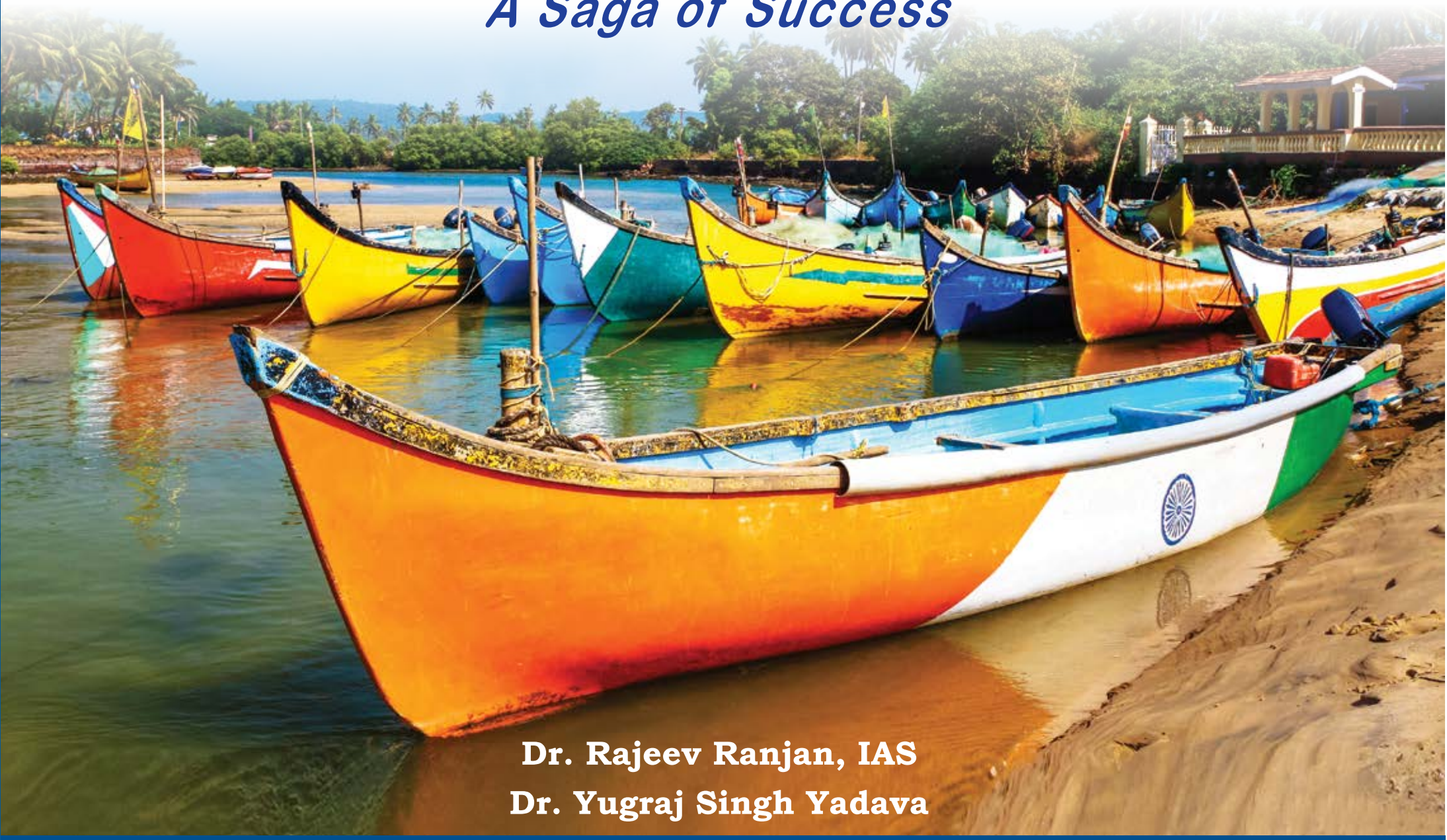
सत्यमेव जयते

Indian Fisheries

A Saga of Success



Dr. Rajeev Ranjan, IAS

Dr. Yugraj Singh Yadava

Department of Fisheries
Ministry of Fisheries, Animal Husbandry and Dairying
Government of India

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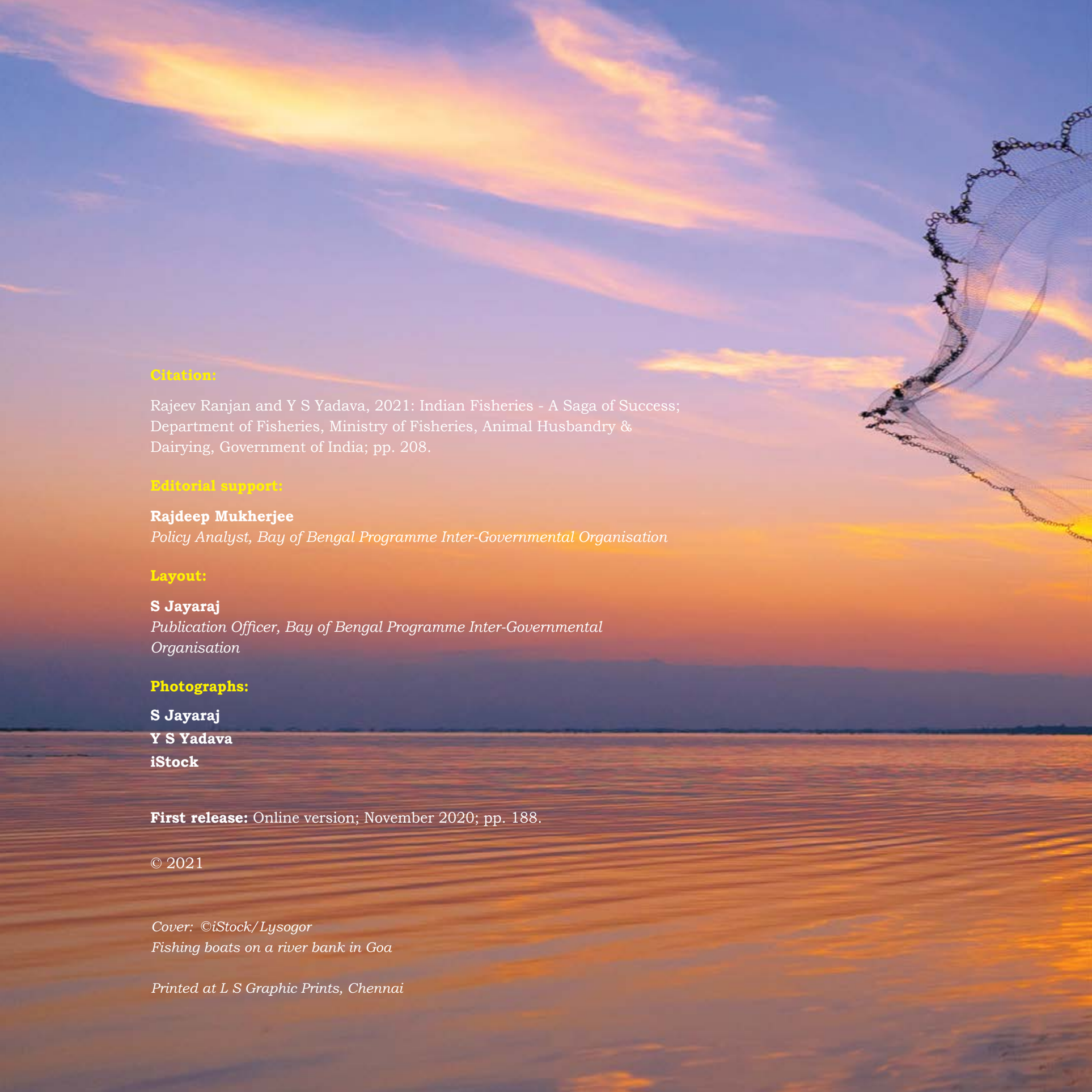

Citation:

Rajeev Ranjan and Y S Yadava, 2021: Indian Fisheries - A Saga of Success; Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India; pp. 208.

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iStock

First release: Online version; November 2020; pp. 188.

Cover: ©iStock/Lysogor
Fishing boats on a river bank in Goa

Printed at L S Graphic Prints, Chennai

Fisherman casting a net

Catla fish arranged for sale

परशोत्तम रुपाला

Parshottam Rupala

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

मंत्री
मत्स्यपालन, पशुपालन एवं डेयरी
भारत सरकार
नई दिल्ली - 110 011

Minister
Fisheries, Animal Husbandry & Dairying
Government of India
New Delhi-110 011

Message

If any nation in the world that can be proud of the bounties of nature bestowed upon it, it is India. The range of the gigantic Himalayas extending from the north-west to the north-east, the extent of the mighty rivers that criss-cross the length and breadth of the country and the oceans that encircle the peninsular half of the nation, has few parallels in the world. And all these geographies harbor the most vibrant and productive fisheries. Besides this natural wealth, the man-made resources in the form of reservoirs and tanks and ponds have further added to India's fisheries and fish farming strength, making it one of the most enviable nations in terms of its fisheries wealth and also towards its contributions to the global fish food basket.

In 2019-20, India's fish production was recorded at 14.2 million metric tonnes and the seafood export earned Rs. 46,662.85 crores (USD 6.68 billion). The fisheries sector provides livelihood support to 28.0 million fishers directly and enhancing the socio-economic well-being of many others in the value chain. With an investment of Rs. 32,000 crores in recent years under the ongoing Schemes and Programmes, the Ministry is committed to take the fisheries sector to newer heights. At the same time, we also endeavor to drive ecologically healthy, economically viable, and socially inclusive growth in the sector that contributes meaningfully towards the economic prosperity and well-being of fishers and fish farmers as well as to the food and nutritional security of the country.

This highly informative publication brought out by the Department of Fisheries not only chronicles the recent developments in the sector but also provides a picture of the sector during the last 7-8 decades and commends the efforts of the millions of fishers, fish farmers, fish processors, researchers and officials who contributed their best, leading to these achievements. I would like to compliment the Department and the authors for preparing this publication, which will contribute to our understanding of the sector and also serve as an important resource book for the fisheries sector.

(Parshottam Rupala)

Fishermen repairing purse seine net -
Mappila Bay Fishing Harbour, Kannur. Kerala.

डॉ. एल. मुरुगन
Dr L Murugan

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

राज्य मंत्री
सूचना एवं प्रसारण मंत्रालय और
मत्स्य पालन, पशुपालन और डेयरी मंत्रालय
भारत सरकार
नई दिल्ली - 110 011
Minister of State for
Information and Broadcasting Ministry and
Fisheries, Animal Husbandry & Dairying Ministry
Government of India
New Delhi-110 011

Message

Today, the Indian fisheries sector stands proud of its achievements, not only because India is among the top capture fisheries and fish farming nations in the world, but also because the sector adds immense value to our nation's economic growth. It has played an instrumental role in ensuring the food and nutritional security of the nation's growing population and in generating employment and sustaining the livelihoods of millions of people across the country. The Indian fish and fish products, sourced from pristine waters through socially inclusive and ecologically sustainable practices, have left an indelible mark on the global seafood market.

Under the visionary leadership of the Hon'ble Prime Minister Shri Narendra Modi ji, the fisheries sector is marching ahead with increased pace. The Government of India's sustained efforts, the enterprising nature of the fishers and fish farmers, the progress made by the fisheries R&D agencies and the value proffered by a range of stakeholders along the value chain have all contributed towards scripting this success story.

We now look forward to effectively implementing the policies and programmes that can sustainably bring about an enhancement in fish production and productivity from our fisheries and aquaculture resources. It is equally important to maintain the ecological integrity of these resources so that they can continue to provide nutritious fish food and contribute meaningfully towards the livelihoods and socio-economic development of millions of fishers and fish farmers who rely on the sector.

I am happy to note the release of this publication, documenting the incredible journey of fisheries and aquaculture in the country. I appreciate the work of the Department of Fisheries, and all those who have contributed in the making of this noteworthy publication.

(Dr L Murugan)

Traditional fishing boats, Port Blair, Andaman and Nicobar Islands.

जतिन्द्र नाथ स्वेन, आईएएस
सचिव

Jatindra Nath Swain, IAS
Secretary

मत्स्यपालन, पशु पालन एवं डेयरी मंत्रालय
मत्स्यपालन विभाग
कृषि भवन, नई दिल्ली - 110 001

Ministry of Fisheries,
Animal Husbandry & Dairying
Department of Fisheries
Krishi Bhawan, New Delhi-110 001

Foreword

The history of fisheries is as old as human civilization itself and predates the commencement of settled agriculture. However, fisheries along scientific lines started from the 18th century with the commencement of studies on the Indian fish fauna during 1785-1789 followed by the cataloguing of the fishes of the River Ganges in 1822, culminating in the enactment of the Indian Fisheries Act in 1897. Developmental activities during the colonial period mostly focused on the documentation of the fisheries wealth of the Indian Sub-continent and conservation of fisheries resources. Developing fisheries as an integral component of the Indian economy started only during the post-independence period under the Five-year Plans.

Sustained efforts to increase fish production and productivity under the Fish Farmers Development Agencies and other schemes helped accelerate the growth in the sector from 1980 onwards, helping meet the increasing food and nutritional needs of the growing population while providing gainful employment to millions of fishers and fish farmers in the country. Both the Central and the State Governments along with the R&D institutions led by the ICAR have played a catalytic role in bringing investment into the sector, and in creating the necessary infrastructure in the form of harbors and landing centres, seed farms and hatcheries and post-harvest and processing facilities, which has resulted in the sustained growth of the sector.

As a testimony to the growing importance of the fisheries sector in the National economy, the Government of India have created a separate Department of Fisheries, followed by a new Ministry of Fisheries, Animal Husbandry and Dairying to pilot the development of fisheries on a much larger-scale and have since launched the flagship scheme, the Pradhan Mantri Matsya Sampada Yojana with an investment of Rs. 20,050 crores for the period 2020-2024-25.

This chronicle, while highlighting the journey of the fisheries sector since Independence, is a saga of the fisheries wealth of the country and of the people who toil under harsh conditions to bring the delicious and highly nutritious fish protein to our plates. The resource book, not only provides an insightful window to the past, but also brings forth the issues that confront the sector and the plans of the Government to address them in order to enable the sector to perform even better in the times to come.

In this context, I on behalf of the Department of Fisheries would like to express my gratitude to Dr. Rajeev Ranjan, IAS, Former Secretary of the Department of Fisheries and Dr. Yugraj Singh Yadava, Director, BOBP-IGO who have painstakingly documented this resource book, both in contents and visuals and have made it a delightful read.

Jatindra Nath Swain

(Jatindra Nath Swain)

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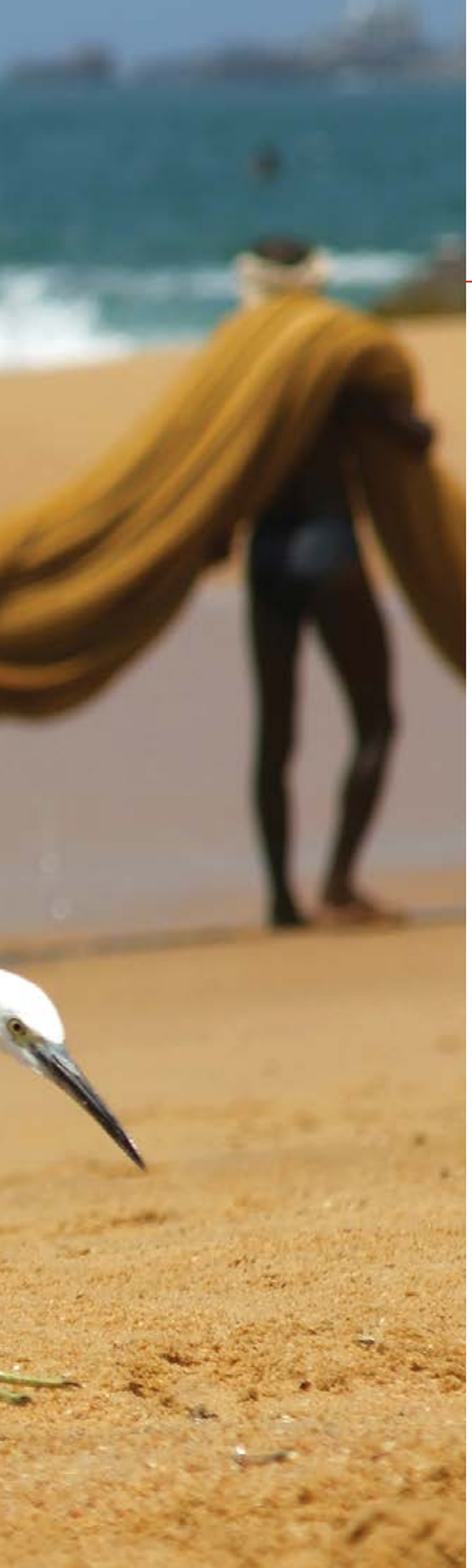
Fishermen operating beach seine in Kovalam, Kerala.



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A shoal of fishes.

Introduction

Introduction

by Dr Rajeev Ranjan, IAS

The objective of documenting the fascinating history of Indian fisheries is to unfold the interesting journey of this important economic sector from the days of the British Raj to the modern India of the Twenty-first Century. The story of Indian fisheries has so far remained largely unsaid, unspoken and untold, except in official documents and some policy narratives. Fish is not just what we see in the market or on our plates, but is woven in a myriad of facts, figures and curiosities, often unheard and unknown to people. After assuming the charge as Secretary of the newly created Department of Fisheries in the Government of India, I realised to my amazement the vast scope and different narratives in this very important sector and also felt the need to talk about the saga of Indian fisheries, from its past to the present, and thus the idea of this book was born. I hope this book will serve as a bridge to connect people with the fishers, fish farmers and the range of service providers that constitute the stakeholders of the sector in India. The purpose of writing this 'Introduction' is to provide a glimpse of the past developments and the future thrust to the sector with the hope that the bigger picture of fisheries and aquaculture in India will unfold in the following chapters of the book, which will also serve as a handy resource book for reference.

Fisheries and aquaculture play a very important role in ensuring nutritional and food security of the nation as well as for employment creation in the country. Fish is an important source of food, nutrition, employment and income to billions of people across the world. Rich in omega-3 fatty acids, it is an excellent source of healthy and affordable protein and also one of the healthiest foods to mitigate hunger and malnutrition. It is estimated that for more than 3 billion people in the world, 20 percent of their average per capita intake of animal protein comes from fish.

In India, the **fisheries resources** are rich and diverse, making it one of the leading fish producing countries in the world. During the last 70 years, the transformational changes in the sector have led to significant increase in fish production and India now has a critical role to play in the domestic, regional and global food security. The sector also generates substantial employment opportunities and currently provides livelihood to more than 2.8 crore poor and historically excluded fishers, fish workers, fish vendors and fish farmers at the primary level and several crores along the long value chain.

The path to this development has not been simple. The collaborative and concerted efforts of the Government at the Center and the States, the stakeholders, especially fishers, fish farmers, fisheries Scientists and the vibrant private sector have made this possible. As envisioned by the Government, the sector has immense potential to double the income of fishers and fish farmers and bring in the desired economic prosperity.

India's **fish production** increased from 7 lakh tonnes in 1950-51 to 142 lakh tonnes in 2019-20, a twenty- fold increase. The last two decades have been even more spectacular as 85 lakh tonnes of fish were added to the basket as compared to 49 lakhs tonnes in the first 50 years. Further, out of the 85 lakh tonnes of fish produced in the last two decades, 45 lakh tonnes were added in the last five years. This phenomenal increase in production has been possible due to the massive contribution of freshwater and brackishwater aquaculture in the country.

The baby steps taken in the initial years of development are now long strides. In recent years, the sector has shown an impressive growth with an average annual growth rate of 10.88

Hon'ble Prime Minister of India, Shri Narendra Modiji handing over deep sea fishing vessel document to fisherman in Tamil Nadu.

percent (2014-15 to 2018-19) and fish production has registered an average annual growth of 7.53 percent during the same period. India is one of the leading exporters of seafood. Today, globally, the country stands **first** in farmed shrimp production and export, **second** in aquaculture production (after China), **third** in total fish production (after China and Indonesia) and **fourth** in export of fish and fish products.

During 2019-20, India's export of seafood stood at Rs. 46,662 crores, making it the largest contributor (with 18 %) to agricultural exports of the country.

Notwithstanding the fisheries sector's significant contributions to the national economy in terms of livelihoods, employment generation and food and nutritional security, the sector also faces several challenges that need to be addressed to sustain the growth trajectory. Being primarily small-scale in nature, the majority of the traditional and artisanal fishers and fish farmers directly depend on the sector. This overdependence on the sector is one of the main reasons for the key stakeholders *i.e.* the fish workers, fish vendors and fish farmers to fall behind the national indices of socio-economic development.

The lives and livelihoods of the traditional marine fishers are intertwined with the oceans since time immemorial. Being small-scale in nature and owing to the rich productivity of the coastal waters, fishing was concentrated in the near- shore areas, which, over time, is threatening the sustainability of the resources. To remedy this, developmental interventions along with an enabling regulatory framework is being worked out by the Government to optimize distribution of fishing effort into the Exclusive Economic Zone (EEZ) and beyond into the high seas sustainably.

Fishing is a means of **livelihood** in India, as opposed to its pre-dominantly commercial nature in the developed countries.

The sector is also characterized by unpredictability and seasonality of catch, where prices obtained for catch on any given day can be highly uncertain. Available evidences also suggest that coastal fishing communities, in general, are resource poor with lower levels of literacy and poorer conditions of life, as compared to the national averages. In addition, the technology used for fishing in India is also very basic. About 52 percent of the fishing vessels in India are motorized and contributing to about 16 percent of the marine fish production. Almost the entire mechanized vessel fleet of India is below 24 m length overall and they contribute to about 83 percent of the total catch. The balance 1 percent comes from the traditional boats.

The developmental interventions in this regard include implementation of sustainable fishing practices that are based on sound management plans, modernization of fishing vessels, comprehensive Monitoring, Control and Surveillance (MCS) regime, improving safety at sea, and supported by a robust regulatory and managerial framework. **Empowerment** of the traditional fishers to optimally harness the deep sea and oceanic resources, especially the tuna resources in the EEZ and in the high seas is considered a priority area. Similarly, development of fisheries in the Andaman and Nicobar Islands and the Lakshadweep Islands is also essential to empower the fishers in these remote areas to optimally harness the resources from the waters surrounding the Islands and contribute to the national fish basket.

Promotion of additional and alternative livelihoods can gradually wean away the extra effort from the marine capture fisheries. In this regard, mariculture activities such as cage farming, seaweed cultivation and coastal aquaculture offer promising options. Therefore, setting up of a modern marine fishing sector and implementation of sustainable fishing practices would be a priority area for the Government in the next five years. Further, the Government would also not lose track of the safety nets that are essential to secure the welfare of small-scale fishers and fish farmers.

Visit of the Hon'ble Minister of Fisheries, Animal Husbandry and Dairying to Tamil Nadu and Goa – Distribution of fish seed to mariculture farmers and witnessing a cage culture unit off the coast of Rameshwaram in Tamil Nadu.

India has a **long coastline** of 8,118 sq. km and an EEZ of 20.2 lakhs sq. km. However, the fishing infrastructure is inadequate and most of the landing and berthing sites are rudimentary and need modernization. Clearly, given the public goods nature of the infrastructure and the involvement of huge investments with long gestation period, the Government plans to continue to support such activities by modernizing the existing harbours and landing sites and building new infrastructure to cater to the growing needs of the marine fishing fleet. Besides overall technological upgradation of the marine fishery sector, training and capacity building of the stakeholders through the entire value chain is part of the Government's plan to modernize the sector and allow for the optimal exploitation of the resources and minimize wastage. While striving to achieve this, the Government needs to also ensure effective management of the fish stocks and their conservation where required, following stock assessment of various species and other established techniques such as remote sensing and electronic tracking of fish.

Since trawling is considered to be an unsustainable fishing practice, the Government of India has accorded administrative approval for the replacement of 2,000 trawlers in the Palk Bay in Tamil Nadu with deep sea fishing vessels as a diversification measure along with other viable options for management of the resources such as co-management. This project helps fishermen in the Palk Bay, who are not exposed to deep-sea fishing, to venture deep into the Indian Ocean and other deep sea areas to catch species like tuna that are in high demand. Moreover, it will protect the ecosystem from further damage as well as settle the ongoing issues with Sri Lanka. To equip the Palk Bay fishermen for deep sea fishing, using long line and gill nets, capacity building programmes are organised and training given to the selected beneficiaries through the Central Institute of Fisheries Nautical Engineering and Training (CIFNET) in Cochin and Chennai. The training provides both the basic understanding of the resources and also hands-on practices on handling techniques. The Department of Fisheries is in the process of bringing potential international buyers for deep sea catches such as tuna, in collaboration with the Marine Products Export Development Authority (MPEDA) of the Ministry of Commerce, Government of India. The officials of the

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Top, middle and bottom: Inland aquatic resources in India.

Tamil Nadu Fisheries Development Corporation (TNFDC) have participated in the International Sea Food Show organised by JETRO in Tokyo, Japan and met with potential importers of tuna who have shown willingness to collaborate for promoting export of tuna and also to facilitate proper training for enhancing the handling and processing skills.

To ensure the **safety and security** of the fishermen at sea there is a need to disseminate information about the weather and availability of the fishery resources and the Government is planning to provide wireless communication equipment (VHF sets) to all the registered fishing crafts. There are also plans to set up Fisheries Information and Service Centers (FISC), a single-window information center responsible for data collection on resource landings, dissemination of information about the Potential Fishing Zone, various Government welfare schemes, weather warning, etc.

Simultaneously, an array of additional and **alternative livelihood activities** like promotion of open sea cage culture, seaweed culture and bivalve farming are being introduced in the Palk Bay region which will mitigate the fishing pressure in the Bay and improve the socio- economic status of the fisherfolk in the region. Cage farming will not only protect the livelihoods of fishers but will also increase their socio-economic conditions. The coastal waters which are productive but yielding less due to intensive fishing can be better utilised for cage farming to improve the productivity by enhancing habitats or growing fish seed in closed structures. The seaweed culture is undertaken mostly by the fisherwomen in the coastal districts. One crop takes 45 days for harvesting. The harvested seaweeds are dried in the sunlight on the beaches and marketed on dry weight basis. Bivalve farming is eco-friendly, low cost and could be easily adopted by fishers. Integrated bivalve farming has been successfully demonstrated by the ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) since 1980s and the same has been adopted by the fishers in central and northern Kerala and also in some parts of Karnataka and Maharashtra.

In recent decades, freshwater and brackishwater aquaculture has largely propelled the growth of the sector. From 19 lakh tonnes in 2000-2001, aquaculture production has now increased to about 88 lakh tonnes. The rapid growth of shrimp aquaculture in the last one decade is one of the finest examples of the contribution of the private sector around the fulcrum

Display of an assorted catch of marine species.

of robust governmental policies and programmes. Today, India is one of the **largest producer** of farmed shrimp in the world. During 2019-20, India exported USD 489 crore worth of frozen shrimp, which constituted almost 25 percent of the world's frozen shrimp exported. States like Andhra Pradesh have made spectacular progress and transformed into the fish bowl of the country with 30 percent of the production coming from this State alone. Gujarat has also shown spectacular development in shrimp farming and the coastal fallow lands are being put to productive use.

About 88 percent of the farmed fish comes from freshwater and is dominated by the Indian Major Carps (IMC). However, the increase in production and productivity from aquaculture is also beset with several issues such as disease, lack of species diversification and genetic improvement, poor seed quality, high input cost, access to institutional credit and insurance, environmental sustainability, etc. The Government is addressing these issues on priority basis to allow for increased fish production from the freshwater resources.

Aquatic animal health management has emerged as the prime concern for ensuring sustainability of the farming operations. Unauthorized introduction of exotics, poor biosecurity measures, use of banned antibiotics and related food safety issues are threatening the sustainable growth of aquaculture. The Government's plans in this regard include establishing a sound regulatory framework for prevention, control and spread of aquatic animal diseases; prudent use of inputs in aquaculture; regulated import of aquatic animals and their products; seed and feed certification; accreditation of hatcheries; and end-to-end traceability from 'catch to consumer.' The success of the plans would also necessitate coordinated and concerted efforts between the Center and the States and among the States.

The growth in aquaculture would also depend on how effectively the horizontal and vertical expansion takes place. Identification of new areas, especially for coastal aquaculture would allow for its horizontal expansion. Vertical hikes would require technology infusion and water management such as high-density aquaculture in ponds, Recirculating Aquaculture Systems (RAS), Bio-floc, aquaponics, cage culture, etc. to harvest 'more crop per drop'. Diversification of practices would also provide the right fillip to increase production and productivity from aquaculture.

Reservoirs, also called the 'sleeping giants', have high potential to contribute to the country's fish basket. Tapping the potential of reservoirs requires a judicious mix of conserving the *in situ* breeding areas in the reservoirs and supplemental stocking with the right quality of fingerlings of suitable species. The plans also focus on integrated development of reservoirs by creation of *in-situ* hatcheries and fingerling rearing units along with cage cultivation for optimally harnessing the productivity of the reservoirs.

One of the key **concerns** in the fisheries sector is the huge post-harvest loss and wastage, which needs to be addressed urgently. Interventions in the entire value chain would include use of the best practices on board fishing vessels to eliminate the chances of contamination and enhancement of shelf life, modernization of fishing harbours and fish landing centers, refrigerated storages and an efficient transport chain that would carry fish to the remotest corners of the country. Further, modern fish markets, processing units, availability of quality ice and clean water would also be needed to improve the post-harvest sector. Traceability of fish from 'bait to plate', eco-labeling and branding of Indian farmed fish would be the other areas of intervention that would allow for benchmarking with global best practices. The upcoming online fish marketing units are a significant development and can help in improving the value chain and increasing the sustainability of the resources.

India's increasing population, urbanization, higher incomes and changing food habits has increased the demand for fish and enabled the growth of domestic market to absorb the increasing fish supply. However, the per capita fish consumption of India is still on the lower side. The **COVID-19 pandemic** has brought to fore many issues and we have also learnt lessons on how to build the resilience of the communities so that they can withstand the hardships caused by unforeseen events of high magnitude. One of the key lessons that we have learnt from this pandemic is the need for focusing on the promotion of fish consumption within the country. In this direction, the Government of India is chalking out multi-pronged strategies with focused interventions and a clear road map for improving the domestic marketing of fish and fish products.

Recognizing the importance of fisheries to the economy of the country and for focused and holistic development of the sector

with socio-economic wellbeing and welfare of fishers, fish farmers and fish workers at the core, the Government of India in February, 2019 created a separate Department of Fisheries and followed up with the creation of a new Ministry of Fisheries, Animal Husbandry and Dairying in June, 2019.

The recently concluded **Blue Revolution Scheme** launched in 2015-16 for 'Integrated Development and Management of Fisheries' with an outlay of Rs 3,000 crore over a period of 5 years made vital contributions towards development of the fisheries sector. While examining the need for a holistic development of fisheries and aquaculture in the country, it is seen that one of the critical factors that influence the envisaged outcomes is the degree of financial investment in the sector. In the fisheries sector, there is a need for infusion of substantial capital investment along the value chain aimed at value creation, value addition and value realization.

Blue Revolution or the 'Neel Kranti Mission' had the vision to achieve economic prosperity of the country, improve the socio-economic conditions of the fishers and fish farmers as well as contribute towards food and nutritional security through utilisation of the full potential of water resources for fisheries development in a sustainable manner, keeping in view the bio-security and environmental concerns. The 'Neel Kranti Mission 2016 (NKM 16)', being the year in which it was envisioned by the Hon'ble Prime Minister, was a multi-dimensional approach to all activities concerned with the development of the fisheries sector as a modern world-class industry in India. It focused on tapping the full production potential and enhanced productivity substantially from aquaculture and fisheries resources, both inland and marine. The key goal was to substantially increase the share of the Indian fisheries in the export market. It was to ensure doubling the income of fishers and fish farmers with inclusive participation of the socio-economically weaker sections of the society. The **vision** was for "Creating an enabling environment for integrated development of the full potential of fisheries of the country, along with substantial improvement in the income status of fisheries and fish farmers keeping in view the sustainability, bio-security and environmental concerns."

Capital investment in the sector has been from both public and private sources. However, traditionally the Central

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A haul of finfish from marine cage culture.

Governmental spending in the sector has been much lower *vis-à-vis* the spending on agriculture and other allied sectors. This indicates that in addition to the Central Government's spending, there is a huge capital formation in the fisheries sector driven by both the private sector and the States/UTs. It also indicates that the Government spending in crucial areas of the sector has a multiplier effect in catalyzing additional financial infusion, and mobilizing the growth of a vibrant private sector around the Government interventions.

In order to sustain and accelerate the growth in the fisheries sector, given the fact that the estimated Central Government's capital expenditure multiplier is 3.25 (RBI, Monetary Policy Report, 2019) and its long-lasting multiplier effects, infusion of Government capital into the sector would catalyse private investment and give a greater thrust to the development of the sector.

Stepping up public and government expenditure/investment in the sector would also provide a stimulus to private investment and in turn lead to accelerating the growth. Investment in asset creation activities like construction of fishing harbours, cold chain, markets, processing plants, aqua parks and logistics, value addition, etc. will not only generate employment and value but also indirectly facilitate area expansion, contributing

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A wooden fishing vessel from Veraval, Gujarat.

to enhanced fish production and leading to a sustained uptrend in the economic cycle of the sector.

Towards this end, the Government of India through its schemes and programmes envisions to leverage an investment of more than Rs. 50,000 crores in the next five years that includes contributions of State/UT Governments, beneficiary and institutional finance. The projected investment is likely to create a foundation for the growth of the sector and aid in filling the critical gaps, undertaking demonstrative activities and technology infusion, which in turn, is expected to propel both horizontal and vertical growth of the sector.

In order to consolidate the fisheries sectorial gains, sustain growth and address some of the critical gaps in the sector in a sustainable, responsible, inclusive, and equitable manner, the Government of India in June 2020 approved the **Pradhan Mantri Matsya Sampada Yojana (PMMSY)** with an investment of Rs. 20,050 crores.

The PMMSY happens to be the **largest ever investment** in the history of Indian fisheries and would revolutionize the fisheries sector. Under PMMSY, focused and sustained interventions will be made for addressing the issues of fish production and productivity, fisheries infrastructure and post-harvest management, and modernization and strengthening of the value chain. Emphasis will be laid on harnessing the resources in a sustainable and responsible manner, addressing the critical gaps, infusion of technology and water management aimed at 'more crop per drop', quality and hygiene in fish and fish products, and enhancing the stakeholders' economic returns along the value chain combined with a robust fisheries management and regulatory framework. Priority will be given for promoting the interests of traditional and small-scale fishers, marginal fish farmers and fish workers along with their social, physical and economic security needs.

Through an array of 100 diverse interventions along the fisheries value chain from production to consumption, the PMMSY has something for everyone- traditional fishers to fish farmers and youth to entrepreneurs. The scheme would touch the lives of lakhs of fishers, fish farmers, fish workers and fish venders directly and indirectly every year and the objective is not to leave anyone behind. The Scheme envisages to add an additional fish production of 70 lakh tonnes by 2024-25, enhance aquaculture productivity from the present national average of 3 tonnes to 5 tonnes per hectare, reduce the post-harvest losses from 25 percent to around 10 percent, generate about 55 lakh direct and indirect employment opportunities, double fisheries exports from Rs. 46,589 crores (2018-19) to Rs. 1 lakh crore by 2024-25 and enhance the per capita fish consumption from the current 5-6 kg to 12 kg over the next five years. Thrust would be given towards sustainability, end-to-end traceability from 'catch to consumer', enhancement of fisheries export competitiveness, and a robust fisheries management and regulatory framework.

In view of the Covid-19 pandemic, the Department of Fisheries had to fast track the implementation of the Scheme for creating immediate employment opportunities. The Operational Guidelines of the Scheme were issued within a short span of 30 days. Through proper coordination and by continuous engagement with States/UTs, the Scheme was rolled out in a record time and the Hon'ble Prime Minister launched the Scheme on 10th September 2020.

The PMMSY received overwhelming response from the States/UTs and other agencies. During 2020-21, proposals from thirty-four (34) States/UTs and other organizations at a total cost of Rs. 2,881.41 crore with central share of Rs. 1,089.86 crore have been approved and funds released to the State/UT Governments.

A sound **fisheries extension** system in the marine sector, implemented through the 'Sagar Mitra' will allow for the dissemination of information and knowledge about the best practices as well as the schemes and programmes amongst the stakeholders.

Domestic fish marketing is an important segment of the commercial activities and a future growth area. There are several companies which carry out retail marketing of fresh fish, ready to eat, ready to cook and value added fish food varieties through their chain of retail fresh fish outlets and sea food restaurants across different areas. Only prime quality fish is sold to the public at an affordable price in hygienic condition. Many of these companies are able to attract good investor funding and the Covid-19 crisis has given a further impetus to such e-marketing companies.

Marine algae, commonly known as **seaweeds** are one of the potential renewable resources of the oceans. There are about 900 species of green seaweed, 4,000 species of red seaweed and 1,500 brown seaweed species found in nature all over the world. The utility offered by the seaweed bio-resources is enormous. They are mainly utilised in phyco-colloid industries. Agar, algins and carrageenan are the three polysaccharides obtained from seaweeds which have over 200 identified extensive industrial uses. The global seaweed phyco-colloid industry is a billion-dollar industry, which has crossed 90,000 metric tonnes of production with a market value of USD 1.2 billion in 2015 (FAO, 2016). Many edible seaweeds are rich in proteins, vitamins, minerals and trace metals. Some species of seaweeds are directly consumed as food in Asian countries like China, Japan, the Philippines, Korea and some European countries. The seaweed biomass is gaining prominence in nutraceutical industry also wherein new emerging applications in several bio-based, high value edible commodity products such as drugs and medicines as well as functional foods are being developed. The potential of seaweeds as sources of biofuel has been identified in the recent past with impressive substitution capacity over the fossil fuels. Further, the use of sap of different seaweeds as plant growth stimulant is gaining momentum for sustainable agriculture productivity.

In India, about 844 species of seaweeds have been reported. Natural seaweed collection has been the livelihood for the coastal fisherwomen for several decades, especially in Gujarat and Tamil Nadu. Red seaweeds, gracilaria and gelidiella are being commercially harvested for agar production and sargassum and turbinaria are harvested for alginate production since the early 1950s in India. These algae are harvested from 20 islands and the mainland coast of the Gulf of Mannar and the Palk Bay in Southeast coast of India. Farming of seaweeds in India began since 1964 with the studies carried out by ICAR-CMFRI on the indigenous varieties and later the Central Salt and Marine Chemicals Research Institute (CSMCRI) has also played a vital role in the development of seaweed farming in the country with the introduction of *Kappaphycus alvarezii* brought from Japan. Since then, this species has taken over the other native species such as gracillaria and gelidiella due to its fast growth and high yield giving a considerable income to the fishers of Ramanathapuram District of Tamil Nadu. However, considering

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Top and bottom: Seaweed collectors in Mandapam, Tamil Nadu.

the global production of farmed seaweeds, India's production of about nearly 2,500 tonnes is very less.

The Indian sub-continent with its extensive coastline has **enormous potential** for seaweed farming in its coastal States. However, the resource is highly underutilised, scattered and localised at present and still relies on the traditional farming techniques. Presently, seaweed is grown by the fishing community in Ramanathapuram, Thoothukudi, Pudukottai and Thanjavur districts in Tamil Nadu. Even though commercial farming doesn't exist, it has been reported that seaweeds grow abundantly along the Gujarat coast, and around the Lakshadweep and Andaman Nicobar Islands. There are also rich seaweed beds around Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam and Chilka in Orissa.

Besides, ICAR-CMFRI has also successfully developed series of nutraceutical products for use against medical complications arising due to hypothyroidism, obesity, etc., from the bioactive leads isolated from the seaweeds. Scaling up of the production and industrialisation of such products offer large scope in the coming years. In addition to its importance in terms of industrial products and foreign exchange potential, sustainable production of seaweeds has a potential to contribute to the society through mass employment generation at the first level, *i.e.*, seed hatcheries, grow out operation and processing; at the second level through industries, supplying goods and services; and at the third level through the provision of associated jobs. Less labour-intensive farming methods in the shallow coastal waters and the possibility of round the year production makes the seaweed farming a promising livelihood avenue for the weaker sections in the coastal community.

The Government of India is also promoting **seaweed farming** along the Indian coast through the funding support provided by the National Fisheries Development Board (NFDB) under its various schemes. Considering the untapped potential from these aquatic resources, the Government of India through the Central Sector component of the PMMSY has allocated an amount of Rs. 640 crores exclusively for the development of seaweed cultivation along the country's EEZ. The mission mode project envisages a production of over 10.60 lakh tonnes of seaweed on wet weight basis by 2025, with the generation of direct employment for more than 4 lakh women and additional employment through the by-product industry and along the value chain. The Scheme also provides a road map for the development of seaweed farming sector in the country through the following strategies: support for expansion of the present cultivable area; technological upgradation to mass-scale seaweed farming; ensuring quality seed supply by providing support in establishing seaweed banks, nurseries, tissue culture units, promotion of private seed nurseries; utilisation of the existing labour and skill development by involving more local people in the neighbourhood of the cultivation areas; increasing the capital investment in seaweed farming; establishment of small-scale seaweed processing units, etc.; cluster or area-based approaches in farming; and the value chain development along with the integration of other components of PMMSY. Convergence with schemes and programs of the Centre/State/UT Governments with end-to-end solutions are also envisaged to achieve the maximum possible benefits to the country's economy as well as livelihood and welfare of the marginalised fisher communities, especially the women.

