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NITI Aayog

India's Blue Economy:

Strategy for Harnessing Deep-Sea and Offshore Fisheries

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MESSAGE

India's fisheries sector plays a pivotal role in the economy. India is the world's second-largest fish producer and its efforts contribute significantly to the global food system. With immense potential for growth, both domestically and internationally, fisheries have been recognised as a 'sunrise sector' poised to drive economic expansion. Strengthening this sector will not only meet rising global demand but also empower millions of fishers, fostering sustainable and inclusive growth.

India's deep-sea and offshore fisheries, in particular, hold vast untapped potential that can significantly enhance the sector's contribution to the economy. This report, *"India's Blue Economy: Strategy for Harnessing Deep-Sea & Offshore Fisheries"*, outlines a comprehensive roadmap for responsibly unlocking these resources in a balanced and scientific manner. It focusses on regulatory reforms, fleet modernisation and infrastructure upgradation, institutional strengthening and capacity building, financing mechanisms, environmental sustainability, and stakeholder inclusion and partnership. By tackling key challenges and leveraging emerging opportunities, the report aims to accelerate deep-sea fishing operations and contribute to the broader development of India's fisheries sector.

I congratulate the Agriculture and Allied Sectors Division of NITI Aayog for their efforts in preparing the report. I am confident that this timely and highly relevant document will serve as an invaluable resource for policy makers, fisherfolk and industry stakeholders, helping to drive the continued and sustained growth of India's fisheries sector.

Suman Bery

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सदस्य
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PREFACE

Fishery has emerged as the fastest growing economic activity in the primary sector for more than a decade now. As a result, its share in gross value added of agriculture and allied activities and primary sector has seen significant increase. What is more impressive is that share of fisheries in total GVA of the economy has also shown increase in the recent decade. Demand side factors strongly favour high growth in this sector.

Between the two segments of fishery, marine fishing in India has much lower growth despite a long history of marine fishing in the country which traditionally focused on coastal and inshore resources. The reasons for this are stressed coastal stocks on account of overfishing, habitat degradation and climate change. Thus, harnessing deep-sea resources becomes imperative for accelerating growth, meeting demand for marine fish and environmental sustainability.

Beyond the continental shelf, the deep waters extending past the 200 nautical miles boundary of the Exclusive Economic Zone (EEZ) hold untapped potential estimated at 7.16 million tonnes. Thus deep-sea and offshore fishing presents significant opportunity for expanding India's fisheries sector, reducing pressure on coastal fisheries and driving economic transformation in coastal communities.

Harnessing this potential requires a strategic approach that integrates advanced technologies, enhances fish productivity and strengthens value addition in the supply chain. Ensuring regulatory reforms, modernizing fleet and processing technologies, improving cold chain infrastructure will be crucial to enhance exports and increase fishers' incomes. Sustainable deep-sea fishing practices must be at the core in order to ensure ecological balance while unlocking the economic opportunities.

The report presents a "Blue Strategy Framework" designed to guide the sustainable utilization of deep-sea and offshore resources. It outlines a roadmap focused on improving governance, promoting sustainable deep-sea and offshore fisheries, fostering inclusive participation of small fishers, modernizing the sector, and mobilizing resources and finances through well-articulated policy recommendations. By fostering innovation, encouraging investment and strengthening institutional mechanisms, India is well positioned to emerge as a leader in the Indian Ocean region, leveraging its rich marine heritage for long-term prosperity.

I congratulate the team of the Agriculture Technology Vertical of NITI Aayog for their efforts in developing this important document. I hope that it will serve as a crucial resource for policymakers, fishers, and industry stakeholders, offering insights into achieving a resilient and sustainable future for India's fisheries sector.

