pomfrets and crabs are also seeing an increased domestic consumption.[28]

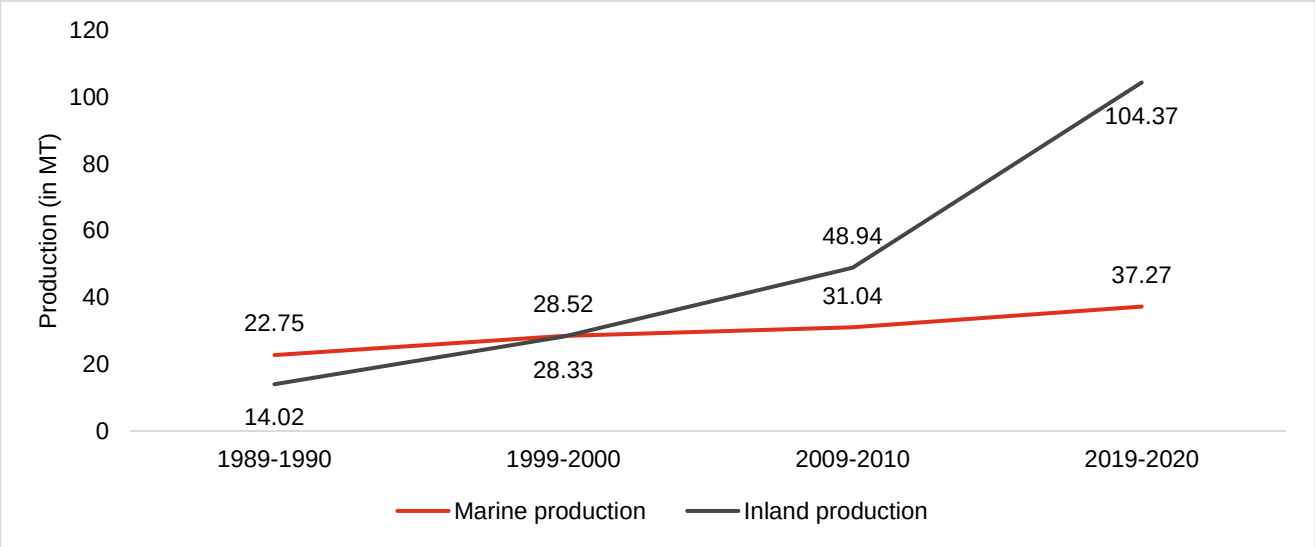
## 2.2. Increasing global demand and export potential

India has become the second-largest aquaculture producer and fourth-largest fish-exporting nation in the world. In 2019–20, the export earnings from the fisheries sector were INR 46,663 crore, with an annual average growth rate of 7%. Today, some countries in Southeast Asia have also started rapidly increasing their aqua export volumes and are emerging as major competitors to India. Aquaculture has grown at a faster pace as a means for meeting the growing export demand. Inland production was almost equal to marine capture in 2000, but it grew to about three times that of marine capture by 2020. The Government of India (GoI) aims to increase fisheries exports to INR 1 trillion by FY25 by supporting infrastructure development of fishing harbours and fish landing centres under its schemes.[29] Additionally, private players have taken advantage of this opportunity and developed export-oriented supply chain models, which include organised procurement, processing, certification, packaging and branding. Another set of market players – such as technology companies, input companies and logistic service providers – are also playing significant roles in the growth of this sector.



27 https://krishi.icar.gov.in/
28 https://www.indianretailer.com/
29 https://pib.gov.in/PressReleasePage

**Growth in marine and inland production**




Source: Handbook on Fisheries Statistics: 2020

## 2.3. High-value livelihood opportunity

Aquaculture is a resource-intensive (capital and water) economic activity. The returns from aquaculture depend on factors such as species, stocking rates, quality of seeds and feed, monitoring, farming techniques and management throughout the production cycle. However, in a few areas, farmers practice traditional methods and produce fish with minimum input costs.

The estimated net income per acre from fish and shrimp cultivation is about INR 0.5–1.5 lakh per cycle, which is significantly higher than that from agricultural crops like paddy and vegetables. This higher return also involves higher risk, especially in the case of shrimp culture. However, high demand and higher returns are enabling small and marginal farmers to start practising aquaculture or increase the culture area over a period of time. States like Andhra Pradesh and West Bengal, which have sufficient water available, have developed ecosystems for thriving aquaculture clusters. For example, Andhra Pradesh has robust industry infrastructure and lower input costs compared to other states. The cost of shrimp production in the state is INR 60–70 per kg, which is significantly lower than that in Gujarat.[30]

## 2.4. Policy-level support to the sector

The fisheries sector impacts multiple SDGs. Owing to this, the GoI has focused on scaling up fishing and aquaculture with holistic and long-term goals. In 2020, the National Fisheries Policy was launched with a vision ‘to develop an ecologically healthy, economically viable and socially inclusive fisheries sector that contributes towards economic prosperity and wellbeing of fishers and fish farmers and provides food and nutritional security to the country in a sustainable and responsible manner’.[31]

**Pradhan Mantri Matsya Sampada Yojana (PMMSY):** The GoI launched the PMMSY as an umbrella scheme to support the Blue Revolution. The scheme focuses on sustainably growing fish production up to 220 lakh metric tonnes by 2024–25. The expected investment of the scheme is INR 20,050 crore, of which the Centre’s share is approximately INR 9,407 crore. State governments and beneficiaries will contribute INR 4,880 crore and INR 5,763 crore respectively in five years (from 2020–21 to 2024–25). The key focus areas of the PMMSY have been highlighted in the table below, along with the activities associated with each area.