Recognizing the importance of critical infrastructure for boosting exports and seaweeds in providing additional livelihood opportunities especially to rural women, the Department of Fisheries ensured that two critical initiatives are announced in the **Union Budget 2021**.

a) Seaweed park in Tamil nadu

In the Union Budget 2021, creation of a seaweed park in Tamil Nadu has been announced. This initiative would promote seaweed farming and the seaweed-based industries together and will facilitate full-fledged expansion of the seaweed sector. Further, it would be a 'One Stop Park' for the entire seaweed value chain and will link the stakeholders *i.e.* farmers, processors, buyers, exporters, importers, retailers together for optimal outcomes thereby maximizing value addition, minimizing wastage, increasing farmers income and creating employment opportunities. It will be developed on a 'hub and spoke' model.

An investment of Rs. 100 crores is envisaged for establishing the seaweed park.

b) Development of 5 major fishing harbours as hub of economic activities

In the Union Budget 2021, it has also been announced that 5 major fishing harbours – Kochi, Chennai, Visakhapatnam,

Paradip, and Petuaghat will be developed as hubs of economic activity with world class infrastructure and amenities, seamless and quality cold chain and hygienic handling for reducing post-harvest losses.

An investment of Rs. 600 crores is envisaged for developing the fishing harbours.

Ornamental fisheries and its allied industry in India have enormous prospects by virtue of the availability of adequate resources, favourable ecological conditions, huge potential and interest in the country, which can be turned into a successful sector. Keeping this in view, the Government proposes to promote ornamental fish farming in a big way through the PMMSY. This is expected to contribute significantly in income and welfare of a large number of urban and rural population, especially the youth, women and entrepreneurs in the country.

By the promotion of ornamental fisheries and its allied industry, the Government is taking important steps towards employment creation, well-being of small-scale farmers and low skilled youth residing in the rural coastal and inland areas, upholding their socio-economic status and promoting their holistic development. The successful implementation of ornamental fisheries will be a fruitful endeavour in terms of its huge employment potential.

The thrust areas in this sector include promoting hobby of aquarium keeping, promoting cluster-based approach in production, developing captive breeding in diverse varieties of ornamental species, self-reliance in aquarium and allied industry, promoting ease of doing business, creation of marketing and infrastructure facilities, focused R&D, training and capacity building, etc. It is assumed that all this can be achieved in a planned manner and with the active participation of the States and other stakeholders, as envisaged in the Ornamental Fisheries Action Plan: 2020 – 2025 prepared by the Department of Fisheries, Government of India. The Action Plan will guide the sector in a coordinated way to facilitate optimum utilization of the ornamental fish resources with well-organised production and marketing systems.

The ornamental fisheries have also been identified as one of the focus areas for entrepreneurship development, livelihood support and doubling the income of farmers with a budget allocation of Rs. 576 crore under the PMMSY and Rs. 500 crore under a World Bank funded programme. A substantial investment has also been targeted from the private sector for ornamental fisheries development in the country during the same period.

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Clown fish, a popular ornamental for hobbyists.

In addition, to address the critical gaps in fisheries infrastructure, the Government has created the

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Demonstration of ornamental fish breeding in Agatti Island, Lakshadweep.

Fisheries and Aquaculture Infrastructure Development Fund (FIDF) during 2018-19 with a fund size of Rs. 7,522 crores. The FIDF provides concessional finance to the State Governments and its entities, including the private sector for the development of fisheries infrastructure facilities.

The Department of Fisheries, Government of India has accorded high priority for creation of robust and modern fisheries and aquaculture infrastructure such as modern fish markets, cold chain, marketing, fishing harbours and landing centers, brood banks, hatcheries, etc.

Projects to the tune of Rs. 3,644.78 crores in both Government and private sector have been approved and interest subvention under FIDF is provided with an outlay of Rs. 2,171.32 crores. Approval of 14 modern Fishing Harbours at a total project cost of Rs. 3,451.32 crores in the States of Tamil Nadu, Andhra Pradesh and Gujarat is noteworthy with interest subvention under FIDF provided with an outlay of Rs. 2020 crores.

The fisheries sector in India offers several **strengths** such as high growth rate, vast and diverse resources, tropical climate with multiple commercial species, low investment with high returns, low gestation period, skilled workforce, strong technical backup, huge consumer base, urban and young population, export opportunities and policy support. At present, 100 percent Foreign Direct Investment (FDI) in aquaculture (automatic route) is permitted. The Government has enabling policies and regulations to encourage private sector and develop entrepreneurship. There is also a policy synergy between the Center and the States and the Government is committed to promote ease of doing business, incur required public spending to incentivise and catalyse private sector growth, support start-ups and bring in fisheries management reforms for effective governance, advocacy and ensuring food and nutritional security.

Investment opportunities for entrepreneurs, especially youth in fisheries sector include aquaculture, reservoir cage cultivation, mariculture-sea cage farming, seaweed farming and value addition, ornamental fisheries, bivalve farming, technology-based aquaculture, nucleus breeding centers, broodstock multiplication centers, brood banks and seed banks, hatcheries, aquaculture inputs, feed manufacturing, cage fabrication, infrastructure for RAS, bio-floc, fisheries infrastructure through Public-Private Partnership (PPP) mode, cold chain including cold storage, ice plants and refrigerated transport, processing infrastructure, modern markets, value addition units, distribution chains, and also opportunities in subsidiary industry such as boat building yards, engine and motors, gear manufacturing, communication devices, safety appliances, aquaria manufacturing, aerators, buoys and sinks, etc.

Development of markets and value chain integration of marine and freshwater fish is equally important for ensuring sustainable production. Though modern and innovative marketing models are emerging in recent years, marketing practices followed presently are predominantly old and traditional in many areas with inefficiencies pervading across the value chain. In view of these, a comprehensive strategy is essential to upgrade marketing infrastructure, reform fish auctioning systems, develop niche labels for increasing profitability and ensuring quality, enhance traceability of consignments, strengthen market intelligence, and promote exports. The potential of harvest and post-harvest technologies for efficient harvesting, value addition and for ensuring foolproof quality assurance mechanisms need to be harnessed to improve the overall efficiency of the value chains. There are several demonstrated technologies such as energy-efficient fishing vessels and gear designs, use of alternate sources of energy for powering fishing operations, use of satellite-based prediction techniques to reduce fuel consumption, new fish preservation and processing technologies, better packaging systems, and technologies for zero-energy waste management. Therefore, such technologies can be adopted and up-scaled for the benefit of fishers, fishery entrepreneurs and other value chain intermediaries.

Blue economy promises to bring about transformational changes that aim at the sustainable use of the oceanic resources, emphasizing on the promotion of smart and inclusive growth in diverse, but interconnected segments such as marine fishing and allied sectors; ocean-based energy exploration; and shipping as well as coastal tourism. India has a major stake in promoting blue economy, since the livelihood of the large number of costal inhabitants in the country depends on the wealth of the oceans. About 4 million people are directly dependent on marine fishing and allied activities for their livelihood, besides those depending on coastal aquaculture, coastal tourism, shipping, sea mining, offshore energy production and other related services.

Another major reason why blue economy is poised as a game changer for India is because of its likely contribution towards the **country's food security** in the form of increased marine fish production. It is estimated that by 2030 India will require about 18 million metric tonnes of fish to meet the demand (NFDB, 2018). When considering the fact that today we produce about 14.2 million metric tonnes annually there is a gap of 4 million metric tonnes that needs to bridge. Given the limitations of the marine capture fisheries sector and the modest enhancements that are likely from the deep sea resources, rather substantial enhancements would be from the land-based fisheries and aquaculture systems and from mariculture. The promises are immense, so are the challenges but it is reasonable to target a production of 4-5 million metric tonnes from mariculture by 2030 with careful planning and concerted action.

Finally, in order to meet the compelling demands ensuring a growth trajectory that fulfills the requirements of today and leaves an equally better fishery for tomorrow, the Government is formulating a National Fisheries Policy, which is based on the cardinal principles of equity and equality and adopts a people centric and participatory approach, mainstreams gender, and maintains inter-generational equity.

The Department of Fisheries has drafted the **'National Fisheries Policy'** in consultation with all stakeholders, for holistic development of the fisheries sector for the next one decade by integrating the existing National Policy on Marine Fisheries, 2017, the Draft National Inland Fisheries and Aquaculture Policy, the Draft National Mariculture Policy, including elements of post-harvest. The draft Policy Document has been translated into 11 different languages and circulated to States/UTs as well as uploaded on the website of the Department inviting comments from stakeholders. The comments received from the stakeholders are being examined and finalized through a Committee of Experts constituted for this purpose.

The draft Marine Fisheries (Regulation and Management) Bill, a long pending and an important legislation for regulation and management of fisheries in the EEZ and the high seas drafted in the Department was revised based on stakeholder consultations to make it less regulatory and revised draft *i.e.* the Indian Marine Fisheries Bill, 2021 is under consideration.

The Covid-19 Pandemic has not stopped the Department from recognizing the good work of the States and stakeholders. On 21 November, 2020 **World Fisheries Day**, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying presented various awards for the best performing States, District, Quasi Government Organisation/Federation/ Corporation/Board, Cooperative Societies/FFPO/SHG, Enterprise/Entrepreneurs, Fishers and Fish Farmers and Hatchery Operators, in recognition of their accomplishments in fish production and productivity, development and adoption of improved technologies and practices in fish farming.

Odisha has been adjudged the overall best performing State. Uttar Pradesh has been awarded the best performing State among the Inland States, while Assam has been awarded the best performing State among the North Eastern States.

One of the key tasks entrusted to the Officers of the Department during the peak Covid-19 pandemic was to identify key activities having high impact and draft Action Plans for each of the activity to take them forward on a mission mode.

Action Plans were prepared for 10 such **mission mode** activities namely: Seaweed cultivation, Integrated Aqua Parks, Fish Fingerlings, Island Development, North-East Development, Export Promotion, Post-harvest Management, Cold water Fisheries, Integrated Development of Coastal Fishing Villages and Fisheries Extension.

COVID-19 pandemic has also **impacted** the fisheries sector seriously. The major losses are accruing due to:

(a) Loss of export as overall export in 2020-21 is much lower than the previous year's export of USD 7 billion; (b) wastage and rotting of fish products during March-May 2020; (c) reduced domestic demand which is expected to drive down the production of fish substantially compared to last year's 13.4 million tonnes. As a result, the sector is expected to contract and impacts are also expected to linger on in 2021-22. Exports are not expected to pick up fully in the near future as the destination markets will continue to have low demand (as restaurants and hotels restart slowly) and already have stockpile of supply. Unless substantial measures are taken up to boost domestic consumption, the production and related supply chains will remain constrained.

Most small aquaculture grow-out farms and motorized vessel-owners have eroded working capital due to wastage and distress sale and are unlikely to be able to resume production/capture at the pre-COVID-19 levels, especially due to the inherent inability to access critical working capital finance. A large number of fishworkers whether employed in marine and inland capture fisheries, coastal aquaculture or inland aquaculture have been adversely impacted in terms of jobs, income and their private small savings; and lakhs of them are unlikely to regain productive jobs at least in the short-term. The loss of employment is across urban and semi-urban areas (for workers who are employed in supply and value chains) and in rural areas (workers in production activities and logistics) pushing the more vulnerable urban and rural households into poverty.

Without planned and coordinated sector-wide efforts for appropriate recovery that mainstreams "Build back Better", impacts on the sector will perpetuate. In search of financial recovery of the largely unorganized sector, there would be a rush to cut cost and increase margins at all levels. Unless provided with incentives for sustainable practices and behaviors, chances are that there would be increased overexploitation when marine fish capture resumes after the monsoon season to over compensate after the loss of profitable spring catch, lower investment on sustainable culture practices, increase in low quality extensive aquaculture, continued poor handling/ hygiene with a push for poor/contaminated stock in the market. All of these would inhibit sustainable and resilient growth of the sector in future, create long-term damages and therefore various measures are being taken to mitigate the situation and to avoid further collapse of the sector.

To recover from COVID-19 impacts, the fisheries sector faces some simultaneous **challenges**: Firstly, ensuring availability of working capital for small and marginal fishworkers and small fisheries sector enterprises that have been impacted by substantial or total erosion of such working capital. This needs to be done by facilitating access to finance that corresponds to formalization of this nearly informal sector. Secondly, the expanding domestic consumption to protect a level of production as close as possible to that of pre-COVID-19 crisis. Thirdly, augmenting the domestic fish and fish products supply to consumers in a manner that is safe. If possible, it should meet

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standards which are required for exports so that when exports open up, there should be seamless trade and supply chains which take advantage of these. This also ensures that India transforms one segment of its food supply chains to higher level of food safety.

Various advisories were issued from the Central Government to the State Governments/UTs in the wake of Covid-19 to mitigate the impacts *e.g:* advisory was issued on 24.3.2020 to include fish and shrimp in the list of commodities exempted from the lockdown and allow movement of fish and fish products, fish seed & feed for the fish farmers and aquaculture farmers, etc.

The States/UTs were requested on 26.3.2020 to send detailed report on immediate measures taken and proposed to be taken to mitigate the hardships faced by the fishers, fish farmers, fish workers and fish venders during the 21 days lockdown. The advisory issued on 28th March, 2020 to the State Governments/ UTs was to review the situation in their respective State/UT regarding security and health concerns of migrant fish workers during the 21 days lockdown and to take immediate remedial measures, etc.

Also, several regulatory relaxations were done to cushion the impact of Covid-19 on the fisheries sector on the whole.

Even without Covid-19 crisis, the fisheries sector had several challenges. While the growth in the past 10 years had been impressive, many lacunae remained in the sector. The Government of India has initiated **several reforms** that are required to ensure long-term viability of the sector, so that not only the future growth is sustainable and inclusive, but also resilient to internal and external shocks. To address the internal risks/shocks, the ideas for reform include: (a) gradual transitioning to a regulated regime of capture fishery from the current 'open access' regime; (b) conservation of diverse biological regimes and richness; (c) creation of alternative livelihood opportunities through diversification and appropriate skilling of fishworkers who are to be weaned away from capture fisheries as a consequence of the gradual transition to regulated regimes and improved conservation regimes; (d) management of genetic quality of brood stock, quality assurance of fish feed; and (e) creation of entrepreneurship models for sustainable growth of the sector, etc.

Fisheries governance is of extreme importance in the context of blue economy and good governance is the key to sustainable development of its constituent sectors. In India, control and regulation of fishing and fisheries within territorial waters is the exclusive province of the States, whereas beyond the territorial waters, it is the exclusive domain of the Union Government. There is an exhaustive set of legal instruments, which have been been introduced from time to time to govern fishing and allied activities along the coast. **The Marine Fisheries Regulatory Acts** of the State Governments, which are the pillars of fishery regulations in the coastal States, need to be reformed and updated to address the emerging issues. There is a need to follow the ecosystem approach to fishery management to ensure sustainable development. Similarly, the extensive use of technology such as GIS and remote sensing applications, vessel monitoring systems, automatic identification systems and other management options are necessary to strengthen MCS. India also needs to harness multilateral negotiations and international cooperation to develop and expand its maritime operations.

The ongoing fisheries subsidies disciplines negotiations in WTO are of critical importance to the fisheries sector of the country. The Department of Fisheries has led the multilateral negotiations on the matters related to fisheries subsidies disciplines at WTO. In close coordination with coastal States/ UTs and the Department of Commerce, India's position on various key issues of fisheries subsidies disciplines were carefully articulated in WTO meetings, and the case for Special and Differential Treatment (S&DT) was built for India and other developing countries and it was ensured that the S&DT position tabled by India was duly incorporated in the negotiating text drafted by the Chair of the Negotiation Group on Rules in WTO. The Government worked towards ensuring that the relegated issue of S&DT is propelled to centre stage of negotiations and the rights of coastal States in making determination in their sovereign jurisdictional waters was pitched for. Similarly, in the **Indian Ocean Tuna Commission (IOTC)**, which is a Regional Fisheries Management Organization in the Indian Ocean with the mandate to conserve and manage tuna and tuna like species, the degree of compliance has improved significantly over the years and is much higher than even that of some of the developed nations.

Apart from the above **priorities**, other areas that need attention are financial support, extension, skill development and ensuring social safety nets for the people engaged in marine fisheries and allied sectors. Presently, credit for fishermen is mainly catered to by informal financial agents such as auctioneers, middlemen and private moneylenders. Inter-linked deals with such financial intermediaries often result in bondage and involve huge costs in the form of inflated interest rates and auction commission. Measures are being taken *e.g.* Kisan Credit Cards, etc., to improve financial inclusion of fishermen through the provision of flexible and affordable credit which suit their unique requirements. Similarly, a strong fishers' extension system is needed to consolidate the gains in the sector as well as to address the emerging challenges by conveying the relevant information to major stakeholders, in addition to translating policy goals into action domain. To utilize the emerging opportunities and tackle hindering challenges in the sector, fishermen, fish workers, value chain intermediaries and Fishery Department personnel have to be trained adequately. Investments are required to plug the gaps and to develop human resources for the future growth of the sector. Finally, measures for strengthening social safety nets in the form of insurance coverage, pension schemes, social welfare programs, etc., are needed to insulate fishermen and small and marginal entrepreneurs from natural calamities and other adverse events. A larger coordination and institutional mechanism is required at the national and State levels for strengthening the weak links in the fisheries sector. It is envisaged that the newly created Ministry at the Centre with specific mandate to cater to the requirements in marine and inland capture, aquaculture and fisheries research and education will lead to a **major growth** of this sector and will help fulfill the vast potential in this area.

I'm very happy that this book is being brought out in hard print format and has also been updated from the earlier e-version brought out in November 2020, based on several requests for such a printed copy for reference. The publication of this printed book also marks an important juncture when the fisheries sector is on the cusp of transformational changes and I'm hopeful that the lessons from the past will help in shaping a bright and inclusive, sustainable and resilient future for the Indian fisheries.

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A beach-seine operation in Visakhapatnam.

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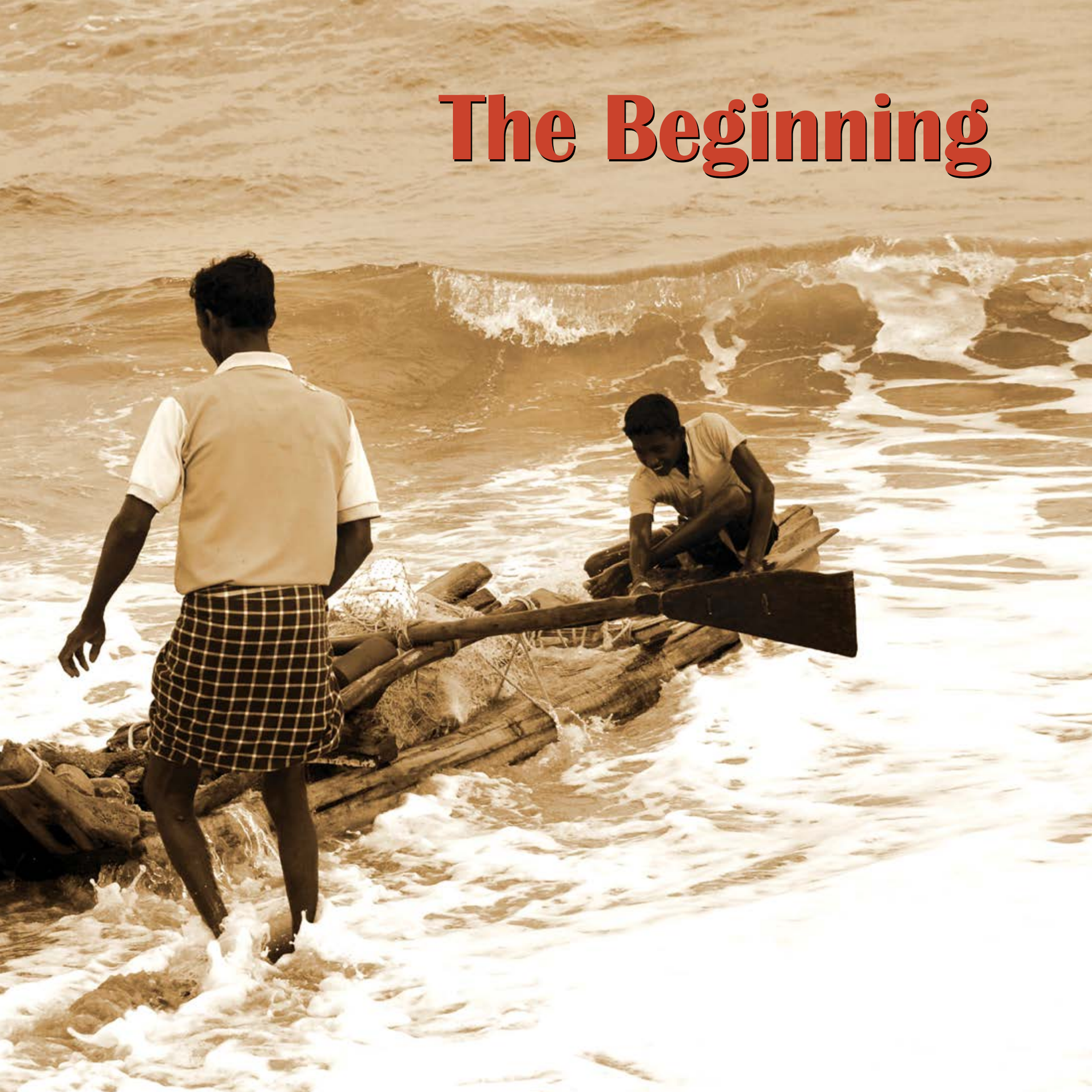
A catamaran returning from fishing trip. Devaneri, Tamil Nadu

The Beginning



1.0 The Beginning

Fish is an inseparable part of Indian mythology, religion and culture. There are very few forms of animal life that besides being an integral part of Indian food, are also intertwined in the social milieu. Possibly the first reference to fish in social life can be traced back to the early Harappan civilization. Appearing in many artefacts, especially pottery, it was possibly a symbol of the water God. In Indian mythology, the importance of fish can be traced to the Matsya Purana (in Sanskrit, Matsya is fish and Purana is ancient legend or lore), one of the eighteen major Puranas, the sacred literature of Hinduism. In this Purana, Matsya is the first avatar or reincarnation of Lord Vishnu, one of the most important Gods in the Hindu pantheon and along with Brahma and Shiva, is considered to be a member of the holy trinity (Trimurti) of Hinduism.

Fish also occupies the centre stage of many stories and folklore in India, the most famous being the 'Abhijñānaśākuntalam' a well-known Sanskrit Play by the famous Indian poet Kalidasa, dramatizing the story of Shakuntala told in epic Mahabharata. It is considered to be the best of Kalidasa's works, written around fourth century CE.

Fish or 'Pisces' in Latin, is also one of the earliest zodiac signs on record, with the two fish appearing as far back as c. 2300 BC on an Egyptian coffin lid. It is the twelfth sign of the zodiac, and is also the final sign in the zodiacal cycle.

In India, fish is called by many names, such as 'Meen' or Machh and 'Machili'. The former is more popularly used in the southern States and the latter in the northern region of the country. The word 'Meenakshi', referring to the eyes of a women as to those of a fish, is considered as a standard of beauty. And 'Matsanyaya', a political term used in ancient India related to the maxim of the bigger fish devouring the smaller ones, hence anarchy, disorder or lawlessness.

The Story of Matsya Purana

One-day King Vaivasvata Manu was offering water to his forefathers in a waterbody when a small fish or matsya came close to him seeking shelter. Taking pity, the King placed the fish in a water-bowl. As the fish outgrew the bowl, it was moved to a pond and then to a river and finally to the ocean. Astonished, the King realized that it was not a common fish but a reincarnation of Lord Vishnu and then the Fish also asked the King to prepare as a catastrophic flood would soon engulf the Earth. Assembling all forms of life and boarding a ship, the King and others on the ship were saved from the flood and steered to safety by the Fish. The King then as advised by the Matsyaavatara started rebuilding humanity again.

Hindu Mythology, Vedic and Puranic,
by W. J. Wilkins [1900] at sacred-texts.com

The earliest coins of the Pandyan Kingdom had stylized fish engraved on one side. Fish is also depicted in many ancient architecture, especially in temples. The most famous being a carved ceiling with fish in a wheel of life in a sixth century cave temple in the town of Badami in the southern State of Karnataka in India.

The official seal or the emblem of the Government of Uttar Pradesh in northern India, designed in the year 1916, depicts the combination of a 'pair of fish and the arrow-bow, embellished with three waves'. The symbolism attached with each of these characters relate the pair of fish with the rulers of Oudh Kingdom, the bow and arrow identifying Hindu Lord Ram and the waves depicting the confluence of the rivers Ganga-Yamuna, portraying the geographical, historical and cultural integrity of the State of Uttar Pradesh.

In the Bengali communities in India, fish occupies a unique status when solemnising marriages. As the bride enters her new household, she is welcomed with a decorated fish. Looking at the fish is said to mark her auspicious start in the new household. And of course no Bengali marriage feast goes without a couple of fish dishes that provide the gastronomic delight to the guests.

The relationship of fish and Bengalis does not end with food or marriage rituals. It also extends to the sports arena. The famous football clubs of Kolkata, Mohun Bagan Athletic Club and the East Bengal Football Club have giant prawn (or chingri) and hilsa fish respectively as their mascots. Any team winning the match means bumper sale of their mascot on that day.

Fish also forms an important object of art and craft. The Madhubani paintings, said to be one of the most famous art forms that originated from India, depict fish in the most artistic forms. The use of fish in these paintings signifies prosperity and fertility and is considered to bring good luck.

And finally, modern Indian literature and movies have not gone untouched with fish being the central character of a couple of classics. To mention a few, 'Chemmeen', the famous novel authored by S K Pillai and published in 1962, depicts the aspirations, struggle and grief in the lives of the fishermen of Kerala. Chemmeen was also made into a movie in 1965, winning the National Award in the Best feature film category. 'Padma Nadir Majhi', a famous Bengali novel written in 1973 by Manik Bandopadhyay and later a Indo-Bangladesh Joint Production is a poignant depiction of the advent of capitalist intervention in the small business enterprises of fishing and how the poor fishers are exploited.

Moving from the social and cultural aspects of fish to the development of fisheries in India, the early references can

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Top: Fish in wheel of life. Sixth century cave temple, Badami, Karnataka.

Bottom: Madhubani painting

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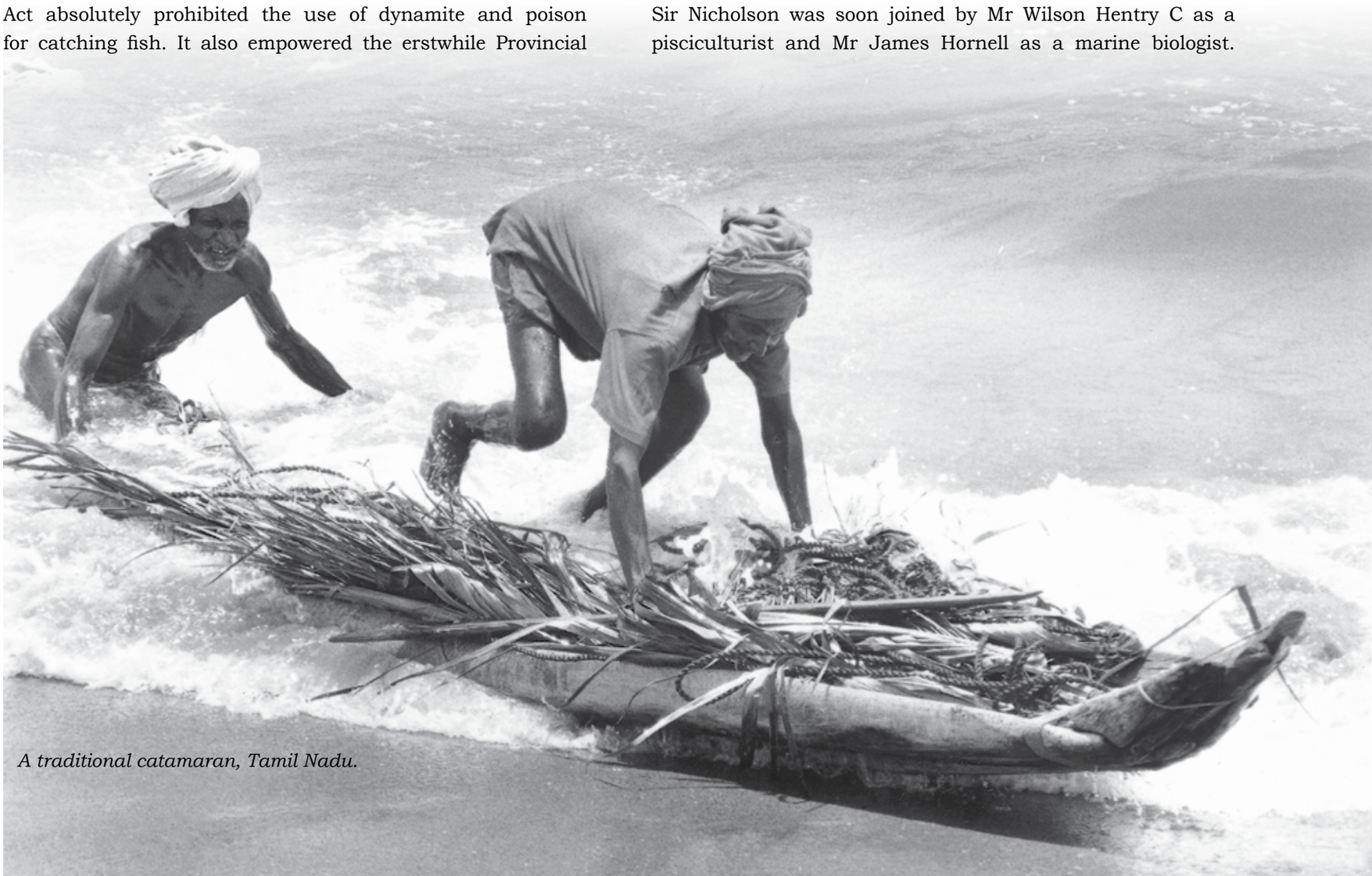
be traced to the pioneering works of the British explorers and scientists in the seventeen and eighteenth centuries.

Mr James Russel's 'Study of the Indian Fish Fauna' during 1785-1789 and later the 'Catalogue of the Fishes of Ganges' by Dr Buchanan Hamilton in 1822 can be cited as the earliest works showcasing the fish and fisheries of India. Dr Francis Day, a Surgeon Major with the Madras Medical Service was the first Director General of Fisheries in 1864 in India and in 1878 he published two reports – the 'Freshwater Fish and Fisheries of India and Burma' and the 'Sea Fish and Fisheries of India'.

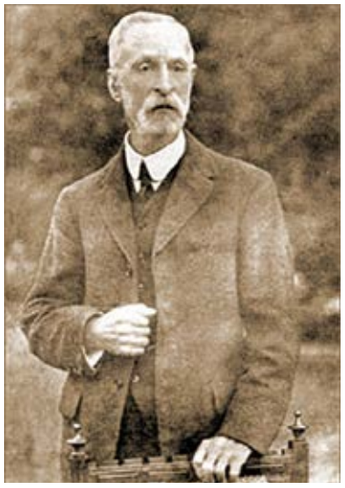
Dr Day is also credited with the formulation of the first legislative measure to conserve fisheries in India by enacting the Indian Fisheries Act (Act IV of 1897) that covered the whole of India. This Act, the first piece of fisheries legislation in the country, is also an important landmark in the developmental history of fisheries in India. With a larger focus on conservation, the Act absolutely prohibited the use of dynamite and poison for catching fish. It also empowered the erstwhile Provincial Governments to frame rules for regulating (a) the erection and use of fixed engines, (b) the construction of weirs, and (c) the dimension and kind of nets to be used and the mode of using them; and for prohibiting all fishing in specified waters for a period not exceeding two years. The Indian Fisheries Act, 1897, was in vogue until recently in many States of India. Salt was a highly regulated commodity in British India and Dr Day's efforts resulted in the grant of duty free salt for curing fish.

Madras Presidency could perhaps be termed as 'pioneering' in many aspects with regard to the development of fisheries in India. It established a Bureau of Fisheries in 1907 with Sir Fredrick Nicholson as the first Honorary Director of Fisheries in 1908. Sir Nicholson continued in this position until 1917 and was also the founder of the Madras Fisheries Department, which became the forerunner in the development of fisheries in the country.

Sir Nicholson was soon joined by Mr Wilson Hentry C as a pisciculturist and Mr James Hornell as a marine biologist.



A traditional catamaran, Tamil Nadu.



Sir F A Nicholson, K.C.I.E., ICS, Honorary Director of Fisheries (1907-1918) & Founder of the Madras Fisheries Department.

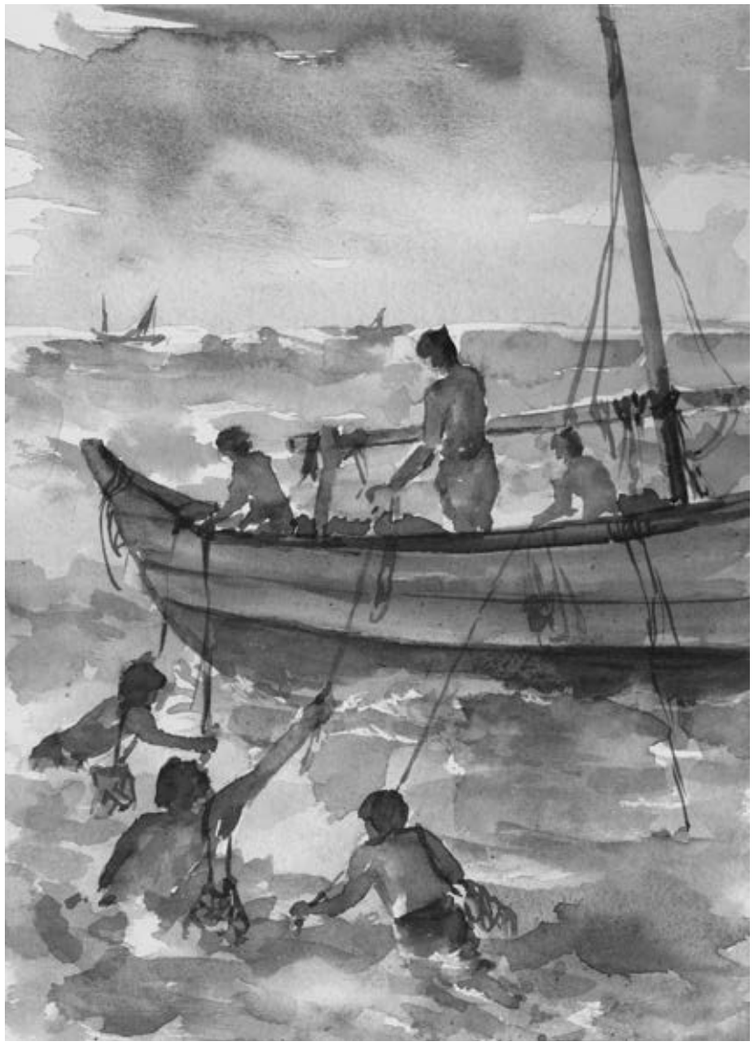
Mr Hornell also succeeded Sir Nicholson in 1918 as the first full-time Technical Director of Fisheries. The trawler 'Violet' for the first time undertook cruises in 1907 in search of trawling grounds and discovered the extensive trawling grounds of Wadge Bank (5,000 sq. miles) off Kanyakumari and other smaller banks adjoining the Thanjavur coast. Apart from this, survey with trawls along the Malabar coast were also undertaken in 1908.

Mr Hornell was the first to propose mariculture system in India and identified Krusadai Island for setting up mariculture farms. The cultivation of the edible oyster was taken up in 1907 and after the survey of Pulicat Lake in 1908, culture methods were also initiated in Pulicat. From 1921 onwards, oysters were regularly marketed. In 1920, Mr Hornell also brought out the handbook on 'The Common Molluscs of South India'.

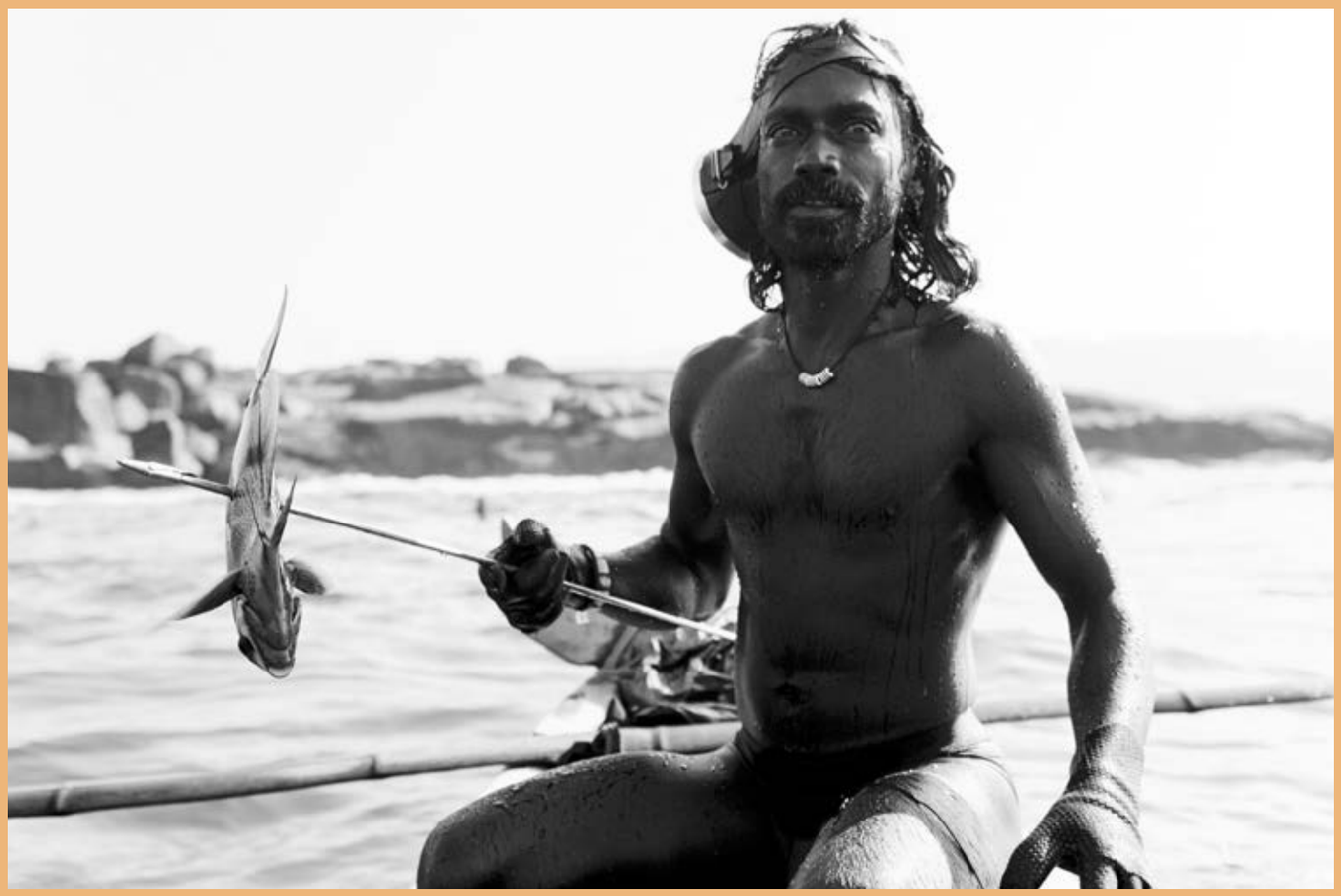
Pearl and chank fisheries were crown monopolies enjoyed by the local rulers of the region from time immemorial. The pearl fishery occurred in irregular cycle. Mr Hornell, also known as the father of pearl and chank fisheries of India and Ceylon initiated the harvesting of pearl oyster *Pinctada fucata* from the pearl banks of Tuticorin and also sowed the idea of pearl culture in 1916.

Similarly, the Madras Fisheries Department took over the Tuticorin chank fishery from the Port Officer, Tuticorin in April 1909 and, thereafter, the fishery of chanks (*Xancus pyrum*) became commercially important contributing to the harvesting of 8 to 10 lakh chanks a year and offering employment to about 1,000 divers during the chank fishing season (October-May in the Gulf of Mannar and from June-August in the Palk Bay).

The first attempts to introduce trout in the Nilgiris Hills in India during 1863 and then during 1886-1887 by Dr Day and Mr M Ivor failed. However, in 1906, Mr Wilson obtained 100 fingerlings from Ceylon of which only 27 survived and were released in Parsons Valley stream. In 1907, he obtained ova of rainbow trout (*Salmo gairdneri*) from New Zealand and successfully hatched them and they established well in the Nilgiris district. Many other species such as Tench or Doctor fish (*Tinca tinca*), English carp (*Carassius carassius*), Gourami (*Osphronemus goramy*) and European Carp (*Cyprinus carpio*) were imported from different countries and they too established well. Mr Wilson, established trout culture in the Nilgiris on a scientific basis, and set up a trout hatchery at Avalanche in Nilgiris district in 1907. In 1909, a hilsa hatchery was also



Harvesting of chank off the coast of Tuticorin, Tamil Nadu – Watercolour on paper.



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Spear fishing, a traditional method used in the olden days.

© BOBP/E Amalore

Shoe dhoni, a boat popular in Andhra Pradesh in the earlier days.

A seven-log catamaran, Tamil Nadu.