(Ramesh Chand)

Place : New Delhi
Date : July 08, 2025

बी. वी. आर. सुब्रह्मण्यम
B.V.R. Subrahmanyam
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FOREWORD

The fisheries sector has emerged as a crucial pillar in India's socio-economic growth, significantly contributing to food security, employment generation and export earnings. Over the past decade, the sector has witnessed robust growth, with an average growth of 9%, reinforcing its role in driving rural prosperity and coastal development. India's Exclusive Economic Zone (EEZ) of over 2 million sq.km, along with the deep waters beyond the continental shelf, presents vast opportunities for the sustainable harnessing of deep-sea and offshore fisheries. Recognizing this immense potential, the Government has prioritized a focused and holistic approach to fisheries development, placing the welfare of the fishermen and coastal communities at the core of its vision.

Spanning nine coastal states and four union territories, India's fisheries sector has evolved through policy reforms, technological advancements and targeted investments. Various Ease of Doing Business initiatives have been undertaken to streamline regulations, modernize infrastructure and enhance market access for the fishers. The efforts aim to promote responsible deep-sea fishing, diversify fish production and ensure long-term ecological sustainability.

Given the Government's emphasis on unlocking deep-sea fisheries potential, report entitled *"India's Blue Economy: Strategy for Harnessing Deep-Sea and Offshore Fisheries"* is timely and significant. It provides a strategic roadmap for sustainable harnessing of the untapped potential of India's deep-sea resources, focusing on regulatory reforms, fleet modernization and infrastructure upgradation, institutional strengthening and capacity building, financing mechanisms, environmental sustainability, and stakeholder inclusion and partnership. By aligning with global best practices and Sustainable Development Goals, this initiative will not only strengthen India's position in the global fisheries market but also enhance the livelihoods of millions of fishers and coastal communities.

I congratulate the Agriculture and Allied Sectors Division of NITI Aayog for preparing this highly relevant report. I am confident that this report will serve as a valuable guiding document for policy makers and industry stakeholders, paving the way for a resilient and sustainable future for India's fisheries sector.

Dated: 2nd July, 2025

[B.V.R. Subrahmanyam]

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July 9, 2025

Acknowledgement

Over the past decade, India's fisheries sector has experienced remarkable growth. It grew at an impressive annual rate of 9%, reflecting strong momentum. However, the vast potential of the Exclusive Economic Zone (EEZ) and beyond remains largely untapped. Recognizing this, the Union Budget 2025-26 identifies the fisheries sector as a 'sunrise sector' and proposes a framework for sustainable harnessing of fisheries from the Indian Exclusive Economic Zone (EEZ) and high seas, with a special focus on Lakshadweep and the Andaman & Nicobar Islands. This reaffirms the Government's commitment to strengthening the fisheries sector in India and improving the livelihood of coastal communities.

I am privileged to present the report titled *'India's Blue Economy: Strategy for Harnessing Deep-Sea and Offshore Fisheries'* to the nation, as it offers a transformative opportunity to sustainably harness untapped resources, boost economic growth, and improve the livelihoods of over 30 million fishers.

India has a vast coastline spanning 11,098 km, covering nine coastal states and four union territories. The country's EEZ extends over 2 million sq. km. Beyond the continental shelf, deep waters stretch beyond 200 nautical miles, offering significant potential for expansion. The EEZ holds an estimated 7.16 million tons of fishery resources, including high-value species such as tuna, billfish, and deep-sea shrimp. These resources offer immense potential for economic expansion and job creation. However, harnessing them requires a sustainable and responsible approach to prevent overexploitation and ensure the long-term health of marine ecosystems.

By promoting deep-sea and offshore fishing, the strategies outlined in the report aim to reduce pressure on coastal fisheries while creating new income-generating avenues for fishing communities. Investments in fleet modernization, infrastructure development, expanding market access, and providing skill development programs will empower fishers with better livelihoods and economic security. However, realizing these benefits requires addressing regulatory challenges, infrastructure gaps, technological constraints, and sustainability concerns, among others.