30 https://www.agrifarming.in/
31 National Fisheries Policy, 2020, GoI

| Key focus areas of the PMMSY | Focused activities |
|---|---|
| **Infrastructure creation** | Fishing harbours, landing centres, post-harvest and cold chain infrastructure, fish markets and marketing infrastructure, integrated modern coastal fishing villages, development of deep-sea fishing, integrated aqua parks, aquatic referral laboratories, disease diagnostic and quality testing labs |
| **Extension services** | Traceability, certification and accreditation, genetic improvement programmes and nucleus breeding centres, promotional activities for fish consumption, branding, geographical indication (GI) in fish, aquaculture extension services, biofloc, organic aquaculture promotion and certification, and potential fishing zone (PFZ) devices |
| **Modernisation through technological interventions** | Development of new production technologies for inland and marine systems, fisheries and aquaculture start-ups, bio toilets, insurance coverage for fishing vessels, fisheries management plans, e-trading/marketing, fishers and resources surveys and creation of national databases |

Source: Operational Guidelines, Pradhan Mantri Matsya Sampada Yojana (PMMSY)

**Envisioned impacts of the PMMSY[32]**

- Enhancing fish production from 137 lakh metric tonnes (2018–19) to 220 lakh metric tonnes by 2024–25
- Sustained average annual growth of about 9% in fish production
- Doubling the export earnings from INR 46,589 crore in 2018–19 to about INR 100,000 crore by 2024–25
- Enhancing productivity in aquaculture from the present national average of 3 tonnes to about 5 tonnes/ha
- Reducing post-harvest losses to 10%
- Achieving per capita domestic fish consumption to 12 kg from about 5–6 kg
- Providing 55 lakh (direct and indirect) employment opportunities in the sector



[32] https://pib.gov.in/PressReleasePage.aspx?PRID=1626941#:~:text=The%20Pradhan%20Mantri%20Matsya%20Sampada, growth%20rate%20of%20about%209%25.

**Fisheries and Aquaculture Infrastructure Development Fund (FIDF):** The FIDF was launched in 2018–19 with a total fund size of INR 7,522.48 crore. It was introduced with the aim of creating marine and inland fisheries infrastructure facilities and increasing fish production to 20 million tonnes by 2022–23.[33] The FIDF provides financial support to the state governments, union territories and state entities for fisheries infrastructure development through nodal agencies such as the National Bank for Agriculture and Rural Development (NABARD), National Cooperative Development Corporation (NCDC) and scheduled banks.[34]

These centrally sponsored schemes are complemented by other schemes promoted by state governments. Given the high-production and export-dependent business models of aqua products, India saw considerable losses during the pandemic. To overcome this vulnerability of export-oriented businesses, various states and agencies like Marine Products Export Development Authority (MPEDA) and NFDB have introduced policies and allocated INR 100–200 crore to push domestic consumption.

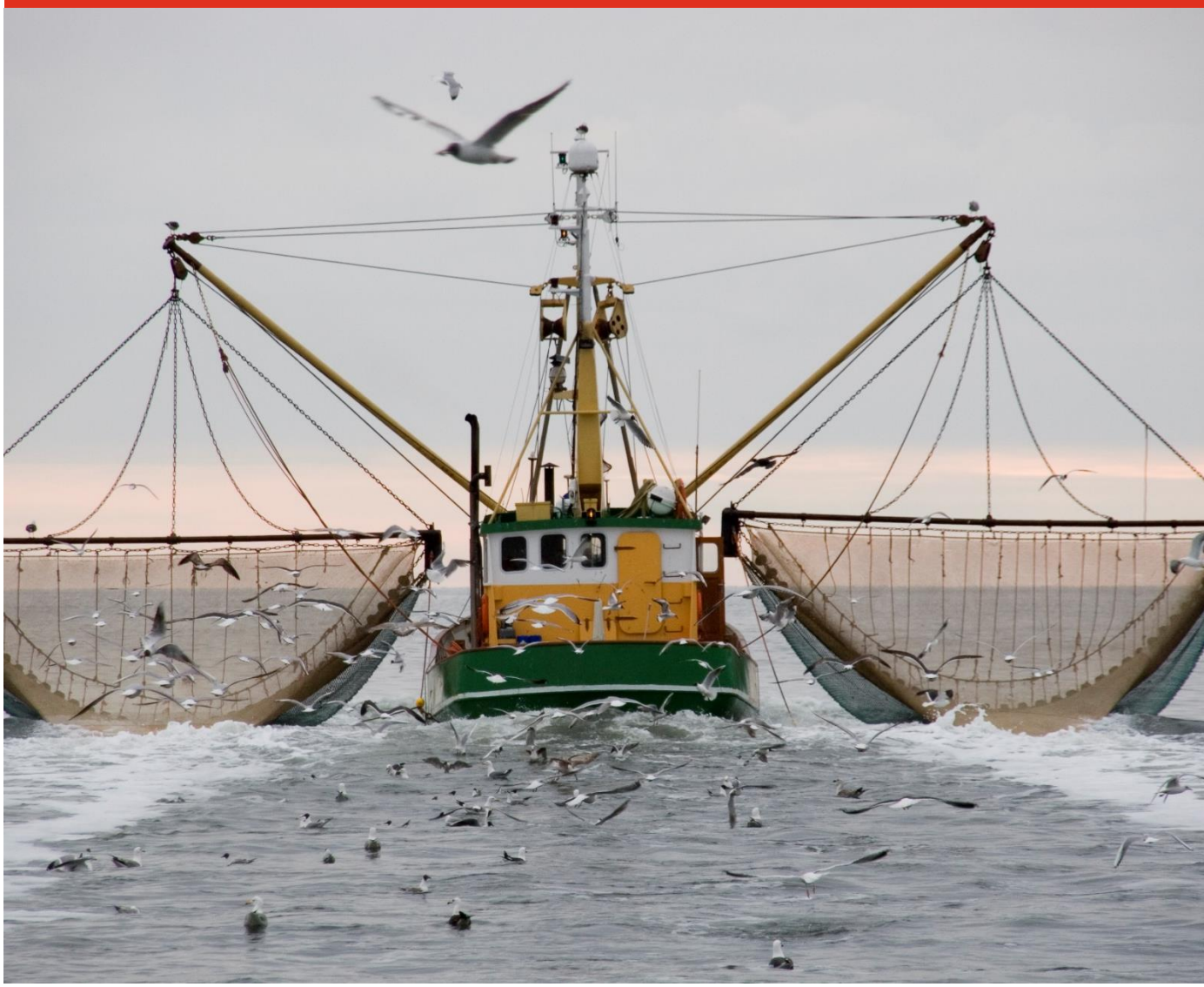
**A few other programmes targeted at the development of the fisheries sector**