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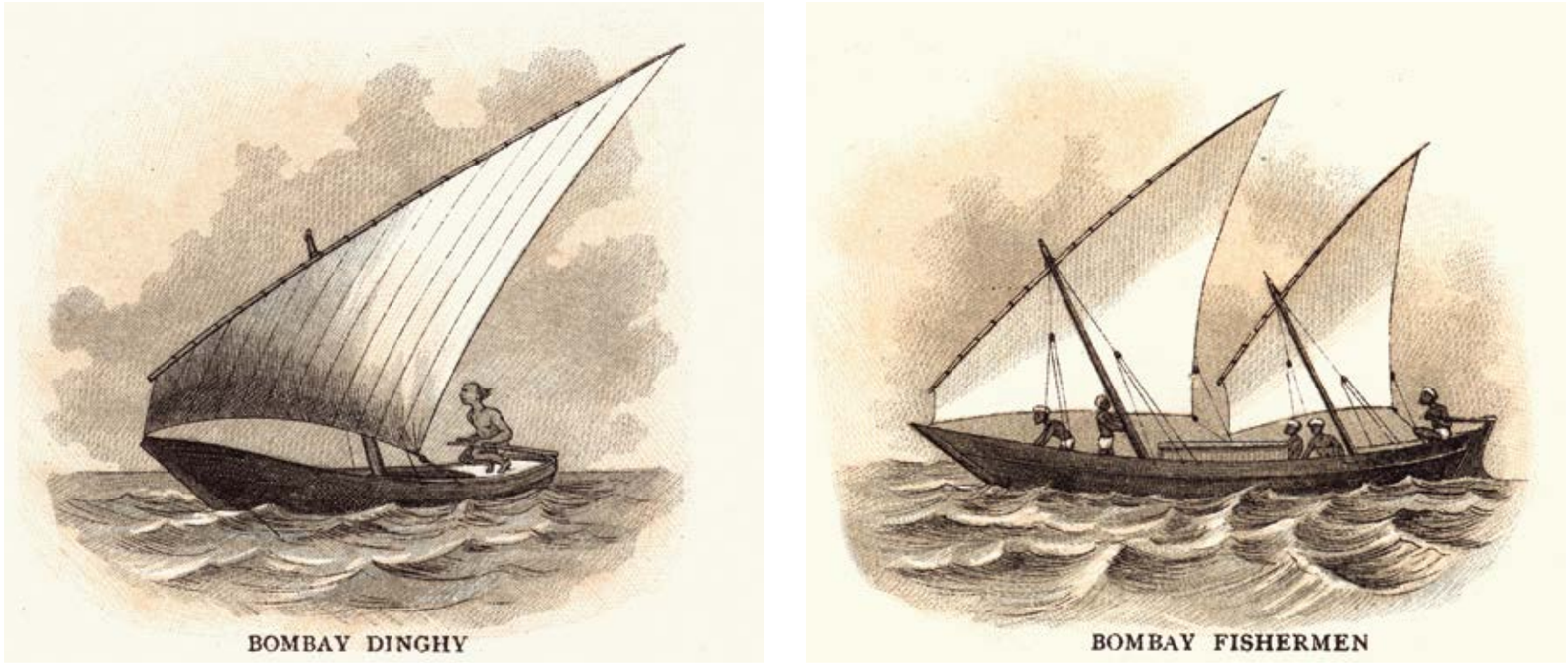
Fishermen mending net, Uppada, Andhra Pradesh.



Traditional Dinghy Boat (Left) and Fishing Boat (Right) from Bombay. A 19th century engraving.

established at Lower Anicut on the Coleroon River. Mr Wilson succeeded in artificially fertilizing hilsa eggs but the hatching was not successful.

Of the many pioneering fisheries development works that took place in the erstwhile Madras Presidency, reservoir fisheries development is one of them. The Indian Major Carp, catla was stocked in Stanley Reservoir (Mettur Dam) in 1934. Fish curing yards were set up in 1874 by the Board of Revenue to provide wholesome salted fish to the public and to curb the use of salt earth by the curers. In 1908, an experimental station was set up at Ennore near Chennai for conducting experiments in salting, curing and preservation of fish. Some initial experiments in refrigeration were also conducted in 1912-13 with ice and subsequently with a small ammonia brine-freezing plant.

The Credit Cooperative Societies Act of 1904 initiated the setting up of fisheries cooperatives in India and the first fishermen cooperative society was organized at Malpe in South Kanara in 1913. It was considered that cooperatives could be a powerful tool for the upliftment of fishermen communities. In 1918, the Madras Government directed the Department to take up the development of the fishing community as its primary duty and the spread of cooperative methods among fisherfolk be accelerated.

While Madras Presidency led the fisheries development in India during the pre-independence period, some developments also took place in the northern provinces of British India, such as the introduction of rainbow trout in Kashmir during 1898-1900 by Mr Frank J Mitchel, a Scotsman. Trout seed was obtained from England and Mr Mitchel established the first trout hatchery in Harwan in 1901. Later, rainbow and brown trout were also introduced in the river Chenab and other streams of Jammu province, where they adapted well. The Maharaja of Jammu and Kashmir also created the first Fisheries Department in his State and Mr Mitchel was appointed its first Director.

The story of Indian fisheries in the British Raj ends here.

* * *

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Fishing boats lined up on Varkala beach, Kerala.

Serving the Nation

2.0 Serving the Nation

The Constitution of India guides the distribution of work between the Central Government, the State and Union Territory (UT) Governments and also lists the work that falls within the jurisdiction of both the Centre and the States/UTs. In the case of fisheries, Entry 57 of List 1 of Seventh Schedule of the Constitution specifies *Fishing and Fisheries beyond Territorial Waters* as Union Subject, whereas Entry 21 of List II speaks of Fisheries as a State Subject. Reading both the Entries together, it follows that control and regulation of fishing and fisheries within the territorial waters is the exclusive province of the State, whereas beyond the territorial waters, it is the exclusive domain of the Union. The Central Government acts as a facilitator and coordinator responsible for policy formulation, carrying out fishery research and channelling funding support to the States/UTs in line with the national priorities and the commitments made to the State/UT Governments.

In exercise of the powers conferred by the Constitution, the business of the Government of India is transacted in the different Ministries, Departments, and the specified Secretariats and Offices following rules for the allocation of the business called the Government of India (Allocation of Business) Rules, 1961. Accordingly, the Department of Fisheries in the Ministry of Fisheries, Animal Husbandry and Dairying, within the purview of its allocated business helps the States and UTs in development of fisheries within their territorial jurisdictions and also the coastal States/UTs in their territorial waters, besides attending to the requirements of the sector in the Exclusive Economic Zone (EEZ).

The fisheries sector occupies a key position in the socio-economic development of India. At the eve of Independence, India's fishery was largely artisanal and localized. This prompted the Government to focus on the fisheries sector for two reasons:

Fishers waiting for the arrival of the fishing boats, Jalaripalem, Andhra Pradesh.

© BOBP/ S Jayaraj

Launching of an open-decked FRP boat with longtail engine, Kottivakkam, Tamil Nadu.

(1) to promote fisheries production in order to ensure food safety (subsequently foreign exchange earnings were also added); and (2) socio-economic development of the fishers and fish farmers. As a result, starting from a purely traditional activity in the fifties, both aquaculture and fisheries have now transformed to commercial enterprises and contribute to the national economy, food and nutritional security, employment and also as a stimulus for the growth of a number of subsidiary industries, in both upstream and downstream segments of the sector.

The contributions of fisheries to the national economy are substantial. During 2019-20, the sector's Gross Value Added (GVA) was Rs. 1,26,370 crores at constant prices of 2011-12 (NSO), which was about one percent of the total GVA and 6.42 percent of the GVA from the agriculture and allied sector. During the same period, the sector has earned foreign exchange worth Rs. 46,663 crores by exporting 12.89 lakh tonnes of marine products. Overall, from 2011-12 to 2019-20, the sector has registered an average annual growth of 8.99 percent, which is higher than the growth of the national economy (6.70%) at constant (2011-12) prices.

With rapid progress in mechanization and developing indigenous R&D capacity, the total fish production in India increased from 0.73 million tonnes in 1950 to 2.87 million in the median year of 1984 and further to 14.16 million tonnes by 2019-2020, recording an increase of about 19 times over 1950 and a CAGR of about four percent.

In this success story of fish production, the performance of aquaculture was remarkable, growing from about 18 thousand tonnes in 1950, largely from traditional homestead farming, to 7.80 million tonnes in 2019 with a CAGR of about 9.41 percent. At the same time, inland capture fishery grew by 2.60 percent

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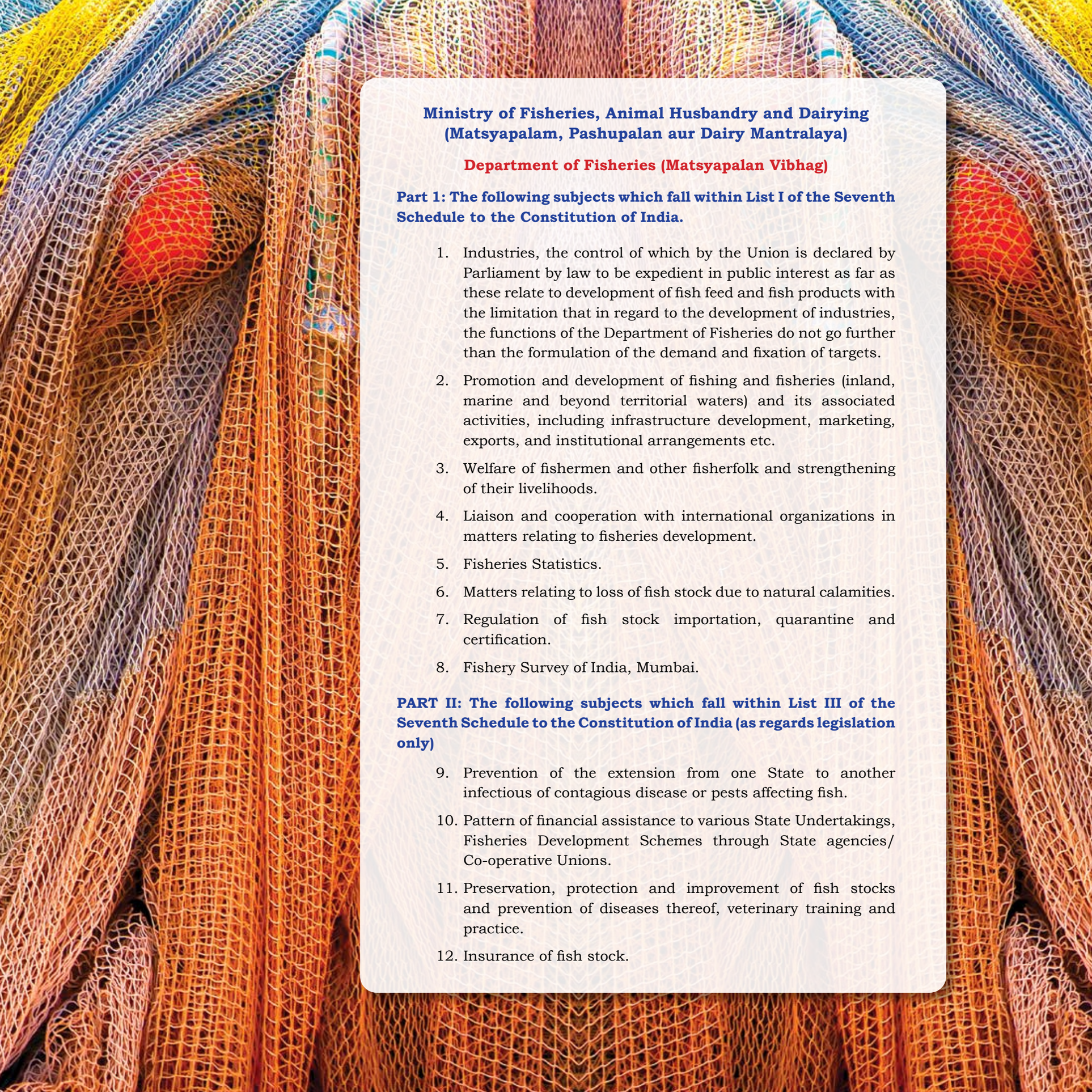
Fishing nets



Ministry of Fisheries, Animal Husbandry and Dairying (Matsyapalam, Pashupalan aur Dairy Mantralaya)

Department of Fisheries (Matsyapalan Vibhag)

Part 1: The following subjects which fall within List I of the Seventh Schedule to the Constitution of India.

1. Industries, the control of which by the Union is declared by Parliament by law to be expedient in public interest as far as these relate to development of fish feed and fish products with the limitation that in regard to the development of industries, the functions of the Department of Fisheries do not go further than the formulation of the demand and fixation of targets.
2. Promotion and development of fishing and fisheries (inland, marine and beyond territorial waters) and its associated activities, including infrastructure development, marketing, exports, and institutional arrangements etc.
3. Welfare of fishermen and other fisherfolk and strengthening of their livelihoods.
4. Liaison and cooperation with international organizations in matters relating to fisheries development.
5. Fisheries Statistics.
6. Matters relating to loss of fish stock due to natural calamities.
7. Regulation of fish stock importation, quarantine and certification.
8. Fishery Survey of India, Mumbai.

PART II: The following subjects which fall within List III of the Seventh Schedule to the Constitution of India (as regards legislation only)

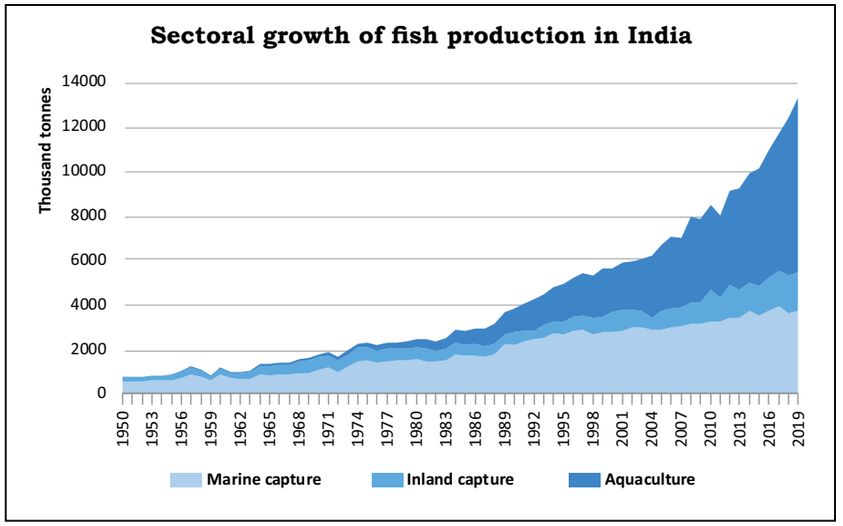
9. Prevention of the extension from one State to another infectious of contagious disease or pests affecting fish.
10. Pattern of financial assistance to various State Undertakings, Fisheries Development Schemes through State agencies/ Co-operative Unions.
11. Preservation, protection and improvement of fish stocks and prevention of diseases thereof, veterinary training and practice.
12. Insurance of fish stock.

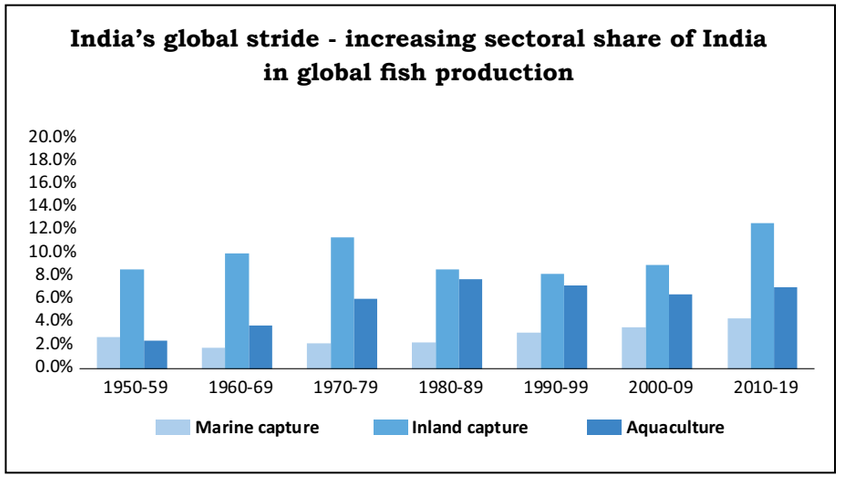
and marine capture fisheries by 3.07 percent. The growth in production, apart from meeting the domestic needs, also helped India in solidifying its position in global fishery, thus moving from the 8th largest producer in 1950 to the third largest in 2019. India's fish production now contributes to about 6 percent of the global fisheries production, with inland and marine sectors contributing to 13 percent and 4.4 percent respectively. The contribution of aquaculture to the global aquaculture production stands at 7.2 percent. At the national level, more than half of the fish comes from aquaculture (52%), followed by marine (34%) and inland (14%) capture fisheries (FAOSTAT).

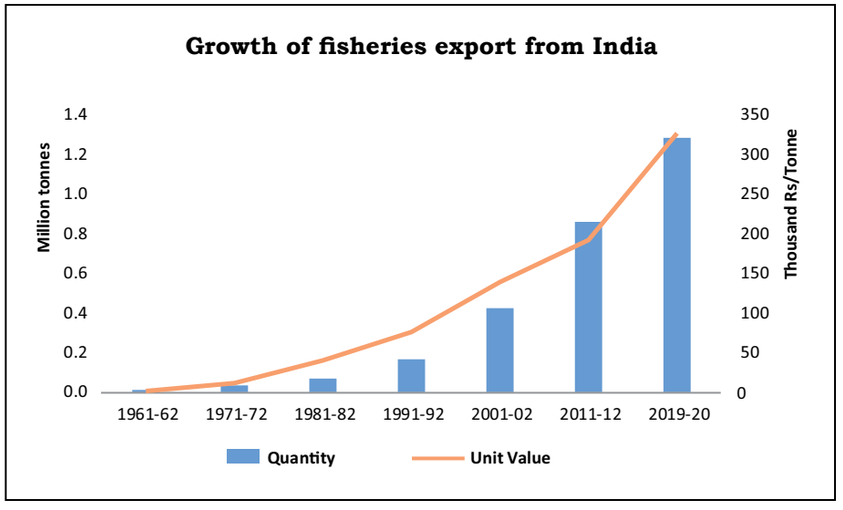
As per the Government data, amongst the States and Union Territories, Andhra Pradesh is the biggest fish producing State with 29 percent share in total production in 2019-20, largely due to it numero uno position in inland and marine fisheries (35% and 15% share respectively), followed by West Bengal (13%) and Gujarat (6%). Gujarat's claim to top 3 position in 2019-20 comes from its largest share in marine fisheries production (19%). Bihar (6%) and Assam (5%) are the other inland fisheries States while Tamil Nadu (16%), Kerala (13%) and Maharashtra (12%) are other important marine fisheries States.

Catla, rohu, silver carp, mrigal carp and other fresh water fishes makes about half of the total fisheries production in India and are largely sourced from aquaculture. Catla is the single largest species in India contributing to about 22 percent of the total fishery production during 2010-18. Other major species include whiteleg shrimp, an exotic species introduced during 2010, striped catfish, giant tiger prawns, Indian mackerel and Indian oil sardine (FAOSTAT).

The bounty in production also opened the door for export of fish and fish products from India. The role of the private sector is laudable in this regard. With the passage of time the country developed international standard fish processing facilities earning the trust of its trade partners. The trade prospects of India increased manifold with the introduction and success in whiteleg shrimp production starting from the early part of the present decade. The value of the total quantity exported from India has increased from a meagre Rs. 39.2 million in







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Top: Fishing vessel at low tide in Digha Mohona, West Bengal.

Bottom: Sardine catch from a purse seine loaded on a small boat. Kannur, Kerala.

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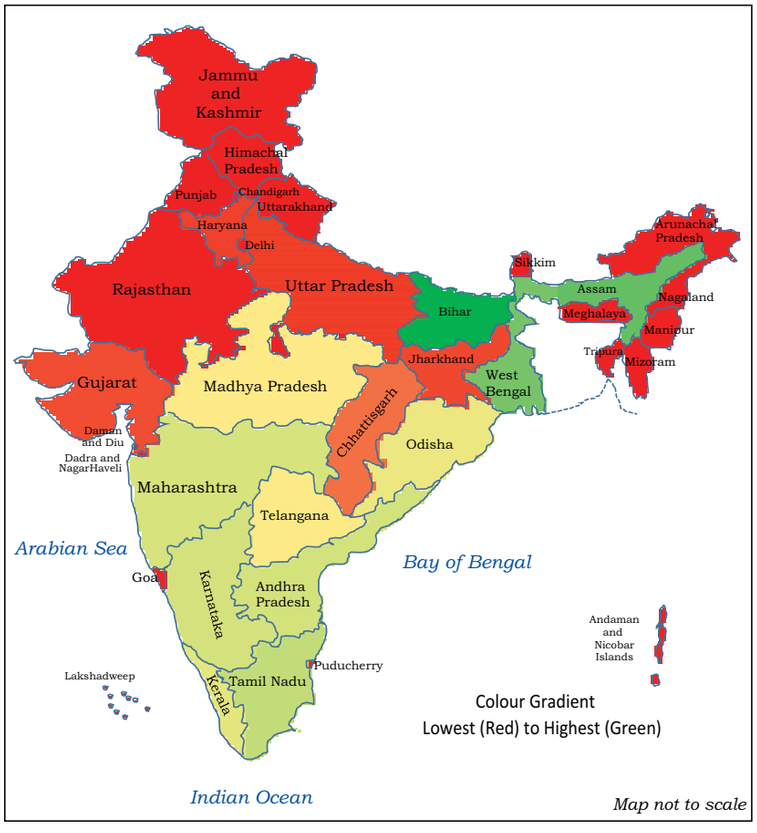
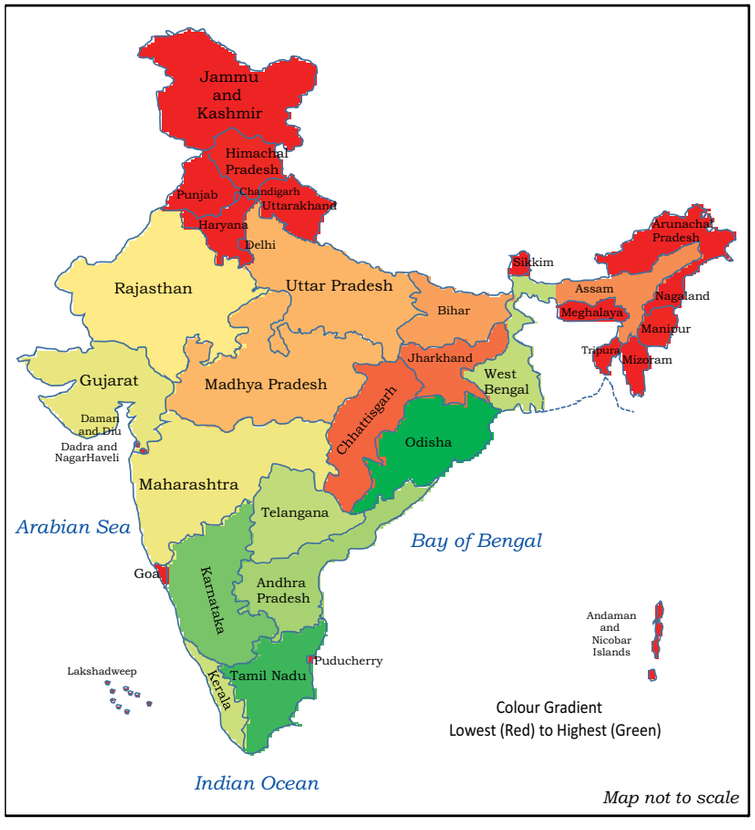
Carps, scampi and tunas displayed for sale.

Distribution pattern of fisher population, 2017



Area-wise (in hectare) spread of water bodies (excluding rivers & canals) in 2018



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Top 20 species in India in terms of volume produced during 2010-19

Rank	Species	Share (%)
1.	Catla	22
2.	Freshwater fishes *nei*	11
3.	Roho labeo	8
4.	Cyprinids *nei*	6
5.	Striped catfish	5
6.	Marine fishes *nei*	4
7.	Indian oil sardine	3
8.	Whiteleg shrimp	3
9.	Silver carp	3
10.	Giant tiger prawn	3
11.	Croakers, drums *nei*	2
12.	Clupeoids *nei*	2
13.	Natantian decapods *nei*	2
14.	Indian mackerel	2
15.	Hairtails, scabbardfishes *nei*	2
16.	Mrigal carp	2
17.	Bombay-duck	1
18.	Snakeheads (=Murrels) *nei*	1
19.	Anchovies, etc. *nei*	1
20.	Molluscs	1

Nei - Not elsewhere indicated

1960-61 to Rs 4,66,630 million in 2019-20 – a remarkable growth. The unit value realization has also improved from Rs 3,763 per tonnes in 1961-62 to Rs 59,918 per tonnes in 1988-89 to Rs 3,61,825 in 2019-20. While Japan, USA and Europe were the traditional markets for India, products are now also being exported in higher quantities to China, eastern and western Asia.

The employment potential of fisheries has always remained a major objective of the development process. In addition to existing active participants in the sector, over the years, fisheries have successfully absorbed additional members from the community owing to population growth. Many fishers were also successful in building capital to pursue additional livelihoods or different livelihoods. As of 2014 Livestock Census, there are 16 million people engaged in fisheries, of which 35 percent are fisherwomen. Majority of the fishers (35%) are full-time that is earning their livelihood only from fisheries sector. The marine fisher population in India is estimated at 3.77 million in 2016, of which 0.93 million are active fishers. About 0.52 million people are engaged in fishing and allied activities, of which 69 percent are women. Women are especially active in fish marketing where they constitute about 86 percent of the workforce. About 14 000 women are engaged in fish seed collection and an equal number in the shell collection activities. Recent estimates from the States show that there are about 28 million people including fishers and fish farmers engaged in fisheries, which is about 2.04 percent of the population of India signifying the importance of the sector in generating remunerative livelihoods in the far-flung areas.

Over the years, India has developed a strong infrastructure base to support the fisheries sector. Currently, there are seven major fishing harbours, 87 minor fishing harbours and 211 fish landing centres in the country which are commissioned or being developed. In addition, there are several thousand beach landing centres and river landing centres. In contrast, during 1985, there were five major fishing harbours, 26 minor fishing harbours and 97 fish landing centres in the country. This infrastructure provides valuable support to the fishing vessels for landing their catch and berthing.

* * *

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Fishing in the River Brahmaputra.

Snapshot of Indian Fisheries

A. General Setting

Parameter	Value
Area of the country (Million sq. km.)	3.29
Population (Million)	1210.19
Total number of urban households* (Million)	80.33
Total number of rural households* (Million)	168.08
Average household size* (Urban) (Person)	4.9
Average household size* (Rural) (Person)	4.6

** National Population Census 2011*

Fisheries Sector in Indian Economy

Period	GVA at constant (2011-12) prices (Rs Crore)			Share (%) in	
	Fisheries and aquaculture	Agriculture, forestry & fishing	Total (All sectors)	Agriculture, forestry & fishing	Total
2011-12	68,027	15,01,947	81,06,946	4.53	0.84
2012-13	71,362	15,24,288	85,46,275	4.68	0.84
2013-14	76,487	16,09,198	90,63,649	4.75	0.84
2014-15	82,232	16,05,715	97,12,133	5.12	0.85
2015-16	90,205	16,16,146	1,04,91,870	5.58	0.86
2016-17	99,627	17,26,004	1,13,28,285	5.77	0.88
2017-18	1,14,730	18,40,023	1,20,34,171	6.24	0.95
2018-19	1,25,084	18,87,145	1,27,44,203	6.63	0.98
2019-20	1,26,370	19,68,571	1,32,71,471	6.42	0.95
Growth	***8.99***	***3.50***	***6.70***	***5.30***	***2.14***

Source: National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India

Period	Value of output at constant (2011-12) prices in Rs Crore			Input cost	GVA
	Inland Fish	Marine Fish	Total		
2011-12	46,181	33,924	80,105	12,078	68,027
2012-13	49,189	34,721	83,910	12,548	71,362
2013-14	52,548	37,317	89,865	13,378	76,487
2014-15	56,552	40,096	96,648	14,416	82,232
2015-16	59,023	47,481	1,06,504	16,299	90,205
2016-17	63,383	54,191	1,17,573	17,946	99,627
2017-18	69,435	66,376	1,35,811	21,081	1,14,730
2018-19	74,125	73,818	1,47,944	22,859	1,25,084
2019-20	75,737	73,523	1,49,260	22,889	1,26,370
Growth (%)	**6.68**	**12.02**	**9.08**		**8.99**

Source: National Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India

B. Inland Fisheries

Parameter	Value
Resources	
Rivers and Canals (km)	2,01,495.65
Small, Medium & Large Reservoir (Number)	9,058
Small, Medium & Large Reservoir (Ha)	35,24,724.18
Tanks and ponds (Ha)	24,78,263.21
Brackish water (Ha)	11,60,162.50
Beels (Ha)	4,24,850.93
Oxbow Lakes (Ha)	1,17,800.45
Derelict Water (Ha)	2,30,136.38
Other than Rivers and Canals (Ha)	3,00,724.52
Total water bodies excluding rivers and canals (Ha)	82,36,662.17
Fish Production in 2019-20 (Million tonnes)	10.44

C. Marine

Parameter	Value
Resources	
Length of Coastline (Km)	8,118
Exclusive Economic Zone (Million sq. km.)	2.02
Continental shelf area (approx.) (Million sq. km.)	0.53
Landing Centres	1547
Fishing villages	3477
Fisherfolk population	3,774,577
Fishing resources (potential yield)	
Demersal (mainland) (Tonnes)	2298281
Pelagic (mainland) (Tonnes)	2631827
Lakshadweep (excluding oceanic) (Tonnes)	14490
A&N Islands (excluding oceanic) (Tonnes)	43794
Oceanic (for entire EEZ) (Tonnes)	230832
Others (Tonnes)	91369
Total potential yield (Tonnes)	5310593
Employment	
Active fishermen (Number) (2016)	927,081
Fishing allied activities (Number) (2016)	521745
Total engaged in fishing and allied activities (2016)	1448826
Registered deep sea going fishing vessels (2019) (Number)	53
Registered **motorized non-mechanical** (Number)	136920
Registered **motorized mechanical** (Number)	66198
Registered **non-motorized** (Number)	65876
Total registered fishing vessels (Number)	269047
Fish Production in 2019-20 (Million tonnes)	3.73

D. Consumption

Annual per capita consumption of fish and shrimp[E] (Urban) (Kg)	3.02
Annual per capita consumption of fish and shrimp[E] (Rural) (Kg)	3.19
Number of urban household consumes fish (Million)	16.87
Number of rural household consumes fish (Million)	44.54

E = estimated from the Handbook of Fisheries Statistics 2020 and National Population Census 2011.

E. Fisheries production and utilization

States/UTs wise Inland and Marine Fish Production during 2014-15 to 2018-19 (In lakhs tonnes)																		
S. No.	State/UT's	2014-15			2015-16			2016-17			2017-18			2018-19			2019-20		
		I	M	T	I	M	T	I	M	T	I	M	T	I	M	T	I	M	T
1	Andhra Pradesh	15.0	4.8	19.8	18.3	5.2	23.5	21.9	5.8	27.7	28.4	6.0	34.5	33.9	8.8	42.7	36.1	5.64	41.7
2	Arunachal Pradesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0	0.1
3	Assam	2.8	0.0	2.8	2.9	0.0	2.9	3.1	0.0	3.1	3.3	0.0	3.3	3.3	0.0	3.3	3.73	0	3.7
4	Bihar	4.8	0.0	4.8	5.1	0.0	5.1	5.1	0.0	5.1	5.9	0.0	5.9	6.0	0.0	6.0	6.41	0	6.4
5	Chhattisgarh	3.1	0.0	3.1	3.4	0.0	3.4	3.8	0.0	3.8	4.6	0.0	4.6	4.9	0.0	4.9	5.72	0	5.7
6	Goa	0.0	1.1	1.2	0.0	1.1	1.1	0.0	1.1	1.2	0.1	1.2	1.2	0.0	1.2	1.2	0.04	1.01	1.1
7	Gujarat	1.1	7.0	8.1	1.1	7.0	8.1	1.2	7.0	8.2	1.3	7.0	8.3	1.4	7.0	8.4	1.58	7.01	8.6
8	Haryana	1.1	0.0	1.1	1.2	0.0	1.2	1.4	0.0	1.4	1.9	0.0	1.9	1.8	0.0	1.8	1.91	0	1.9
9	Himachal Pradesh	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.14	0	0.1
10	Jharkhand	1.1	0.0	1.1	1.2	0.0	1.2	1.5	0.0	1.5	1.9	0.0	1.9	2.1	0.0	2.1	2.23	0	2.2
11	Karnataka	2.2	4.0	6.2	1.7	4.1	5.8	1.6	4.0	5.6	1.9	4.1	6.0	2.0	3.9	5.9	2.29	4.03	6.3
12	Kerala	2.0	5.2	7.3	2.1	5.2	7.3	1.6	4.3	5.9	1.5	4.1	5.6	1.7	5.5	7.1	2.05	4.75	6.8
13	Madhya Pradesh	1.1	0.0	1.1	1.2	0.0	1.2	1.4	0.0	1.4	1.4	0.0	1.4	1.7	0.0	1.7	2	0	2.0
14	Maharashtra	1.4	4.6	6.1	1.5	4.3	5.8	2.0	4.6	6.6	1.3	4.7	6.1	1.0	4.7	5.7	1.18	4.43	5.6
15	Manipur	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3	0.32	0	0.3
16	Meghalaya	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.14	0	0.1
17	Mizoram	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.07	0	0.1
18	Nagaland	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.09	0	0.1
19	Odisha	3.4	1.3	4.7	3.8	1.4	5.2	4.5	1.5	6.1	5.3	1.5	6.8	5.1	2.5	7.6	6.6	1.58	8.2
20	Punjab	1.1	0.0	1.1	1.2	0.0	1.2	1.3	0.0	1.3	1.4	0.0	1.4	1.4	0.0	1.4	1.51	0	1.5
21	Rajasthan	0.5	0.0	0.5	0.4	0.0	0.4	0.5	0.0	0.5	0.5	0.0	0.5	0.6	0.0	0.6	1.16	0	1.2
22	Sikkim	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
23	Tamil Nadu	2.4	4.6	7.0	2.4	4.7	7.1	2.0	4.7	6.7	1.9	5.0	6.8	1.6	5.1	6.8	1.74	5.83	7.6
24	Telengana	2.7	0.0	2.7	2.4	0.0	2.4	2.0	0.0	2.0	2.7	0.0	2.7	2.9	0.0	2.9	3	0	3.0
25	Tripura	0.7	0.0	0.7	0.7	0.0	0.7	0.7	0.0	0.7	0.8	0.0	0.8	0.8	0.0	0.8	0.78	0	0.8
26	Uttarakhand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.99	0	7.0
27	Uttar Pradesh	4.9	0.0	4.9	5.0	0.0	5.0	6.2	0.0	6.2	6.3	0.0	6.3	6.6	0.0	6.6	0.05	0	0.1
28	West Bengal	14.4	1.8	16.2	14.9	1.8	16.7	15.3	1.8	17.0	15.6	1.9	17.4	15.9	1.8	17.7	16.19	1.63	17.8

States/UTs wise Inland and Marine Fish Production during 2014-15 to 2018-19 (In lakhs tonnes)																		
Sl. No	**State/UT's**	**2014-15**			**2015-16**			**2016-17**			**2017-18**			**2018-19**			**2019-20**		
		I	**M**	**T**	**I**	**M**	**T**	**I**	**M**	**T**	**I**	**M**	**T**	**I**	**M**	**T**	**I**	**M**	**T**
29	A&N Islands	0.0	0.4	0.4	0.0	0.4	0.4	0.0	0.4	0.4	0.0	0.4	0.4	0.0	0.4	0.4	0	0.4	0.4
30	Chandigarh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0	0.0
31	D& NHi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.32	0.3
32	D&D	0.0	0.3	0.3	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2	0.2			0.0
33	Delhi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0	0.0
34	J&K	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2	0.21	0	0.2
35	Ladakh*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
36	Lakshadweep	0.0	0.1	0.1	0.0	0.2	0.2	0.0	0.3	0.3	0.0	0.2	0.2	0.0	0.2	0.2	0	0.2	0.2
37	Puducherry	0.1	0.4	0.5	0.1	0.5	0.5	0.0	0.5	0.5	0.1	0.4	0.5	0.1	0.5	0.5	0.07	0.44	0.5
India		66.9	35.7	102.6	71.6	36.0	107.6	78.1	36.3	114.3	89.0	36.9	125.9	95.8	41.8	137.6	104.4	37.3	141.6

*Source: Handbook on Fisheries Statistics, 2018, 2020. For 2019-20, figurs for Dadra & Nagar Haveli (D&NH) include figures for Daman & Diu (D&D). A&N Island is Andaman and Nicobar Islands; J&K is Jammu & Kashmir. I = Inland capture and culture fisheries; M = Marine capture fisheries; T = Total. * Ladakh became an Union Territory on 31st October 2019. Before 2019, figures are included in J&K.*

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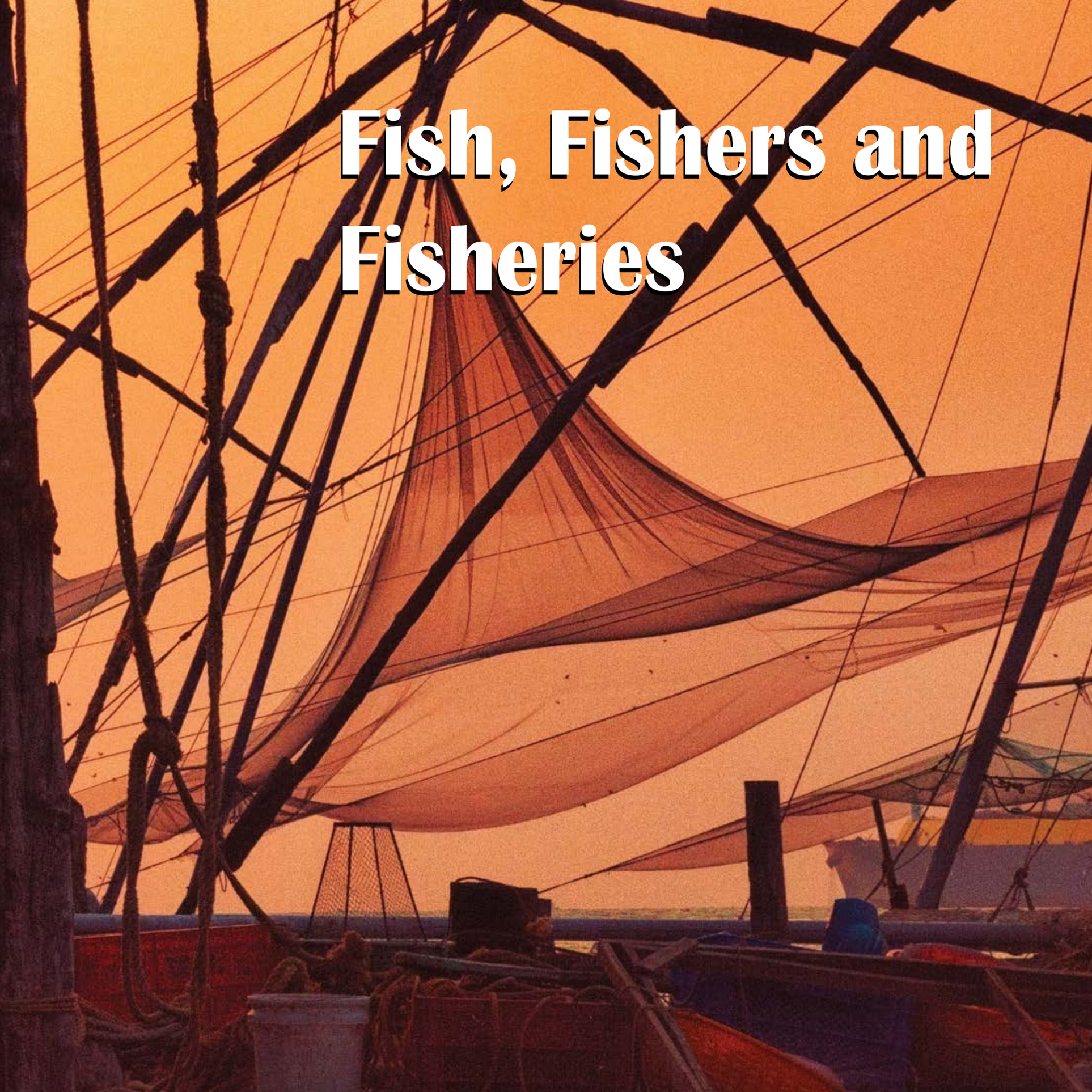
Chinese fishing net, Kochi, Kerala.



Fish, Fishers and Fisheries

3.0 Fish, fishers and fisheries

The fisheries sector in India is a kaleidoscope of variety and vividity. Its vast. Its beautiful. It's a haven of biodiversity. It's a riot of colours. Be it the lofty heights of the Himalayas, the mighty Indian rivers and their floodplains, the streams or rivulets of the western Ghats, or the oceans that surround the peninsular half of the Sub-continent, fish, fishers and fisheries in one or the other forms are omnipresent. This is what makes the fisheries sector different from the other food production sectors in the country.

The story of Indian fisheries begins with the rivers. Rivers in India are considered to be holy. They are sacred. They are worshipped. The confluence of three rivers, the Ganges, the Yamuna and the Saraswati at Prayagraj (Allahabad) also witnesses the greatest congregation of humanity every twelve years. With their majestic flows through the mountains and dissecting the great Indian plains, the rivers are the connection between the mountains and the seas. Rivers in the Sub-continent have spawned civilizations and fostered human settlements along their tracts. The Gangetic plains, the Brahmaputra valley, the deltas of Mahanadi, Godavari, Krishna and Cauvery and the Narmada valley are excellent examples of this. The fertile land of Punjab is known as the land of five rivers – Beas, Chenab, Jhelum, Ravi, Sutlej.