This report provides a roadmap to responsibly harness India's deep-sea and offshore fisheries potential, aligning with global best practices and Sustainable Development Goals (SDGs). It identifies six key policy interventions: i) overhauling policies and regulations; ii) strengthening institutional and capacity building; iii) modernizing fleets and upgrading infrastructure; iv) sustainable fisheries management; v) mobilizing resources and financing; and vi) fostering stakeholder inclusion and partnerships. It also outlines investment priorities and monitoring mechanisms necessary to ensure long-term ecological and economic sustainability.

Building on the sector's strong growth trajectory, the strategy offers a much-needed framework to strengthen governance, foster innovation, and enhance stakeholders' participation. Through targeted interventions in policy, infrastructure, sustainability, financing and community engagement, this initiative will help India emerge as a global leader in sustainable deep-sea fisheries as well as ensure inclusive growth for coastal communities.

I take this opportunity to express my sincere gratitude to Hon'ble Vice Chairman Shri Suman Bery, NITI Aayog, for his encouragement and support. I am deeply grateful to Shri B.V.R. Subrahmanyam, CEO, NITI Aayog, for his constant support and guidance in ensuring excellence in our work. I also

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extend my deep gratitude to Prof. Ramesh Chand, Hon'ble Member, for his valuable insights that helped refine the report. My heartfelt thanks to all the Members of NITI Aayog for their support and contributions.

I am also grateful to the State Support Mission, NITI Aayog, for providing funds for the following workshops: a) 'Harnessing the Potential of Fisheries in Marine States' was held on 5 January 2024, b) 'Harnessing the Potential of Fisheries in Inland States' held on 15-16 February 2024. It was through these workshops that the recommendation to undertake this study emerged. The study has ultimately culminated in the form of this report.

I would like to extend my deep appreciation to the collective and diligent efforts of the entire team of the Agriculture and Allied Sector Vertical involved in preparing this report.

The inputs from Dr. J.K. Jena, Deputy Director General (Fisheries Science), Indian Council of Agricultural Research (ICAR), have been particularly helpful to improve the proposed framework and strategies. Dr. U. Sreedhar, Principal Scientist and Head, Central Institute of Fisheries Technology (ICAR-CIFT), Vishakapatnam; Dr. Dineshbabu A.P., Principal Scientist and Head, Central Marine Fisheries Research Institute (ICAR-CMFRI), Kochi; Dr. Muktha M., Senior Scientist, ICAR-CMFRI, Vishakapatnam and Dr. Akhilesh K.V., Senior Scientist, ICAR-CMFRI, Vishakapatnam, have been gratefully acknowledged for their significant contributions to bring out this report.

The report has also greatly benefited from the critical comments and valuable suggestions of the distinguished reviewers from the Indian Council of Agricultural Research (ICAR), ICAR-CMFRI, Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO), Cochin Shipyard Ltd, Sustainable Seafood Network of India (SSNI), Indian National Centre for Ocean Information Services (INCOIS), Centre for Marine Living Resources & Ecology (CMLRE), Ministry of Earth Sciences, Security and Law Division, NITI Aayog. Additionally, I would like to thank the Fishery Resource Assessment, Economics and Extension Division (FRAEED), CIFT, Indian Coast Guard, National Security Council Secretariat, and National Centre for Sustainable Coastal Management for their critical inputs during the brainstorming sessions.

I extend my gratitude to the line ministries, especially the Ministry of Fisheries, Animal Husbandry & Dairying, the Ministry of Ports, Shipping and Waterways, the Ministry of Earth Sciences, and the Ministry of Commerce and Industry, for their valuable cooperation. I am particularly thankful to the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, for acknowledging this strategy report as a key input towards formulating an enabling framework for sustainable fisheries in the EEZ of India and the High Seas.

I thank Shri Yugal Joshi, Program Director, NITI Aayog and Ms. Keerti Tiwari, Director, Communication, NITI Aayog, for their thorough review and design of the report. Lastly, I would like to acknowledge the contributions of all other stakeholders who played a crucial role in shaping this report. I am confident that this report, with its comprehensive strategic roadmap, will serve as a guiding document to drive deep-sea and offshore fisheries development and contribute to the upward trajectory of India's fisheries sector.