- SagarMala project of the Ministry of Shipping for fishing harbours and fish landing centres[35]
- Pradhan Mantri Kisan Sampada Yojana (PMKSY) for post-harvest facility development[36]
- Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and Rashtriya Krishi Vikas Yojana for the development of ponds and waterbodies[37,38]
- Blue Revolution provides financial assistance for the construction of houses, community halls for recreation and common working places. Apart from this, a Group Accident Insurance Scheme (GAIS) is being offered to all fish farmers in the country[39]
- Kisan credit card (KCC) of Ministry of Agriculture and Farmers Welfare to meet working capital requirement of fishers and fish farmers for production and productivity-related activities[40]
- Promotion of FFPOs/FPCs through the PMMSY and Ministry of Agriculture and Farmers Welfare to empower fish farmers and fishers[41]



33 https://www.fidf.in/
34 Ibid.
35 www.sagarmala.gov.in
36 https://www.mofpi.gov.in/Schemes/pradhan-mantri-kisan-sampada-yojana
37 https://nrega.nic.in/
38 https://rkvy.nic.in/
39 https://dof.gov.in/blue-revolution
40 https://agricoop.nic.in/
41 PMMSY guidelines on Formation and Promotion of Fish Farmer Producer Organisations (FFPOs)

# 3. Key challenges of the fisheries sector



The fisheries sector has strong potential for creating a positive socioeconomic impact. However, in spite of technical advancements and increase in production, the fish value chain faces several diverse challenges in India. Hence, it becomes important to identify and understand how these factors impact the development and growth of the fisheries sector.

## Production challenges

### Slow adoption of new techniques and technologies

To cater to the rising demand and growth expectations, the fisheries sector must adopt the latest techniques and implement new-age technologies in order to boost production. However, at the production level, the uptake of new hatchery technologies, water-efficient aquaculture practices like RAS, sustainable marine production techniques like mariculture and mechanised boats with the latest GPS/satellite tracking systems has yet to gain momentum.

For example, the projected mariculture production potential based on the area available in the Indian region is 4 to 8 million tonnes annually, whereas the current estimated mariculture production is less than 0.01 million tonne per year.[42] Similarly, the distribution of intensive production techniques like RAS is very slim. Traditional systems produce around 2–10 metric tonnes/ha of fish, while RAS may produce up to 500 metric tonnes/ha of fish per year in the same area.[43]

### Limited extension services

Extension services provide the information and services needed by an aqua farmer, marine or inland fisher. Despite rapid growth in the sector, it suffers from a lack of extension services. For example, many aqua farmers do not have easy access to soil- and water-testing facilities, consultations, and real-time market information. Moreover, spot prices for aqua products are unavailable across states. Although there has been an increase in expenditure on extension services (both by the Central and state governments), it is not in line with the growth of the sector.

### Lack of quality inputs and access to credit

Available inputs like seeds, feed, growth supplements and medicines used in aquaculture have quality concerns. Often, inputs are suggested by local shops as per their convenience without proper diagnosis. Even though various regulations have been enacted by the Central and state governments, ensuring quality of inputs remains a challenge. The lack of quality inputs reduces yield and this in turn has a significant economic impact.

Upgrade of vessels, adoption of the latest technologies and equipment, and other necessary advancements require massive investments. Due to limited financial capacity and poor access to credit facilities, the fishing community is unable to make these investments. Various schemes have been introduced by the Government for purchase of vessels (like deep sea fishing vehicles), technology adoption and welfare promotion. However, even such schemes require a significant beneficiary contribution (in the form of a loan/matching amount) from the fisher, which makes the benefits inaccessible.

## Economic and infrastructure challenges

### Poor price discovery mechanism

Fish trading in India still follows traditional practices, and there is no efficient electronic trading platform. Traders in the landing centres and wholesale markets still practice the open auction method, without weighing or examining the quality of the products. Boat owners and fishers often realise non-remunerative prices due to such a price discovery mechanism and limited access to buyers. Small and marginal aqua farmers with low bargaining power are forced to sell their products to middlemen and traders at a set price. This leads to lower return on investment despite quality produce.

[42] Cold Chain and Post-Harvest Infrastructure Development 2022
[43] RAS Action Plan towards Blue Revolution

### Post-harvest losses

Fish is a highly perishable commodity, and its putrefaction starts right from the point of harvest. Wastage of fisheries products is very high in India and goes up during the monsoon. Such post-harvest losses impact the availability of edible fish in the market and increase the stress on resources for production of higher volumes.

|  |  |  |
|---|---|---|
| **Physical loss** | **Quality loss** | **Market-induced losses** |
| This loss occurs during catching, loading, unloading, processing and sales. Spoilage of fish happens mainly due to infection caused during the longer setting of fishing gear, delayed return period of vessels and insufficient use of ice during storage and transport. | This loss occurs mainly due to improper handling of fish during the pre-processing and processing stage, packaging and transport. Quality loss is sometimes an outcome of physical loss. | Market-induced losses are mainly due to deliberate delays in purchase by buyers, fluctuations in supply and demand, and distress harvesting at the wrong time. |

### Lack of cold chain facilities

Resilient cold chain facilities for aqua products include ice plants, cold storage, reefer and insulated vans, and chilling units. However, the fish industry in India uses only 1% of the total storage capacity available in the country.[44] Fresh fish is transported to distant states from the major production clusters with inadequate cold chain facility. For example, fish from Andhra Pradesh is transported to Kerala, Maharashtra, Tamil Nadu for processing and to states like West Bengal and Assam for end consumption. Such long-distance movement of a perishable product in thermocol boxes with limited quantity of ice impacts the quality of the product.

### Unorganised retail market with quality issues

Fish vending in India is generally unorganised, and hygiene and quality factors are often ignored by small retailers and street vendors. Retailers have minimal infrastructure to store their products at the necessary temperature and conditions. Hence, consumers often receive low-quality products due to poor handling, interrupted cold chains and inadequate ice usage.