The Indian rivers have been the central point of many tales and events that depict love, war, pride, and prejudice. The Battle of the Hydaspes was fought in 326 BC between Alexander the Great and King Porus of the Paurava kingdom on the banks of the river Jhelum. In 1671, the Mughal army fought with the Ahom Kingdom on the Brahmaputra river at Saraighat, in Guwahati, Assam. River Yamuna in Agra, provides the backdrop to the famous Taj Mahal, the white marble mausoleum that rests the love of the Mughal King Shah Jahan. And Sohni Mahiwal, the tragic love story, was also set on the banks of a river, the Chenab in Punjab.

Ten major rivers (Indus, Brahmaputra, Ganga, Yamuna, Narmada, Tapi, Godavari, Mahanadi, Krishna and Cauvery)

along with their tributaries make up the river system of India. These rivers can be either termed as Himalayan rivers or the Peninsular rivers and they originate from one of the following main watersheds:

1. *Aravalli range*
2. *Himalaya and karakoram ranges*
3. *Sahyadri or Western Ghat*
4. *Vindhya and Satpura ranges and the Chotanagpur Plateau*

Most of the Indian rivers flow eastwards and drain into the Bay of Bengal but there are only three rivers (Narmada, Mahi and Tapti) that run from east to the west and drain into the

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Confluence of Zanskar river (left) with Indus river (right), Nimmu Valley, Ladakh.

Arabian Sea. Most of the rivers originating from the Himalayas are transboundary in nature and either have their origin in the neighbouring countries or drain into them.

The length of the rivers, their tributaries and associated irrigation canals are estimated at 2,01,496 km. Of the many ecosystem services and goods that the rivers, their tributaries and the floodplains offer to society, fisheries remain amongst the top. Such strong connections between the communities and their associated water bodies also led to the origin of castes that are now associated with fishing in the rivers and their floodplains.

The Indian rivers and their associated water bodies are home to the most diverse and rich fish fauna. Studies indicate the availability of 256 fish species in the Ganga river system, 126 species in the Brahmaputra river and its tributaries and around 76 fish species from the rivers in peninsular India. The prominent groups include the Indian Major Carps (IMCs) and minor carps, catfishes, featherbacks, mystus, mahseers and hilsa. The fauna also includes a large variety of smaller species that are important for their taste and nutritive values. Among crustaceans, the freshwater prawn or scampi dominates the fauna. Iconic aquatic mammals and reptiles such as the Gangetic dolphin (*Platanista gangetica gangetica*) and gharial (*Gavialis gangeticus*) also inhabit some of the major river systems such as the Ganga and the Brahmaputra.

The original zoogeographic distribution of these species has also been interesting. Catla, rohu and mrigal that constitute


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Ganga Aarti ritual at Dashashwamedh Ghat, Varanasi, Uttar Pradesh.

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Top: Pilgrims performing ritual in the river Ganges, Varanasi, Uttar Pradesh.

Bottom: A faithful offers "Tarpan" to the divine, Durgapur West Bengal.

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Bank of the Ganges river with ghats, Varanasi, Uttar Pradesh.

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Top: Kumbh Mela festival, the world's largest religious gathering on the Ganges river in Allahabad, Uttar Pradesh.

Bottom: Pilgrims bathing in Holy Ganges river at sunrise in Varanasi, Uttar Pradesh.

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the IMCs are endemic to the Ganga and Brahmaputra rivers, though later introduced into rivers such as Sutlej and the Peninsular rivers by stocking them in the reservoirs located on these rivers. The IMCs form the backbone of freshwater aquaculture production in the country as rivers are the only source of obtaining mature/gravid IMC species for maintaining the vitality of the germplasm.

Mahseer species such as *Tor tor* and *Tor putitora* (golden mahseer) are endemic to the Himalayan rivers and *Tor khudree* or the Deccan mahseer to the Peninsular rivers. Similarly, chocolate mahseer (*Neolissochilus hexagonolepis*) is endemic to the southern tributaries of the river Brahmaputra originating from the State of Meghalaya. Ascending up in the mountains, mostly in the sub-temperate to temperate ranges, the Indian snow trout constitutes an endemic fish species. Though small in size, it forms a valuable food fish for the inhabitants of such areas.

The famous hilsa (*Tenualosa ilisha*) or the Indian shad, an anadromous species that migrates from the seas to freshwaters to breed and then returns back to the seas for its remaining lifecycle, has a much wider distribution in the Indian rivers. While the larger hilsa fishery takes place in the Ganga and the Brahmaputra river systems, the species also forms a fishery in the river Godavari and the river Narmada on the west coast. In the past, hilsa was also available in the peninsular rivers, though their population in recent years is almost negligible. Owing to many man-made structures and changes in the riverine environment, hilsa that once used to migrate up to Agra in the river Yamuna and up to Dibrugarh in the river Brahmaputra, now has a restricted run and its fishery has also reduced substantially.

The hill streams are also exceptionally rich in their fish fauna and provide a variety of species catering to the ornamental fish market. Hill streams of north-eastern India and the Western Ghats are particularly rich in ornamental species such as the loaches, which form a very diverse group of fishes.

A variety of fishing boats that are open decked and an equally diverse range of fishing gear operate in the Indian rivers and their tributaries. The gears are mostly passive such as set nets and dip nets. Traps and barriers are also extensively used in many areas.

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Aerial view of the Brahmaputra river.

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Floating hamlets on Lake Loktak, Moirang, Manipur.

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A kattumaram with sail in Pulicat Lake, Tamil Nadu.

Floodplains are an integral part of the Ganga and the Brahmaputra river systems in India. No description of these rivers can be complete without their inclusion. As a continuum of the rivers and their tributaries, floodplain lakes serve as the lifeline of the river systems. In the Ganga river system, these lakes abound in Eastern Uttar Pradesh and Bihar, while in the Brahmaputra river system the lakes are a conspicuous part of the valley landscape. The Barak river system in Assam also has floodplain lakes, though less in number.

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Gharial or gavial (Gavialis gangeticus) in the Ganges river.

The floodplain lake resource size constitutes an area of about 1.2 million ha in the two river basins. These water bodies have not only sustained fisheries for the communities but have also served as a receptacle for the excess riverine flows during the monsoon months. Juveniles of many commercially important fish species migrate to the floodplains for their early growth. In the post-monsoon months when the water recedes from the floodplains, the exposed soil serves as a fertile and valuable landmass for raising crops.

The estuaries, as the tail end of the riparian tracts, are the transitional zones between the rivers and the seas. All the major rivers flowing into the Bay of Bengal or the Arabian Sea have estuarine stretches and the total resource of the 53 estuaries is estimated to be 1.44 million ha. As the estuaries provide an admixture of fresh and saline water, their productivity levels are high and they sustain fin and shell fishes that have wide adaptive ranges. Some of the major fin and shellfish fauna harvested from the estuaries include prawns and shrimps, mullets, sea bass, milk fish, perches, clupeids and threadfin. The estuaries also provide the finest nurseries and breeding grounds for these species.

The rivers in their last-mile carry heavy loads of detritus and organic material, which gets deposited in the estuarine stretches and enhances their carrying capacities to sustain a wide variety

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Community fishing during Bhogali Bihu celebrations, Panbari Village, Kamrup District, Assam.

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Community fishing during Bhogali Bihu celebrations, Panbari Village, Kamrup District, Assam.

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of flora and fauna. Among the major estuarine systems in India, the Hooghly-Matlah estuarine system located in West Bengal is the largest covering the Gangetic delta Sundarbans, which has a total area of about 8000+ km^2. Besides Sundarbans, most of the other estuaries also harbour a variety of mangrove forests that provide a range of ecosystem services to the nation in general and the local communities in particular.

Along with the rivers and their floodplains and the estuaries, the natural lakes and wetlands form another important source of inland and coastal fishery resource in the country. Starting from the mountains, a large number of lakes exist in the higher, middle and lower altitudes. Besides their natural beauty and pristine conditions, these lakes offer the potential for fisheries of coldwater species such as the endemic snow trout and the introduced exotics such as the rainbow and brown trout. Arctic char can constitute another important fish species if introduced in these lakes. In the lakes located in the mid to lower altitudes, common carp and mirror carp are ideal species for stocking and providing food fish and also livelihoods to the local communities. The lakes in the mid and lower altitudes are also important from the tourist point of view, the most famous in this regard being the lakes in Kashmir valley (Dal and Nagina) and in the Kumaon hills (Nainital and Bhimtal).

In the plains, especially in the basins of rivers Ganges and Brahmaputra, the *tals* and *jheels* constitute vital resources for fish production as also for a variety of plant protein. M*akhana* or fox nut (*Eurayle ferox*) and *singhara* or water caltrops (*Trapa bispinosa*) grown abundantly in these lakes are valuable cash crops. Dried makhana is widely used as a snack or in different ways in savouries and desserts.

The estuarine lakes such as Chilika in Odisha, Pulicat in Tamil Nadu/ Andhra Pradesh and Vembanad in Kerala are importanat water bodies providing commercially important fisheries and a range of ecosystem services. Like estuaries, these lakes also have brackish water and sustain fin and shell fish species that can tolerate variation in salinities. Estuarine lakes such as Chilika are home to the iconic Gangetic and Irrawaddy dolphins, protected under the Wildlife (Protection) Act, 1972.

Moving to man-made water bodies in the inland sector, reservoirs constitute a vital fisheries resource. It is estimated that the country has 19,370 reservoirs, covering a total area of 3.15 million ha. These reservoirs are located under different types of terrains and soil types and are exposed to diverse climatic conditions and they receive drainage from a variety of catchment areas. Gobindsager and Pong reservoirs in Himachal Pradesh, Rihand in Uttar Pradesh, Gandhisagar in Madhya

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Prayer flags on the banks of a high altitude lake in the Himalayas.

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Traditional wood boats, Dawki, Meghalya.

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Tso Moriri Lake with prayer flags, Ladakh.

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Roasted phool makhana or crispy lotus seed.

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Lotus leaf collected for use as cattle feed.

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A variety of fin and shell fishes of commercial importance.

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A variety of fin and shell fishes of commercial importance.

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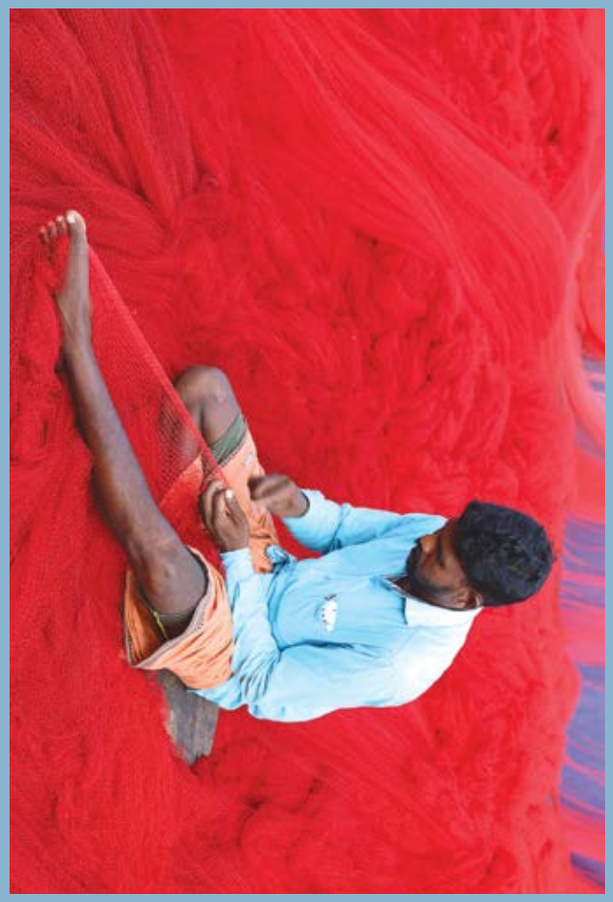

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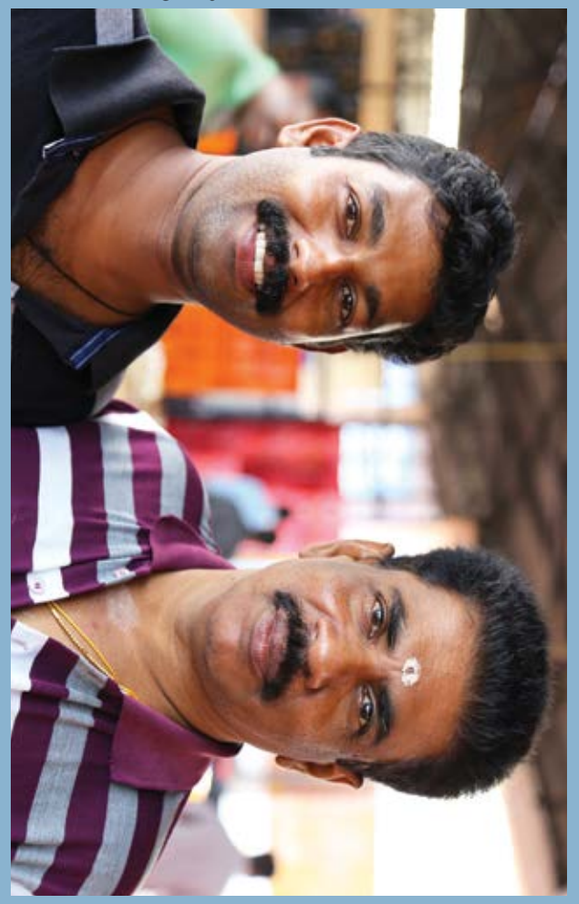

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The fisher wealth of India.

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The fisher wealth of India.

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Aaliyar Dam Mountains and Water, Pollachi Tamilnadu.

Pradesh, Nagarjunasagar shared by both Andhra Pradesh and Telangana, Stanley (Mettur) in Tamil Nadu, Ukai in Gujarat and the number of reservoirs of recent origin constructed across the river Narmada and its tributaries and located in the States of Madhya Pradesh, Maharashtra and Gujarat constitute the most important man-made water bodies in the country.

While the generation of hydro-power and irrigation has been the prime consideration for construction of the dams across the rivers in India, development of fisheries in these water bodies became an economic activity to utilize their biological productivity through fisheries and also for providing livelihood to the thousands of the riparian fishermen who were catching fish in the rivers prior to the construction of the dams. With proper fish stocking and harvesting strategies, most of the reservoirs are producing sizeable quantities of fish that add to the fish production from the inland fisheries resources.

With respect to their size and fisheries management considerations they can be categorised as large reservoirs (>5000 ha), medium reservoirs (1000 – 5000 ha) and small reservoirs (<1000 ha). Mostly located in a tropical climate, the Indian reservoirs are considered to be productive and can be manipulated to several combinations of stocking and harvesting and in the process be a valuable source of fish production from the inland waters. The productive potential of these water bodies can be further enhanced through the use of cage/pen fish farming in the reservoir proper and in the extensive network of irrigation canals that carry water from the reservoirs to the agriculture fields.

The Indian marine fisheries sector is as vibrant and colourful as its inland counterpart. Fringed by the Arabian Sea on the west, the Bay of Bengal on the east and the Indian Ocean in the south, human settlements in Peninsular India are largely along

Neyyar reservoir in Thiruvananthapuram, Kerala. It is a gravity dam with a scenic lake at the foot hills of Western Ghats.

the coastline. These settlements also constitute some of the oldest civilizations in the sub-continent that have contributed to religion, literature, seafaring and trade. The diverse fishing communities of southern India are also as old and traditional as those of the riparian tracts in northern India.

The Arabian Sea and the Bay of Bengal together account for about 3 percent of the world's oceanic area but receive close to 9 percent of global river runoff. This relatively large freshwater input modulates some important features of the northern Indian Ocean. The two seas interact with the land over approximately 8, 118 km of coastline in the mainland and the two groups of Islands. The seafloor area of the Indian seas is about 70 percent of the land area, and about 37-40 percentage of the population lives within the coastal belt.

The Arabian Sea is located in the north-western part of the Indian Ocean, between the Arabian Peninsula and the Indian Sub-continent. It merges with the Gulf of Oman to the northwest and the Gulf of Aden in the southwest and spans a total area of 1, 491, 000 square miles. The maximum width of the Arabian Sea is approximately 2, 400 km, and its maximum depth is 4, 652 metres. The depth of the sea varies as it joins the Indian Ocean to the south, but it is generally approximated at 2, 700 meters. The Indus river is the largest river flowing directly into this sea; others include the Netravathi, Sharavathi, Narmada, Tapti, Mahi, and the numerous rivers of Kerala in India. The Arabian Sea coast of central India is known as the Konkan coast, and that of southern India is known as the Malabar coast.

The Arabian Sea has two important branches — the Gulf of Aden in the southwest, connecting with the Red Sea through the strait of Bab-el-Mandeb; and the Gulf of Oman to the northwest,

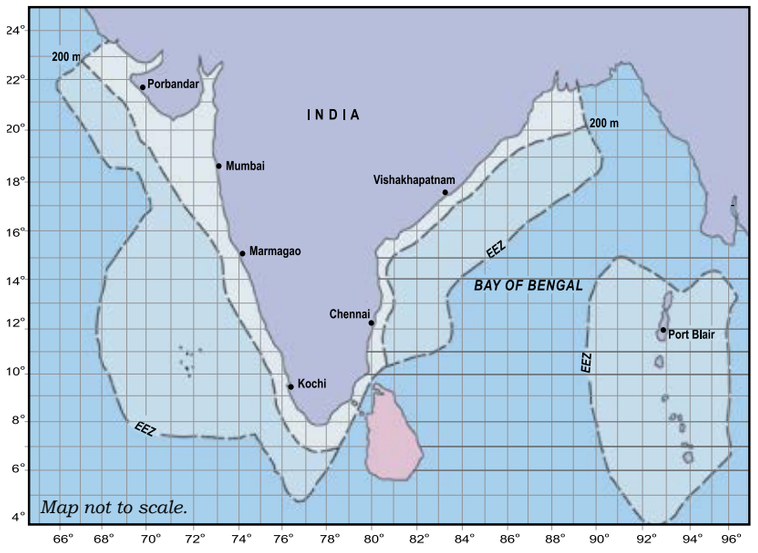
connecting with the Persian Gulf. Its islands are few, the chief being Socotra, off the coast of Yemen, and the Lakshadweep, off the Indian coast. The Arabian Sea has some of the most extreme climatic regimes due to seasonal fluctuations in air and water temperatures. Thus, it harbours excellent examples of ecosystem responses to natural environmental stresses.

The Bay of Bengal is a sea that forms the northeastern part of the Indian Ocean. The Bay of Bengal resembles a triangle in shape and occupies an area of 2, 172, 000 km². It is bordered by India and Sri Lanka to the west, Bangladesh to the north, and Myanmar and the southern part of Thailand to the east. Its southern boundaries reach Sri Lanka, and the Indian Union Territory of Andaman and Nicobar Islands. Many major rivers of India flow west to east into the Bay of Bengal: in the north, the Ganges and the Brahmaputra rivers, and in the south Mahanadi, Godavari, Krishna and Cauvery rivers. The Sundarbans mangrove forest is formed at the delta of the Ganga, Brahmaputra and Meghna rivers on the Bay of Bengal. The Irrawaddy river of Myanmar also flows into the Bay.

The Bay of Bengal is located in the tropical monsoon belt. Its environment is strongly affected by monsoons, storm surges and cyclones. Approximately 2.5 billion tonnes of sediments are discharged from the Ganges river annually. Silt from the rivers has created large sandbars near the river mouths, which has turned the Bay into a shallow sea, especially off the coast of Bangladesh. In deeper waters, high-salinity, low-temperature and low-oxygen waters persist through the year. The river Ganges has carved particularly large canyons. The Ganges sediment cone is the world's widest and thickest.

The coastal and marine (C&M) ecosystems and biodiversity of the country include mudflats, estuaries, creeks, mangroves, coral reefs, marshes, lagoons, seagrass beds, sandy and rocky beaches, covering an estimated area of 42, 808 sq. km. The Gulf of Mannar in Tamil Nadu, the Gulf of Kachchh in Gujarat, the Sundarbans in West Bengal and the Andaman and Nicobar Islands and Lakshadweep are the hotspots of biodiversity in the country. Mangrove cover in India is spread over an area of 4, 740 km² accounting for nearly three percent of the world's mangrove vegetation. Sundarbans in West Bengal accounts for almost half of the total area under mangroves in India and provides a home for many threatened umbrella species.

Exclusive Economic Zone of India



The country's C&M biodiversity also comprises over 560 species of corals, 14 species of sea grasses and 39 species of mangroves, 3, 498 species of crustaceans, 3,370 species of molluscs, 765 species of echinoderms, 2, 546 species of fishes, 35 species of reptiles and 25 species of marine mammals. Of the fish species, about 200 are considered to be commercially important.

In 1976, India enacted its legislation on Territorial Waters, Continental Shelf, Exclusive Economic Zone (EEZ) and other Maritime Zones, paving way for the country to declare an area of 2.02 million sq. km as its EEZ. This area comprises 0.86 million sq. km (42.6 % of the total) on the west coast, 0.56 million sq. km (27.7%) on the east coast and 0.60 million sq. km (29.7%) around the Andaman and Nicobar Islands. The continental shelf area amounts to 530, 000 sq. km of which 71 percent area is available in the Arabian Sea (west coast) and the remaining 29 percent in the Bay of Bengal (east coast). With the absolute right on the EEZ, India has also acquired the responsibility to conserve, develop and optimally exploit the marine living resources within this area.

The country has a long coastline of 8 118 km where 3, 477 fishing villages are located. The marine fisher population in India is estimated at 3.77 million, of which 0.93 million are active fishers. About 0.52 million people are engaged in fishing and allied activities, of which, 69 percent are women. Women are especially active in fish marketing where

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Angling black marlin.

A traditional boat from the Lakshadweep Islands.


JUBILEE YEAR 2000 CHETLAT

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Collecting fish from a purse-seine haul.

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Drying fish in Digha beach, West Bengal.

© ICAR-CMFRI

Retrieving a purse seine.

© ICAR-CMFRI

Raising fish in floating cages in coastal waters.

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A trawler on way to the fishing ground.

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A purse-seiner getting ready for sail.

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Coracles at Shivanasamudra, Mandya District, Karnataka.

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A modern fishing harbour in Chinnamuttom, Tamil Nadu.

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Open-decked FRP canoes getting ready for fishing.

© BOBP/ S Jayaraj

Back from a fishing trip.

Fishing fleet structure of India

#	Craft/Gear	East coast	West coast	Total
	Mainland India			
Mechanized				
1	Trawlers	9,815	20,671	30,486
2	Gillnetters	2,563	3,939	6,502
3	Dol/Bagnetters	191	3,203	3,394
4	Liners	47	2	49
5	Ring seiners	297	646	943
6	Purse seiners	0	1,189	1,189
7	Others	31	57	88
8	Total mechanized (1 to 7)	12,944	29,707	42,651
9	Motorized	56,961	38,996	95,957
10	Non-motorized	15,468	10,221	25,689
11	Mainland Total	85,373	78,924	1,64,297
	Islands (A&N Islands and the Lakshadweep)			
12	Mechanized			162
13	Motorized			3464
14	Non-motorized			1848
15	Island Total			5474
	National			
16	Mechanized			42,813
17	Motorized			99,421
18	Non-motorized			27,537
	Grand Total			1,69,771

CMFRI census, 2016

they constitute about 86 percent of the participants. About 14, 000 women are engaged in fish seed collection and an equal number in the shell and fish seed collection activities. The marine fisheries sector as a whole has a predominance of small-scale fisheries.

The marine fisheries sector is characterized by a range of fishing vessels varying in design, construction material, size, engine and gear and area of operation. These vessels range from the catamarans and dugout canoes to the open decked fibre-reinforced plastic (FRP) boats in the traditional and motorized category. The mechanized boats that have wheelhouse include the trawlers, gillnetters, small long-liners and purse seiners and are made using different hull materials such as wood, FRP and steel. However, with the increasing motorization, the catamarans and canoes are giving way to the FRP boats that use outboard motors. Except for a few fishing gear like pole and line and hook and line, most of the other gear are not selective and catch a variety of species.

As per the 2016 census of marine fisheries, the country has 1,69,771 fishing vessels, which include 42,651 mechanized vessels, 95,957 motorized vessels and 25,689 non-motorized vessels. The vessels on the east coast constitute 52 percent of the total and the remaining 48 percent operate from the west coast. The two groups of Islands, Andaman and Nicobar and Lakshadweep have a total of 5,474 vessels.

In 2019, the country produced 3.56 million metric tonnes of fish showing a marginal increase of 2.1 percent from the previous year. Tamil Nadu produced the maximum fish (0.78 million tonnes) followed by Gujarat (0.75 million tonnes) and Kerala (0.54 million tonnes). The redtoothed triggerfish was the major resource in the harvest (0.27 million tonnes), followed by ribbon fish (0.22 million tonnes), penaeid prawns (0.20 million tonnes), non-penaied prawns (0.18 million tonnes), lesser sardines (0.17 million tonnes), Indian mackerel (0.16 million tonnes), threadfin breams (0.15 million tonnes) and oil sardines (0.15 million tonnes). In 2019, out of the total of 3.56 million tonnes landings, 1.69 million tonnes (48%) came from pelagic waters and 1.20 million tonnes (34%) from demersal resources. The remaining landings comprised 0.44 million tonnes (12%) of crustaceans and 0.23 million tonnes (6%) of molluscs.

The value of marine fish landings during 2019 at the landing centre level was estimated at Rs. 608.81 billion. The unit price per kg of fish at the landing centre was Rs. 170.5. At the retail level, the estimated value was Rs. 923.56 billion and the unit price was Rs. 258.7. The marketing efficiency determining the producer's share of the consumers was found to be 65.9 percent.

In marine fisheries, the main focus is on ensuring sustainability (ecological, economic, social, and institutional) to ensure the economic viability of fishing operations. The coastal States/UTs

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A trawler getting ready for fishing.

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Traditional fishing boats, Thengapattanam, Tamil Nadu.

have specific areas reserved (based on depth or distance from shore) for traditional fishers where mechanised fishing is not permitted. Such Territorial Use Rights for Fisheries or TURFs have proved to be useful in sustaining the livelihoods of artisanal fishers.

Management of fisheries follows an integrated approach, blending traditional knowledge and science with business principles and effective engagement of both primary stakeholders, and also those engaged in ancillary activities to ensure that fisheries are ecologically and economically sustainable.

* * *

A large purse-seine boat, Puducherry Fishing Harbour.

Modernization of Indian Fisheries

4.0 Modernization of Indian Fisheries

Modernization of Indian fisheries started soon after independence. The First Five-Year Plan (FYP; 1951-56) of the country held that the fisheries sector was one of the most promising means of improving the diet of the people. Though underdeveloped, the fisheries sector was then contributing about Rs. 100 million annually to the national income. The First FYP recognised that owing to the low productivity of both inland and marine fisheries, the consumption was also low and increase in production was required to meet the minimum dietary requirements of the people of India. Realizing the vast unutilized potential in both inland and marine fisheries, the Plan underscored the need for a rapid survey so as to determine the scope of development.

The First FYP accepting that there was inadequacy and inaccuracy in fisheries statistics and precise estimates of production of fish were difficult to obtain, the Plan based on available evidences, estimated the fish production at about a million tonnes, of which about 70 percent was attributed to the marine sector and the remaining 30 percent to freshwater fish. Madras, Travancore-Cochin and West Bengal were the three States which accounted for a major part of the production.

In the case of marine fisheries, the Plan emphasised on the mechanisation of country craft and introduction of new mechanised boats; introduction of mothership operations; charting for deep-sea fishing and development of the identified fishing grounds; provision of training facilities; creating adequate ground organisations; supply of requisites to the fishermen; and efficient marketing. The Plan also proposed

A traditional catamaran crossing the surf. *© BOBP/Harry Miller*

the adoption of fishing technologies such as purse seining and trawling to increase fish production.

For the inland sector, the necessary steps identified were towards prevention of overfishing and the destruction of fry and fingerlings by adopting, where necessary, adequate legislative measures. The Plan emphasised the need to improve derelict tanks and *beels* and to demonstrate improved cultural practices. In view of the dispersed nature of inland fisheries in the country, the Plan also recognized the need for an extension organisation.

In the marine sector, the number of boats in operation was estimated at about 70,000. Recognising the fact that the small country craft could not operate beyond a few miles from the shore and spent much of their time in travelling to the fishing ground, their production per unit of effort was also low. Therefore, mechanisation of fishing operations would enable the fishermen to extend their area of fishing and also to fish for longer hours. The manner in which mechanisation could be accomplished was likely to vary from region to region. It was felt that in some areas, the indigenous crafts would be suitable for mechanisation through the installation of small inboard or outboard engines; in other areas, they could be brought into service on the basis of mothership operations. In still others, the Plan considered it more economical to introduce new types of small powered fishing craft, scientifically designed, and constructed but conforming to the traditional lines of the crafts in vogue.

With regard to the use of mothership operations on the west coast of India, the Plan provided for 2 tugs as motherships-one to be located off the Saurashtra coast and the other at Cochin. Considering the development of off-shore fisheries, the Plan felt the need for the introduction of larger types of powered fishing vessels such as purse seiners and trawlers. The Plan considered the purse seines to be useful for catching mackerel, oil sardines and other shoaling fish which appeared in the Indian waters during certain months and provided for two purse seiners, for experimental purposes, one to operate around Karwar, mostly for catching mackerel, and the other to be based at Cochin for catching oil sardines.

The Plan also considered the useful exploratory trawling surveys carried out by the Fisheries Department of the Government of

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A sail boat in Mandapam, Tamil Nadu.

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First trial of a four-log catamaran fitted with Yamaha outboard engine, Kanniyakumari, Tamil Nadu (1986).

A traditional stitched boat of yesteryears, Andhra Pradesh.

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A women fish vendor, Puri, Odisha.

Estimating marine fish landings in India

Prior to independence, fishery data were collected only by trade inquiries and anecdotal evidences. Soon after its establishment in 1947, the Central Marine Fisheries Research Institute (CMFRI) initiated collection of marine fish catch statistics and the Institute conducted a preliminary survey in 1948 to collect information required for formulating a sampling plan. Several pilot surveys were conducted in different regions of the country between 1950-51 and 1954-55. These included a survey along the 160 km coastline of the erstwhile Malabar in which 61 landing centres were grouped into 12 geographical strata. A three-stage sampling design was followed. Similar surveys with varying details were carried out in subsequent years along the erstwhile Travancore-Cochin, Madras, Andhra, Canara and Bombay coasts.

The CMFRI initiated estimation of marine fish landings through a multi-stage stratified probability sampling design along the west coast of India in 1959. This was subsequently extended to the entire Indian coast in the following years. Vast experience gained by the Institute in the collection of marine fish catch statistics and the results of the pilot surveys conducted by CMFRI have gone a long way in the development of the sampling design currently followed by the Institute. India is among the few nations which have adopted a sampling system based on the theory of sampling for collecting fishery catch statistics.

India and of the State Government of West Bengal in waters off Bombay and in the northern parts of the Bay of Bengal. The surveys located good fishing grounds and collected other useful data which indicated that the off-shore waters offered considerable scope for fishing. Off the coast of Tamil Nadu, Wadge Bank and Pedro Bank were also recognized to have equally good prospects. Keeping this in mind, the Plan provided for 3 small trawlers for the West Bengal Government for bull trawling and for renovating the Government of India's trawlers and fitting them with equipment for bull trawling in the Arabian Sea for which they were considered suitable.

The Plan was very mindful of the conservation of the resources and their sustainable exploitation and suggested that for trawling to be commercially successful it was necessary that there should be a sustained catch over a longer period. A close analysis of the catch landed in ports was, therefore, essential to ensure that the grounds were not depleted. To ensure that the minor harbours were fully operational and free from silt, the Plan also provided for the provision of a dredger.

In hindsight, the First FYP was very forward looking and the developmental approaches identified in the Plan thus set the tone for the modernisation of the fisheries sector in the country. All subsequent Plans built increments over the larger directions provided in the beginning and the higher budgetary allocations in the ensuing Plans, expanded the scope of work as also the area for development.

Adopting the Mahalnobis Model that laid emphasis on industrial growth, the Second FYP (1956-61), fixed a target to increase fish production by 50 percent during the next ten years. While stocking of water bodies was already initiated in the First Plan, this Plan focussed on the development of human-centric marine fisheries, noting that the problems of fishermen had to be understood and solved in the context of the environment in which they lived. It further noted that while technological developments and research had vital contributions to make, the central emphasis should be on the fishermen, the community and the environment in which they worked.

The Plan identified four areas for development of marine fisheries sector, namely, (1) improvement in fishing methods, (2) development of deep-sea fishing, (3) provision of fishing harbours, and (4) organisation of fish transport, storage, marketing and utilisation of fish. Understanding the limitations of an individual fisher, the Plan promoted the expansion of fisheries cooperatives. Noting the success of motorization, when the 600 odd boats motorized during the First Plan in Bombay could increase the fish production four-fold (from 10,000 to 40,0000 tonnes per annum), the Second Plan considered this as a means of extending the operation of artisanal fishermen in the sea. Carrying forward the emphasis laid on the R&D activities in the First Plan, the Central Inland Fisheries Research Institute and the Central Marine

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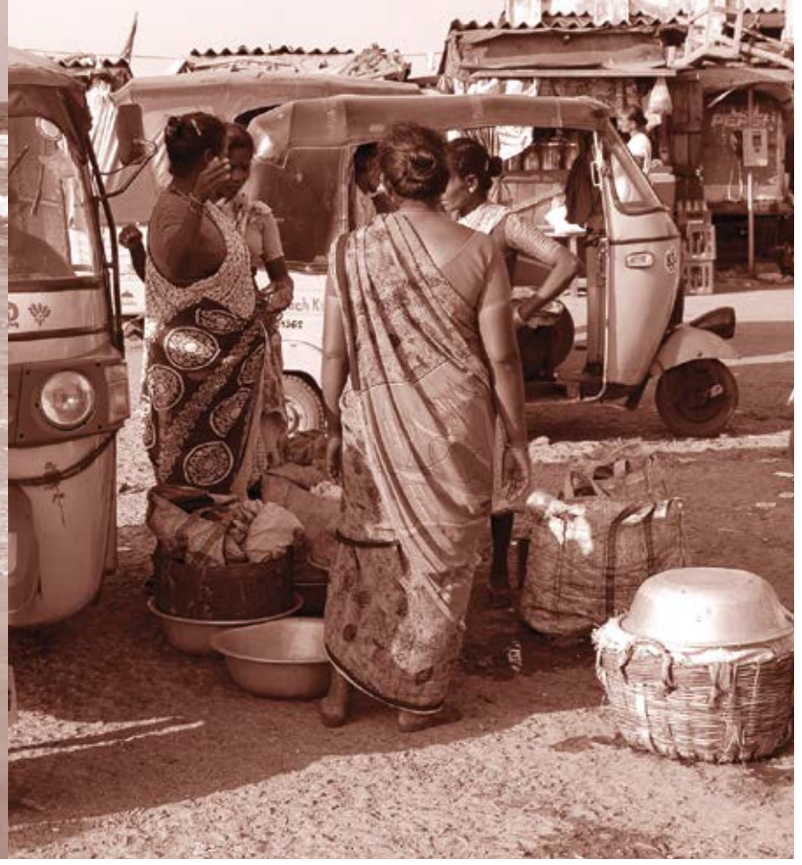
A stitched boat ready for launching, Andhra Pradesh.



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Women fish vendors waiting for transport, Tamil Nadu.

Fisheries Research Institute were given the responsibility of exploration, technology development, assessment and training.

During the Third FYP (1961-66), the expansion of fisheries cooperatives, initiated in the previous Plan, started showing results and about 2000 cooperatives were established with over 200 000 memberships. Southern and western India led this movement- a feature that stills remains prominent. However, this growth of cooperatives also had its share of problems. In the absence of a business model, the cooperatives lacked adequate capital to pull out the members from the traditional arrangements, where traders largely controlled the market. To address these issues, the All India Federation of Fishermen Cooperatives was set up in 1980. Renamed the National Federation of Fishers Cooperatives Limited (FISHCOPFED) in 1982, its objective is to promote and develop the fishery cooperative movement in India, to educate, guide and assist fishers in their efforts to build up and expand the fishery cooperative sector and serve as an exponent of cooperative opinion in accordance with cooperative principles. Currently, it has 20,639 member societies with a total membership of about 3.2 million persons.

The Third Plan also witnessed two major external aggressions from China (1962) and Pakistan (1965), placing strain on the resources as well as a setback to the ground-level activities. However, with the good foundation laid in the earlier two Plans, the total fish production increased from 0.96 million tonnes to 1.37 million tonnes, increasing the sector's contributions to the food and nutritional security of the country.

The two wars and increased inflation resulted in three Annual Plans and the Fourth FYP was initiated during 1969-74. With the objectives of growth with stability and a progressive move towards self-reliance, a fundamental change in the national economy started emerging, although this period also witnessed another India-Pakistan War in 1971. The newly nationalized 14 major Banks were mandated to expand rural credit and along with the emphasis on agriculture production, a revolution also started unfolding in the fisheries sector. About 5,700 mechanised boats brought into operation during 1961-69 started showing results. A scheme on the development of fishing harbours (FHs) initiated in 1964 resulted in the setting up of 16 small harbours and a beginning was also made towards the construction of major FHs. With education and training

gaining focus, the Central Institute of Fisheries Education was established in Bombay in 1961. In 1967, all the Fisheries Research Institutes were transferred to the Indian Council of Agricultural Research (ICAR). This period also witnessed a focus on fisheries extension and the establishment of extension wings in the fisheries institutions and the setting up of the Marine Products Export Development Authority in 1972 under an Act of the Parliament to boost the export of Indian seafood.

In inland fisheries, the Fourth Plan proposed enhancing production and supply of fish seed, reclamation of derelict water areas for fish farming and the development of reservoir fisheries. The ICAR initiated the path-breaking All India Coordinated Research Projects (AICRIP) on Composite Fish Culture, Air-breathing Fish Culture and Development of Reservoir Fisheries. Simultaneously, the Government set up the Fish Farmers Development Agencies (FFDAs) that became a running mate with the AICRIP in bringing the first blue revolution in the country. In the marine sector, to accelerate mechanization and strengthen indigenous trawl fishing, the Plan provided a host of benefits including deferred payment facilities for the indigenous trawlers in collaboration with the Industrial Development Bank of India, subsidy towards the cost of trawlers, resource surveys and increase in landing and berthing facilities. The Indo-Norwegian Project played a major role in these developments.

Castnet fishing in the backwaters of Kochi, Kerala.

The next three Plans (Fifth to Seventh; 1974-1990, including the Rolling Plans during 1978-1980), consolidated the gains of the earlier Plans. Production increased from 2.25 million tonnes to 3.79 million tonnes, with aquaculture gradually increasing its share in the total fish production. An increase in the fish farming area, better availability of fish seed and hand-holding by the FFDAs contributed to this growth. Aquaculture now also emerged as a key area for further development and to meet this objective, the Government sought the World Bank support through an IDA credit of USD 20 million in December 1979 (Credit 963-IN). The focus was on increasing carp production and the Project concluded in March 1989. A scheme on strengthening data collection from inland fisheries and aquaculture resources was also initiated during the period.

In the marine fisheries sector, the first Deep-sea Fishing Policy was announced in 1977, providing for chartering of fishing vessels. In 1981, the Government introduced the Charter Policy to address the issue of the limited fishing capability of indigenous craft. To rectify the deficiencies in the 1981 Charter Policy, a revised Charter Policy was announced in 1986. This policy enabled the acquisition of fishing vessels by the Indian companies either through import/construction in India or through Joint Venture (JV). The policy facilitated a greater inflow of foreign exchange through the export of fish caught by these vessels.

The scheme on motorization of the traditional fishing craft was introduced in the 1980s, resulting in the introduction of the ring seine fishery, which was considered an efficient method to harvest oil sardine shoals along the south-western coast of the mainland. At the same time, the introduction of Beach Landing Crafts (BLCs) with assistance through cooperative societies in Orissa and Andhra Pradesh was scripting another success story. With the boat design support coming from the Bay of Bengal Programme (a field Project of the FAO set up in Chennai in 1979), the BLCs soon became a mainstay of the marine fisheries sector. During the 1990s, the fish processing industry further developed, moving the seafood exports from resource-based to product-based. The increasing use of higher horsepower engines made mechanized and motorized fishing more efficient, resulting in a gradual decrease in the number of traditional non-motorized fishing craft. This trend further accentuated in the 2000s, with the number of non-motorized crafts further going down. In 1977, a Committee set up by the Government also estimated the annual harvestable potential of marine fisheries in the Indian EEZ as 4.46 million metric tonnes.

On the Institutional front, the Central Institute of Fisheries Nautical and Engineering Training (CIFNET) catered to the development of trained manpower for the fishing industry and the Institute's vessels provided in-vessel training to the trainees. The Integrated Fisheries Project (IFP that later became NIFPHATT) was engaged in experimental fishing for promoting diversified fishing methods, besides the introduction of fish products on a semi-commercial scale. The Central Institute of Coastal Engineering for Fishery (CICEF) conducted pre-investment investigations, examination and designing infrastructure facilities (FHs, coastal aquaculture farms, etc.). Four major fishing harbours, 18 minor harbours and 86 landing centres were commissioned by the end of the Seventh Plan. The Fishery Survey of India (FSI), with its Zonal Bases located on the west and east coasts and also in the Andaman & Nicobar Islands, provided valuable information on the availability of fisheries resources in the Indian EEZ.