(Dr. Neelam Patel)

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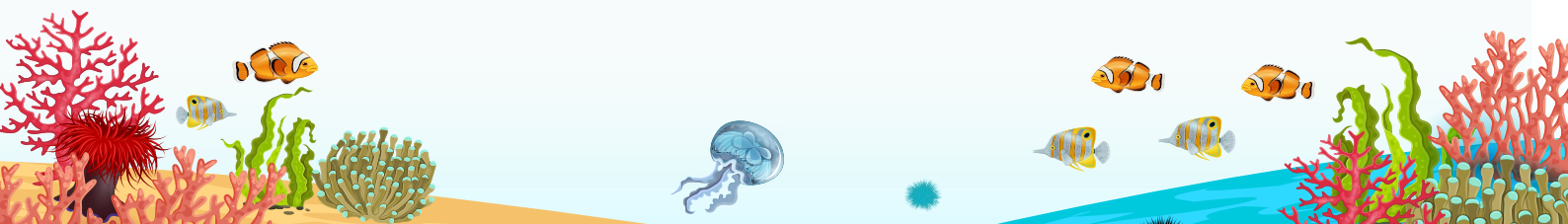

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ABNJ - Areas Beyond National Jurisdiction

CCAMLR - Convention for the Conservation of Antarctic Marine Living Resources

CIFT - Central Institute of Fisheries Technology

CMLRE - Centre for Marine Living Resources and Ecology

CMFRI - Central Marine Fisheries Research Institute

CPDAC - Coastal Protection Data Analysis Centre

EEZ - Exclusive Economic Zone

FAO - Food and Agriculture Organization (of the United Nations)

FFPO - Fish Farmer Producer Organization

FSI - Fishery Survey of India

GPS - Global Positioning System

ICG - Indian Coast Guard

INCOIS - Indian National Centre for Ocean Information Services

IOTC - Indian Ocean Tuna Commission

IUU - Illegal, Unreported and Unregulated

MoES- Ministry of Earth Sciences

MPEDA - Marine Products Export Development Authority

NFDB - National Fisheries Development Board

PMMSY - Pradhan Mantri Matsya Sampada Yojana

QMS - Quota Management System

RE - Revised Estimates

RFMO - Regional Fisheries Management Organization

SDG - Sustainable Development Goal

SHGs- Self Help Groups

SIOFA - Southern Indian Ocean Fisheries Agreement

UNCLOS - United Nations Convention on the Law of the Sea

VMS - Vessel Monitoring System

Executive summary

India has an extensive maritime area, with a coastline stretching over 11,098 km across nine coastal states and four union territories. The country has a long history of marine fishing with a focus traditionally on coastal and inshore resources. The thriving fisheries sector contributes significantly to the national economy (for instance, in 2023-24, export earnings from fish and fishery products were ₹ 60,523 crore, witnessing a 100% increase as against ₹ 30,213 crore in 2013-14). This sector supports the livelihoods of around 30 million people. However, the full potential of its deep-sea fishery resources remains largely unexploited.

The deep waters beyond the continental shelf, extending beyond the Exclusive Economic Zone (EEZ) boundary of 200 nautical miles (nmi), contain select high-value fish stocks, including tuna, billfish, and shrimp species. The EEZ potential is estimated at 7.16 million tonnes, including conventional and non-conventional resources (DADH, 2018). This suggests significant opportunities for expansion. However, these resources are vulnerable to overexploitation due to their slow growth rates and long lifespans.