### Quality concerns around fish products for export and domestic consumption

Quality is the primary yardstick applied by both importing countries and national food safety agencies for accepting food products, including fishery products for human consumption. Spoilage of fish starts due to outdated catching and harvesting methods, incorrect killing procedures which trigger biochemical reactions in fish, and improper post-harvest handling of produce. All of this makes fish unpalatable. Export of fish and shrimp is also affected due to the presence of pathogenic microorganisms and residual antibiotics. In the USA, seven out of eight import rejections of frozen shrimp are due to the presence of residual antibiotics.[45]

[44] Cold chain and post-harvest infrastructure development, 2022 Action plan (GoI, 2017)
[45] https://krishi.icar.gov.in/jspui/bitstream/123456789/8722/1/Quality%20Concerns%20of%20Indian%20Fishery.pdf

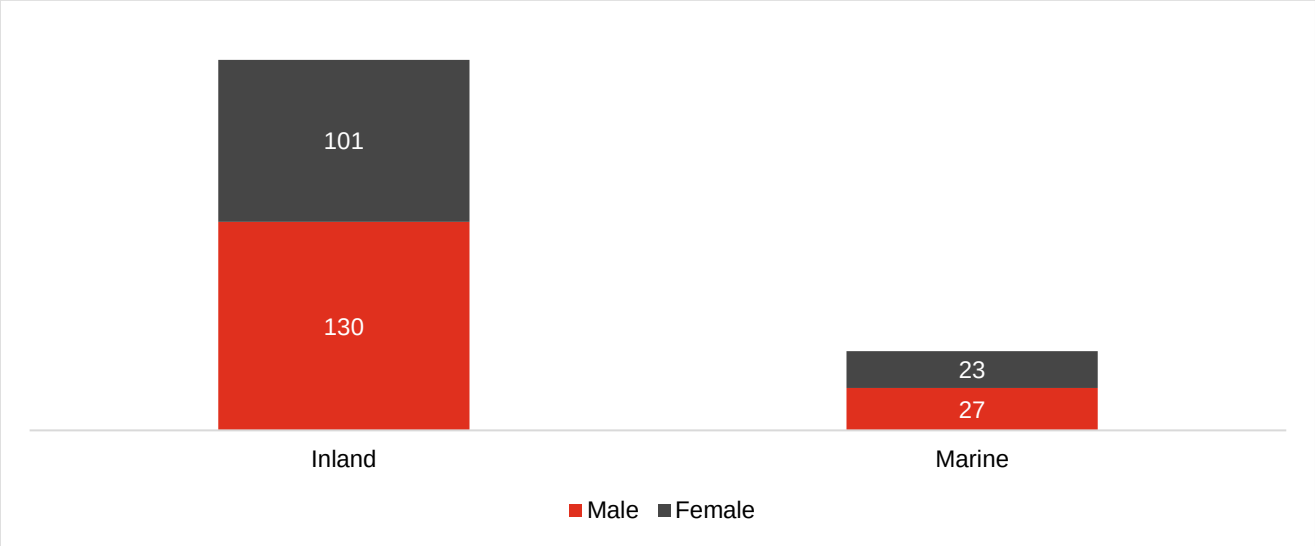
# 4. Importance of the fisheries sector for livelihoods and sustainability



## 4.1. Importance of fisheries for livelihood generation

The fisheries sector in India stimulates the growth of subsidiary industries and is a source of livelihood for a large section of the country's economically backward population. A large part of the rural population is involved in the production and catching of fish, and a significant number of people from urban and semi-urban areas are also involved in the supply chain and subsidiary industries. Gender distribution of employees in inland and marine fisheries in India, including aqua farmers, fish workers and fishers, is shown in the figure below.[46]

**Fish and aqua farmer population in India (in lakhs)**




Source: Handbook on Fisheries Statistics: 2020, Department of Fisheries, GoI

A total of 8,93,258 marine fisher households reside in the coastal states and union territories, with 22.6% in Tamil Nadu, 17.4% in Andhra Pradesh and 13.6% in Kerala. Nearly 91.6% of the marine fisher families are from traditional fisher families.[47]

In states such as Andhra Pradesh, West Bengal and Odisha, aquaculture is their primary source of livelihood for fish farmers, and they engage in the activity full time. However, a majority of the aqua farmers and fishers in the country are small-scale fish farmers, artisanal fishers or aquaculture labourers. Marine fishers across states who are either boat owners or crew members are commonly engaged full time in fishing activities. A substantial number of fishers and aqua farmers are engaged seasonally and consider this as a part time or secondary economic activity. Nevertheless, such households are dependent on fishing and fish farming for risk mitigation and livelihood diversification. Another section is engaged in the post-harvest value chain of the fisheries sector, such as logistics management, trading, auctioning, wholesale, export, retail and labour.

Fisheries play a crucial role in providing livelihoods, nutrition and food security to a major section of the coastal population. Women in these areas play a key role in pre-harvest and post-harvest activities. However, they have minimum involvement in offshore and long-distance capture fishing. Of the women engaged in marine fishing-related activities in India, 52.1% participate in making or repairing nets, 86.4% in marketing and 90.3% in curing and processing activities.[47] It is important to look at the gender participation disparity to understand the involvement of women in fisheries activities.

[46] Handbook on Fisheries Statistics: 2020, Department of Fisheries, GoI
[47] Marine Fisheries Census 2016, Department of Fisheries, GoI

In addition to direct engagement in fish farming and fishing, there are plenty of upstream and downstream economic opportunities in the production clusters as the local population is involved in ancillary industries such as feed and medicine production, equipment manufacturing, ice plants, boat building and repair, and transportation.

## 4.2. Neoteric techniques and technologies in fisheries

Fish farming in India has evolved over the years by adopting new species, equipment, techniques, inputs, etc. This has helped in augmenting aquaculture production over the years. The Government has launched initiatives to promote various new techniques for both fresh water and saline water species. These new-age techniques have the potential to enhance production by using the available water resources optimally.

### RAS

RAS is a highly intensive, eco-friendly and water-efficient farming system with zero environmental impact.[48] In this system, fish are typically reared in indoor or outdoor tanks in a controlled environment. It is an intensive high-density method of fish culture unlike other aquaculture production systems or traditional fish production practices. RAS filters and cleans the water by recycling it back to fish culture tanks. Water is recycled and reused after mechanical and biological filtration and removal of suspended matter and metabolites. This technique can be encouraged for small-scale fish farmers and entrepreneurs to initiate and expand fish production where land and water are scarce. It can also be promoted under backyard RAS.

### Biofloc technology

Biofloc technology converts toxic materials such as nitrate and ammonia into a proteinaceous feed. In this aquaculture technique, limited exchange of water takes place with high stocking density and strong aeration.[49] The biofloc system has been developed to improve environmental control over aquatic animal production. It has the potential to address critical issues of aquaculture such as high cost of feed (accounting for about 60% of the total production cost) and limited availability of tanks.[50] The biofloc system has been adopted in other countries, and the Department of Fisheries, GoI, is now promoting it in India.