This period will also be remembered as a watershed as significant policy and legislative developments took shape that contributed to increased sustainability in the marine fisheries sector. The enactment of the Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976 legally allowed India to define the concepts of the EEZ and *inter alia* to demarcate areas relating to territorial waters, continental shelf and the EEZ. The Act also facilitated exploration, exploitation and utilization of marine living resources in the sea around India extending to 200 nautical miles. Soon after came the Coast Guard Act, 1978, which provides for the constitution and regulation of an Armed Force of the Union for ensuring the security of the maritime zones of India and other national interests in such zones.

A model Marine Fisheries Regulation Bill was circulated to the coastal States/Union Territories (UTs) in 1979 to improve fisheries management in the territorial waters and also reduce the growing intra-sectoral conflicts on resource use. Based on the Bill, all the coastal States/UTs enacted their Marine Fishing Regulation Act (MFRA) and the rules and regulations thereunder. Goa, Karnataka and Kerala were the first to enact

When hook & line fishing overtook bulk fishing methods...

Kanyakumari District is famous for its traditional fishermen, easily the most skilled and adventurous fishermen on the Indian coast. These skills include the ability to use a variety of fishing gears and seafaring skills of the highest order. When dynamism and endurance capacity is added, you get a group of fishermen who are in demand across India and abroad. The skill and dynamism of the Kanyakumari fishermen can be attributed to their survival needs in one of the roughest seas with limited but diverse fish resources.

One skill, which was honed over generations, is the use of the hook & line, which is ideal to exploit the diverse resources of the large number of small reefs that dot the sea-bottom off the Kanyakumari coast. However, this fishing method was not always as widely used and lucrative as it has been in the last half-century or so. Up to the 1930s, hook & line fishing as a livelihood was mostly associated with poverty.

This could be attributed to the state of material technology and the low price of fish. The timber used for the *Kattumaram* – the main fishing craft of the area – was from the silk cotton tree or other softwoods that absorbed water. Hence *Kattumarams* required drying after every trip and were not durable. The nets and lines were made of natural fibres and required considerable labour to manufacture and to maintain; the hooks were made by the local blacksmiths. All this made hook and line fishing very low in productivity, bringing very limited incomes.

The gears that dominated that era were the *karaimadi* (shore seine) and the *thatthumadi* (boat seine). These methods required larger investments and were owned by the richer section of the village. Most fishermen were crew members on these larger units and dependent on the whims of their owners. Those who opted for their own small hook & line fishing unit were the proudly independent, but poor, fishermen.

The 1940s and 50s brought important changes that made hook & line fishing a lot more attractive. *Albizia falcataria* trees, grown as shade trees in tea plantations in Ceylon, were imported for matchstick making and were found ideal for making durable *Kattumarams* that did not absorb water to the same extent. Lines made of synthetic fibre ('German roll') became available, as did the internationally famous 'Mustad' hooks. All these went on to improve the productivity and scope of hook & line fishing. This period also saw a significant improvement in roads and transport, improving the price for fresh fish. This meant that a basket of reef fish, a few seer fishes, or one big shark became as profitable as a crew-share of small pelagics caught by the shore seines or boat seines. This resulted in the growth of independent small-scale fishing units dependent on hook & line operations. When nylon nets became available, small fishing units that combined hook & line with a variety of small gillnets became the mainstay of Kanyakumari fishing, eclipsing the importance of shore seines and boat seines by the 1960s.

Hook & line fisheries, with the advent of improved hooks and synthetic yarn led to many innovations, including the use of artificial baits and lures. The long lines became longer and more elaborate till they led to the use of mechanized boats to catch sharks with bottom long lines all over the west coast of India in the late 1980s, signaling the start of India's first truly indigenous deep-sea fishing fleet in the Thoothoor region of Kanyakumari.

Albizia stipulata, found in the Eastern Ghats and used by the East coast fishermen of Tamil Nadu, was not accessible to the Kanyakumari fishermen. Kattumaram timber purchase was largely a local affair with a fisherman and his carpenter searching for suitable trees in the nearby Western Ghats.

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Conveyor belts for loading ice, Kochi, Kerala.

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Crushing ice for loading in boats, Kochi, Kerala.

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Three wheelers serve as ideal vehicle for retail marketing, Kochi, Kerala.

India – Norway Cooperation in Fisheries Sector: A Success Story

World War II brought in its wake a deep realization of the need for peace and friendship among nations. In Norway, there was growing consciousness of the interdependence of the nations and of the widening gap between the western industrial nations and the underdeveloped areas of Asia, Africa and Latin America. Accordingly, in 1952, the Norwegian Parliament, by a unanimous vote, established the 'Norwegian Foundation for Assistance to Less Developed Countries'.

Norway, experienced in fishing, thought it might best be able to give technical assistance in this sector. India, offered a tremendous potential for the development of fisheries and this brought India and Norway together under the auspices of the United Nations on October 17, 1952 and a tripartite agreement was signed for developing the fishing industry and improving the living conditions in the communities concerned, by (i) Increase in production by improving fishing methods, (ii) Increase profits by better utilization of the fish, (iii) Improve sanitary conditions and health of the population and (iv) Improve the living standard of the community in general.

Initially, the Project selected two fishing villages north of the city of Quilon (now Kollam) in Kerala. The immediate practical problems were mechanization of fishing boats, facilities for maintenance, introduction of new fishing gear and methods, ice factories, cooling vans and boats for hauling fresh fish. A sales organization for marketing the fish had also to be set up.

After three years' experience in the Quilon area, a second fishing center was established in Cochin, the only natural port in the area at that time. The Project imported three large fishing vessels from Norway to conduct oceanographic research and to try out various types of modern fishing gear and find out the fish resources and marine conditions for the further development of the fisheries.

The lack of harbours along the Indian coast had prevented development of modern fisheries. Most fishing was done from the sandy beaches in vallams, or canoes. The Project, therefore, tried to develop off-shore fishing, The Project boat-yards fabricated 25 to 36 feet boats equipped with trawl nets and landed exceptionally good catches. By that time mechanization was generally accepted, and more than half of the fishermen in the Project area had abandoned the old methods and acquired motorboats.

In 1961, the Norwegian Development Agency provided the Project a modern research vessel, the Varuna, which became a decisive factor in research and of great significance for the Indian fisheries as a whole. The Varuna was also a training ship for Indian oceanographers, skippers and engineers.

In the same year the Project was also enlarged, providing for projects in other Indian States. At the same time plans were made for a new station in Cannanore (now Kannur) in northern Kerala. Besides providing technical and administrative assistance, the Project also provided special equipment, such as boats, engines, fishing gear, machinery for boat building yard and mechanical workshop, ice factories and freezing plants, equipment and gear for training purposes.

In May 1964, the Norwegian Development Agency and the Food and Agriculture Organization of the United Nations signed a contract for the establishment of an advanced institute of fisheries in Bombay (now Mumbai). The project was financed by the Government of India and the UN Special Fund.

In the expanding Project in Kerala, the emphasis had moved to deep-sea fishing. Two stern trawlers and an outrigger were purchased. These boats were deployed for doing deep-sea fishing in the Bay of Bengal, the Arabian Sea and the Indian Ocean. In the shopping centre of the city of Alwaye (now Aluva), a growing industrial centre in Kerala, a modern Norwegian fish market was also built; the first fish market of its kind in India.

Fishing in India as whole, as well as under the Norwegian Project, was in a period of active development. Government of India had well realized that fisheries were an industry worth developing. Mechanized fishing had come to stay and was a determining factor in the development. Cannanore, as one of Norway's pilot projects in India included many facilities comprising freezing plant and ice factory, boat building yard and training center for fishing skippers.

The station in Karwar built a new harbour by the end of 1966. Mechanized boats of 28 to 45 feet were doing trial fishing along the coast, whereas larger research vessels did deep-sea fishing. For ages Karwar had been a centre for mackerel and sardine fishing, but with old-fashioned gear, which was then replaced by trawlers and purse seines. Previously, the catches had to be taken all the way to Bombay; but now were delivered to the Project, which took care of inland marketing, bringing fish to places where there was previously no delivery.

The Ramnad-Mandapam coast in Tamil Nadu was also selected for deep-sea fishing by the Project. The State Government decided to reorganize the fishing industry on a stable footing on the East coast, and made Mandapam the centre for such development. The Project offered technical know-how and supplied modern equipment to fishermen for deep-sea fishing operations. Three Norwegian trawlers were assigned to Mandapam several years ago, and they had succeeded in locating promising fishing grounds.

In 1963 and in 1965, Varuna operated in the coastal waters off the west coast of India and in the adjacent waters of the Laccadive and Maladive archipelagoes. Research cruises were also undertaken in the equatorial region of the Indian Ocean, in the Gulf of Mannar, Palk Bay and off the Indian east coast from Palk Bay to Vizag. The vessel covered a total of nearly 135,000 nautical miles during her 300 days at sea every year. About 60 of CMFRI's scientists took part in the cruises and worked on the material collected.

The Project pioneered in India in developing motorized fishing and in developing new methods of fishing, processing and distribution. By late 1965 there were about 1200 motorized boats in Kerala, and new boatyards and freezing plants were appearing in increasing numbers. One can in justice say that the Indo-Norwegian Project had met the challenge of its age. Its progress made for higher living standards of the Indian fishermen and showed that more developed nations can make a vital contribution to fishing progress where it is most needed.

Based on an article from Fishing News International; Vol.5 No 3, March 1966. The original article was written by Kåre Larssen.

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The Bay of Bengal Programme: Another Story of Success

With the conclusion of the Indo-Norwegian Project in the early seventies and the indelible mark it left on the development of marine fisheries in India, the Bay of Bengal Programme (BOBP) came into existence in the year 1979. Seven countries (except Myanmar) around the Bay of Bengal (BOB) were part of this regional programme implemented by the Food and Agriculture Organization of the United Nations. The Programme its first phase brought in technologies for up-gradation of the marine fisheries sector that included the use of fibre-reinforced plastic (FRP) for boat fabrication and promotion of new designs of boats. Some of designs adopted by the fishermen became highly popular and are still in vogue. The initial trials on seaweed farming in Ramnathapuram District of Tamil Nadu were also initiated during the mid- eighties. Assessment of the fisheries resources that began in this phase continued in the subsequent phases, broadened our understanding of the fisheries wealth of the Bay.

The second phase started in the mid-eighties and focussed on the transfer of technologies, developing extension services and credit programmes and enhancing the role of women in fisheries. A dedicated fish market, exclusively for women vendors was established in Chennai. The use of iceboxes for fish marketing was developed and promoted and so also the demonstration of low-cost methods for fish drying. This phase also saw the pioneering work on cleaner fishing harbours. By the time the third phase started in the mid-nineties, management of fisheries had assumed significance and the BOBP shifted gear to promote sustainable fishing practices, stakeholder participation, and participatory approach to fisheries management. Many projects implemented in this phase also focussed on improving the management functions in the Department of Fisheries.

As a regional project, it was highly successful in bringing the BOB countries together. At the end of the third phase in 2000, the member-countries also agreed to move towards a self-sustaining inter-governmental organisation to carry forward the task of sustainable fisheries development in the region. Nothing better can testify the contributions of the BOBP in the Bay of Bengal region.

their MFRA in 1980, with other States/UTs gradually enacting the law to regulate their fishing fleets. The MFRAs have provisions for regulating fishing and conservation measures in the territorial waters, which inter alia also include the reservation of zones for various categories of fishing vessels and providing exclusive rights to traditional fishermen and for the declaration of closed seasons for conservation and safety of life when the seas are rough. Some of the provisions in the MFRAs were trendsetters in the management of marine fisheries in the world. Bull or pair trawling was banned in this period as its environmental impact became evident.

As the schemes for fish production in both marine and inland sectors started yielding results, the emphasis moved to improving social security nets and a 'National Welfare Fund for Development of Fishermen Villages' was established to provide for housing, sanitation and drinking water, and Group Accident Insurance Scheme. In July 1988, with the creation of a new Ministry of Food Processing Industries (MoFPI), activities relating to the processing of fish, technical assistance and advice to fish processing industry, and deep-sea fishing matters, including the FSI moved to the MoFPI. In January 1989, the National Fisheries Advisory Board was set up to improve coordination between the stakeholders in the sector and providing advice to the Government on the orderly development of the fishing industry, the export of marine products, etc.

In aquaculture, the FFDAs by now covering a large number of Districts in the country were bringing an incremental increase in fish seed production, that contributed to an average yield of 1,560 kgs/ha/annum in FFDA districts from the 900 kg/ha/annum achieved during the Sixth Plan. The Brackishwater Fish Farmers Development Agencies (BFDAs) were also set up to catalyse shrimp farming in the coastal areas of the country.

Two Annual Plans, covering the period 1990-1992, preceded the Eighth FYP (1992-97). In the first Annual Plan in March 1991, the New Deep-Sea Fishing Policy (NDSP) was introduced as a part of the economic reforms programme and also to broad base the 1986 Charter Policy. The key planks of this Policy were (i) leasing of foreign fishing vessels to operate in the Indian EEZ; (ii) engaging foreign fishing vessels for test fishing and (iii) forming joint ventures between foreign companies and Indian companies on 49:51 equity basis in deep-sea fishing, processing and marketing. With the approval of the Policy, the Government issued licenses to the joint venture, lease and test fishing vessels.

While consolidating the gains of the earlier Plans, especially in aquaculture, this Plan also stands out in many respects, in particular, the agitation by the artisanal and small-scale fishers against the NDSP and the Supreme Court's judgement on shrimp farming. In 1995, the Government set up a Review Committee on Deep Sea Fishing (also referred to as the Murari Committee) to review the NDSP. The Committee in its report submitted to the Government in February 1996 recommended scrapping of the NDSP and provided a set of 21 actions that would promote the development of an indigenous deep-sea fishing fleet.

The Apex Court's judgement on shrimp farming, based on a Public Interest Litigation, established violation of the Coastal Regulation Zone Notification of 1991 by the shrimp farms that practiced semi-intensive and intensive farming practices. The judgement ordered the demolition of all such farms in the coastal areas, permitting only traditional and improved traditional shrimp aquaculture. To ensure that the coastal areas would not be impacted in the future by unsustainable shrimp farming practices, the Court also ordered the establishment of an Aquaculture Authority to be headed by a retired Justice of the High Court and supported by a committee comprising the representatives of the concerned Ministries and experts. The Aquaculture Authority was set up in February 1997, with its headquarters in Chennai.

This period also saw the first move by the Fisheries Division in 1994 towards setting up of a separate Ministry of Fisheries. A World Bank Project on 'Shrimp and Fish Culture (CR 2329-IN') with an IDA Credit of USD 85 million, though signed in December 1991 (Second Annual Plan) was initiated in 1993. The Project was implemented in five States- Uttar Pradesh (Fish culture), Bihar (Fish culture), West Bengal (Shrimp and fish culture), Odisha (Shrimp and fish culture) and Andhra Pradesh (Shrimp and fish culture). The Project concluded in December 1999 and helped in promoting and enhancing the role of the private sector in shrimp farming and also in the development of reservoir and ox-bow lake fishery in the Project States. In 1995, through a grant-in-aid from the Government of Japan,

A brief history of marine fisheries census in India

Even prior to the beginning of the Five-Year Plans, during 1948-49, the Central Marine Fisheries Research Institute (CMFRI) carried out the first planned survey of marine fishing villages in the country. This survey provided information on village-wise fisher population, the number of active fishermen and the types of fishing units. To understand the potentialities and the changing pattern of the traditional fisheries sector, CMFRI subsequently carried out quinquennial frame surveys in 1957-58 and 1961-62. These surveys provided a detailed picture of the fishing activities and potentialities, fishermen population, fishing crafts and fishing gears. To update the information, a fresh frame survey was conducted in 1973, which was of a protracted nature and a larger part of the information under this survey was collected during 1975-76.

During 1980, CMFRI carried out another census, covering seven maritime States *viz.*, West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Gujarat and the two Union Territories (UTs), Pondicherry and Goa, Daman and Diu. This census was carried out in a short period of one month availing the services of about 1,500 persons engaged locally, besides 165 staff of the Institute.

However, a planned census could only be carried in 2005, with CMFRI covering all the maritime States and UTs on the mainland and the Fisheries Survey of India (FSI) covering the two Island Territories. A total of 3,325 marine fishing villages, 1,376 marine Fish Landing Centers (FLCs) and 7,64,868 marine fisher households were covered in the exercise.

In the 2010 census also, CMFRI covered all the 9 maritime States and the UTs on the mainland and the FSI covered the two Island Territories. This census also provided vital details on the social and educational status of fishermen, infrastructure facilities, etc. from 3,432 marine fishing villages, 1,537 FLCs and 8,74,749 fisher households.

The most recent marine fisheries census was carried out in 2016 following the earlier pattern of geographical coverage by CMFRI and FSI. This census provided up-to-date details on the social and educational status of fishermen, infrastructure facilities, etc. from the 3,477 marine fishing villages, 1,265 FLCs and 8,93,258 marine fisher households.

The Department of Animal Husbandry Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare supported all the three census carried out in 2005, 2010 and 2016.

two modern trawlers (FV *Sagarika* and FV *Samudrika*) with in-built facilities for fish processing were provided to the IFP, Kochi for fishing and product development.

India's role in setting the global agenda on fisheries also stands out during this period. India ratified the United Nations Convention on the Law of the Sea (UNCLOS) on 29 June 1995, played an active role in the adoption of the Code of Conduct for Responsible Fisheries (CCRF) by the FAO Council on 31 October 1995 and became a founding member of the Indian Ocean Tuna Commission, with its multilateral agreement coming into force on 27 March 1996.

In the first year of the Ninth FYP (1997-2002), two significant developments took place. First, the FSI returned to the Fisheries Division in July 1997 from the MoFPI and soon after the Fisheries Division was moved from the Department of Agriculture and Cooperation to the Department of Animal Husbandry & Dairying, though both were part of the same Ministry of Agriculture and Cooperation. In 2000, a re-assessment of the annual harvestable potential from the Indian EEZ was carried out that indicated a potential of 3.92 million tonnes. During 2000- 01, the Ministry of Commerce and Industry also allowed the import of deep-sea fishing vessels through a special import license. Under this EXIM policy, Indian companies imported and operated deep-sea fishing vessels on a deferred payment basis.

This Plan period also witnessed some novel achievements such as the initiation of the Uniform Seasonal Ban on Fishing by all the coastal States/UTs for a period of 45 days to support conservation of resources as also protection of lives during the

Legal framework governing fisheries in India

The Indian Parliament enacted the Territorial Sea, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act in 1976, which paved the way for establishment of a 200 nautical mile (nm) EEZ from January 15, 1997. Since then, India has also enacted a number of other laws and regulations which have bearing on the sustainable exploitation of the marine fisheries resources in the Indian EEZ, including the Indian Coast Guard Act, 1978; the Maritime Zones of India (Regulation of Fishing by Foreign Vessels), Act, 1981 and the related Rules of August, 1982; and the Environment Protection Act, 1986, etc. The other Central legislations, which have important bearing on the fisheries sector include the Merchant Shipping Act, 1958, the Marine Products Export Development Authority Act, 1972; the Wildlife (Protection) Act, 1972 and the Biological Diversity Act, 2002. However, there is still no law to regulate the Indian-owned fishing vessels operating in the EEZ.

The Marine Fishing Regulation Act (MFRA) enacted by all the coastal States/UTs came as a response to the growing conflicts in the coastal waters. Realizing the problem, the Central Government prepared a model Bill which was circulated to the coastal States/UTs in 1979, paving the way for enactment of the MFRAs. The MFRAs of the maritime States/UT Governments and the provisions under the Maritime Zone of India (Regulation of Foreign Fishing Vessels) Act, 1981 prohibit fishing by mechanized fishing vessels in the areas earmarked for the traditional and small-motorized crafts.

The inland fisheries sector is regulated through the provisions of the Indian Fisheries Act, 1897, which has been repealed by the inland states as their own Act. However, a model Bill for regulation of inland fisheries and aquaculture is under consideration of the Central Government. The provisions under the Wildlife (Protection) Act, 1972 have been used to set up marine parks/sanctuaries along the coastline in India. While the larger objectives have been towards protection/conservation of fauna and flora, in some cases these reserves have infringed on the livelihoods of the traditional fishers.

India's international commitments

India's concern for environment and sustainable development is adequately reflected in various policy documents and the country's policies and programmes are well-integrated with the ongoing international processes in ensuring sustainable development. India has so far ratified major international agreements and arrangements and has also undertaken significant measures for their successful implementation.

India along with other countries has also signed the declaration on the 2030 Agenda for Sustainable Development, comprising seventeen Sustainable Development Goals (SDGs) at the Sustainable Development Summit of the United Nations in September 2015. India is committed to achieving the 17 SDGs and the 169 associated targets, which comprehensively cover social, economic and environmental dimensions of development and focus on ending poverty in all its forms and dimensions.

SDG 14: Life Below Water especially talks about fisheries and making fisheries sustainable by reducing pollution, managing fishing effort, curbing illegal fishing, setting up of marine protected areas, etc. India is making steady progress towards achieving these objectives. The National Policy on Marine Fishing adopted in 2017 has incorporated fisheries-specific goals into itself to ensure progress.

India's international obligations under some of the important instruments relating to both fisheries and environment

Instrument	Accession, Acceptance Ratification	Entry Into Force
International Convention for the Regulation of Whaling (Washington DC, 1946)	Adherence 09 March 1981	09 March 1981
Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington DC, 1963)	Ratified 20 July 1976	18 October 1976
Convention on Wetlands (Ramsar, Iran, 1971)	01 February 1982	01 February 1982
Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	20 July 1976	01 July 1975
The Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979)	1 November 1983	1November 1983
Convention on the Conservation of Antarctic Marine Living Resources (Canberra, 1980)	Acceptance 17 June 1985	17 July 1985
United Nations Convention on the Law of the Sea (Montego Bay, 1982)	29 June 1995	29 July 1995
Convention on Biological Diversity (Rio de Janeiro,1982)	Ratification 18 February 1994	18 February 1994
Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities (Declaration, Washington DC, 1995)	23 November 1995	23 November 1995
Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (New York, 1995)	Accession 19 August 2003	19 August 2003
Agreement on setting up of the Indian Ocean Tuna Commission	25 November 1993	NA
Agreement on setting up of the Bay of Bengal Programme Inter-Governmental Organisation	26 April 2003	NA
UN Resolution on Sustainable Development: 'Transforming our world: the 2030 Agenda for Sustainable Development'	September 2015	Voluntary

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Landing fish from an FRP boat, Andhra Pradesh.

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Boat building, Vishakhapatnam, Andhra Pradesh.

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Patrol Vessels of Marine Police, Fishing Harbour, Puducherry.

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IND-30, a new design of FRP boat launched in 2010.

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Use of ice boxes in fishing, Nadukuppam, Tamil Nadu.

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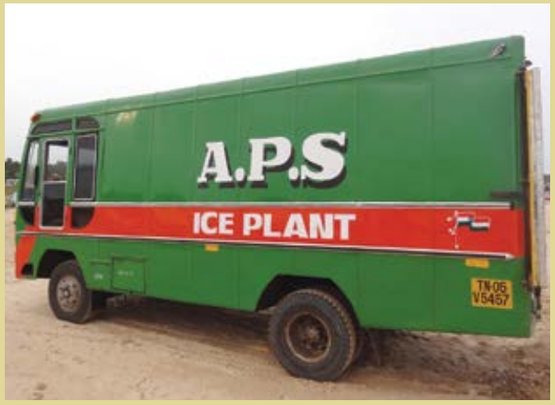
Cycles and mopeds for fish vending, Kerala.



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Supply of ice at the fish landing site.

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Use of solar energy in fishing boats.

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Fisherwomen set out for marketing, Kerala.

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Net mending, Munambam, Kerala.

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Twin outboard motors in traditional crafts.

monsoon months when the sea is rough. Though the trials for satellite-based Potential Fishing Zone (PFZs) forecasts started during the late eighties, the real breakthrough came with the integration of Ocean Colour Monitor (OCM) derived chlorophyll concentration and Advanced Very High Resolution Radiometer (AVHRR) derived sea surface temperatures by the Indian Space Research Organisation in the mid-nineties. Subsequently, the validations of the PFZ forecasts were carried out during 1999–2002 using FSI vessels. The PFZ advisories are now being widely disseminated to the fishermen and have proved to be highly useful to them in locating pelagic shoals thus saving time and fuel.

A second grant-in-aid from the Government of Japan brought a unique Trailer Suction Dredger (TSD *Sindhuraj*) in 1999 for maintenance dredging of the FHs and Fish Landing Centres (FLCs). The dredger, custom-built for use in the FH/FLC basins, could rotate 360° on its pivot and reach the nooks and corners of the harbour basin for dredging. The dredger was given to the Dredging Corporation of India for operation.

In inland fisheries and aquaculture, the funding pattern of FFDAs and BFDAs was revised to provide more funds for activities and reducing the support for staff salaries. While carp farming was booming, shrimp aquaculture received a setback in 1997 on account of the White Spot Syndrome Virus (WSSV) that nearly crippled the sector. Funding support for setting up of fish markets, procurement of patrol boats by the coastal States/UTs and extension activities continued during the Plan. The Scheme on Group Insurance for Active Fishermen was revised providing higher compensation on death and permanent disability of fishermen.

In the global fisheries agenda-setting, India contributed to the development of the International Plans of Action on Illegal, Unreported and Unregulated Fishing, Conservation of Sharks, Rays, and Seabirds, Managing Fishing Capacity and towards setting up of the Sub-Committee on Aquaculture under the FAO Committee on Fisheries. At the regional level, India played a key role in the adoption of the Phuket Resolution that initiated the process of the establishment of the FAO Bay of Bengal Programme as an Inter-Governmental Organisation and also in the initiation of the GEF-funded Bay of Bengal Large Marine Ecosystem Project.

The Tenth FYP (2002-2007) also has many landmark achievements to its credit. The word 'Fisheries' was added to the name of the Department, rechristening it as the Department of Animal Husbandry, Dairying & Fisheries. Following the recommendations of the Murari Committee, a Comprehensive Marine Fishing Policy was formulated in 2004 (CMFP, 2004) with the objectives of (1) augmenting marine fish production to a sustainable level, boosting export of seafood and increasing the per capita fish protein intake in the country; (2) ensuring socio-economic security of the artisanal fishermen whose livelihood solely depends on this vocation; and (3) ensuring sustainable development of marine fisheries with due concern for ecological integrity and biodiversity. It is one of the first policy measures that started shaping the third millennium in India's fisheries sector.

Use of aerators in shrimp ponds.

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Haul of farmed tiger shrimp.

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A farmer couple in Andhra Pradesh.

In 2003, India helped in the establishment of the Bay of Bengal Programme Inter-Governmental Organisation, setting up a model for south-south learning and regional cooperation. In 2005, the Coastal Aquaculture Act was promulgated paving the way for setting up of the Coastal Aquaculture Authority in December 2005 and in the subsequent year (2006), the National Fisheries Development Board was set up to foster development finance and technology development and implementation. In 2005, the Central Marine Fisheries Research Institute, based on a census on marine fisheries, brought out interesting facets of the marine sector.

In aquaculture, while carp production increased manifold contributing to almost half of the country's total fish production, the story in shrimp farming was the opposite. Hit by the WSSV and non-availability of disease-free broodstock of tiger prawn from the wild, shrimp production was at its lowest ebb. Many alternatives like procurement of shrimp nauplii from the Andaman and Nicobar Islands and broodstock from Myanmar were tried but did not help in reviving the tiger prawn farming. With no further options, the Government introduced the exotic Pacific whiteleg shrimp (*Litopenaeus vannamei*) on a trial basis. This introduction with necessary precautions and bio-security measures came out successful and later on with full introduction in the subsequent Plan, India scripted one of its most notable achievements in the productive utilization of the coastal areas for shrimp farming.

The gains of the previous plans were many and the Eleventh Plan (2007-2012) focussed on their consolidation. Fisheries management was becoming more evident in the developmental agenda. A fresh assessment of marine fisheries harvestable potential carried out in 2011, indicated a potential yield of 4.41 million tonnes. An action plan for instituting Monitoring, Control and Surveillance was drawn up. An on-line programme of registration of fishing vessels (RealCraft) took shape during the period. The boom in shrimp farming was now visible. A dedicated quarantine facility was set up in Chennai to screen the exotic whiteleg before it reached the hatcheries for breeding. In freshwater farming, Pangasius species became the second biggest contributor after the carps.

The Twelfth Plan was short-lived. In January 2015, with the establishment of the National Institution for Transforming India

A modern fishing vessel, Fishing Harbour, Visakhapatnam, Andhra Pradesh.

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Top, right and bottom: Modern fishing Trawlers, Kochi/Munambam, Kerala.

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(NITI Aayog), the Government brought in revised directions and policy inputs to better serve the needs and aspirations of the people of India. The Government initiated a scheme on 'Blue Revolution' that has provided the platform for meeting the needs of the sector in a holistic manner. In 2018, the most recent stock assessment was also carried out for the Indian EEZ and the annual harvestable potential was estimated at 5.14 million tonnes.

Today, Indian fishery is a mix of traditional practices and wisdom as well as modern science. A marine fisher now receives information on the potential fishing zone to plan his fishing activity. The improved mobile network has led to better real-time coordination. With the expansion in markets, India is now a major exporter of fish. While there are issues as expected in a dynamic activity such as fisheries, indigenous capacities are developed in all aspects to address them. Creation of a Department of Fisheries in the Ministry of Fisheries, Animal Husbandry & Dairying in 2019 is another watershed in this success story of Indian fisheries. All this, indeed, marks a new beginning for the fisheries sector.

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Fish processing industry in India

Modern fish processing started in the post-independence period, around 1954, as an export-oriented activity. The sector received the benefits of various government schemes to grow in leaps and bounds. However, the sector remained export-oriented.

Introduction of trawling during the late 1960s and subsequently with the arrival of the Mexican trawlers in the early seventies, shrimps and prawns became the prime candidate for the processing sector. Parallel to this mainstream development, there were also developments in the processing of sharks, especially shark fins. In Veraval, Gujarat, shark fishing became quite popular from the late 1980s owing to the scope of processing them for fin and liver oil. This was a small-scale activity that proliferated rapidly during the next decade raising concerns over the sustainability of the species.

Processing of shrimps, which remain the top candidate species, received a boost with the introduction of the Pacific whiteleg shrimp in the early 2000s. The production of farmed shrimp increased several-fold, ensuring the supply of raw material. There was already an established export market for the shrimp and the processing sector increased its capacity to explore the opportunity. In recent times, the emphasis of the Government in the offshore fishery and the response from the harvesting sector to the stimulus provided by the Government has led to an increase in tuna landings. Tunas, especially, principal tunas such as yellowfin and skipjack tuna are in demand globally and have sufficient availability in the Indian waters. Therefore, the processing of tunas is becoming popular in recent times.

The processing sector, in its developmental stages, went through several modifications, chiefly to ensure that it met the standards set by the importing countries like the European Union and internationally accepted standards such as HACCP to ensure product safety. The sector rapidly rose to these changes in the business environment and today India has become a significant member in the global fisheries trade. Data shows that from 1977 to 2016, freezing of fish has increased at a CAGR of four percent and that of canning increased by six percent. Curing, however, has declined over the period.

Currently, according to the information available with the Marine Product Export Development Authority (MPEDA), there are 614 processing units in the country with a capacity of 35,723 tonnes. 358 processing plants in the country are as per the European Union norms and they have an installed capacity of 20,869.34 tonnes. There are 656 cold storages, 43 chilled storages, 90 dry fish storage and 52 other storages with an installed capacity of 498,858 tonnes. There are also 569 pre-processing plants in the country. The processing sector is largely concentrated on the west coast with Kerala having about 23 percent of the processing units of the country.

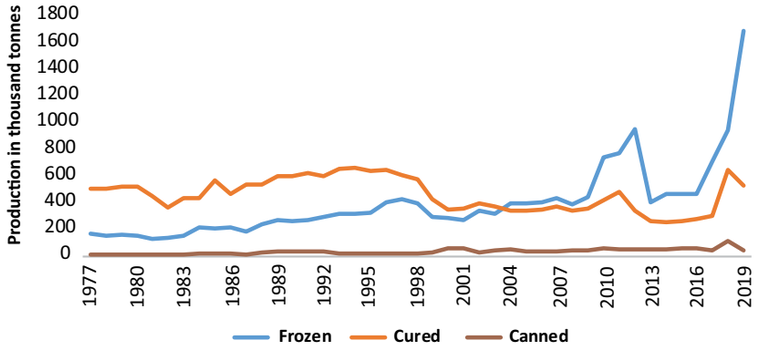
Fish processing units in India registered with various MPEDA regional offices (As of November 2021)

Sl. No.	Office	EU-Approved		Non-EU		Total	
		No	Capacity (MT)	No	Capacity (MT)	No	Capacity (MT)
1	RD Bhubaneswar	16	803.60	15	522.72	31	1,326.32
2	RD Chennai	9	504.65	12	1,055.70	21	1,560.35
3	RD Kochi	87	3,780.70	25	767.4	112	4,548.10
4	RD Kolkata	25	1,339.85	24	670.21	49	2,010.06
5	RD Mumbai	38	3,630.34	23	1,834.38	61	5,464.72
6	RD Veraval	43	2,672.54	56	3,004.52	99	5,677.06
7	RD Vijayawada	27	1,575.39	10	667.4	37	2,242.79
8	RD Vizag	14	646.5	5	125	19	771.50
9	SRD Bhimavaram	36	2,132.07	5	229.5	41	2,361.57
10	SRD Hyderabad			1	81.4	1	81.40
11	SRD Mangalore	23	2,124.66	45	4,383.96	68	6,508.62
12	SRD Porbandar	14	840.54	17	928.24	31	1,768.78
13	SRD Tuticorin	26	818.5	18	583.38	44	1,401.88
14	Total	358	20,869.34	256	14,853.81	614	35,723.15

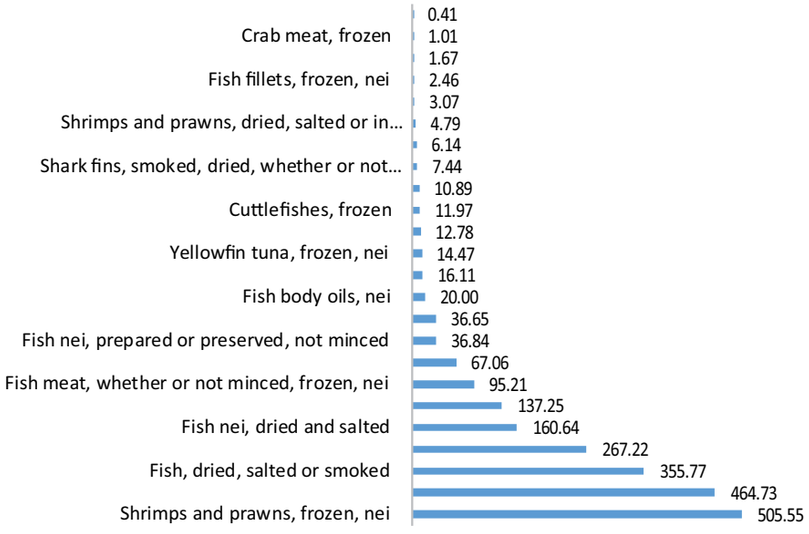
Source: MPEDA

The Ministry of Food Processing Industry, nodal agency for fish processing considers the processing sector as a sunrise sector with sound potential to grow. However, throughout the journey of the sector, the potential of the domestic market remains untapped. The domestic market generates over Rs 800 billion in retail sales and is largely unorganized. It is a fertile ground for selling processed fish products as with changing lifestyle people are likely to purchase more ready-to-cook and ready-to-eat products. This is already evident from the growth of online retail sale of processed fish in the metros and urban centres. In addition, the per capita fish consumption is still limited and there is a scope for increasing the consumption through suitable product marketing strategies.

Growth in freezing, curing and canning of fish products in India



Preserved and processed commodities produced in India in 2019 (in thousand tonnes)



Aurofish – A model to promote small processing units

A small-scale processing unit, Aurofish, located in the Union Territory of Puducherry demonstrates the possibility of the processing sector as well as the scope of domestic market. Aurofish was a brainchild of a wife-husband duo Anitha and Mouttouvel from Vaithikuppam village in Puducherry. Anitha used to run a small fish stall in the city. She was aware of the multi-ethnic culture of Puducherry, rows of restaurants and demand for quality fish, especially tunas, favourite of the large expatriate population in the city. In 2016, the Bay of Bengal Programme Inter-Governmental Organisation launched a Project, 'Ocean Partnership for Sustainable Fisheries and Biodiversity Conservation – Models for Innovation and Reform' with funding from the World Bank. The Project was meant for the development of sustainable tuna fisheries in the country. Anitha was identified as a potential entrepreneur in the Project owing to her concern for the sustainability of tuna and breaking into small-scale processing. The alliance led to three successful innovations. First, a state of the art processing (cleaning, cutting, freezing and packaging) unit was set up at Vaithikuppam village. Second, a group of twenty fishermen was created who were trained in sustainable fishing methods and hygienic handling; and third, the brand 'Aurofish' was created as a symbol of sustainable and safe tuna with a clientele base largely consisting of French restaurants, Japanese consumers and local health-conscious population. The supply chain was much shorter than the traditional supply chain as Aurofish was positioned as a processor-marketer. Resultantly, it was able to receive a premium for its quality offering, which was also passed on to the fishers to encourage them to continue sustainable harvesting. Her initiative demonstrates how entrepreneurship can be created in the fisheries sector and how women can play a greater role in the fisheries value chain. The story of Aurofish can be watched on YouTube at https://www.youtube.com/watch?v=lQh6ZOdW9_E&feature=emb_logo

Hauling sardines caught in a purse seine net off the coast of Mappila, Kannur, Kerala.

Growth of Fisheries Exports

The Beginning

Pearls were perhaps the first 'fishery' product exported from India to the Greek and Roman empires and later to the Arabian countries. Archives are also replete with local-level trade of fish and fish products with the neighbouring countries since time immemorial. During the Second World War, agar derived from the seaweeds was exported from India for medical and public health needs. This product was for the first time processed in India in 1940 at the Laboratory of the Scientific and Industrial Research Board, Delhi and also by the Department of Research of the State of Travancore.

In the post-Independent India, fish exports mainly comprised low-value dried products. During the Second FYP, about 27,000 tons of fish products, consisting of dried, dry-salted and wet-salted fish were exported to the neighbouring countries. Small quantities of shark liver oil were also exported. Mr Madhavan Nair, the owner of Cochin Company, is credited with the first shipment of frozen shrimp from the Port of Cochin in 1953. The Third FYP and the succeeding Annual Plans focussed on increasing fish production and thereby the country's potential to boost the export of fish and fish products. This effort yielded fruits and in 1967-68, the value of the export of fish and fish products reached Rs. 18 crores. The pattern of exports also underwent a change; moving from cured fish to frozen prawns.

As the contributions of the export of fish and fish products to the economy increased, in particular to the earnings of foreign exchange, the Government stepped up its efforts and in 1972 set up the Marine Product Export Development Authority (MPEDA) under an Act of the Parliament. The coordinated efforts of MPEDA led to increase in India's export to the lucrative European, USA and Japanese markets. Collation of market intelligence, aggressive advertising, facilitating buyer-seller meetings in international trade fairs, and showcasing India's seafood brought the required fillip to the exports. Simultaneously, MPEDA also got involved in promoting coastal shrimp farming by setting up hatcheries for quality seed production, maintaining product quality, traceability and adopting best practices.

An international container cargo ship.

Prior to the establishment of the MPEDA, the Government had also set up the Export Inspection Council (EIC) in 1963 under an Act of the Parliament to ensure the sound development of export trade through quality control and inspection and matters connected therewith. The role of EIC is to ensure that products notified under the Export (Quality Control and Inspection) Act, 1963 are meeting the requirements of the importing countries in respect of their quality and safety.

Around the time when MPEDA was being conceived, the young seafood industry in the country came together to form the Seafood Exporters Association of India (SEAI). The SEAI was set up during 1970 with the main objective to protect and promote the interest of the companies engaged in the seafood business and to develop the international trade of seafood from India. With its headquarters in Kochi, SEAI has

regional offices and provides an effective interface between the industry and the Government.

The seafood export industry in India is now over 50 years old. Initially, focus was on canned shrimp exports and then due to the non-availability of suitable cans in the country, the industry moved to export of frozen shrimp. The export of other varieties of fish, squid, cuttlefish, octopus, crabs, clams and mussels started in the late 1960's. The dividends of these efforts are visible today. During 2019-20, the value of India's export of fish and fish products stood at USD 6.67 billion, which is about 4 percent of the global export trade. The exports in terms of quantity reached 1.28 million tonnes (2019-20) from 0.945 million tonnes during 2015-16, recording an annual average growth rate of 7 percent during the period.

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Cargo destined for export.

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Top: Tuna delicacies; Bottom: Fried shrimp.

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Seafood display in a supermarket.

Growth in the product basket

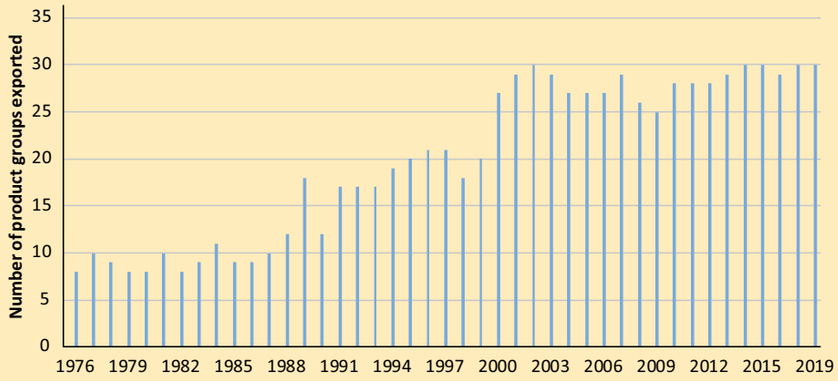
The significant growth in exports from India also catalysed in product diversification. Until the late 1980s about 9-10 different product groups were exported that gradually increased to about 18 product groups in the 1990s, 28 in the 2000s and 29 in the 2010s. From a production angle, this implies that more and more processed products are now being exported. This is helping India in better control over the value chain, ensuring that the increasing share of the revenue thus created is retained domestically. With this growing emphasis on value addition, a scope is unfolding to upgrade the value chain and increasing the net domestic benefits.