Harnessing the deep-sea resources can boost India's fisheries sector, augment seafood exports, and generate new employment opportunities in coastal regions while reducing the fishing pressure on coastal fishery resources. Deeper waters present unique opportunities, but the associated management challenges are not adequately addressed. By addressing the multifaceted challenges and opportunities, the report aims to catalyze the growth of deep-sea and offshore fishing operations, thereby contributing to the overall development of the country's fisheries sector. It provides a comprehensive strategy roadmap for harnessing the untapped potential of India's deep-sea fishery resources in a sustainable and responsible manner.

The report aims to achieve the following objectives:

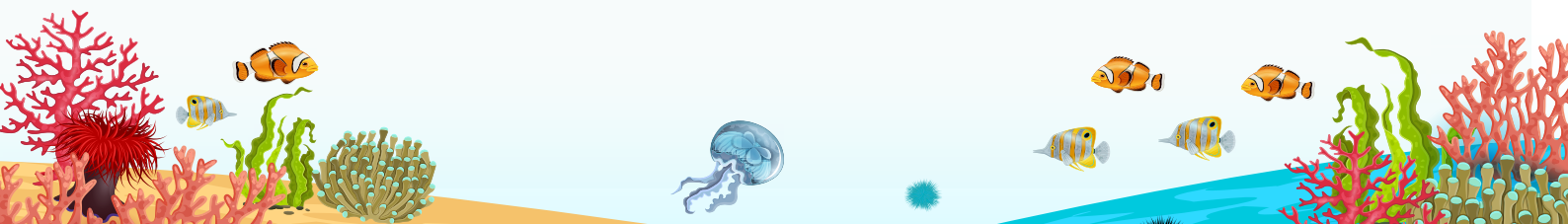
i. To assess the current status, techniques, and growth trends in India's deep-sea fishing sector, highlighting the existing gaps and untapped potential.

ii. To identify the critical infrastructure, technological, and sustainability challenges inhibiting India's growth and development of deep-sea fishing activities.

iii. To determine growth opportunities to be unlocked by harnessing the deep-sea fishery resources within the EEZ and international waters.

iv. To improve the socio-economic condition of resource users; foster participatory management; ensure equity; strengthen collaboration with regional fisheries organizations.

v. To recommend feasible policy interventions at the national and state levels to promote sustainable deep-sea fishing practices, addressing issues such as licensing, incentives, subsidies, and regulatory frameworks.



vi. To establish robust monitoring, control, surveillance, and enforcement mechanisms to ensure the long-term sustainability of deep-sea fish stocks and marine ecosystems.

vii. To examine global best practices in deep-sea fishing and sustainability measures that can be adopted in the Indian context, considering the unique challenges and opportunities.

viii. To develop a roadmap for investments and infrastructure development required to build India's deep-sea fishing capacity, including fleet modernisation, skill development, and post-harvest facilities.

The strategy report spans nine chapters, covering the deep-sea fishing sector both within the Indian EEZ and international waters accessible through regional fisheries agreements. The report aligns the development of the sector with the United Nations Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water), ensuring that the proposed policies and strategies contribute to the sustainable use of marine resources and the conservation of ocean ecosystems. The chapters include:

Chapter 1 provides the background and rationale for a dedicated deep sea and offshore fishing strategy in India.

Chapter 2 provides an overview of techniques, technologies, and vessels employed in global deep-sea and offshore fishing operations and their economic and sustainability considerations as it directly impacts the quantity and the value of the fish caught, cost structures, and ultimately, the fisherfolks' income.

Chapter 3 discusses the historical context, current status, growth trends, fishing areas, infrastructure, institutional and regulatory framework related to India's deep-sea and offshore fishing activities.

Chapter 4 highlights the challenges and opportunities of the deep-sea and offshore fishing sector. It focuses on stock assessment, infrastructure and technology gaps; high operational costs; financing, insurance, and capital access; sustainability and conservation concerns.

Chapter 5 explores a comprehensive policy framework required for India's deep-sea and offshore fishing sector to grow sustainably and responsibly. It explores critical elements necessary for effective management and regulation, namely, registration, licensing and access rights; incentives and policy intervention.