### Aquaponics

Aquaponics is a technique in which both fishes and plants are grown using an integrated method.[51] The fish waste serves as fertiliser for growing plants; the plants absorb nutrients and filter the water; and the filtered water is used to replenish the fish tank. Green leafy vegetables with low to medium nutrient requirements are used in aquaponics systems. The fishes and plants grown in aquaponics system are completely organic. The system requires a high initial investment but a lower recurring cost and gives reasonable returns with the advantage of less land and water use, waste reuse and less labour. Aquaponics systems can produce up to five times the quantity of fish in the same aquaculture area per year, besides a good crop of vegetables.

### Cage cultivation

Cage culture presented a new opportunity to optimise fish production from brackish waters and inland water systems such as reservoirs, lakes and floodplain wetlands, and thus enhance the production and income of fishers and entrepreneurs. It has been adopted by fishers in multiple states in India to optimally utilise the available water resources, but the adoption rate is slow. Cage culture in different types of water resources can serve as an alternative source of livelihood to fishers and other value chain players by producing high-value aqua products as per market demands. There are two types of cage cultures used in India: fixed cage and floating cage.

Further, the vast coastline of the country also creates ample opportunities for sea cage farming in coastal states. The relatively shallow inshore water along the coastline of mainland and island territories offers scope for sea cage farming. Sheltered areas such as bays, lagoons, semi-exposed and exposed coasts having less wave action are preferable for undersea cage farming or mariculture.

48 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1724781
49 https://vikaspedia.in/agriculture/fisheries/fish-production/culture-fisheries/types-of-aquaculture/biofloc
50 https://pib.gov.in/PressReleasePage.aspx?PRID=1821599
51 https://dof.gov.in/sites/default/files/2020-07/Aquaponics_System.pdf

Cage farming is gaining momentum gradually as a commercial production system in the country. Research, demonstrations, techno-commercial support and participatory modes are required for expansion of this economically viable aqua farming method.

### Seaweed cultivation

Seaweed is usually grown in marine and shallow coastal waters and on rocky shores. The demand for seaweed has been increasingly growing across the globe, owing to its industrial use. Industrial application of seaweed has high market potential, especially due to India's booming pharmaceutical and chemical industries. There are rich seaweed beds around Maharashtra, Goa, Kerala, Andhra Pradesh and the Chilika Lake in Orissa. Seaweed cultivation can be promoted on a large scale among rural entrepreneurs, women's groups and FFPOs by setting up market linkages.

### Ornamental fisheries

Ornamental fish production is gradually increasing in India. Ornamental fish trade in India constitutes 90% from freshwater fish and 10% from marine. A majority of the ornamental fish breeders in India breed exotic fish. India has diversified 195 indigenous varieties and about 400 marine species.[52] Hence, India's huge potential for ornamental fisheries can be tapped by providing technical, financial and infrastructural support to the youth, women's groups, community-based institutions and entrepreneurs.

## 4.3. Sustainability factors in fisheries

The global fish trade and aquaculture have acknowledged the impact of climate change. Several plans of action and strategies have been worked upon and developed to support the international community.[53] Sustainability is a very critical factor for India's fisheries sector as there is considerable pressure to produce more fish from limited resources for its population of over 1.3 billion.

### Critical factors for sustainability of the fisheries value chain

#### Declining marine fish stocks

Fish stocks across the world are depleting at a rapid pace, posing a threat to the marine ecosystem. A Stanford report suggests that all species of wild seafood will collapse by 2050,[54] which indicates the extent of overfishing and exploitation of living aquatic resources. In the event of overfishing, the rate of fish catch is higher than that of replenishment, thus leading to a collapse of fish stocks. The negative impact of overfishing goes beyond the marine ecosystem and affects the livelihoods and food security of millions of people, especially in India where the dependency is high.

#### Increased water stress in freshwater aquaculture

Freshwater aquaculture is water intensive and, if not managed well, could create massive water stress. One of the reasons is water exchange required to maintain the water quality. As per estimates, recirculating aquaculture systems use 100 litres of water to produce 1 kg of freshwater shrimp, whereas traditional practices require around 15,000 litres of water.[55] Such practices put a lot of pressure on the freshwater ecosystems in the culture areas in the long run.

#### Multi-fold impact of disease incidences

Lack of proper extension services coupled with improper pond management result in the outbreak of diseases, especially in aquaculture clusters. As per estimates, nearly 25% of all intensively cultivated aqua produce is lost due to diseases. Such huge losses in produce threaten the sustainability of the ecosystem. In a bid to treat diseases, aqua farmers often resort to indiscriminate use of antibiotics which remain as residues in the fish. Such heavily treated aqua products adversely impact the human immunity system and create disease-resistant fish/shrimp.

52 https://nfdb.gov.in/PDF/Fish%20&%20Fisheries%20of%20India/3.Ornamental%20Fisheries%20of%20India.pdf
53 The State of World Fisheries and Aquaculture 2020, FAO
54 https://news.stanford.edu/news/2006/november8/ocean-110806.html
55 thefishsite.com/articles/the-many-sides-of-sustainability-in-aquacultur

### Increased production cycles due to distress harvesting

Distress harvesting involves premature harvesting of fish and shrimp owing to disease incidence, market pressure and various intrinsic environmental conditions such as quality of seeds. Often, distress harvesting reduces the production cycle, thus increasing the intensity of production.

### Unscientific practices

Unscientific practices are observed at different nodes of the fish value chain, from production to retail. Overdose of medicines, usage of harmful chemicals during transport and storage of fish, use of poor quality ice, etc., impact the quality of fish and pose health hazards for the consumer. On the other hand, fish drying and curing units often operate in very unhygienic conditions. The fish are often dried on unclean floors and open sand beds which are infested with flies. This process also involves the use of harmful chemicals to make the fish look good, which impacts the health of consumers.

### Climate change

Climate change poses a great challenge to the sustainability of the fisheries sector. It will have an irreversible impact in the form of loss of fishing stocks and loss of livelihoods, thus threatening nutritional security.