Nominal annual average growth in various export markets during 2015-20

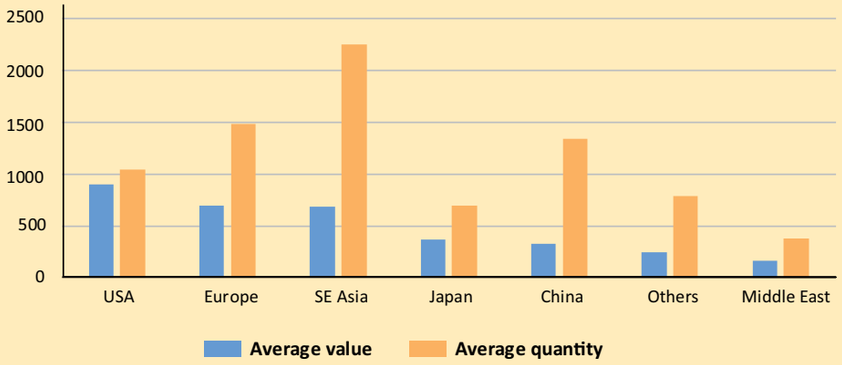
Market	Growth (in %)		
	Quantity	Rupee	USD
Japan	1	2	1
USA	20	21	18
European Union	-2	-1	-2
China	112	114	105
South East Asia	-6	-7	-8
Middle east	1	3	2
Others	7	9	7

Frozen shrimp and prawns remain the traditional and the largest offering in the export basket. The giant tiger prawn, a major component in the making of frozen shrimps until the late nineties, was replaced by the Pacific whiteleg shrimp (*Litopenaeus vannamei*), which is now the star performer in the Indian seafood export. In fact, the success story of Indian exports in the current decade is intertwined with the successful farming of vannamei in the country.

The mutually reinforcing journey of export growth and productdiversity helped India emerging as global leader in fisheries trade



Average market-wise quantity exported (in hundred tonnes) and value generated (million USD) during 2000-20



Traditionally, cuttlefish has been another key product in the trade basket whose demand has remained static and enjoys a high share. Sharks, shark fins and shark oil, on the other hand, though traditional items have now dropped out significantly owing to the increasing concern over the health of many shark stocks, and national regulations to conserve shark species.

Tunas and tuna-like species are now emerging as an important product in the export basket. During the last 2-3 decades, India has grown its capacity to harvest offshore waters leading to increased landings of yellowfin and skipjack tunas. Since the domestic demand for tunas is limited, this is helping in generating enough exportable surplus.

Growth of the markets

In terms of markets, USA, Europe, and Japan have been the key destinations for Indian frozen shrimps and cuttlefishes. Miscellaneous frozen fishes were marketed in the Middle- eastern countries. Subsequently, China and more recently the Southeast Asian countries have emerged as major export destinations for Indian seafood. However, the USA still remains the largest market in terms of value generated. The quantity exported during the last five years (2015-16 – 2019-20) has increased by 20 percent per year while the value realized in USD increased by 18 percent. Phenomenal development happened in case of trade with China, where during the same period, the quantity exported increased over six times from about 50 thousand tonnes to 300 thousand tonnes while the value increased from USD 202 million to USD 1375 million.

India's mission for the future

The 'Indian Seafood Export: Mission 2030' of MPEDA estimates that the Indian exports are likely to grow to USD 11 billion by 2030. However, with suitable interventions, India can increase its share to about 6.7 percent of the global trade generating a revenue of USD 17.8 billion. The future of India's seafood exports mainly depends on the increase in aquaculture production through expansion of the area under farming, species diversification, modernisation of fishing harbours and fishing vessels for quality improvement, value addition, brand promotion in the existing as well as the potential markets and effectively addressing the trade regulations being implemented by the major seafood importers.

The making of brand India

The MPEDA is now actively engaged in the development of 'Brand India'. The branding will highlight the uniqueness of India's fisheries and aquaculture products and will boost exports creating additional employment and ensuring that the larger share of the consumer's rupee is domestically held. This will lead to an overall improvement in the fisheries sector and better product availability in the domestic market also.

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Important seafood varieties destined for exports.

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Important seafood varieties destined for exports.

ICAR-CMFRI Fish Museum.


SILLAGINIDAE
LACTARIIDAE

A. Fisheries Development and Regulatory Agencies

Marine Products Export Development Authority

The Marine Products Export Development Authority (MPEDA) was set up by an Act of the Parliament in 1972 succeeding the Marine Products Export Promotion Council established by the Government of India in September 1961. MPEDA is given the mandate to promote the marine products industry with special reference to exports from the country. It is envisaged that this Organisation would take all actions to develop and augment the resources required for promoting the exports of "all varieties of fishery products known commercially as shrimp, prawn, lobster, crab, fish, shell-fish, other aquatic animals or plants or part thereof and any other products which the Authority may, by notification in the Gazette of India, declare to be marine products for the purposes of the Act". The Act empowers MPEDA to regulate export of marine products and take all measures required for ensuring sustained, quality seafood exports from the country. Additionally, MPEDA is given the authority to prescribe for itself any matters which the future might require for protecting and augmenting the seafood exports from the country. Main functions of the Organisation are: (i) registration of infrastructural facilities for seafood export trade; (ii) collection and dissemination of trade information; (iii) promotion of Indian marine products in overseas markets; (iv) implementation of schemes vital to the industry by extending assistance for infrastructure development for better preservation and modernised processing following quality regime; (v) promotion of aquaculture for augmenting export production through hatchery development, new farm development, diversification of species and up gradation of technology; (vi) promotion of deep-sea fishing projects through test fishing, joint ventures and up gradation & installation of equipment to increase the efficiency of fishing; (vii) market promotional activities and publicity; (viii) carry out inspection of marine products, its raw material, fixing standards and specifications, training, regulating as well as to take all necessary steps for maintaining the quality of seafood that are marketed overseas; (ix) impart training to fishermen, fish processing workers, aquaculture farmers and other stakeholders in the respective fields related to fisheries;

(x) conduct research and development for the aquaculture of aquatic species having export potential through Rajiv Gandhi Centre for Aquaculture (RGCA); (xi) conduct extension and awareness activities, trainings, etc. through the Network for Fish Quality Management and Sustainable Fishing (NETFISH) & the National Centre for Sustainable Aquaculture (NaCSA); and (xii) prescribe for itself any matters required for protecting and augmenting the seafood exports from the country in the future. The headquarters of MPEDA are located in Kochi.

National Fisheries Development Board (NFDB)

The National Fisheries Development Board (NFDB) was established in 2006 as an autonomous organization under the administrative control of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India to enhance fish production and productivity in the country and to coordinate fishery development in an integrated and holistic manner. The objectives of the Organisation are to: (i) bring activities relating to fisheries and aquaculture for focused attention and professional management; (ii) coordinate activities pertaining to fisheries undertaken by different Ministries/Departments in the Central Government and also coordinate with the State/Union Territory Governments; (iii) improve production, processing, storage, transport and marketing of the products of capture and culture fisheries; (iv) achieve sustainable management and conservation of natural aquatic resources including the fish stocks; (v) apply modern tools of research and development including biotechnology for optimizing production and productivity

from fisheries; (vi) provide modern infrastructure mechanisms for fisheries and ensure their effective management and optimum utilization; (vii) generate substantial employment; (viii) train and empower women in the fisheries sector; and (ix) enhance the contribution of fish towards food and nutritional security. In 2014, a regional centre of the Organisation was established in Guwahati to better coordinate fisheries development in north-eastern India. The NFDB is also the nodal agency for implementing various schemes of the Department of Fisheries. The headquarter of the Organisation is in Hyderabad and housed in a landmark fish-shaped building.

Coastal Aquaculture Authority

The Coastal Aquaculture Authority (CAA) was established under the Coastal Aquaculture Authority Act, 2005 and notified vide Gazette Notification dated 22nd December, 2005. The main objective of the Authority is to regulate coastal aquaculture activities in the coastal areas in order to endure sustainable development without causing damage to the coastal environment. The Authority is empowered to make regulations for the construction and operation of aquaculture farms in coastal areas, inspection of farms to ascertain their environmental impact, registration of aquaculture farms, fixing standards for inputs and effluents, removal or demolition of coastal aquaculture farms, which cause pollution, etc. One of the major tasks that the CAA undertakes is the registration of shrimp farms on the recommendations of the State and District-Level Committees constituted for this purpose. It is mandatory that all persons carrying on coastal aquaculture shall register their farm with the CAA. Registration is made for a period of five years, which can be renewed further. The farmers intending to culture SPF *L. vannamei* (white leg shrimp) in the country have to obtain permission from CAA. The Organisation also supports the Quarantine Facility run by MPEDA for white leg shrimp. The headquarter of the Organisation is located in Chennai.

Indian National Centre for Ocean Information Services

ESSO-INCOIS was established as an autonomous body in 1999 under the Ministry of Earth Sciences (MoES) and is a unit of the Earth System Science Organization (ESSO). ESSO-INCOIS is mandated to provide the best possible Ocean Information and Advisory Services (OIAS) to society, industry, government agencies and the scientific community through sustained ocean observations and constant improvements through systematic and focussed research. The major objectives of ESSO-INCOIS, especially for the fisheries sector are to: (i) establish, maintain and manage systems for data acquisition, analysis, interpretation and archival for Ocean Information and related services; (ii) carry out surveys and acquire information using satellite technology, ships, buoys, boats or any other platforms to generate information on fisheries, minerals, oil, biology, hydrology, bathymetry, geology, meteorology, coastal zone management, etc.

(iii) establish Early Warning System for Tsunami and Storm Surges; and (iv) provide consultancy services in the fields of OIAS. The main services provided to the fisheries sector are providing Potential Fishing Zone (PFZ) advisory, tsunami early warning, storm surge alerts and coral bleaching alerts. ESSO-INCOIS is based in Hyderabad.

B. Fisheries R&D Agencies under the Ministry of Fisheries, Animal Husbandry and Dairying

Central Institute of Coastal Engineering for Fishery (CICEF), Bangalore

The Central Institute of Coastal Engineering for Fishery (CICEF), formerly known as Pre-Investment Survey of Fishing Harbours (PISFH) is a premier institution of the Government of India. Established in January 1968, the Institute is engaged in the engineering and economic investigations and preparing the Techno-Economic Feasibility Reports (TEFRs) for Fishery Harbour (FH) projects. The PISFH was set up as a Central Project under the Ministry of Food and Agriculture, and Community Development (Department of Agriculture) in association with the Food and Agriculture Organisation of the United Nations (FAO). It was re-designated CICEF in 1983 with the mandate to: (i) conduct economic and engineering investigations, prepare suitable engineering designs for coastal aquaculture farms and operational procedures for the types of sites for coastal aquaculture commonly found in the country; (ii) test suitability of the design and operational procedures including their economic efficiencies through representative pilot projects in selected areas; (iii) establish on the basis of pilot project results, guidelines for designs and operation of small and large coastal farms in different type of sites in the country; (iv) design appropriate shrimp hatcheries and assist in their establishment and operation, including the training of personnel; and (v) train adequate number of personnel to undertake feasibility studies including site surveys, preparation of farm designs and relevant cost estimates. The core expertise and experience of the Institute lies in the subject matter of developing FH and Fish Landing Centres and the Institute till the end of May 2020 had carried out engineering and economic investigations at 91 sites and prepared TEFRs for 85 sites, besides rendering technical assistance to maritime States in the scrutiny and finalization of the TEFRs. CICEF is located in Bengaluru.

Central Institute of Fisheries Nautical and Engineering Training, Kerala

The Central Institute of Fisheries Nautical and Engineering Training (CIFNET) was established in 1963 as the Central Institute of Fisheries Operatives in Kochi, Kerala to meet the statutory manning requirements of deep sea fishing vessels as laid down in the Merchant Shipping Act of 1958 and skilled personnel required by the supporting shore installations. CIFNET is the only national institute of its kind in the country to meet the training requirements of technical and certified personnel such as Skippers, Mates, Engineers,

and Engine Drivers of mechanized fishing vessels. To meet the requirement, two units of the Institute were established at Chennai in 1968 and at Visakhapatnam in 1981.The Institute now functions with three ocean going fishery training vessels at the three centres. The mandate of the Organisation is to: (i) create technical manpower for the operation of Ocean going/deep sea fishing vessels; (ii) create trained manpower to manage fishery establishments; (iii) training the fishermen of the coastal States under the capacity building training programme under Blue Revolution; (iv) provide training for technical teachers for manning the fishermen training centers attached to Maritime States and Union Territories; (v) conduct studies on fishing craft, fishing gears and equipment and provide extensive training to accelerate advancement in fishing technology for enhancing productivity of fishermen and increasing marine fish production; and (vi) help developing nations in South-east Asia, Middle east and African regions to create technical manpower for development of marine fisheries. It is the only organisation with a specific mandate for regional cooperation to meet India's commitment to south-south development agenda. The headquarters of the Organisation is located in Kochi, Kerala.

Fishery Survey of India, Mumbai

The Fishery Survey of India (FSI) is one of the oldest fisheries organisation in India. It was born as a Deep Sea Fishing Station in 1946 with the objective of augmenting food supply through development of deep-sea fishing. The Project graduated to the status of a Survey Institute in the year 1974 and was named the Exploratory Fisheries Project. With the declaration of the EEZ and consequent changes in priorities in marine fisheries development, there was a growing need for information on resources. In order to address the emerging needs, the Institute underwent a major structural and functional transformation in 1983. It was reorganised and upgraded as a National Institute and rechristened as Fishery Survey of India (FSI) under the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying (formerly under Ministry of Agriculture). The FSI has its headquarters at Mumbai and six bases located at Mumbai, Mormugao, Kochi, Chennai, Visakhapatnam and Port Blair. The mandate of the FSI is to: (i) carry out survey and assessment of fish stocks and

charting of fishing grounds in the Indian EEZ and the adjoining high seas; (ii) monitoring of fishery resources for fisheries regulation, management and conservation; (iii) assessment of suitability of deep-sea fishing gear with special reference to the concepts of maximum sustainable yield, preservation of environment and ecology of marine ecosystem; (iv) marine fisheries forecasting, including application of remote sensing in fisheries management; (v) maintaining data on deep sea fishery resources and dissemination of information to different user groups; and (vi) Human resources development through training of fishing operatives and meeting faculty requirements of sister institutes and organisations. The Institute is regularly engaged in the estimation of fisheries potential yield and in conducting census in the two Island Territories.

National Institute of Fisheries Post-Harvest Technology and Training, Kochi

The National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT), the erstwhile Integrated Fisheries Project, is a subordinate office of the Ministry of Fisheries, Animal Husbandry and Dairying and mandated to carry out applied research and training in the field of fisheries post-harvest technology. It has its headquarters in Kochi and a unit in Visakhapatnam. The main objective of the Institute is to develop value-added fishery products by way of process and product diversification from all varieties of fish, including low value, unconventional species and seasonally abundant fishes. The Institute also imparts training, both regular and need-based in the field of post-harvest technology,

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Research support to fisheries development.

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Fishing vessels in Mangalore Fishing Harbour.

© NETFISH-MPEDA

Workers in a pre-processing facility, Kerala.

© FSI, Department of Fisheries

Matsya Darshini, a longliner of Fishery Survey of India.

refrigeration technology, quality control and development of value added products. The training programmes include on the job training to colleges and university students and fisher women self-help groups. Popularisation of novel products and technologies are achieved through test marketing, trade fairs, exhibitions, brochures, pamphlets and consultancy services.

C. Fisheries Research Institutions under the Indian Council of Agriculture Research

ICAR-Central Institute of Fisheries Education, Mumbai

The Central Institute of Fisheries Education (CIFE) was established by the Government of India, with the assistance of FAO/UNDP in June 1961 to impart post-graduate education and training largely to in-service fisheries personnel of the country to support fisheries developmental activities. It came under the administrative control of the Indian Council of Agricultural Research (ICAR) in April 1979 and subsequently, the scope and mandate has been widened to include education, research and extension. The institute was conferred the status of Deemed-to-be-University in March 1989. The mandate of the Institute is to (i) conduct post-graduate programmes in fisheries sciences; (ii) carry out basic and strategic research in frontier areas of fisheries science; and (iii) Human Resource Development, capacity building and skill development through training, education and extension. Besides, CIFE is recognised as the only Centre of Excellence for Advanced Faculty Training (CAFT) in Fisheries wherein more than 250 faculties/scientists from State Agricultural Universities and ICAR institutes have been trained. The Institute's activities are spread under six divisions including Aquaculture; Fisheries Resources, Harvest and Post-Harvest; Fish Genetics and Biotechnology; Aquatic Environment and Health Management; Fish Nutrition and Biochemistry and Fisheries Economics, Extension and Statistics. Its four Centres located at Rohtak (Haryana), Kolkata (West Bengal), Kakinada (Andhra Pradesh) and Powarkheda (Madhya Pradesh) cover different agro-climatic zones and have inland-saline, freshwater and marine farm facilities for on-farm education and extension. The Institute also has two training-cum-research fishing vessels, MF Saraswati (36 m OAL) and MFV Narmada (11 m OAL). The main campus is located in Versova, Mumbai.

ICAR-Central Inland Fisheries Research Institute, Barrackpore

The Central Inland Fisheries Research Institute was set up as the Central Inland Fisheries Research Station on 17 March 1947 at Kolkata under the Ministry of Food and Agriculture and became an Institution in 1959. In 1967, the institute came under the administrative control of the ICAR. The Institute was initially engaged in both inland capture fisheries and aquaculture. However, the growth of aquaculture activities and importance of aquaculture in the country led to the birth of three separate institutes – the Central Institute of Freshwater Aquaculture (CIFA), the Central Institute of

Brackishwater Aquaculture (CIBA) and the Directorate of Coldwater Fisheries Research (DCFR). The mandate of the organisation is to (i) carry out basic, strategic and applied research for sustainable management of inland open water resources; (ii) develop protocols for productivity enhancement in reservoirs and wetlands and aquatic ecosystems health management; (ii) acts as repository of information on inland open water resources; and (iv) human resource development through training, education and extension. The Organisation has activities placed under seven divisions - Riverine Ecology and Fisheries, Reservoir and Wetland Fisheries, Aquatic Environmental Biotechnology & Nanotechnogy, Fisheries Enhancement & Management, Fisheries Resource Assessment and Informatics, Training & Extension and Agricultural Economics. The headquarters of the Institute is located at Barrackpore, West Bengal and Regional Research Centers at Allahabad, Guwahati, Bangalore and Vadodara, and two Centres at Kochi and Kolkata. The Institute is ISO 9001: 2008 certified.

ICAR-Central Marine Fisheries Research Institute, Kochi

The Central Marine Fisheries Research Institute was established by the Government of India on 03 February 1947 under the then Ministry of Agriculture and later it joined the ICAR family in 1967. During the course of over 73 years, the Institute has emerged as a leading tropical marine fisheries research institute in the world. The mandate of the Organisation is to (i) monitor and assess the marine fisheries resources of the EEZ, including the impact of climate and anthropogenic activity and develop sustainable fishery management plans; (ii) basic and strategic research in mariculture to enhance production; (iii) act as a repository of geo-spatial information on marine fishery resources and habitats and (iv) consultancy services and human resource development through training, education and extension. The Organisation has four regional centres located in Mandapam, Visakhapatnam, Mangalore and Vizhinjam; seven regional stations and 15 field centres spread in the coastal States. It has ten divisions looking after various aspect of marine fisheries such as fishery resource assessment, pelagic fishery, demersal fishery, marine biotechnology and socio-economic evaluation. The major achievements of the institution include regular estimation of national marine fish landings; conducting quinquennial marine fisheries census; stock assessment and health monitoring; technology and product development; policy inputs and knowledge dissemination through publication and library services. The headquarters of the Organisation is located in Kochi, Kerala. The Institute is ISO 9001: 2005 certified.

ICAR-Central Institute Brackishwater Aquaculture, Chennai

The Central Institute of Brackishwater Aquaculture was established in 1987 under the ICAR, Ministry of Agriculture, Government of India to realize the potential in brackishwater aquaculture. The headquarter of the Institute is located at Chennai with an Experimental Field Station at Muttukadu, about 30 km south of Chennai. The Institute has one Research Centre at Kakdwip in West Bengal. The mandate

of the Organisation is to: (i) conduct basic and strategic research for sustainable brackishwater culture systems; (ii) species and systems diversification in brackishwater aquaculture; (iii) act as repository of information on brackishwater fishery resources with a systematic database; and (iv) human resource development, capacity building and skill development through training, education and extension. Currently, the Institute has five divisions, namely, (i) Finfish Culture, (ii) Crustacean Culture, (iii) Nutrition, Genetics and Biotechnology; (iv) Aquatic Animal Health and Environment, and (v) Social Science. Some of the salient achievements include development in captive breeding and seed production of seabass, milkfish, silver moony, spotted scat, mystus catfish, mud crab, and five major shrimp species; indigenous cost-effective functional and grow-out feeds for different life stages of potential candidate fishes; farming technology for shellfish and finfishes in diversified rearing systems; user friendly, cost-effective and novel kits for disease diagnosis, water quality assessment and microbial products for aquatic health management; and genetics and stock improvement of the selected species of brackishwater used in aquaculture, such as Indian white shrimp, seabass and milkfish. The Institute has also successfully sequenced the full genome of the Indian white shrimp, *Penaeus indicus*.

ICAR-Central Institute of Fisheries Technology, Cochin

The Central Institute of Fisheries Technology was established in 1957 as the Central Fisheries Technological Research Station based on the recommendation of a high-powered committee appointed by the Ministry of Food and Agriculture in 1954. It was renamed as Central Institute of Fisheries Technology in 1962 and in 1967 it came under the ICAR. The mandate of the Organisation is to (i) conduct basic and strategic research in fishing and processing; (ii) design and developing energy-efficient fishing systems for responsible fishing and sustainable management; (iii) development of implements and machinery for fishing and fish processing; and (iv) human resource development through training, education and extension. It has three regional research centres located in Visakhapatnam, Mumbai and Veraval. The Organisation has made significant contributions in fisheries technology, namely the development of an

indigenously designed Turtle Excluder Device (TED); traditional fishing canoe from the treated rubber wood and reducing cost of construction of small canoes by 35-40 percent and designing large mesh purse seine which led to the revival of small mechanized purse seine fishery in Kerala. The Institute's headquarter is located in Kochi, Kerala.

ICAR-Central Institute of Freshwater Aquaculture, Bhubneshwar

The Central Institute of Freshwater Aquaculture (CIFA) is a premier research Institute covering freshwater aquaculture in the country and was established in the year 1987 under the aegis of the ICAR. Its origin dates back to 1949 when the Central Inland Fisheries Research Institute established a Pond Culture Division in Cuttack, Orissa, which subsequently became the Freshwater Aquaculture Research and Training Centre (FARTC) and shifted to Bhubaneswar, Orissa and then an independent institution with enhanced mandate. The mandate of the Institute is to: (i) conduct basic and strategic research for sustainable freshwater culture systems; (ii) species and systems diversification in freshwater aquaculture; and (iv) human resource development, capacity building and skill development through training, education and extension. The Institute has five divisions, namely (i) Aquaculture Production and Environment Division; (ii) Fish Genetics & Biotechnology Division; (iii) Fish Health & Management Division; (iv) Fish Nutrition & Physiology Division, and (v) Social Science Section. The Organisation has four regional centres located in Bengaluru, Bhatinda, Rahara and Vijayawada. The Institute is also the Lead Centre

on 'Carp Farming in India' under the Network of Aquaculture Centres in Asia-Pacific (NACA).

ICAR-National Bureau of Fish Genetic Resources, Lucknow

The National Bureau of Fish Genetic Resources (NBFGR) was established in 1983 under the fold of ICAR to provide scientific inputs for the management of fish germplasm resources of the country. The recent accomplishments of the Institute (2015 to 2020) include discovery and first description of 14 species, which are new to science and 6 new records to India. Some of these new species have been captive bred and likely to be promoted for culture. One of the rare species, *Hemibagrus punctatus*, endemic to Western Ghats and reported as extinct during 1998, is revived through exploration and captive propagation. The Institute has developed online database 'Aquatic Genetic Resource Information System' with fish diversity comprising 3,138 databases and various genomics under 'FisOmics' portal. ICAR-NBFGR is one of the designated repositories under section 39 of the Biological Diversity Act, 2002 for fish genetic resources. The sperm cryopreservation technology, normally considered as a conservation tool is upgraded for field validation in 23 hatcheries in 7 States for production of genetically diversified quality seed in carp hatcheries. The National Surveillance Programme for Aquatic Animal Diseases (NSPAAD), implemented by NBFGR through 31 collaborating centres in 19 States and 3 UTs has been highly acclaimed nationally and internationally and is part of a central scheme under PMMSY for future pan India implementation.

ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Nainital

The Directorate of Coldwater Fisheries Research (ICAR-DCFR) is a premier research institute under ICAR and was created as a National Research Center on Coldwater Fisheries (NRCCWF) in September 1987 and upgraded to ICAR-DCFR during the Ninth plan. The mandate of the Institute is to: (i) conduct basic, strategic and applied research in coldwater fisheries and aquaculture; (ii) act as repository of hill fisheries resources, and (iii) human resource development through training, education and extension. Some of the major achievements of the Institute include a database on coldwater fishery resources; dissemination of 'Three Pronged Carp Culture Technology' in Indian Himalayan States; developing customized feeds for different life stages of fish including larval feed for rainbow trout and golden mahseer; establishing biochemical mechanism of cold tolerance in snow trout *Schizothorax richardsonii;* and disease surveillance in different aquaculture farms across the Himalayan States.

A haul of carps.


Aquaplosion

5.0 Aquaplosion

The roots of fish farming in India lie in the eastern and north-eastern States of the country. Raising seeds of carps and other related fish species in homestead ponds is perhaps many centuries old in India. Homestead ponds dotted the entire landscape of the eastern and north-eastern parts of the country, and very few households would go without a pond in the backyard. The ponds served multiple uses for the household that included receptacle for kitchen waste, bathing and washing, and storage for the rainwater. They were inseparable part of the family's life.

In the early part of the history of aquaculture in India, the rivers and tributaries provided the seed during the monsoon months. This seed collected through small set nets placed in the flowing waters of the rivers and their tributaries was stocked in the ponds and raised for family consumption during the year, until the next monsoon arrived and the cycle was repeated. The seeds were mixed; Indian major carps (IMC) that comprised rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus mrigala*) and calbasu (*L. calbasu),* minor carps such as bata (*L. bata*), reba (*C.reba*); small catfishes; and many other smaller varieties mainly belonging to the genus *Puntius* largely constituted the fish fauna stocked in the homestead ponds.

However, the carps were the star in this assemblage of fish seed stocked in the ponds. Being herbivore and feeding on plankton, the carps adapted to the pond environment much better than most of the other species. Because of their inherent faster growth and attaining larger size within a short time, they outgrew the other species and gradually gained recognition as species that could be farmed for domestic consumption and commerce. Catfishes as they became recognizable were weeded out from the pond and so were the other varieties, which were not popular as food fishes.

The process of adding science to this art of fish farming in India started in the early parts of the twentieth century, with researchers first focusing on the breeding of carps and completing their life cycle to allow farmers to have a steady supply of quality seed.

Availability of fish seed became one of the most critical requirements for development of fish farming in India. The IMC species and the exotic Chinese carps, silver carp and grass carp, which were introduced into India in the year 1959 normally do not breed in confined waters. While maturity is possible in the confined waters, breeding takes place in the flooded shallow areas along the course of the rivers or their fast flowing tributaries during the monsoon months. In the initial years of IMC seed production, various strategies were used for breeding the carps, such as breeding them in earthen bundhs where rain water was accumulated during the monsoon period.

With many trials and methods used, the pituitary extract collected from the fishes and later synthetic hormones provided the required breakthrough in closing the life cycle of the cultivable IMC and exotic carp species, and allowing the fish to breed under closed conditions. Dr Hiralal Chaudhuri and Mr K H Alikunhi, researchers working with the Central Inland Fisheries Research Institute (CIFRI), Barrackpore are the pioneers and they achieved the first success in breeding IMC in the year 1957. Subsequently, success was achieved in breeding silver carp and grass carp too during the period 1962-1963. The Institute's fish farm in Cuttack, Odisha provided the location for this breakthrough.

However, the full-scale technology of breeding IMC species and the exotic carps took almost a decade and commercial-scale production of IMC seed started in the early seventies. Following this development, the dependence on seed collection from the rivers and their tributaries gradually stopped from the early seventies.

Mr Neelu Ghosh and Chatterjee brothers of Naihati in West Bengal and Mr Lutfur Rahman of Nagaon district in Assam are some of the first private sector fish breeders in the country

Fishfarmer casting net in homestead pond, Burdwan, West Bengal.

© ICAR-CIFA

A village pond in Odisha.

who set the ground for commercial-scale fish seed production in India. Ghosh and Chatterjee became the icons of carp seed production in the country and the seed produced in their hatcheries reached the far and wide corners of the country in the earlier years of development. Mr Rahman did the same for the growth of fish farming in the north-eastern States.

The development of hatcheries for seed production and raising them into the required sizes for stocking also went through several modifications. Hapas were initially used for breeding and hatching of seed that would then be transferred to the nurseries. Glass jar hatcheries with water circulating through the jars and Chinese hatcheries with breeding and hatching conducted in cisterns with running water came next. These methods were further improvised and the modern hatcheries are compact, use minimum inputs and provide excellent results if the broodstock is properly mature and gravid. The seed production technology of Indian and Chinese carps was fully established in the country by the late seventies.

In the initial years, the requirement of broodstock was met either from the rivers or fishes raised in fish ponds. However, in the later years, farm-raised broodstock became a norm and many fish farmers only raised broodstock to supply to the breeders. Similarly, the practice of fish breeding and raising the seed to fingerling size also gave way, leading to the distribution of activities. Breeders started providing the spawn, that was raised by a set of farmers growing the seed

to fry stage and another set of farmers raising fry to fingerling stage that was sold to the fish famers for raising table-size fish.

Under natural conditions, IMC and Chinese carps breed once in a year during monsoon. However, with the advance in technology fishes are now bred in different parts of the year and the same fish can be bred a couple of times without impacting the strength and vigour of the offspring.

In the history of fish farming in India, the early seventies can be termed as the turning point or the first watershed. With the technology of seed production ready for transfer from the laboratories to the farm, researchers also developed models of composite fish culture using six species combination of Indian and Chinese carps (catla, rohu, mrigal, silver carp, grass carp). Common carp, introduced much earlier from Europe, was the sixth species added to this team of fishes utilizing the different trophic levels of the pond. Farming principles were based on low-cost, low-intensive practices that utilized a combination of natural pond productivity supplemented with fish feed comprising organic material such as rice bran and oil cakes. Use of fertilizers with nitrogen, phosphorous and phosphates (NPK) was also resorted to stimulate the growth of plankton in the ponds.

Two important events took place during this period that shaped the development of aquaculture in India. The Indian

Council of Agriculture Research (ICAR) established the All India Coordinated Research Project on Composite Fish Culture (AICRP-CFC) at CIFRI, Barrackpore in the early seventies. The AICRIP-CFC also established field stations in several places (Guwahati in Assam, Krishnanagar in West Bengal, Cuttack and Bhubaneshwar in Odisha, Ranchi in Bihar, Jaunpur in Uttar Pradesh, Pune in Maharashtra, Karnal in Haryana, Eluru in Andhra Pradesh, Coimbatore in Tamil Nadu). These field stations, covering different zoo-geographies of the country, provided excellent details on the growth performance of the species and other dos and don'ts.

The most remarkable attribute of the AICRIP-CFC was its coordination and 'working in tandem' with the Department of Fisheries (DoF) of the States. The States provided their fish farms for the trials, all the inputs (men, material and money) were provided by ICAR and the entire proceeds from the fish harvest went to the States. Farm managers and other worker of the DoF were also involved in learning the practices from 'beginning to end'. This process cemented the confidence in the States to proceed in large-scale promotion of the composite fish farming.

While the AICRP-CFC was fine-tuning the technology for its full-scale adoption by the farmers, the Union Ministry

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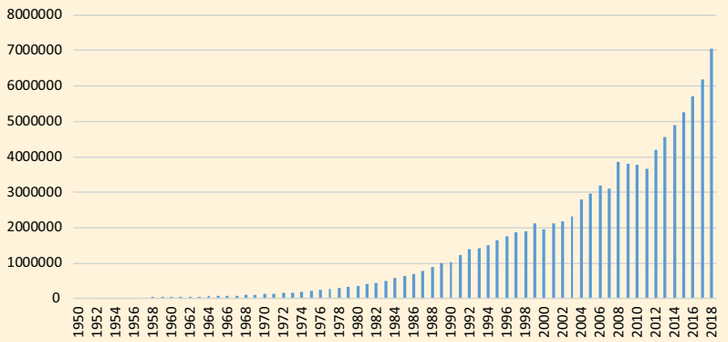
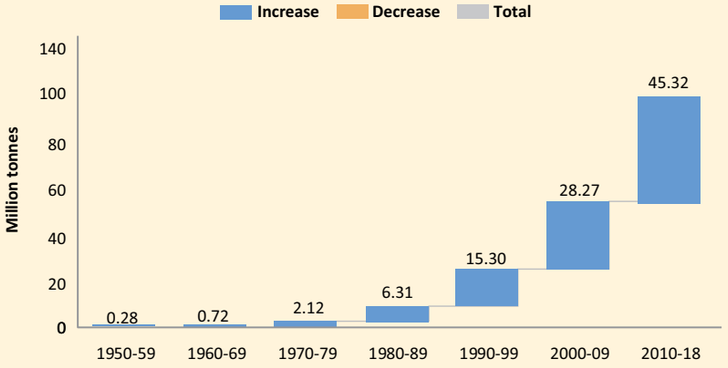
Recirculatory Aquaculture System.

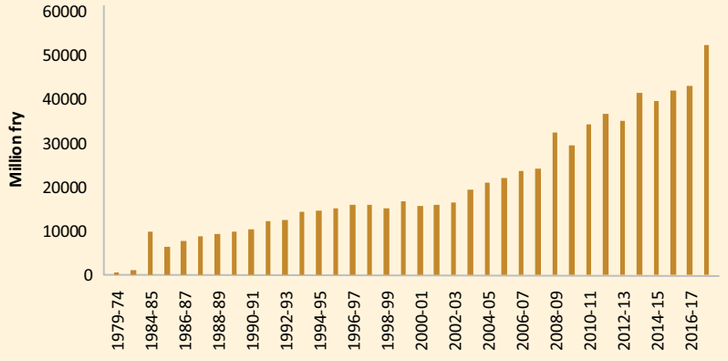
Growth of aquaculture production in India



Additional volume of aquaculture products produced each decade



Growth in fish seed production



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A multipurpose homestead pond, Joygopalpur, West Bengal.

of Agriculture put in place the Fish Farmers' Development Agencies or popularly called the FFDAs to extend the technology by providing subsidy and extension services to the farmers. The FFDA's were also conceived in a novel way to provide functional autonomy to the agencies in carrying out their day-to-day activities. With the District Collector/Deputy Commissioner as the head of the FFDA, the core staff was drawn on deputation from the DoF and a couple of support/ administration staff were hired to constitute the full team. Set up initially in a couple of districts, the FFDAs later covered almost all the districts in the country where fish farming was possible.

The AICRP and FFDA combination did the magic. And by the end of seventies, India witnessed its first 'Aquaplosion' as the then Director of CIFRI, the late Dr V G Jhingran said while establishing the foundation of the Central Institute of Freshwater Aquaculture (CIFA) at Dhauli in Bhubaneswar in 1978. Both seed production and

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A haul of Labeo fimbriatus.

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View of the ponds in the campus of the Central Institute of Freswater Aquaculture, Dhauli, Bhubaneswar, Odisha.

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Haul of Anabas testudineus (Koi).

fish farming were extending their reach from the traditional farming areas of eastern and north-eastern India to the other parts of the country. In a relatively short spell of time, Haryana and Punjab in northern India and Andhra Pradesh in the south became the new achievers in fish farming, with the Godavari belt become a hot-spot of aquaculture in the country.

With moderate stocking densities of 6, 000 fingerlings per hectare and raised over a period of 9-10 months, farmers were able to achieve 3-4 metric tonnes per crop. Depending upon the availability of seed and the monsoon rains, the cycle varied from region to region, beginning first in the north-eastern States and ending in the western and southern States. With this production, the share of aquaculture in the total inland fish production gradually started increasing and with a meagre 10-15 percent in the early years of fisheries development in India, today aquaculture contributes to around 85 percent of the inland fish production, the rest coming from capture fisheries.

This success story of carp farming in India will remain incomplete without the mention of another All India Coordination Research Project on Air Breathing Fishes (AICRP-ABF) covering species such as magur (*Clarias batrachus*), singhi (*Heteropneustes fossilis*), koi or climbing perch (*Anabas testudineus*) and snakeheads or murrels (*Channa* spp.). The AICRP-ABF also followed the same pattern of AICRP-CFC and worked in field stations located in Assam (Guwahati), Bihar (Ranchi) and Karnataka (Bengaluru). However, the success in developing the farming of air-breathing species lagged behind, although in recent years, CIFA has developed technologies that can be transferred to the farmers in the country.

Today, India's freshwater carp farming has gone thorough significant changes. Many farmer-led changes have altered the practices. The six-species combination of Indian and exotic carps is a history now. Most farmers have adopted 2-3 species combination. Shoot fry or fingerlings are stocked and with moderate to high feeding, fishes reach the harvestable size much earlier. Multiple harvesting and multiple stocking is also practiced, which allows farmed fish to reach the consumers round-the-year. Similarly, seed growers are also resorting to heavy socking in the nurseries and meeting the requirements

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Top, middle and bottom: Low-cost feed formulation.

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Top and facing page: Women fishing in homestead ponds, Odisha.

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Trout caught from a pond.

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A haul of trout.

of the farmers throughout the year. Supplementary feed is now more in vogue and the use of traditional feeds such as cow dung and oil cakes is on the decline. Soybean is being increasingly used in supplementary feed.

Development of cold-water fisheries in India is as exotic as the couple of trout species (rainbow and brown) that were introduced into the country during the British Raj. The first trout hatchery was established at Ooty in the Madras Presidency. The second development took place in Kashmir when a hatchery was established in Harwan, located on the outskirts of the city of Srinagar. The history of trout fishing in Himachal Pradesh also dates back to colonial times. The British introduced trout in 1909 to promote angling. At that time, fingerlings were released in various streams and multiplied. With these developments, though India was added to the list of trout faming countries in the world, the growth trajectory remained stymied.

The next breakthrough in the development of trout farming in India came during the mid-eighties when with the assistance of European Community, a Mother Trout Fish Farming Project was established at Kokernag. Besides this, the Department of Fisheries also established a Trout Hatchery at Laribal for producing quality seed of rainbow and brown trout. Assistance from the Dutch Government also allowed the J&K Government to set up a trout feed mill. Trout farming is gradually gaining the status of a major economic activity, with the DoF setting up 59 trout rearing units and hatcheries and the establishment of 533 units in the private sector apart from trout beats set up in 142 rivers, streams and lakes of the State. In addition, the Department has stocked 12 high altitude lakes ranging from 8,000 feet to 12,000 feet above sea level with brown trout.

Almost at the same time the Government of Himachal Pradesh also started negotiations with the Government of Norway and in early nineties, Himachal set up its first trout farm at Patlikuhl in Kullu District. The State has seven trout producing districts (Kullu, Mandi, Shimla, Kinnaur, Chamba, Kangra and Sirmour) and subsequently six more trout farms were set up to boost production. The Government also plans to set up 29 trout hatcheries in the private sector with each hatchery having an ova production capacity of two lakh annually. A total of 568 metric tonnes of trout fish valued at Rs 26 crore was produced in the State during 2018-19.

New technologies such as the Recirculatory Aquaculture Systems (RAS) and Biofloc systems are now gradually gaining acceptance. Both the technologies are aimed at making aquaculture more sustainable and promoting reduction in the use of inputs. RAS works on the concept of a 'closed circuit system', where the waste products are either removed or converted into non-toxic products by the system components. The purified water is subsequently saturated with oxygen and returned to the fish tanks. Biofloc system also provides wastewater treatment and is a novel approach in aquaculture.

Moving from the freshwater carp farming to the coastal area-based shrimp culture brings a totally different facet of Indian aquaculture. The *bheris*, created with embankments in the inter-tidal mud-flats of the estuarine reaches in West Bengal, are the first examples of traditional shrimp farming in India. The *bheris* trapped the seed of fin and shell fishes along with the high tide water and allowed them to grow for a couple of months before harvesting. Occasionally, seed gathered from the wild was also added to increase the shrimp population in the enclosures. The pokkali rice fields in Kerala also practiced similar methods of traditional shrimp farming, alternating shrimp and rice production.

Modern shrimp farming came on the horizon in India in the early eighties. The Kakdwip Research centre of CIFRI carried out some pioneering trials and later the Marine Products Exports Development Authority, seeing the potential of shrimp aquaculture in India, set up two modern hatcheries in the late eighties, one in Odisha (OSPARC) and the other in Andhra Pradesh (TASPARC) to produce quality shrimp seed. These hatcheries, setting the benchmark for shrimp seed production in the country, not only catalysed the setting up of shrimp hatcheries in the private sector, but also gave a fillip to commercial shrimp farming in States like Andhra Pradesh and Tamil Nadu.