Chapter 6 outlines the key investment areas and infrastructure upgradation required to build India's deep-sea and offshore fishing capacity. It covers the development of harbours with support facilities, establishing integrated supply chains with efficient logistics and cold storage, employing modern deep-sea and offshore fishing fleets, and institutionalizing training programs for upskilling the workforce.

Chapter 7 discusses the key components of an effective MCS&E regime tailored for the deep-sea and offshore fishing sector. It covers vessel tracking and communication systems, onboard observer programs, dockside monitoring protocols, reporting and compliance mechanisms as well as security concerns.

Chapter 8 examines the sectors' contributions to achieving SDG 14 and other interconnected goals. It proposes a comprehensive SDG roadmap with specific targets, indicators, and implementation strategies to guide India's progress on this front until 2030 and beyond.

Chapter 9 presents a roadmap outlining key initiatives and milestones for developing the country's deep-sea and offshore fishing sector. Harnessing the full potential of the sector requires a well-planned, multi-layered, and adaptive implementation approach spanning multiple years. The roadmap outlines three strategic phases: (1) laying the foundation and fostering early growth; (2) scaling-up and achieving global competitiveness; and (3) establishing global leadership in sustainable deep-sea fisheries. Based on the detailed phase-wise strategic interventions, six key consolidated areas of interventions have been identified and recommendations under each have been proposed to transform the sector.

Key highlights:

1. Global deep-sea fishing practices

i. Choice of technique must be carefully aligned with the target species, vessel capabilities, and regulatory frameworks that promote sustainable fishing practices.

ii. Species-specific case studies, from orange roughy to Patagonian toothfish illustrate complexities of managing deep-sea fisheries and need for tailored approaches to different species and ecosystems.

iii. Case studies from leading fishing nations provide crucial lessons for India a) China's extensive fleet and global reach demonstrate the potential scale of deep-sea operations, highlighting concerns about overfishing and the need for responsible practices. b) Japan's experience emphasizes the importance of scientific data and international cooperation. c) Spain's adoption of sustainable fishing practices and fleet modernization offers a model for technological advancement. d) United States' comprehensive regulatory framework showcases the value of science-based management and stakeholder engagement. e) Sri Lanka's experience highlights their approach to fleet modernization, export market access, and balancing artisanal and industrial fishing interests in the deep-sea sector.

iv. Key learnings from these global experiences emphasize the critical importance of science-based management, comprehensive regulatory frameworks, collaborative governance, capacity building, international cooperation, and an ecosystem-based approach to fisheries management.

2. India's Deep-sea and offshore fishing sector: Historical Context, Current Landscape, and Emerging Trends

i. Over the past four decades, the Government of India has undertaken various initiatives to develop offshore and high-seas fisheries. However, these efforts primarily relied on capital-intensive fishing fleets and outsourced expertise. They faced significant resistance from fishing communities, failing to achieve

the desired outcomes. This highlights the critical need to develop and explore indigenous capacity and expertise and ensure the active inclusion of fishing communities in the design and implementation of such initiatives.

ii. There is significant untapped potential for India's deep-sea and offshore fishing sector, with an estimated resource potential of around 7.16 million tonnes (MT) in 2018, including both conventional (74%) and non-conventional resources (26%).

iii. There has been a notable increase in the resource potential of the Indian EEZ with conventional resources between 2010 (4.41 MT) and 2018 (5.31 MT).

iv. Considering the depth-wise potential, in the 200-500 m depth zone, the estimate was 97,461 tonnes during 2018, constituting around 1.8% of the total conventional resources.

v. The resource potential in the 200-500 m depth zone was highest on the southwest coast (60%), followed by India's northwest coast (26%).

vi. The estimate for non-conventional resource potential stood at 1.847 MT. Out of the non-conventional resources, the resource potential for deep-sea myctophids was 1 MT, followed by ocean squids (0.63 MT), jellyfish (0.2 MT), and marine algae (0.017 MT), indicating the additional resources that could be tapped for deep-sea fishing.