## 4.4. SDGs and fisheries

SDGs are global goals which ensure balanced economic growth, environmental conservation and social progress, thus creating equal opportunities for everyone. Fisheries constitute a unique sector that encompasses all aquatic ecosystems and is closely connected with land-based ecosystems such as feed resources and other dependencies. Considering the importance of fisheries and their contribution to overall human wellbeing, better linkages between aquaculture, health, food security and natural resource management play a significant role in achieving the SDGs.

| SDG | Objective | Relevance to the fisheries sector |
|---|---|---|
| **Goal 1** | End poverty in all its forms | The fisheries sector provides employment opportunities to 10% of the global population.[56] Sustainable artisanal fishing provides employment to 90% of the global fishing industry and is the basis for the development of small fishing communities, especially in coastal regions.[57] The sector engages a large section of the female workforce in processing, retail vending and ancillary activities across the globe. Its potential is reflected in its ability to alleviate poverty and provide employment to millions of people. |
| **Goal 8** | Decent work and economic growth | |
| **Goal 2** | End hunger, achieve food security and improved nutrition and promote sustainable agriculture | Aquatic food sources are often the cheapest and the most consumed animal-source food, especially in low-income food deficit countries. As per the FAO, fish make up 22% of the overall consumption of animal protein and 66% of all small-scale catches are meant directly for human consumption. The scope and range of the fisheries sector in meeting nutritional security makes it as one of the potent solutions for achieving Goal 2. |

[56] https://news.un.org/en/story/2014/05/468602-fish-more-important-ever-providing-jobs-feeding-world-un-report
[57] https://www.iberdrola.com/social-commitment/sustainable-fishing

| SDG | Objective | Relevance to the fisheries sector |
|---|---|---|
| **Goal 12** | Ensure sustainable consumption and production patterns | The demand for aqua products is increasing consistently, thus adding pressure on the whole value chain and resources to intensify production. The vastness and the interconnected nature of the fisheries sector offer scope for innovative solutions to promote and strengthen sustainable practices across the value chain. This involves switching to methods which reduce disease incidence and minimise the inputs and water usage. |
| **Goal 14** | Conserve and sustainably use the oceans, seas and marine resources | Factors like overfishing, degradation of fish stocks, and habitat, ecosystem and biodiversity pollution are the major threats to Goal 14. Promoting conservative and sustainable catching and optimising vessel movement through technology adoption can help in achieving Goal 14. |

### ESG and fisheries

Managing the various environment, social and governance (ESG) risks involved in the fish value chain is key to the sector's sustainability. These risks include climate change, disease resistance, indiscriminate use of inputs and chemicals, poor management practices, lack of post-harvest infrastructure, and limited access to resources for fishers and fish farmers. Southeast Asia – including India – which is one of the largest fish producing regions in the world, may see a 30% drop in production levels by 2050 due to environmental factors.[58] Also, most of the marine production is already stressed, with nearly 90% of marine fish stocks being either overexploited or depleted.[59] Integration of the ESG framework in the fisheries value chain by mapping and addressing various risks is the key to achieving sustainability.



[58] Aquaculture — ESG Risks and Performance in the Aquaculture Sector Coller FAIRR Protein Producer Index 2021/22
[59] https://www.fairr.org/article/aquaculture-marine-farming/

# 5. Strategic interventions to enable the sector



The growth of the Indian fisheries sector in the last decade has been aggressive. However, it requires further support at various levels to achieve its true potential. With continuous development of the fisheries ecosystem and growth in production, the socioeconomic situation of fish farmers and fishers have significantly improved. However, several challenges are still limiting the growth of the sector and its stakeholders. Hence, there is a need for inclusive strategic interventions involving multiple components of the fisheries sector with short, medium and long-term perspectives.

**Strategic interventions for sustainable growth of Indian fisheries**




## 5.1. Enabling policy framework

The sustainability of the aquatic ecosystem with steady growth in production is significantly dependent upon the implemented policies and schemes. The Government is promoting various environment-friendly technologies to safeguard our aquatic ecosystem, enhance production and support the livelihoods of fishers and fish farmers. A holistic approach to provide the necessary support for easy access to technology, equipment, training, credit, markets, etc., can help fishers and fish farmers adopt new techniques and methods on a large scale. Several fisheries infrastructure development interventions such as value chain infrastructure, mega fisheries parks, state-of-the-art harbours and fish markets and domestic fish markets can be supported through the public private partnership (PPP) mode. Considering the requirements of the blue economy in India, supportive policies for all stakeholders of the value chain are imperative for economic growth, social inclusion and improvement of nutrition and livelihoods. Further, ease of doing business in the sector may attract FishTech companies and entrepreneurs to contribute with innovation, technology, extension services, etc., to improve efficiency in production and the supply chain, traceability and sustainability.

## 5.2. Promotion of fisher community institutions and FFPOs

The fisheries sector requires a multi-pronged approach to streamline the existing issues and encourage improved participation of stakeholders. Strong participation from aqua farmers and fishers is the primary requisite to advance the fisheries ecosystem. A key intervention will be aggregating them into aqua farmer or fisher-based institutions. Collectivisation of producers, especially small and marginal producers, into producer organisations can be one of the most effective ways to address the many challenges. More importantly, it will lead to improved access to investments, infrastructure, technology, inputs and markets. In this context, the two most important areas of intervention would be – (a) aggregating aqua farmers and fishers into FFPOs and (b) supporting and strengthening farmers' interests through FFPOs.

The Government has taken initiatives to promote fish farmers and fishers' institutions and the Department of Fisheries, GoI, has published a framework to promote FFPOs and provide necessary support for the growth of such institutions. Guidelines on the 'Formation and Promotion of Fish Farmer Producer Organizations (FFPOs)' were launched under the PMMSY in 2021 to empower fishers and fish farmers economically and enhance their bargaining power. Along with a conducive policy environment, a structured approach is needed to ground this vision and ensure the sustainability of these institutions.