Tracing the developmental trajectory of shrimp farming in India during the next two decades (1991-2010), the sector went through three stages of 'boom, bust and boom'. The early nineties saw a rapid development in the farming of tiger prawn (*Penaeus monodon*) in Andhra Pradesh followed by Tamil Nadu and Odisha. Many large companies established shrimp farms and in many areas the expansion also had negative impact on the ecology as also the socio-economics of the adjoining areas. These developments culminated in a Public Interest Litigation filed in the Supreme Court of India citing violation of the Coastal Regulation Zone Notification of 1991. Delivering the judgement in December 1996, the Apex Court directed the Government to only permit shrimp farming activities that are environment-friendly and do not impact on the ecology or the lives and livelihoods of the coastal communities.

Around the same time, the white spot syndrome virus also infected the shrimps in the country and farming came to a virtual halt. As the wild populations were also affected, access to disease-free mother shrimp became increasingly difficult and the shrimp farming area in the country shrank rapidly. While many alternatives like sourcing shrimp nauplii from the Andaman & Nicobar Islands or mother shrimp from neighbouring Myanmar were looked into, nothing worked to bring the sector back to its earlier glory.

Following the directives of the Apex Court, in February 1997, the Government established the Aquaculture Authority with its headquarters in Chennai. While the Authority initiated work towards promoting sustainable farming practices, the

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A haul of processed shrimps.

inability to access quality broodstock of tiger shrimp continued to remain a major impediment. Availability of wild broodstock also drastically reduced from the traditional shrimp grounds in the Bay of Bengal.

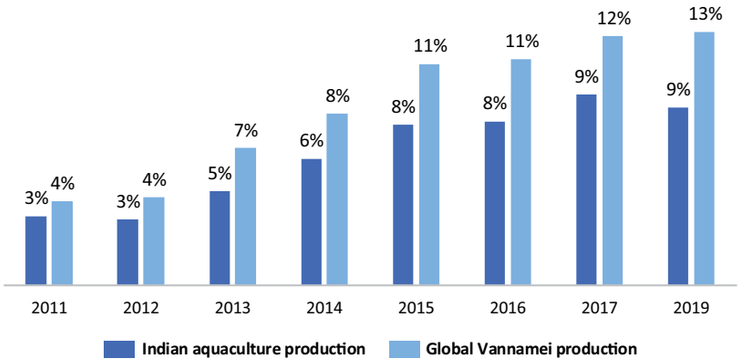
To revive shrimp farming in the country, the Aquaculture Authority during mid-2000 permitted introduction of the exotic Pacific white leg shrimp (*Litopenaeus vannamei*) from Hawaii on trial basis. With the Specific Pathogen Free (SPF) status of the introduced animals and following quarantine procedures and biosecurity measures, the trials proved to be successful. Encouraged with the success, the Government subsequently permitted full-scale introduction following the strict enforcement of quarantine and biosecurity measures.

Thus after the two phases of boom and bust, the country saw another phase of boom starting from the earlier part of this decade. Today, India stands as the third largest producer of shrimp in the world after Ecuador and Indonesia. A total of 176,000 ha is now under shrimp farming producing about 700,000 tonnes per annum, which comprises about 91 percent of white leg shrimp and the remaining 9 percent of tiger shrimp. Presently, 311 hatcheries are permitted to import SPF broodstock of *L. vannamei* from their overseas partners. These hatcheries have production capacity of 45 billion postlarvae (PL). In addition, 90 Nauplii Rearing Centers (NRCs) with a capacity of 8.12 billion PLs have also been established to cater to the needs of the shrimp farmers.

One of the unique development witnessed in this second phase of boom is the growth of shrimp farming on the west coast, especially in the State of Gujarat. This expansion has allowed utilisation of the coastal saline soils, which otherwise could not be put to other productive uses. Similarly, some of the other States like Odisha have placed greater emphasis on sustainable development of shrimp farming.

In 2015, the Government based on the Coastal Aquaculture Authority Act, 2015 established the Coastal Aquaculture Authority (CAA) that subsumed the former Aquaculture Authority and paved the way for a fresh lease to the shrimp farming sector in the country. Over the years, the private sector has played a pivotal role in the development of shrimp farming in the country by setting up of shrimp hatcheries, feed mills,

Share of India's vannamei production in national aquaculture and global vannamei production



Nucleus Breeding Centres and Broodstock Multiplication Centre. The developmental support provided by the Marine Products Export Development Authority, research inputs by the Central Institute of Brackishwater Aquaculture and the regulatory measures enforced by the CAA are all sustaining the right environment for the growth and development of shrimp farming in India.

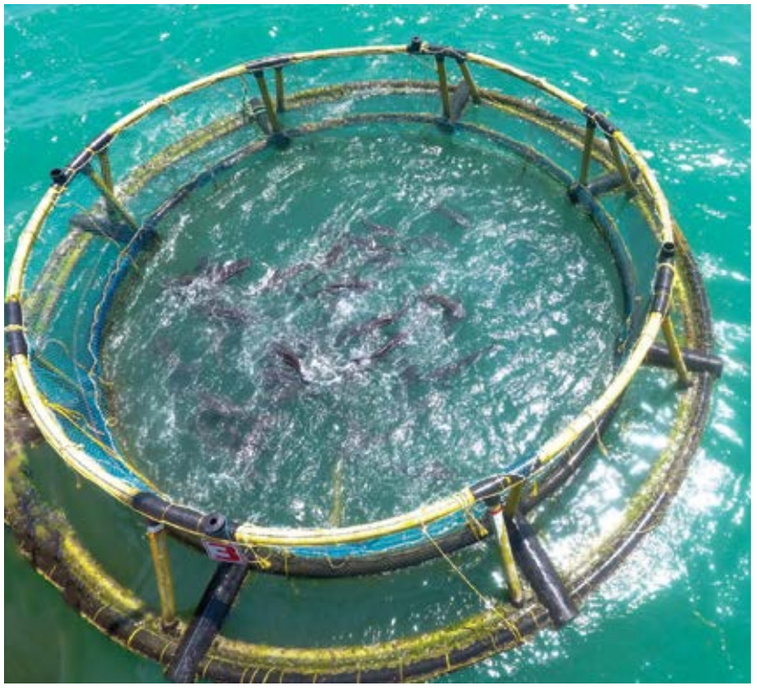
© ICAR-CMFRI

Lobsters fattened in cages.

Mariculture is gradually gaining foothold in the coastal waters of the country. Recognizing the need for increasing fish production for the growing population of the country, the Government has initiated the development of mariculture.

Starting with the cage farming of seabass and cobia species, fattening of crabs and lobsters and farming of mussel and oysters, the contributions of mariculture are now visible. The sustained efforts of the Central Marine Fisheries Research Institute, Kochi have now established technologies for breeding and larval rearing of a number of candidate species (*e.g.* cobia, silver pompano, Indian pompano, orange-spotted grouper, emperor sea-bream, John's snapper and vermiculated spinefoot, green and brown mussels and edible oyster) for mariculture. It is expected that the availability of quality seed in sufficient quantities would kick-start the activities on a larger-scale and also make farming cost-effective.

* * *



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Top: Fish farming in marine cages.
Bottom: Biofloc technology.

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Seafood on display at the fish market.

Fish in the Kitchen

6.0 Fish in the Kitchen

Nobel Laureate Rabindranath Tagore travelled around the world and enjoyed many cuisines. However, at the end of the day, he would find comfort in steamed hilsa or prawn made with coconut. In his 'Chelebela' (Childhood) book, Tagore also mentioned that when down with fever, his diet would be mourala fish broth and rice. In the socio-cultural mosaic of India, fish is enjoyed across religion and income classes. Developed over thousands of years, Indian cuisine responds to local customs, supplies, weather conditions and religious doctrines and fish preparations are no different.

In this maze of cuisines, every region and community has its unique signature. If a Bengali is obsessed with hilsa and a Malyali with karimeen, so is a Punjabi with singhara (a catfish). A new champion fish emerges every now and then as one travels the length and breadth of the country. It could be rohu in Assam, hilsa in West Bengal, pomfrets in Goa, Bombay duck in Gujarat, seerfish in Tamil Nadu and pearl spot in Kerala. And for people from Lakshadweep Island, its skipjack tuna all the way. Nothing else matters.

Proximity to a fish market is the moot topic of discussion when an Assamese, Bengali or a Malayali moves to new city or town. For an Assamese or a Bengali freshwater fish is at the top of the list, while a Malayali would seek the availability of sea fishes.

Fish is also a part of life from sickness to celebration for many communities in the country. While expecting mothers in the northeast are fed with magur, an airbreating fish; catfish diet is said to nourish sick people. Karimeen, rohu, catla, chital and prawn are an integral part of marriage celebrations. Research shows fish, especially small varieties are particularly good for the first 1000 days of a child. Many fishes, such as hilsa, oil sardines and tunas are rich in omega-3 fatty acid and various micronutrients that bring benefit to their connoisseurs.

One advantage of fish is that it offers amazing varieties in terms of species, shapes and sizes. All have their peculiar taste, and the specific ways of cooking make it one of the most versatile food group available to mankind. With the fish diversity of India, one can have a different fish with each meal every single day and still many more fishes will be left to experience. Even a single fish variety, can be cooked in different ways and will be delectable for its connoisseur.

As the story goes for the diehard lovers of hilsa, fried hilsa could be served as a starter, which is quite different from a steamed hilsa, which can be the first course, followed by hilsa with mustard sauce as the main course and finally ending with sour hilsa egg sauce as the desert. Of course, this story predates the concerns for the sustainability of hilsa and there is need to protect gravid hilsa.

Statistics available on fish consumption pattern in India, however, depicts a different picture, camouflaging the love for the fish in many part of the country. Well fish has some problems. As Shakespeare wrote 'Roses have thorns, and silver fountains mud', cleaning fish is time consuming and needs skill; fishes have their peculiar smell and many fishes are too bony that could end up messing the mouth and plate of many. Fish markets are often not the place where one will travel for leisure. These features often dissuade a potential consumer. A large number of people in India also follow vegetarian diet owing to various socio-cultural factors and which when aggregated shows rather a dismal picture.

Data shows that at national level only 265 households in rural India and 210 households in urban India out of thousand households consume fish. That is in a seven-day recall period, 265 households in rural India and 210 households in urban India reported to consume fish during the 68th Round National Sample Survey carried out in 2011-12. The monthly per capita consumption is 0.27 kg in rural areas and 0.25 kg in urban areas. However, at the same time, monthly per capita consumption of chicken is 0.18 kg and 0.24 kg respectively in rural and urban India.

Roasted sea bream served with lemon, orange slices, fresh parsley and spinach.

Fish with ingredients for cooking.

The disaggregated picture at the State-level, however, sheds more light on the meaning of fish in Indian life. In the north-eastern states of Tripura, Assam and Manipur, 600- 900 households out of thousand households consume fish with monthly per capita consumption varying between 500 grams to one kg. In both the Islands, Andaman and Nicobar and Lakshadweep, 700 – 900 households of 1000 households consume fish. Lakshadweep, with a monthly per capita consumption of 2.32-3.80 kg in different atolls has the highest consumption rate in the country.

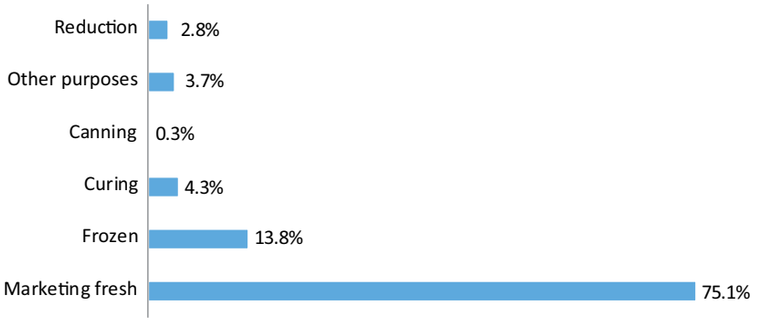
Among the coastal States and Union Territories, fish is popular in Kerala (868/1000), Goa (838/1000), West Bengal (831/1000) and Puducherry (735/1000) (figures show rural households consuming fish). In Odisha, 576/1000 household reported consumption of fish. It is not so popular yet in major marine fish producing States such as Gujarat (54/1000) and Tamil Nadu (218/1000).

The regional pattern of consumption coupled with production pattern has led to a number of large fish markets in India. In the northeast, Jagiroad, a small town 50 km east of Guwahati city, is India's largest dry fish market and probably one of the largest dry fish markets of Asia. The market started developing post-partition, when the Dhaka fish market became inaccessible. Jagiroad is well-connected by rail and road and its central location in the region makes it easily accessible to all the other north-eastern states. Set up in 1958, the fish market is just about one kilometre in length but it handles fish from all over India. The market operates for three days a week and deals with about 500 tonnes of fish every day. There are about 150 shops in the market and about 4000 people earn their living from here.

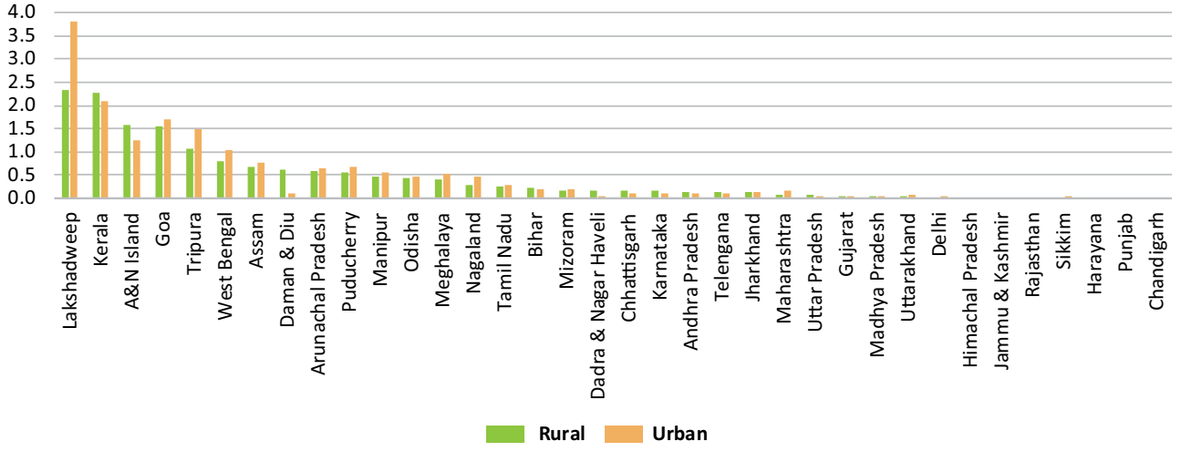
On the other hand, the wholesale fish market in Howrah, West Bengal deals largely with wet fish. It receives fish from all over the country owing to its close proximity to Kolkata market and excellent connectivity. Trading takes place both within and outside the State. Freshwater fishes from Howrah go to Delhi, Bengaluru, Chennai, Hyderabad and other cities while freshwater fishes also come to Howrah market from Odisha, Bihar and Andhra Pradesh.

About 78 percent of fish in India is marketed fresh. It has increased from 66.91 percent in 1991. Various channels are engaged in marketing of fish. Traditionally, a fisher or fish farmer sells the fish to a collector or agent of the wholesaler who in turn sells it to multiple retailers for local market as well as to the transporters for far away markets. Fish retailing is usually carried out from designated places although street vending of fish is also common and an age-old tradition. In coastal States, women are mostly engaged in retail marketing.

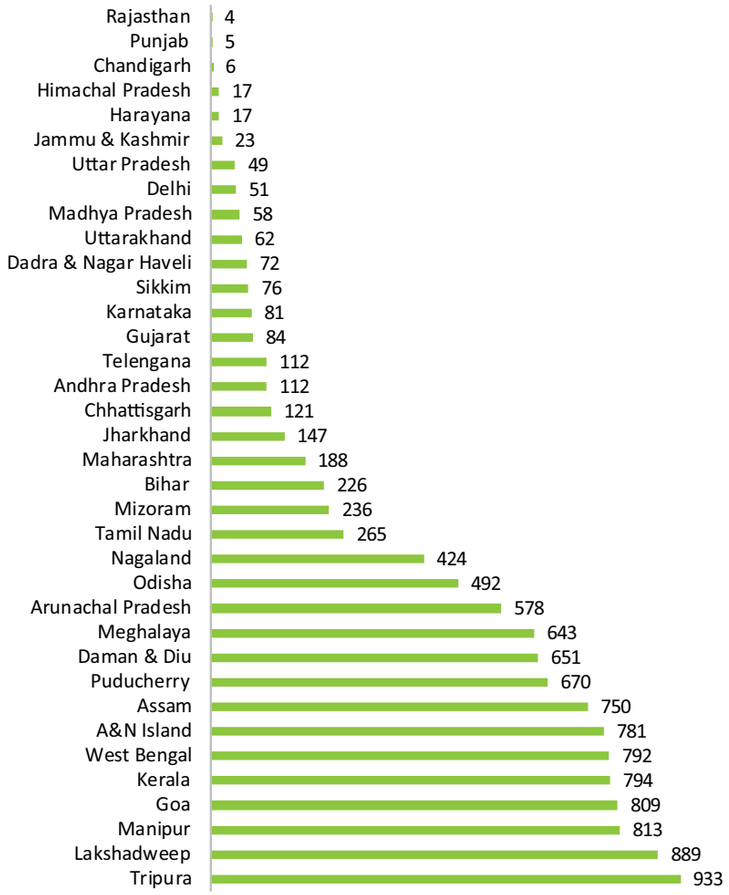
Disposition of fish catch by States/UTs in 2019



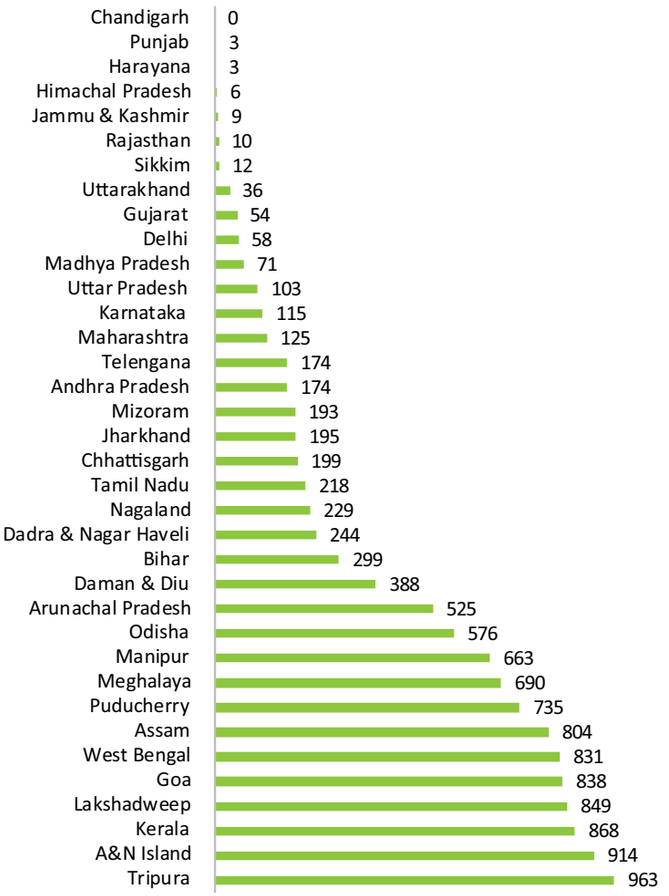
Per capita consumption of fish & prawns by State/UTs (in kg/month)



Number of households reported consumption of fish perthousand households in urban areas



Number of households reported consumption of fishper thousand households in rural areas



A fishmonger inviting customers, Mumbai, Maharashtra.

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Selling fresh fish in the Chowringhee, Kolkata, West Bengal.

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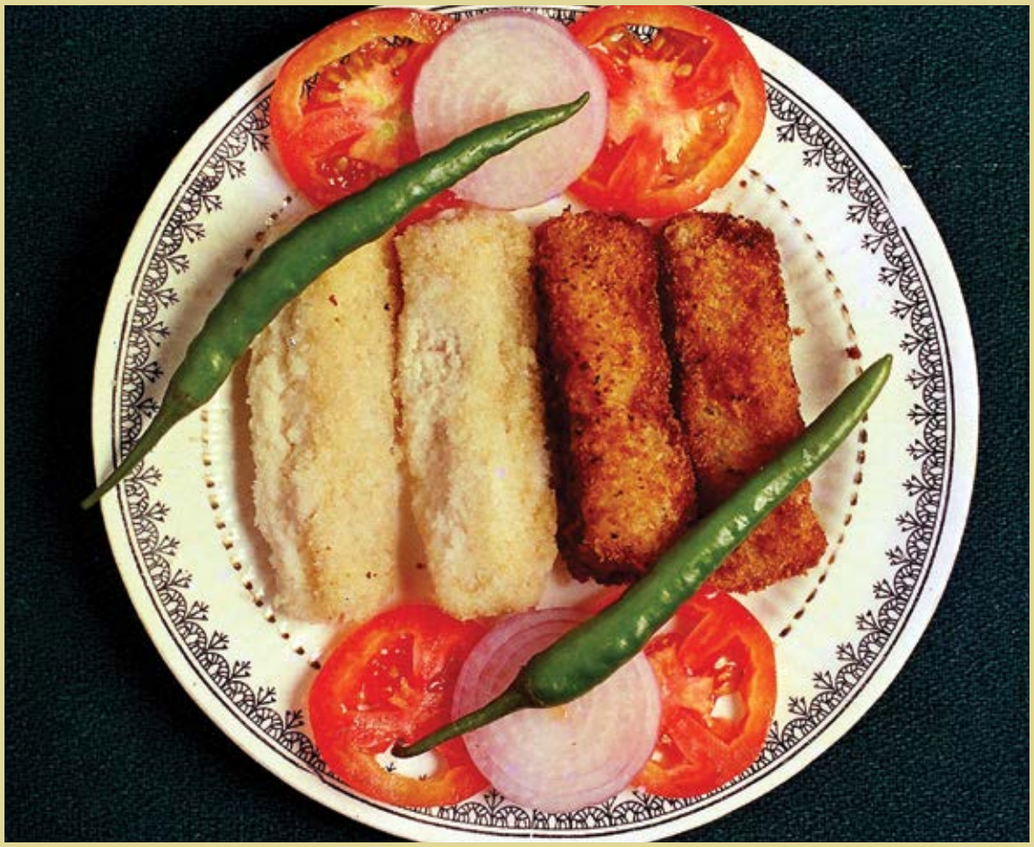

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Fish delicacies from different parts of India.

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Grilled fish with spices, Kerala.

In the cosmopolitan cities in recent years, the changing family profiles with working couples, has spawned online and app-based fish marketing. App-based fish marketing has also gained more popularity after the outbreak of COVID-19 and resultant closure of physical markets for many months. Apart from the flourishing private initiatives to sell fish online, some States agencies have also initiated online sale of fish.

One of the most successful initiative is *'Meengal'* by the Government of Tamil Nadu. *Meengal* is an app-based platform to sell fish. The Tamil Nadu Fisheries Development Corporation (TNFDC) of the State Government operates it. As of now, the operation is limited to Chennai with a plan to expand it to other cities. In *Meengal*, the registered consumers get an updated list of available fish and prices at the start of the day through the app. Once fish is ordered and payment made, the fish is processed, packed and delivered through a private delivery agency. Outbreak of COVID-19 also led to closure of offices and restaurants and to overcome the situation various app-based food delivery agencies started services to deliver food items and grocery items to homes, including fruits and vegetable, fish, meat and egg. A very large online network, as a result, rapidly developed linking physical stores with the consumers. A typical consumer in a large city now has the option to order his/her choice of fish from any part of the city, which is delivered processed and packaged. The popularity of these apps and revival of fish consumption can be gauged from the success of *Meengal*, which since its launch in April 2020 in Chennai, received 13 000 orders and sold 20 tonnes of fish generating a revenue of approximate rupees one crore.

Among the other uses of fish, about 8 percent fish is sold frozen and 4 percent cured. Most popular varieties for freezing are shrimps and prawns, squids, cuttlefishes and tunas. Sharks and other marine fishes are often dried and salted. Freezing and drying is mostly common in coastal states.

To popularize fish consumption, 'Fish Festivals' are now organized at national and State levels in different parts of the country. The National Fisheries Development Board (NFDB) is extending financial assistance to the States/UTs

for conducting State-level Fish Festival of 1-3 days' duration. The fish cuisine stalls are set up by renowned restaurants/ hotel chains, Government Undertakings, in which different varieties of fish and seafood, ready-to-eat and ready to-cook, fish/prawn/shellfish items are prepared and served to the visiting public.

The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR), Lucknow, Uttar Pradesh, in 2006 compiled a list of State Fish for 16 States. The concept involves integration of key stakeholders in the conservation plan where 16 States became partners with NBFGR in developing strategies for conservation and enhancement of their selected State Fish to achieve success in real-time conservation. The objective of the State Fish is to let the State adopt the fish and conserve the biodiversity. Subsequently, Andhra Pradesh and Telangana got separated and both States chose 'Murrel' as their State Fish. Lakshadweep chose 'Butterfly Fish' as their Fish.

* * *

Sl. No.	State/UT	State Fish
1.	Andhra Pradesh	Striped Murrel, *Channa straitus* (Bloch, 1793)
2.	Arunachal Pradesh	Golden Mahseer, *Tor putitora* (Hamilton, 1822)
3.	Bihar	Magur, *Clarias batrachus* (Linnaeus, 1758)
4.	Haryana	Kalbasu/Calabasu, *Labeo calbasu* (Hamilton, 1822)
5.	Himachal Pradesh	Golden Mahseer, *Tor putitora* (Hamilton, 1822)
6.	Jammu & Kashmir	Golden Mahseer, *Tor putitora* (Hamilton, 1822)
7.	Karnataka	Carnatic Carp, *Puntius carnaticus* (Jerdon, 1849)
8.	Kerala	Karimeen/Pearlspot, *Etroplus suratensis* (Bloch, 1790)
9.	Lakshadweep	Butterflyfish, *Chaetodon decussatus* (Cuvier, 1829)
10.	Manipur	Pengba, *Osteobrama belangeri* (Valenciennes, 1844)
11.	Mizoram	Ngahvang/Burmese Kingfish, *Semiplotus modestus* (Day, 1870)
12.	Nagaland	Chocolate Mahseer, *Neolissochilus hexagonolepis* (McClelland, 1839)
13.	Odisha	Mahanadi Mahseer, *Tor mahanadicus* (David, 1953)
14.	Tamil Nadu	Ayirai
15.	Telangana	Striped Murrel, *Channa straitus* (Bloch, 1793)
16.	Tripura	Pabda, *Ompok bimaculatus* (Bloch, 1794)
17.	Uttarakhand	Golden Mahseer, *Tor putitora* (Hamilton, 1822)
18.	Uttar Pradesh	Chital, *Chitala chitala* (Hamilton, 1822)
19.	West Bengal	Hilsa, *Tenualosa ilisha* (Hamilton, 1822)

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Preparing for fishing, Mandarmoni, West Bengal.

The Path to Future

7.0 The Path to Future

Posterity undoubtedly will recall the year 2019 as a watershed in the history of fisheries development in India. The sector never had it so good in the past seven decades of Independent India. The creation of a new Ministry of Fisheries, Animal Husbandry and Dairying, the establishment of a dedicated Department of Fisheries within the new Ministry and the subsequent allocation of Rs. Twenty thousand and fifty crores (Rs. 20,050 crores) for the development of fisheries and aquaculture in the country will stand as milestones in the remarkable journey of Indian fisheries.

These developments, while catapulting the Department to a new height, has also placed a set of tasks and responsibilities to contribute to the aspirations of the Government in becoming a USD 5.0 trillion economy by 2025. While the task set before the Department is daunting, they are achievable. The availability of diverse fisheries and aquaculture resources largely set in a warm tropical environment and comprising a relatively young, dynamic and enterprising mix of fishers and fish farmers can make this happen.

To fulfil the tasks set before the Department, the ambitious Pradhan Mantri Matsya Sampada Yojana (PMMSY) was launched in June 2020, with the following vision:

> *"An ecologically healthy, economically viable and socially inclusive fisheries sector that contributes towards economic prosperity and well-being of fishers and fish farmers and other stakeholders, and meets the food and nutritional security of the country in a sustainable and responsible manner"*

Recognising the needs of the sector and the contributions that fisheries and aquaculture can make towards meeting the food and nutritional security of the growing population in the country, sustaining the livelihoods of the people who are dependent on the sector and in ensuring that the fish harvests from capture and culture are obtained in the most sustainable manner, the PMMSY is a highly ambitious initiative of the Government. With the important objective of not to leave anyone behind and also extend the reach to the last mile, the PMMSY design covers different geographies and is set in a time-frame of 2020-2025.

The PMMSY is also placed within the broader framework of the country's 'Blue Economy', and the efforts of the Department of Fisheries will be oriented to ensure the sector's rightful space in the economic activities that constitute the 'Blue Economy'. The following sections of this Chapter provide information on the new initiatives of the Department of Fisheries and the salient features of the PMMSY.

Use of aerator in shrimp pond.

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Feeding fish in a marine cage.

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Brown seaweed, Gulf of Mannar, Tamil Nadu.

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Fish drying.

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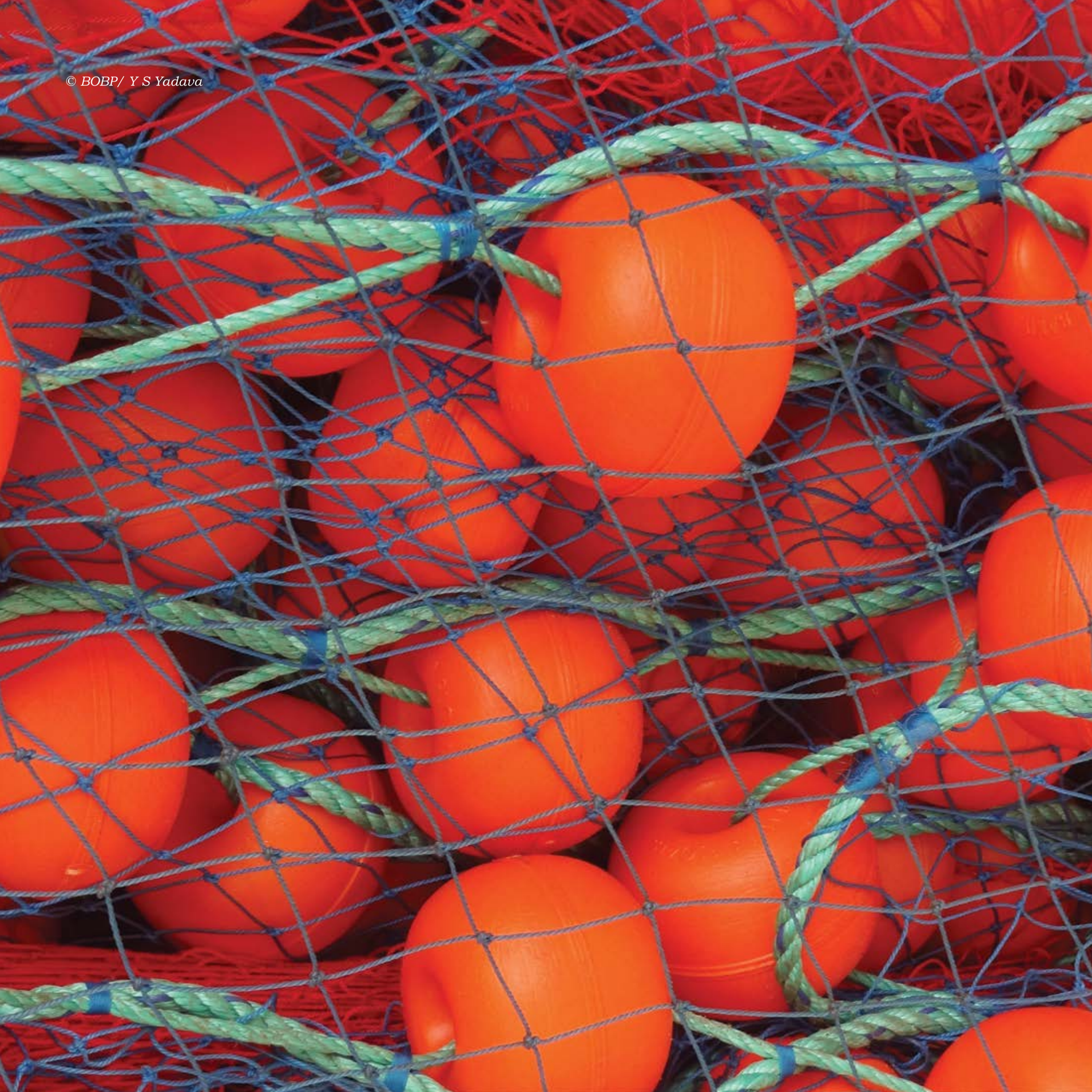
FSI vessel Blue Marlin, Port Blair, Andaman & Nicobar Islands.



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The New Initiatives

(i) Strategy for export earnings and value addition

During 2019-20, India exported 12.90 lakh tonnes of seafood worth Rs. 46,663 crores (USD 6.678 billion), contributing to about 6 percent of the global seafood trade. The USA and South-East Asia were the major importers of Indian seafood and frozen shrimp continued to be the major export item followed by frozen fish. To accelerate the future growth in export of seafood from India, the Government of India has planned interventions in five key areas *viz.*; (i) capture fisheries, (ii) aquaculture, (iii) quality assurance, (iv) value addition, and (v) brand promotion. The strategies for increasing production from capture fisheries involve upgradation of fishing harbours with better cold chain facilities, modernization of fishing vessels with a focus on improvements in on-board hygiene and sanitation, promoting distant water fishing to harness the under/untapped potential, and export of live and chilled products, mainly of marine origin. Initially, facilities in 25 fishing harbours are proposed to be improved that would be helpful in bringing down the wastage. To increase the export of live and chilled fish products, it is proposed to provide better connectivity to major destinations, easing the procedures for the acceptance of cargo by airlines and providing better logistic support, which is estimated to generate an additional export earnings of about USD 0.62 billion/year.

The export earnings from aquaculture sector is considered by (i) improving shrimp aquaculture practices and expansion of the area under farming, (ii) diversification of species, (iii) support facilities like hatcheries, Nucleus Breeding Centres, quarantine units, and (iv) adoption of Better Management Practices. Multispecies Aquaculture Complex for promotion of farming of species like tilapia, cobia, pompano, mud crab, black tiger shrimp, seabass, etc. are proposed to be set up in all the maritime States. These complexes will supply disease-free seed for aquaculture. Further, modernisation of the existing testing facilities and establishment of new units would help in overcoming aquatic animal health problems and in increasing production.

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Increasing the production and export of value-added products, which is presently around 6-8 percent of the total exports is envisaged by establishing about 100 state-of-art processing units and up-gradation of the existing units. Liberalization of the Sanitary Import Permit (SIP) norms for import of raw material for reprocessing to value added products and its export would yield an additional export revenue. Brand promotion for Indian seafood in overseas markets will include measures to overcome non-tariff trade barriers, participation in International seafood/food exhibitions, organizing trade delegations, promotional events, buyer-seller meets, and aggressive campaigns in the national and international media. In tune with its previous policies, the role of Government will be to make key interventions and deploy its available resources to create an enabling environment around which the private sector would grow. Further, India is also developing its certification scheme to promote sustainability in aquaculture production traceability through the entire value chain.

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World Fisheries Day Celebrations

The Government of India has been celebrating the World Fisheries Day (WFD) since 2014 to highlight the critical importance of the fisheries sector globally and to remind all to focus on sustainable fisheries and healthy ecosystems for holistic development of the sector and human lives that are dependent on it. The 2020 WFD was organized by the Department of Fisheries at the NASC Complex, Pusa, New Delhi. The Minister of State for Fisheries, Animal Husbandry and Dairying, Shri Pratap Chandra Sarangi, was the Chief Guest at the occasion. Shri Laxmi Narayan Chaudhary, Minister for Dairy Development, Animal Husbandry and Fisheries, Government of Uttar Pradesh also graced the occasion and received the award on behalf of the State of Uttar Pradesh, for the best performing State in inland fisheries. The fishers, fish farmers, entrepreneurs, stakeholders, professionals, officials and Scientist from across the country participated in the WFD. Speakers on the occasion stressed on the need to protect the life and livelihoods of fishing communities, and to ensure sustainable fish stocks and healthy ecosystems in India.

On the occasion, the Government of India awarded the best performing States for 2019-20, which included Odisha in marine sector, Uttar Pradesh in inland sector and Assam amongst the Hilly and NE States. The Government also awarded best Organisations for 2019-20 that included Tamil Nadu Fisheries Development Corporation Ltd. for marine sector; Telangana State Fishermen Cooperative Societies Federation Ltd for inland sector and the Assam Apex Cooperative Fish Marketing and Processing Federation Ltd. for Hilly region. In the category of best districts, Krishna District, Andhra Pradesh was declared as the best marine District; Kalahandi, Odisha as the best inland District; and Nagaon, Assam as the best Hilly and NE District. Besides, other categories such as Fisheries Enterprise; Fisheries Cooperative Societies/FFPOs/ SSG; Individual Entrepreneurs; Marine and Inland Fish Farmers; and Finfish and Shrimp hatcheries were also awarded in recognition of their contributions to the growth of the sector. The occasion also saw release of several publications of the Department of Fisheries and Fishery Survey of India.

(ii) Trade matters

The trade of fish and fish products is regulated as per the Foreign Trade Policy of the Government of India and implemented by the Department of Commerce. The import of fish and fishery products from Sanitary and Phyto-sanitary (SPS) angle is regulated under the provisions of Section 3 and Section 3A of the Livestock Importation Act, 1898 (as amended from time to time), so as to prevent possible ingress of exotic diseases through the import of fish and fishery products.

Import of fishery products are allowed through the airports and seaports of Bengaluru, Chennai, Delhi, Kolkata, Mumbai, Hyderabad, Vishakhapatnam and Kochi. Besides, the Land Customs Station at Petrapole is also a port of entry for the import of fishery products for human consumption. As a part of the Flagship Programme, 'Ease of Doing Business', 5 new additional entry ports were notified and the existing entry ports were also designated for import of livestock products. In a major policy shift, the Department of Fisheries has approved to dispense with the need for obtaining SIPs for import of SPF shrimp broodstock by the importers in all cases where the broodstock is sourced from oversea suppliers authorized by the Coastal Aquaculture Authority. Similarly, the Department of Fisheries has also delegated powers to the State Governments for issuing permission for the establishment of hatcheries for tilapia, which intend to source the broodstock from approved sources within the country.

Mission Action Plans

In order to achieve the envisioned goals under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), the Government has prepared detailed result-oriented action plans that set physical and financial targets to be achieved in the next five years. Besides the financial support from the Government, which has been the key contributor to the growth of fisheries sector over the years, the action plans, as detailed below, also, take into account the growing trend of private investments in the sector.

(i) Seaweed farming

Recognizing the immense potential of seaweed production in the country and with the funding support from the PMMSY, it is envisaged to increase the seaweed production from the current levels to 11 lakh tonnes (wet weight) in the coming five years. Further, the seaweed-based products, which are in great demand for various uses, both in the national and international markets, will augment the economic gains from the sector, including employment generation in the coastal areas. With an investment of Rs. 640 cores earmarked for the development of seaweed farming, the activities would include setting up of seed banks, nurseries, tissue culture units, processing and marketing units, etc. in all the coastal States and the Union Territories (UTs). It is expected that activities like seaweed farming will provide opportunities to marine fishermen to reduce their dependence on capture fisheries and engage in seaweed farming. The Central Salt and Marine Chemicals Research Institute (CSCMRI) and the Central Marine Fisheries Research Institute are actively engaged with the Government in developing viable culture technologies as well as mapping new potential areas for seaweed farming in the coastal areas of the country.

(ii) Ornamental fisheries

India has rich resources of ornamental fish species in both fresh and marine waters. Ornamentals also have the potential to contribute to livelihoods and the economy, particularly through trade. The Department of Fisheries, through the PMMSY, is providing the required fillip to the development of ornamental fisheries. Schemes and programmes have been identified keeping in view the special needs of the States for developing this important activity.

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(iii) R&D and Extension

To ensure the sustainable growth of the aquaculture sector, the Government is establishing Nucleus Breeding Centres (NBCs) in the country. This would allow the development of a broad genetic base and subsequent development of improved strains through selective breeding that would be essential for attaining self-reliance and long-term sustainability of aquaculture. The candidate species for the purpose are mainly *Peneaus monodon, P. indicus, Litopenaeus vannamei,* Sea bass, Scampi, and Tilapia.

Considering the Krishi Vigyan Kendras (KKKs) as sound institutions for providing extension support, the Government plans to provide all the 713 KVKs in the country with fisheries experts or '*Matsya Visheshagya*'. Further, it is also planned to increase the numbers of Aqua One Centres (AOCs) to provide aquaculture support services and transfer of technology. In the marine sector, the PMMSY has provisions for placing a '*Sagar Mitra'* in each coastal village for providing multiple support services to the marine fishermen and also undertaking fish catch documentation.

(iv) New Technologies

Effective water management in aquaculture means '*more crop per drop*'. To achieve this, the Government is promoting Re-Circulatory Aquaculture System (RAS) and the use of Biofloc technology. To allow the small-scale farmers, especially in the freshwater sector to remain competitive and participate in the modern value chain, integrated production-distribution chains and coordinated exchange between aquaculture farmers, processors and retailers are being encouraged. Ecosystem approach to aquaculture that allows for zoning, site selection and area management, species-specific or activity-based growth clusters and their development with necessary forward and backward linkages are also being promoted.

(v) Development of Integrated Coastal Fisheries Villages

A total of 100 villages have been selected for developing as integrated modern coastal fishing villages in the coastal States/UTs with the objective of maximizing economic and social benefits to coastal fishers. Some of the activities under this programme include:

(i) Saving-cum Relief to both inland and marine fishers @ Rs. 3,000/- per fisher for three months during the fishing ban/lean periods.

(ii) Aligned with the Pradhan Mantri Awas Yojana (PMAY), financial assistance for housing is provided @1.20 lakh and @1.30 lakh to fishermen belonging to the general States and the Himalayan & North-Eastern (NE) States respectively.

(iii) Basic amenities such as drinking water facility and community hall are also assisted with a provision of Rs. 0.50 lakh for general States and 0.60 lakh for Himalayan & NE States.

(iv) The Group Accident Insurance for Active Fishermen, converged with the Pradhan Mantri Suraksha Bima Yojana since June 2017 provides insurance coverage to active fishermen registered with the State Governments and UTs @ Rs. 12.00/fisher insurance premium annually and the compensation includes (i) Rs. 5.00 lakh against death or permanent total disability and (ii) Rs. 2.50 lakh for partial permanent disability. Further, the PMMSY also provides insurance cover for craft and gear.

(v) As a part of Swachh Bharat Abhiyan, it is also envisaged to fit bio-toilets on all mechanized fishing vessels.

(vi) Empowerment of women

Women play a crucial role in fisheries and aquaculture and represent almost half of the total working population

worldwide in the fisheries sector. Women's activities, paid and unpaid, cover the entire range of value chain, as well as pre- and post-harvest activities. Such activities, *inter alia* include seaweed and shellfish collection, fishing, weaving and repairing nets, processing, sales, and local and intra-regional trade. The empowerment provided by the Government of India has led to the overall improvement and upliftment of the socio-economic status of women fish workers. Further improvements in gender equality and recognition of the role of women in fisheries will have profound stimulation towards their participation in the overall development of the fisheries sector.

(vii) Issuance of Biometric identity cards to marine fishers

The Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture in December 2009 launched a 'Central Sector Scheme (CSS) on Issuance of Biometric ID Cards to Marine Fishermen.' The Scheme involves two major activities that include (a) data collection and authentication by the respective States/UTs and (b) digitization of data, capturing of biometric details of individual fishers, production and issuance of cards. The main objective of the Scheme is to create a National Marine Fishers' Database (NMFD), which could be accessed by all the authorized agencies in the Centre and coastal States/UTs. A consortium of three Central Public Sector Undertakings led by Bharat Electronics Limited (BEL), Bangalore has been entrusted the task of data digitization, capturing biometric details and other works relating to design, production and issuance of the ID Cards to marine fishers. The Electronics Corporation of India Limited (ECIL), Hyderabad and the Indian Telephone Industries Limited (ITI), Bangalore are the other two members of the consortium.

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(viii) Kisan Credit Card (KCC) to animal husbandry farmers and fishers

Extension of the Kisan Credit Card (KCC) facility to fisheries and animal husbandry farmers, as announced by the Government in its 2018-19 budget, helps them to meet their short-term credit requirements for the rearing of animals, poultry birds, fish, shrimp, other aquatic organisms and capture of fish. The Reserve Bank of India in February, 2019 issued detailed guidelines for the extension of the KCC facility to fisheries and animal husbandry farmers that include individuals and groups/partners/share croppers/tenant farmers, self-help groups (SHGs), joint liability groups (JLGs) and women groups. The existing KCC holders will get a credit limit of Rs. 3.0 lakh for fisheries activities and the new cardholders will have a credit limit of Rs. 2.0 lakh, exclusively for fisheries. Under the scheme, interest subvention is made available for animal husbandry and fisheries farmers @ 2.0 percent per annum at the time of disbursal of loan and additional interest subvention @ 3.0 percent per annum in case of prompt repayment as Prompt Repayment Incentive.

(ix) Promotion of deep sea fisheries

The potential contribution of marine resources to future growth and prosperity has been recognized at the highest levels in the Government in India. Marine fisheries are a major source of employment and food security for more than one million coastal fishermen and households, who also generate further multiplier employment in ancillary activities and fish processing and marketing.

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India's Exclusive Economic Zone or EEZ (2.02 million sq. km) contains diverse and multi-species fish stocks, exploited by multi-gear fisheries, which are mostly concentrated in coastal areas (<100m depth). The fishing fleet structure mainly comprises 24 percent mechanized vessels, 52 percent motorized vessels and 25 percent non-motorized vessels, operating from 1,547 landing centers located in the 9 coastal States, 2 UTs and the 2 Island groups.

The potential of tuna fishery resources in the Indian EEZ is estimated as 2,30,832 tonnes [consisting yellowfin tuna 83,500 t and skipjack tuna 99,500 t]. Against this potential, the catch of oceanic tunas in 2018 was 74,486 t (comprising 37,488 t of yellowfin tuna and 36,387 t of skipjack tuna). It indicates that only about 40 percent of the oceanic tuna resources of the EEZ are being utilized. Besides, there is scope for utilization of resources in the high seas beyond the EEZ, which are shared resources and available to the country. Therefore, it is essential to optimally harness deep-sea and oceanic resources, especially the tuna resources in the EEZ and high seas which fetch high value in the international market. Given the sub-optimal level of harnessing of tunas and other deep-sea fisheries resources in the EEZ and the high seas, support under PMMSY is provided to traditional fishermen for acquiring deep-sea fishing vessels, promotion of technologically advanced resource-specific fishing vessels and fishing gear through the State/UT Governments. Training and capacity building for undertaking deep-sea fishing is also supported under PMMSY.

(x) Strategy for promotion of entrepreneur models

The PMMSY encompasses a wide array of interventions/ activities aiming towards achieving ambitious targets of fish production and productivity, doubling of exports, generation of large- scale employment opportunities, doubling of fishers' and fish farmers' income, post-harvest infrastructure and management, addressing critical gaps in quality, technology, and modernisation and strengthening of the value chain, traceability, and establishing a robust fisheries management framework and fishers' welfare. Such integrated projects are implemented as entrepreneur/business models and fisheries entrepreneurs may be promoted as 'Aquapreneurs'. In the implementation of PMMSY, the private sector participation, wherever appropriate and feasible, is encouraged including in the operation and management of assets created under PMMSY in order to leverage the resources, expertise and efficiencies of the private sector. Encouragement to private investment and facilitation of growth of entrepreneurship in the fisheries sector is one of the key anticipated outcomes of PMMSY.

The PMMSY also considers the feasibility of contract farming and buy-back arrangements wherever appropriate and feasible, with a view to reducing the risk of price fluctuation, stabilizing fish farmers' incomes and ensuring an assured market for the producer as well as better quality products for the fish marketing firms and consumers. Establishment of Fisheries Incubation Centers (FICs) would be supported under PMMSY in Government as well as the private sector. They would be managed through the State/ Central Government entities including the National Fisheries Development Board (NFDB) and/or through professional private firms/agencies. The FICs would provide opportunities to young professionals/entrepreneurs, fisheries institutes, fisheries researchers, cooperatives/federations, progressive fish farmers, fisheries-based industries and other entities to showcase their innovations and innovative ideas, technologies in fisheries and commercialize them for the benefit of fishers/ fish farmers. This would also help in creating new businesses opportunities, development of entrepreneurs (aquapreneurs) and employment generation in the sector.

A key point of advantage of the entrepreneur model is that it allows for suitable integration and convergence and can be packaged with requisite forward and backward linkages and rolled out as coherent viable business models that would seamlessly integrate production chains with post-harvest, marketing and trade and amplify outcomes. The major objectives are to (i) attract enhanced private investment in fisheries and aquaculture, (ii) enhance production, productivity and profitability across the value chain by achieving economies of scale, encouraging technology uptake and addressing value chain gaps, (iii) foster linkages among producers, aggregators, processors and exporters for better price realization and enhanced incomes, (iv) generate sustainable employment and livelihood opportunities, especially among youth and women in rural and semi-urban areas,

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A shrimp haul.

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Aerators in a shrimp pond.

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Blue Marlin – Longliner of Fishery Survey of India.

(v) leverage the existing knowledge capital and expand into newer and untapped markets, and (vi) create an ecosystem for the growth of entrepreneurship in the fisheries and aquaculture sector. Eligible beneficiaries include individual entrepreneurs and private firms, fishers, fish farmers, fish workers and fish vendors, SHGs/ Fisheries Cooperatives/JLGs/ Fish Farmers' Producer Organizations/Companies (FFPOs/Cs).

(xi) Formation and operation of FFPOs

The PMMSY envisages for setting up of 500 Fish Farmers Producer Organisation (FFPOs) so as to ensure economies of scale for fish farmers in the country. Supported with 100 percent central funding, the objective is to create an FFPO movement in the country for the fisheries sector, with an expectation that over a period of five years (2020-21 to 2024-25), progressive small and marginal fish farmers and all deep sea fishers will eventually be a part of this movement. For the purpose of creation and operation of FFPOs, it is proposed to take up this programme in 17 States namely Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Odisha, Tamil Nadu, Kerala, Tripura, Mizoram, Maharashtra, Manipur, Uttar Pradesh and West Bengal. The indicative activities for the FFPOs/ Company are (i) procurement of inputs (fish seed/feed/ construction material), (ii) pond culture/cage culture/pen culture/RAS/Raceways/Biofloc (for both marine and inland), (iii) dissemination of technology, (iv) innovative fisheries activities, (v) primary processing, (vi) product branding, (vii) development of fish and fishery products/by-products, (viii) quality control, (ix) cold chain development, (x) packaging/ levelling/standardisation, (xi) export, (xii) any other fisheries-related activity that would be suitable for undertaking by the FFPOs/Companies.

(xii) Fisheries and Aquaculture Infrastructure Development Fund (FIDF)

In order to address the infrastructure requirements for the fisheries sector, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying during 2018-19 created the Fisheries and Aquaculture Infrastructure Development Fund (FIDF), a dedicated fund with a total corpus of Rs 7,522.48 crore. The FIDF provides concessional finance to the Eligible Entities (EEs), including State Governments/ UTs and other State entities for the development of identified fisheries infrastructure facilities through Nodal Loaning Entities (NLEs) namely (i) National Bank for Agriculture and Rural Development (NABARD), (ii) National Cooperative Development Corporation (NCDC) and (iii) All scheduled Banks. Under the FIDF, the Department of Fisheries provides interest subvention up to 3 percent per annum for providing the concessional finance by the NLEs at the interest rate not lower than 5 percent per annum. Loan lending period under FIDF is five years from 2018-19 to 2022-23 and the maximum repayment period is of 12 years, including a moratorium of 2 years on repayment of principal.

(xiii) National Surveillance Programme for Aquatic Animal Diseases (NSPAAD)

The National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) was initiated in April 2013 for the purpose

of monitoring and control of the spread of diseases of national and international concern, which has become a primary requirement for effective health management and ultimately for sustainable aquaculture. This programme is also aimed at providing scientifically accurate and cost-effective information for assessing and managing risks of pathogen transfer associated with trade in aquatic animals and improving production efficiency and in rapid detection of new and exotic infectious diseases through advanced diagnostic techniques. It would help in certifying freedom from diseases of concern within a defined geographical area or a specific population and give a boost to our aquatic animal exports. With financial assistance from NFDB, NSPAAD is being implemented in a network mode through the involvement of 29 collaborating institutes in the country that include ICAR Fisheries Institutes, Colleges of Fisheries, State Fisheries Departments and other relevant collaborating partners.

(xiv) Directorate of Aquatic Animal Health and Quarantine (DAAHQ)

Based on the recommendation of the National Farmers' Commission to strengthen the bio-security in livestock and marine sectors, a new sub-component of setting up of Aquatic Animal Quarantine (AAQ) Units and Disease Diagnostic Laboratories was introduced under the component of the Directorate of Animal Health of the Central Sector Scheme on Animal Quarantine and Certification Services in the XIth Five-year Plan. Under this sub-component, it was initially envisaged to set up one AAQ Unit each on the East Coast (Chennai) and West Coast (Mumbai) with a coordinating unit at the Headquarters in New Delhi. It was also proposed to establish Disease Diagnostic Laboratory as an integral part of each AAQ Unit with necessary staff and equipment. The said set up is now proposed to be established as the Directorate of Aquatic Animal Health & Quarantine (DAAHQ) in the

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Department of Fisheries under the Central Scheme on Blue Revolution. The first AAQ Unit and a Disease Diagnostic Centre (DDL) is being set up at Padappai in the Kanchipuram District of Tamil Nadu, Chennai. Site selection for another unit in Maharashtra is in progress.

(xv) National Fisheries Policy, 2021

The draft National Fisheries Policy (NFP), 2021, presently under finalization is the first attempt in the country to formulate a comprehensive policy for all the sub-sectors and offers to consolidate the sectoral gains and ensure sustainable growth through policy support in order to enable and accelerate fisheries development in a responsible and inclusive manner. The NFP focusses on multi-pronged strategies and focused interventions to provide the requisite impetus for realizing the full potential of the sector. It encompasses production and management aspects in marine and inland fisheries, aquaculture, fisheries value chain, trade, social security net and international cooperation in the sector. The major outcomes through the NFP would be towards enhancement of production and productivity in a sustainable manner; cooperation among various stakeholders as well as States and Center; strengthening of fisheries infrastructure facilities; empowerment of fishers, farmers and fish workers; doubling of farmers' income, etc.

(xvi) World Bank Project on Blue Revolution

The Department of Fisheies has submitted a World Bank Project to the Department of Economic Affairs (DEA) on 'Blue Revolution: Harnessing the Potential of Aquatic Resources' at a total cost of Rs. 12,861 crores (USD 1978 million) out of which World Bank has agreed to fund its share of Rs. 3,250 crores (USD 500 million). The project duration will be five years and the activities under the Project have been identified with clear indicators.

The Project has three different components. ***Component 1*** has three sub-components *viz.* (i) National Fisheries Digital Platform for augmented financial access and gradual formalization of fish workers and fisheries sector enterprises through the establishment of a national digital platform and mobile apps for self-registration and verification, etc., (ii) Facilitating access of individual fish workers and micro and small fisheries sector enterprises to Government's Programs for working capital financing through the mobilization of local functionaries, fisher cooperatives, industry and traders' associations; handholding micro and small fisheries enterprises to prepare bankable proposals, etc., and (iii) Facilitating adoption and coverage of insurance in Fisheries Sector through (a) regulatory directions making insurance for 'consequent loss' mandatory for relatively large (>4ha) shrimp farms and all shrimp processing units; (b) develop eligibility and performance criteria for smaller shrimp and other aquaculture farms to receive grants against insurance premium; (c) dialogue with the insurance industry on the implementation of self-reporting procedures by the farms adopting insurance and verification by random inspections; and (e) disbursement of grants based on verification of performances.

Component 2 has 4 sub-components *viz.* (i) Advocacy and promotion through (a) evidence-based advocacy among stakeholders involved in the supply chain and facilitators such as the insurance industry and banks to promote the idea of safe fish and fish products for domestic consumers; (ii) Establishment of Urban Retail Chains (to expand the domestic consumption for safe fish and fish products), to drive the 'safety, hygiene and traceability' agenda in the entire value/supply chain by consumer demand for safe fish, and to create productive jobs, (iii) Promoting circular economy in fisheries supply chain, (to use fish wastes, usually 30% of the weight of fish) by providing support in the form of credit guarantees, viability gap financing and performance incentives, depending on the nature of business proposals, and based on compliance to performance standards; and (iv) New value chains and diversification (promoting new value chains of seaweed mariculture and ornamental fishery and cold water fisheries) to start with to create new jobs for women and other vulnerable fish workers using an 'enterprise model.'

Component 3 has 4 sub-components *viz.* (i) Establishing Traceability Systems and Residue Monitoring; (ii) Knowledge Provision Services; (iii) Communication and Branding; and (iv) Project Management, Monitoring and Reporting.

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Salient Features of the Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Fisheries and aquaculture are an important source of food, nutrition, employment and income in India. Fish being an affordable and rich source of animal protein and omega 3-fatty acids is one of the healthiest options to mitigate hunger and malnutrition. Fisheries sector in India provides livelihood to more than 28 million fishers and fish farmers directly and millions more along the value chain. From *tunas* in the Indian ocean to the *trouts* in Himalayas, from *seaweeds* in Tamil Nadu to *shrimps* in Andhra Pradesh, from *karimeen* in Kerala to *ilish* in West Bengal, India produces a variety of fish.

Fisheries sector in India offers several strengths such as high growth rate, vast and diverse resources, multiple commercial species, low investment with high returns, low gestation period, skilled workforce, strong technical backup – R&D, huge consumer base, urban and young population, export opportunities and robust policy support. The sector has immense potential to double the fishers and fish farmers' incomes as envisioned by the Government and usher in economic prosperity.

In recent years, the sector has shown impressive growth with an average annual growth rate of 10.88 percent (2014-15 to 2018-19) and the fish production has registered an average annual growth of 7.53 percent during the same period. The Gross Value Added (GVA) of fisheries sector in the national economy during 2018-19 stood at Rs 2,129.15 billion (current prices) which constituted 1.24 percent of the total National GVA and 7.28 percent share of Agricultural GVA. Today, globally, India is the 2nd largest aquaculture producing nation, largest cultured shrimp producing and exporting nation and 4th largest fish exporting nation in the world. India's marine products exports stood 1.39 million tonnes and valued at a record Rs. 465.89 billion (USD 6.73 billion) during 2018-19 with an average annual growth rate of about 10 percent in recent years. About 18 percent of agricultural exports of India are fish and fish products. The gains of India's fisheries sector are due to collaborative and concerted efforts of both Central and State Governments and a vibrant private sector. The rapid growth of aquaculture, especially shrimp sector, in the last one decade is one of the finest examples of the contributions of private sector around the fulcrum of robust governmental policies and programmes.

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Skipjack tuna.

The Sector offers huge investment opportunities in fish farming in fresh/saline/brackishwater, reservoir cage cultivation, mariculture-sea cage farming, seaweed farming and value addition, ornamental fisheries, bivalve farming, technology-based aquaculture, nucleus breeding centers, broodstock multiplication centres, brood banks and seed banks, hatcheries, aquaculture inputs, contract farming and buy back arrangements, feed manufacturing, cage fabrication, infrastructure for re-circulatory aquaculture systems/bio-floc, value chain, hygienic handling in harbours

and landing centres, cold chain including cold storage, ice plants and refrigerated transport, processing infrastructure, modern markets, value addition units, distribution chains, opportunities in subsidiary industry such as boat building yards, engine and motors, gear manufacturing, communication devices, safety appliances, aquaria manufacturing, aerators, buoys and sinks, etc.

Recognizing the importance of fisheries to the economy of the country, for focused and holistic development of the sector with socio-economic wellbeing of fishers, fish farmers and fish workers at the core, the Union Cabinet in its meeting held on 20th May, 2020 approved the "Pradhan Mantri Matsya Sampada Yojana (PMMSY) - A scheme to bring about Blue Revolution through sustainable and responsible development of fisheries sector in India" as a part of *Athmanirbhar Bharat* relief package at an investment of Rs. 200.50 billion comprising (a) Central share of Rs. 94.07 billion, (b) State share of Rs. 48.80 billion and (c) Beneficiaries share of Rs. 57.63 billion. PMMSY happens to be the highest ever investment in the history of India's fisheries sector.

The PMMSY has been approved as an umbrella scheme with two separate components namely (a) Central Sector Scheme (CS) and (b) Centrally Sponsored Scheme (CSS). The CSS component is further segregated into non-beneficiary oriented and beneficiary orientated sub-components/activities under the following three broad heads:

a. Enhancement of Production and Productivity
b. Infrastructure and Post-Harvest Management
c. Fisheries Management and Regulatory Framework

The scheme intends to address critical gaps in fish production and productivity, quality, technology, post-harvest infrastructure and management, modernisation and strengthening of value chain, traceability, establishing a robust fisheries management framework and fishers' welfare.

Aims and Objectives:

a. Harnessing of fisheries potential in a sustainable, responsible, inclusive and equitable manner;
b. Enhancing of fish production and productivity through expansion, intensification, diversification and productive utilization of land and water;
c. Modernizing and strengthening of value chain - post-harvest management and quality improvement;
d. Doubling fishers and fish farmers' incomes and generation of employment;
e. Enhancing contribution to Agriculture GVA and exports;
f. Social, physical and economic security for fishers and fish farmers; and
g. Robust fisheries management and regulatory framework. The PMMSY would focus on sustainable and responsible development of the sector through an array of diverse interventions along the fisheries value chain from production to consumption. The Scheme envisages to add an additional fish production of 7.0 million tonnes by 2024-25, enhance aquaculture productivity from the present national average of 3 tonnes to 5 tonnes per hectare, reduce post-harvest losses from 25 percent to around 10 percent, generate about 5.5 million direct and indirect employment opportunities, ouble fisheries exports from Rs. 465.89 billion (2018-19) to Rs. 1,000 billion by 2024-25, enhance per capita fish consumption from the current 5-6 kg to 12 kg over the next five years, encourage private investment and facilitate growth of entrepreneurship in the fisheries sector.

Interventions under the PMMSY would be aimed at enhancing fish production and productivity, modernization and strengthening of the value chain, creation of fisheries infrastructure, post-harvest management and robust fisheries management and regulatory framework. Emphasis will be laid on addressing the critical gaps, infusion of technology and water management aimed at *'more crop per drop'*, improving quality and hygiene in fish and fish products, value addition, marketing and promotion and initiatives aimed at enhancing stakeholders' economic returns. Thrust would be given for sustainability, standards and end to end traceability from *'catch to consumer',* enhancement of fisheries export competitiveness and a robust fisheries management and regulatory framework.

The scheme would create a conducive environment for private sector participation, development of entrepreneurship,

promotion of ease of doing business, encouraging innovations etc. in fisheries sector. Promotion of startups in fisheries and aquaculture, incubation centers, river and sea ranching, entrepreneur models are some of the pioneering approaches envisaged under PMMSY.

While implementing PMMSY, to the extent possible, 'cluster or area-based approaches' will be adopted in order to enhance the competitiveness of the fisheries sector, facilitate economies of scale, generate higher incomes, accelerate growth and expansion of the sector in an organized manner, amplify outcomes, etc. Potential growth clusters/areas for development of fisheries and aquaculture will be identified and will be developed as an integrated cluster with requisite interventions/activities, forward and backward linkages and with facilities for quality brood, seed and feed, critical infrastructure, processing and marketing networks, etc.

A haul of seabass from a farmer's pond.

Thrust will be given on water management, spatial planning, new and emerging technologies like Recirculatory Aquaculture Systems, Biofloc, aquaponics, marine and reservoir cage cultivation, and productive utilization of land and water for aquaculture including promotion of aquaculture in alkaline and saline areas. Focused fisheries development in J&K, Ladakh, Islands, Northeast, and Aspirational Districts through area-specific strategic development planning based on local needs is envisaged. For addressing diseases, antibiotics and residues issues, aquatic health management is given focus under PMMSY supported by an Integrated Laboratory Network.

Large-scale promotion of aquaculture in northern India, especially in alkaline and saline areas is a focus area under PMMSY for which adequate resources would be earmarked. Species diversification, promotion of high value species like seabass, scampi, mud crab and thrust on *Penaeus indius* (shrimp) farming, including establishing a national network of brood banks for commercially important species is envisaged.

The PMMSY includes a range of new activities such as a) Genetic improvement of commercially important fish species and establishing Nucleus Breeding Center for self-reliance in shrimp brood stock; b) Development of coastal fisher communities in a holistic manner through integrated modern fishing villages with necessary infrastructure; c) Promotion of startups and incubation centers in fisheries and aquaculture; d) Collectivization of fishers and fish farmers through Fish Farmer Producer Organizations to increase bargaining power of fishers and fish farmers; e) Promotion of organic aquaculture and certification; f) Development of aquaparks as hub of fisheries and aquaculture activities as one stop 'parks' with assured, affordable, quality inputs under one roof, post-harvest infrastructure facilities, business enterprise zones, logistic support, business incubation centers, marketing facilities, etc.; g) Insurance coverage for fishing vessels; h) Promotion of good aquaculture practices, use of 'Block Chain Technology', encouraging global standards and certification, accreditation of broodbanks, hatcheries, farms, etc.; i) Enhanced insurance cover for fishers, fish farmers, fish workers and those associated directly with fisheries sector; i) Well-structured extension support services to engage youth in fisheries extension; j) Creation of 3477 *Sagar Mitras* in

Ornamentals, a good source of livelihoods, revenue and recreation.

coastal fisher villages as a link between fishers and government; k) Fitment of bio-toilets in mechanized fishing vessels- *Swachh Sagar;* l) A national platform for E-marketing and E-trading of Fish; m) Support for acquisition of technologically advanced fishing vessels; n) State-of-the-art wholesale fish markets; o) Upgradation of fishing vessels for improving the export competitiveness; and p) Ornamental fisheries and seaweed cultivation which have huge employment generation and export potential, etc. Major investments are also proposed for construction and strengthening of Fishing Harbours and Fish Landing Centers for hygienic handling of fish, reduction of post-harvest losses and higher value realization, etc. Reforms in their management and operations would be a focus area.

In financial terms, investments to the tune of Rs 36,330 million will be made on inland fisheries and aquaculture development, including the northeast and Himalayan States and the UTs; Rs 12,360 million investments will be on technology-RAS, Biofloc, pen culture and reservoir cages; Rs 13,500 million investments will be on providing livelihood support to fisher families annually during fish ban/lean period; Rs 4,380 million investments will be on aquatic quarantine facilities, laboratory network, and disease monitoring to safeguard from disease and quality checking for antibiotic residues; Rs 6,000 million investments will be on aquaparks; Rs 6,360 million investments will be on marine cage culture; Rs 16,060 million investments will be on deep sea fishing for empowering traditional fishers; Rs 6,400 million investments will be on seaweed cultivation; Rs 5,760 million investments will be on ornamental fisheries; Rs 35,000 million investments will be on Fishing Harbours and Fish Landing Centres which would be further enhanced by dovetailing with Sagarmala Scheme of the Ministry of Shipping; Rs 14,000 million investments will be on post-harvest and cold chain; Rs 10,000 million investments will be made on fish markets and marketing infrastructure; Rs 7,500 million investments will be made on the development of integrated modern coastal fishing villages; Rs 14,000 million investments will be made on post-harvest and cold chain; and Rs 4,440 million investments will be made on safety and security of fishermen at sea, including safety kits, boats and nets, etc.

The PMMSY will focus on strengthening and deepening the domestic markets with special attention to improved urban marketing for ensuring seamless supply of quality and varied products right from live fish to processed and value-added fish to consumers as well as ensuring higher returns to the entrepreneurs, fishers and aqua farmers. Under PMMSY, entrepreneur models, branding and promotion of fish in domestic markets on the lines of egg will be given emphasis.

In order to consolidate the outcomes and save public resources, PMMSY envisages suitable linkages and convergence with various Central government schemes wherever feasible. Some of the identified central schemes for linkages and convergence envisaged under PMMSY with the schemes/sub-schemes being undertaken by Ministries/Departments include the following:

Sagarmala Programme of the Ministry of Shipping for fishing harbours/fish landing centers and any other admissible activities.

a. Pradhan Mantri Kisan Sampada Yojana of the Ministry of Food Processing Industries for post-harvest and cold chain facilities, etc.

b. Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) for pond construction and water bodies development.

c. Rashtriya Krishi Vikas Yojana and other schemes of the Ministry of Agriculture and Farmers Welfare for pond construction and other admissible activities.

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Eyed ova.

d. National Rural Livelihoods Mission for admissible activities and marketing.

e. Schemes of the Department of Commerce for modernization/construction of fishing harbours and other admissible activities, promotion and doubling of fisheries exports, certification, traceability, branding, etc. in association with MPEDA.

f. Kisan Credit Card (KCC) of the Ministry of Agriculture and Farmers Welfare to meet the working capital requirement of fishers and fish farmers for production and productivity related activities.

g. Promotion of Fish Farmers Producer Organizations/ Companies (FFPOs/Cs) through PMMSY and Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare wherever possible, to economically empower the fishers and fish farmers and enhance their bargaining power.

h. Technology demonstration, genetic improvement and Nucleus Breeding Centers in collaboration with the Department of Agricultural Research and Education (DARE) and the Department of Commerce (MPEDA).

i. Ministry of Earth Sciences – Indian National Center for Ocean Information Services (INCOIS) for Potential Fishing Zones (PFZ) advisories and devices.

j. Ministry of Home – Border Management for coastal security, Monitoring Control and Surveillance (MCS) related activities, including Biometric cards, etc.

k. Department of Space – ISRO for MCS activities including satellite-based communication and/or tracking devices such as transponders.

l. Ministry of Jal Shakti – various issues concerning water management and utilization.

The PMMSY fully recognizes the role of the States/Union Territories for effective implementation and optimal outcomes. While majority of the activities under the Scheme would be implemented in partnership with States/UTs, in some of the key areas of national importance, the entire funds would be borne by the Central Government.

Unlike Blue Revolution, for the first time under PMMSY, a well-structured 'Implementation Framework' would be created for effective implementation right up to District and Sub-district levels by creation of institutional mechanisms. State Programming Units, District Programme Units and

The intended beneficiaries under the PMMSY are:

- **Fishers**
- **Fish Farmers**
- **Fish Workers and Fish Vendors**
- **Fisheries Development Corporations**
- **Self Help Groups (SHGs)/Joint Liability Groups (JLGs) in fisheries sector**
- **Fisheries Cooperatives**
- **Fisheries Federations**
- **Entrepreneurs and Private Firms**
- **Fish Farmers Producer Organisations (FFFPOs)/Companies**
- **SCs/STs/Women/Differently Abled Persons**

Sub-district Programme Units would be created in some of the high fisheries potential districts based on a set of parameters. It is expected that these arrangements would give the much-needed focused attention and a mission mode direction to PMMSY.

The PMMSY envisages development of Fisheries Management Plans and Integrated District Fisheries Development Plans under the leadership of District Collector/Deputy Commissioner through a District Level Committee, which will be consolidated at the State/UT-level into State Fisheries Development Plans, for effective planning; optimal utilization of resources and integrating with other schemes and programmes.

Enhancing exports to Rs 1,000 billion by 2024-25 is one of the key objectives of PMMSY. Towards this end, focus will be given under PMMSY for species diversification, value addition, infrastructure creation and modernization, end to end traceability, brand promotion, certification, etc. in close collaboration with MPEDA.

The PMMSY envisages an activity-wise minimum assured financial allocation with clear quantifiable physical targets. This gives an assured investment in key sub-sectors unlike the thin and wide spread of financial resources under the earlier scheme on Blue Revolution.

Promotion of good aquaculture practices, end to end traceability from 'catch to consumer', use of Block Chain Technology, Global Standards and Certification, Accreditation of Brood Banks, Hatcheries, Farms, etc. are incorporated as a part of the scheme for the first time. These steps will ensure quality, higher productivity, improve export competitiveness and fetch higher prices to fishers and farmers.

Funding Pattern: PMMSY will be implemented with the following funding pattern.

Central Sector Scheme (CS)

a. The entire project/unit cost will be borne by the Central Government (*i.e.* 100% central funding).

b. Wherever direct beneficiary-oriented *i.e.* individual/ group activities are undertaken by the entities of Central Government including NFDB, the central assistance will be up to 40 percent of the unit/project cost for General category and 60 percent for SC/ST/ Women category.

Centrally Sponsored Scheme (CSS)

The funding pattern for the CSS component of PMMSY are on the lines of existing funding pattern of the CSS-Blue Revolution-Integrated Development and Management of Fisheries implemented by the Department of Fisheries.

The CSS component and sub-components implemented by the States/UTs (**Non-beneficiary oriented**): The entire project/unit cost will be shared between the Centre and the States as detailed below:

a. North-eastern & Himalayan States: 90 percent Central share and 10 percent State share.

b. Other States: 60 percent Central share and 40 percent State share.

c. Union Territories (with legislature and without legislature): 100 percent Central share.

The CSS component and sub-components implemented by the States/UTs (**Beneficiary oriented *i.e.* individual/group activities**). The Government financial assistance of both Centre and State/UTs Governments together will be limited to 40 percent of the project/unit cost for General category and 60 percent of the project/unit cost for SC/ST/Women. This assistance will in turn be shared between the Centre and State/UTs in the following ratio:

a. The North-eastern & Himalayan States: 90 percent Central share and 10 percent State share.

b. Other States: 60 percent Central share and 40 percent State share.

c. Union Territories (with legislature and without legislature): 100 percent Central share.

* * *

Fresh fish and seafood arrangement on a black granite.

The Making of this Book

Woman with fish, a stone carving on a 7th Century historical temple in Karnataka.

8.0 The Making of this Book

The idea of tracing the developmental history of Indian fisheries and presenting it as a story in a lucid and illustrative manner came to me as soon as I took over as Secretary of the newly created Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. The proposal was discussed with Dr. Yugraj Singh Yadava, Director, Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) and my colleagues in the Department, Dr. J Balaji, Joint Secretary (Marine Fisheries) and Mr. Sagar Mehra, Joint Secretary (Inland Fisheries) and then the task of documenting the long and interesting saga of Indian fisheries, spanning more than three centuries was initiated.

The key information for this story came from the rich archives of the Department of Fisheries, Government of Tamil Nadu and the reports of the former Planning Commission of the Government of India, providing the chronological history of planning and developing the fisheries sector in the pre and post-Independent India. Interestingly, in the days of the Raj, Madras Presidency was the focus of fisheries activities and many pioneering works were carried out in the Presidency that covered documentation of the resources, initiating surveys and the exploitation of fisheries, the introduction of exotic fish species for farming and building conservation frameworks. The Reports of the Planning Commission are a history in themselves and it became easy for us to pick up the activities that transformed Indian fisheries from a subsistence avocation to an enterprise that today rubs shoulders with the most advanced fisheries and aquaculture in the world.

The BOBP-IGO's Library, a repository of valuable documents of yesteryears, also served as a valuable source of information. And Dr. Yadava, who is a witness to the developments that shaped the Indian fisheries sector during the last 45 years, provided valuable insights from his extensive engagements in a variety of activities in the sector, ranging from the first blue revolution in aquaculture in the late seventies to the most recent contributions of the Pacific whiteleg shrimp in coastal aquaculture. Statistics, though kept to a minimum, were obtained from different Government Organisations as also from the Food and Agriculture Organization of the United Nations.

Dr. Balaji and Mr. Sagar Mehra provided valuable details on the Pradhan Mantri Matsya Sampada Yojana (PMMSY) and also offered critical inputs at the draft stages that helped in bringing the book to this shape.

The photos in this book are the 'icing on the cake'. They make the journey of Indian fisheries interesting and inspiring. Sourced from the archives of the BOBP-IGO, iStock and contributed by the Fisheries Research Institutions in the country, the photos are a story in themselves. They vividly elucidate the diversity of fisheries and aquaculture of India, the variety of fin and shellfish species that are harvested from the wild or raised in the ponds and the lovely men and women who toil to bring fish to our plates. Many of the natural resources that provide fish are also deeply ingrained in the social and cultural milieu of the country and nothing else but the photos could only depict that eternal link with society.

As writers of this book, we are happy that the idea we progressed has taken the shape of this lovely document, bringing out the interesting facets of a sector which not only reflects on its glorious past of three centuries but is also poised to contribute to the Indian economy in the years to come.

Dr. Rajeev Ranjan, IAS

Dr. Yugraj Singh Yadava

Public ferries on Brahmaputra river carrying passengers from Majuli Island, Jorhat, Assam.

Acknowledgements

9.0 Acknowledgements

Data and information used in this book is collected from various agencies and individuals. Their contribution is thankfully acknowledged.

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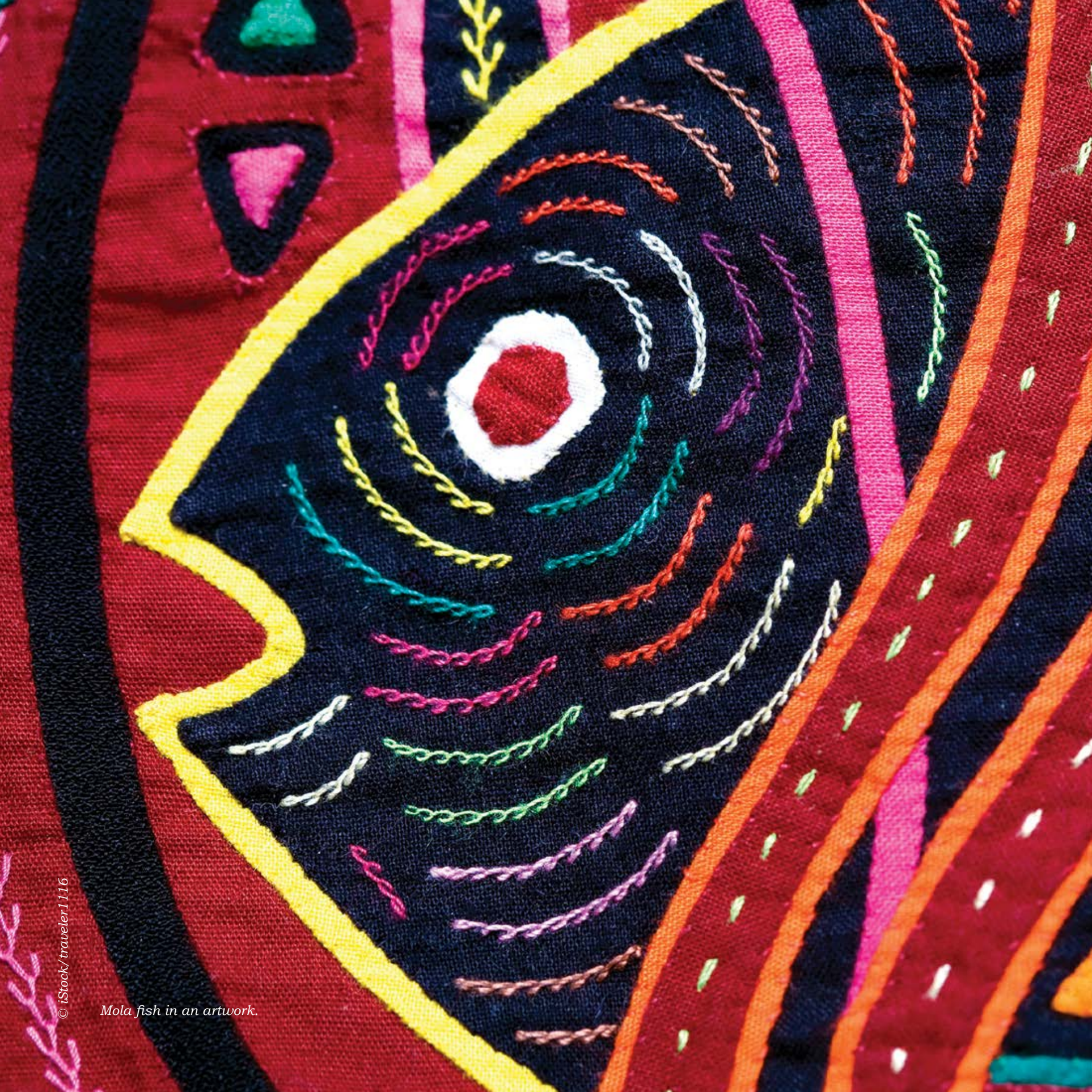

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Mola fish in an artwork.

Woman using a coracle for fishing, Mysore, Karnataka.

Dr. Rajeev Ranjan, IAS earlier served as Secretary (Fisheries), Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, a newly formed Department for ensuring sustainable and holistic development of the fisheries sector in India. With a vast experience of over 36 years in Government, Dr. Rajeev Ranjan has made significant contributions and has held many challenging and important assignments, particularly in the fields of developmental finance, commerce and industry. In his assignments with the Government of India, he has served as Special Secretary, Goods and Service Tax (GST) Council in the Department of Revenue, Ministry of Finance; as Director in the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry; and as Chief (Joint Secretary Level) in the National Manufacturing Competitiveness Council and prepared the 'National Strategy for manufacturing.' As Project-in-Charge, Dr. Rajeev Ranjan played a pivotal role in the modernization of Intellectual Property (IP) Offices in the country and also in bringing significant amendments to the Patent Act and revamping of the IP administration. Dr. Rajeev Ranjan is currently Chairman and Managing Director, Tamil Nadu Newsprint and Papers Limited (TNPL) and has served as Chief Secretary and as Vigilance Commissioner and in various other important roles in the Government of Tamil Nadu. Dr. Rajeev Ranjan's passion lies in catalysing reforms and bringing in systematic changes in organizations and improving systems and governance.

Dr. Yugraj Singh Yadava heads the Bay of Bengal Programme Inter-Governmental Organisation. With a career spanning 45 years, Dr. Yadava in his initial service worked as a Fisheries Scientist with the Indian Council of Agricultural Research. In 1994 he took over as the Fisheries Development Commissioner to the Government of India and in August 2000 moved to the Bay of Bengal Programme of the Food and Agriculture Organization of the United Nations, which later became an Inter-Governmental Organisation. Concurrently with his key assignments, he also served as Member Secretary of the Aquaculture Authority/Coastal Aquaculture Authority. Dr. Yadava's research and developmental works inter alia include pioneering studies on the large rivers and their floodplains; promoting small-scale fisheries and aquaculture, in particular, the revival of the brackishwater aquaculture; promoting the Code of Conduct for Responsible Fisheries in the South Asian region; and building the resilience of small-scale fisher communities to combat the vagaries of the sea and climate-induced changes in the Bay of Bengal region. Having worked in 10 countries in South and South-east Asia, his contributions to the global agenda on fisheries and aquaculture are equally impressive. He is presently also the Vice-chair of the global network of Regional Fisheries Bodies. A prolific writer and photographer, Dr. Yadava has about 150 publications and 50 000 photographs on fisheries and aquaculture from different parts of the world in his photo archives.

सत्यमेव जयते

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