**An FFPO is an association or group of fishers or fish farmers or fisheries stakeholders, organised with the primary objective of carrying out sustainable fisheries value chain business activities and registered under any law for the time being in force, or promoted under a scheme or programme supported by the Central or state government.**

With the objective of improving returns for fish farmers and fishers, FFPOs can promote several socio-economic activities for their members and other value chain actors. Some broad activities of FFPOs are listed below:

| FFPO initiatives | Key activities |
|---|---|
| **Capacity building and ecosystem development** | • Capacity building of members<br>• Dissemination of best practices and cross learning among members<br>• Water and resource management in production clusters<br>• Technology-driven tools and equipment delivery<br>• Promotion of new aquaculture techniques |
| **Market linkages** | • Linkage with market intermediaries and processors to sell produce<br>• Direct market linkage in other states<br>• Establishing wholesale or retail outlets |
| **Infrastructure development** | • Cold storage units, various types of chiller boxes, storage units, ice factory<br>• Pre-processing, processing units, food parks<br>• Logistics and transport |

| FFPO initiatives | Key activities |
|---|---|
| **One-stop shop for fisheries: Owned and run by FFPOs** | • Supply of inputs and equipment to members at affordable prices<br>• Aggregation of fish from members and trade<br>• Leasing machinery and tools<br>• Extension services<br>• Information centre: Technical know-how, market information, information on Government schemes, SMS-based service delivery |

There is a need to promote FFPOs in fish production clusters across states in a time-bound manner and to provide them with support to become self-sustainable. A few critical areas that require support are as follows:

### Scaling up funding support

FFPOs need financial stability to run a profitable and sustainable business. Grant support and zero-interest loans can help them to stabilise and acquire required resources indispensable for carrying out their economic operations. Additionally, there is a need to ensure easy access to institutional loans for FFPOs to initiate or expand any economic activity. Sensitisation of bank officials regarding the financing requirements of FFPOs is a necessary step in this direction.

### Customised support from Government schemes

Central and state government departments run sector-specific schemes to support fish farmers, entrepreneurs, processors, and seed and feed manufacturers for the overall growth of the fisheries-based economy. The Government may therefore suitably customise all such schemes to recognise FFPOs and provide them additional and preferential benefits within such schemes. Inclusion of FFPOs within the definition of micro, small and medium enterprises (MSMEs) will also open new avenues of support for raising capital for business operations. Additionally, FFPOs will also become eligible for various Government schemes which identify MSMEs as the primary beneficiaries.

## 5.3. Infusing neoteric techniques and technologies

Traditional practices of fish farming tend to impact productivity. Moreover, large water bodies such as reservoirs are not optimally utilised in India and only the natural yield is harvested by fishers. In this context, sweet water cultivation techniques like biofloc technology, RAS, aquaponics, cage culture and saline water practices like mariculture and seaweed cultivation need large-scale adoption to enhance production and productivity. Resource non-intensive techniques such as RAS and biofloc can be promoted across the country with a special focus on north-eastern states, Uttarakhand, Himachal Pradesh, Jammu and Kashmir, and coastal states. Organised efforts for awareness creation, capacity building and technical and financial support are required to promote large-scale adoption of such techniques.

## 5.4. Promoting a sustainable and responsible fisheries value chain

The fisheries sector has multiple segments that require a greater focus on sustainability. In the current context, it is extremely important to adopt sustainable and responsible marine fishing and aquaculture practices.

### Marine fishing

#### Use of AIS transponders

AIS transponders help in keeping the deep-sea fishermen safe by mapping the position and identification of boats and providing information about boat movement. Real-time tracking of such movements helps in restricting vessel movement in conservation zones, no-fishing zones or during periods when fishing is prohibited. While governments have taken initiatives to use transponders on such boats, there is an urgent need to use it on all fishing boats.

### Satellites and drones

Going forward, the use of satellites and drones can provide a holistic view of the ecosystem with spatial and temporal information which helps in monitoring. Data regarding vessel movement, duration of catch, etc., can be tracked closely using such technology. Analytical reports can be generated from the data collected and can be used to create risk-based spatial fishing plans, share information to reduce catch of vulnerable species, support fishery rebuilding efforts, etc.

### Adoption of advanced data and information systems

The evolution of advanced technologies like the internet of things (IoT), big data and advanced analytics have made possible collection and interpretation of complex data for better decision making, navigating between conflicting goals (profitability vs. sustainability), and optimisation of fish catching and management. Data points like catch reporting and trade information can be indicators for assessing the extent of fishing. Deployment of data and information systems is necessary to gather, analyse and act on such information. Such systems have interlinked components for data collection, analysis and dissemination. They can be deployed across all states and all marine fishers can be covered under these systems.

### Ensuring sustainability of fishing stocks

Some catching practices can have a deep impact on the marine ecosystem. For example, smaller mesh nets used by fishers cause loss of biosphere surrounding the fish. Bottom trawling affects the seabed. Such catching methods harm the environment. Hence, good catching practices such as hook and line need to be practiced to reduce the impact on the surrounding environment and select the catch. For example, any small fish or unwanted fish can be returned into the water without harming the species.

Fishing stocks should be at a level wherein their availability will be indefinite and the fish population remain productive. To prevent overfishing and replenish stocks, efforts like ban period must be implemented with strict surveillance. Strict measures need be taken to restrict fishing during the ban period of six to eight weeks which must be observed annually in coastal states. Government and non-governmental organisations can engage fishers in alternative livelihoods during this period.

### Infrastructure development

The PMMSY has a major focus on infrastructural development. 42% of the PMSSY funds are set aside for the creation and upgradation of infrastructural facilities. The need to develop marine infrastructure has been recognised to ensure safe fishing, including upgrade of vessels and technology adoption.

## Aquaculture

### Prohibiting indiscriminate use of antibiotics

Aqua farmers sometimes use various antibiotics indiscriminately to prevent losses due to diseases. Such extensive use of medicines and antibiotics often leaves residues, affecting the health of consumers as well as the marine habitat. Sustainable aquaculture depends on environment-friendly treatment strategies for fish diseases. There is a need to set up systems for capacity and awareness building among aqua farmers and to ensure easy access to soil and water testing and extension services in order to guide them with proper diagnosis and action.

### Strengthening disease surveillance mechanisms and extension services

Limited access to extension services and absence of disease surveillance mechanisms make aquaculture (especially shrimp) vulnerable and force farmers to undertake distress harvesting. This reduces the duration of production cycles, makes the production process intensive and puts stress on available natural resources. A strong disease surveillance system which monitors the incidence of diseases along with extension services that can provide inputs on quality of soil, water, etc., are required for ensuring sustainable production.

### Adoption of less water-intensive techniques

The aquaculture production process uses fresh water, thus putting stress on water resources in the habitat. To reduce usage of water, new age technologies like RAS may be adopted, especially in places where access to electricity and freshwater is limited.

**Minimising post-harvest losses in the aqua value chain**

Post-harvest losses not only create economic losses across the aqua value chain but also threaten our food security. To reduce post-harvest losses, efforts are needed to (a) strengthen supply chain infrastructure and (b) improve post-harvest technology and value addition.

Moreover, in addition to the supply side, it is also the responsibility of consumers to adopt responsible consumption practices. Awareness of the importance of consuming local and seasonal fish and the impact of wastage on the aquatic ecosystem can help end consumers adopt more responsible practices.

## 5.5. Integrated supply chain management

The fish supply chain of India is dependent on multiple value chain players. The various players are closely interlinked and any actions taken by one member affect the entire chain. Therefore, specific interventions are required for the reduction of fish wastage, thus improving the sustainability of resources.

Although processing and exporting companies often have organised supply chains, inefficiencies have been observed at multiple points in domestic fish supply chain, from the landing point to the consumer. Hence, there is a need to streamline the domestic supply chain to reduce the post-harvest losses and ensure the supply of quality products to end consumers. There is a need to encourage entrepreneurs and private agencies to create efficient technology-driven supply chains and domestic fish retail marketing networks.

### Efficient technology-driven equipment for the domestic supply chain

Medium and small players of the value chain often face higher-order losses during transport of fish from distant states. Due to lack of cold chain facilities, retailers are often compelled to sell their products on the same day at a low price, and the quality of fish is also compromised. Hence, it is important to promote and adopt new-age cold chain instruments such as insulated boxes, rotomoulded ice boxes, small cold storage units and freezer vehicles. The Government has stressed the development of cold chain infrastructure for fish, and there is a need for quick implementation of such schemes.

### Digitisation for efficient supply chain management

Inefficiencies in the fish supply chain lead to high wastage and higher consumer prices. Several technologies have emerged that are altering the traditional modes of operation. Besides the need to adapt, supply chains can also reach the next horizon of operational effectiveness, leverage emerging digital supply chain business models and transform companies into a digital supply chain.

Fully integrating supply chain management technologies, including demand planning, asset management, warehouse management, transportation and logistics management, procurement, and order fulfilment, is the need of the hour in the aqua products supply chain. The digitised supply chain will enable all players to share data on a real-time basis, thus enabling monitoring of the entire supply chain. A fully digital supply chain can generate insights for increased efficiencies, reduction of waste, optimum utilisation of assets and resources, and greater profits. Technologies such as GPS tracking, radio frequency identification (RFID), barcodes, smart labels, location-based data and wireless sensor networks (WSN) – all play a part in a digital supply chain. In addition, cloud technologies integrated with web services can unify information and processes to create trader-partner visibility and more efficient collaboration.

### Introduction of traceability of fish

Traceability is the ability to trace the origin of a product to its source at any step of the supply chain. It helps in ensuring food safety, promotes sustainable production and consumption, and keeps a check on misappropriation at any stage. The pandemic is increasing consumer concerns about food safety, processing distribution and sustainability. Hence, traceability in the food supply chain is becoming a priority across the globe.

Aqua products go through eight important phases: source, hatchery operations (aquaculture only), nursery operations (aquaculture only), growing techniques, harvesting, processing, market and consumers.[60] Due to its complex nature, there is scope for fraudulent activities and misappropriation in the aqua supply chain, which makes management and traceability difficult. Given the potential of this sector, it is imperative to regulate the environmental footprint of these activities.

[60] https://www.mdpi.com/2304-8158/10/10/2265/htm

Adopting traceability can help in ensuring the sustainability, transparency and integrity of the whole sector through reliable product information. A socially responsible product can translate into higher profit margins, enhanced customer loyalty and improved brand reputation.[61] Traceability systems are based on blockchain, IoT, WSN and RFID and ensure reliability from production to consumption.

### Application of blockchain for supply chain management

Blockchain technology can be used to address the traceability issue by integrating fish farmers or fishers and all stakeholders and gathering specific data on environmental impact, feed, growth and fish health, which are the key factors for sustainable production.

## 5.6. Promoting value addition by small and micro enterprises

Since fish processing is an export-oriented industry, value addition becomes an opportunity to realise higher foreign exchange. Established Indian private players are augmenting their presence in the global market and exporting processed aqua products across the globe. However, there is still untapped potential for medium and small entities to enhance their processing volumes and supply packaged, ready-to-eat products to domestic consumers.

### Access to improved infrastructure and equipment for small and micro enterprises

Post-harvest management and value addition for aqua products require high capital investment. The high cost of infrastructure such as cold chains, cold storage units and processing equipment is one of the major factors limiting the growth of small players and entrepreneurs. Only medium and large companies have the financial capacity to invest in this infrastructure in India. While the Government has been providing financial assistance through various schemes to promote access, an '**entrepreneurial model**' can be used to encourage small and micro-level enterprises in production clusters. Existing equipment manufacturers can be further capacitated and supported to provide customised low-cost but high-end equipment to such enterprises. The major areas where small and micro-level enterprises require support are shown below:

| Focus area | Extension services |
|---|---|
| **Access to finance** | Access to finance at nominal interest rate for small and micro enterprises to meet capital and operational costs |
| **Post-harvest equipment** | Availability of equipment such as cutting machines, solar dryers, and cleaning and processing equipment, at a low cost |
| **Packaging** | Support with modern packaging techniques such as vacuum packaging and modified atmospheric packaging for chilled products and suitable vacuum packaging, bottle packaging, etc., for dry fish, pickles and similar products |
| **Capacity building for value addition** | Enablement of interested entrepreneurs, women, producer groups and FFPOs to prepare value-added products, including traditional and regional items<br><br>Structured training, SoPs and manuals, followed by handholding |
| **Branding and certification** | Support in acquiring Food Safety and Standards Authority of India (FSSAI) and other required certification and building a brand for products |

[61] https://krishi.icar.gov.in/jspui/bitstream/123456789/71387/1/11_ICT.pdf

# About FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies.

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## About PWC's Agriculture and Natural Resources team

PwC India has a dedicated and highly experienced team working in the agriculture and natural resources sector. The team provides advisory services related to agriculture and agribusiness management, animal husbandry, fisheries, long-term transformational project implementation, food processing, value chain development, credit access, policy, impact assessment, performance improvement, commodity trading, integrated resource management, inputs, and infrastructure.

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