vii. The strategy for harvesting high-sea non-conventional resources differs from other offshore and high-sea resources. Some non-conventional resources are slow-growing and late to mature, making them susceptible to overfishing with signs of declining biomass (e.g., orange roughy exploited by bottom trawlers at great depths). In contrast, flying squid and myctophids are large-biomass resources, but require processing for human consumption. Globally, myctophids are used for fish meal production.

viii. With regard to the conventional offshore and oceanic fisheries, the total conventional resource potential for the Indian EEZ, including the Andaman and Nicobar Islands, is estimated at 2,30,832 t.

The highest potential is estimated for skipjack tuna (99,500 t), followed by yellowfin tuna (83,500 t) and pelagic sharks (25,000 t), underscoring the economic importance of tuna fisheries. However, it is also important to note that the stock of yellowfin tuna in the Indian Ocean is currently subject to overfishing, and the Indian Ocean Tuna Commission (IOTC) has recommended rebuilding measures to ensure its long-term sustainability, which also has implications for India's tuna fisheries.

ix. Offshore and oceanic fisheries have significant potential, but challenges hinder its full exploitation. The migratory nature of oceanic tunas and allied resources leads to fish harvesting in the EEZs of neighbouring countries or the high seas by distant water fishing nations, highlighting the limitations that Indian fishers face due to policy gaps and inadequate infrastructure support. Wadge Bank

in the Northern Arabian Sea and Laccadive waters, some of the best offshore fishing grounds within the Indian EEZ, have remained largely unexploited and are even subject to poaching.

x. As of 2023, only four Indian-flagged vessels owned by the Fishery Survey of India (FSI) are available for high-seas fishing. This is significantly lower compared to countries with the largest number of authorized fishing vessels, such as Sri Lanka (1,883) and Iran (1,216) in the IOTC region. This stark disparity highlights India's limited participation in high-seas fisheries, given its vast coastline and strategic position in the Indian Ocean. The limited presence could be attributed to operational, regulatory, and infrastructural challenges, including the cessation of Letter of Permit (LoP) vessels in 2017.

xi. The major fishing areas and the key species are:

   a. Arabian Sea Region: Gujarat, Maharashtra, Goa, Karnataka, Kerala and the broader Central Arabian Sea; key species: tuna, seer fish, billfish, and deep-sea shrimps.

   b. Bay of Bengal Region: Tamil Nadu, Andhra Pradesh, Odisha, West Bengal; key species: tuna, sharks, and demersal fishes.

   c. Andaman and Nicobar Islands Region: Andaman and Nicobar archipelago in the Bay of Bengal; key species: tuna, billfish, and deep-sea shrimps.

   d. Lakshadweep Archipelago Region: The Lakshadweep Islands in the Arabian Sea off the southwestern coast of India; key species: tuna and tuna-like fish, sharks, Other pelagic species like billfishes, deep-sea shrimps, and squids.

xii. India's deep sea and offshore fishing sector is governed by a multi-layered institutional and regulatory framework involving various agencies and stakeholders at the national, state, and regional levels. This framework aims to regulate and manage fishing activities, ensure sustainable resource utilisation, and address conservation, safety, and economic development issues.

xiii. However, India currently does not have specific regulatory laws for fisheries in the 12-200 nmi of its EEZ. This implies that the Indian fishing vessels operate in the EEZ and ABNJ without proper legal authorisation or protection from the country. This regulatory gap has contributed to issues of illegal, unreported, and unregulated (IUU) fishing.

xiv. Further, maritime states are currently limited to issuing licenses only for fishing activities within the 12 nmi territorial waters. Addressing these regulatory gaps is crucial for the sustainable development of India's deep-sea fisheries sector.

xv. There is a need to enact comprehensive legislation for the regulation of fishing in the EEZ, to clearly define the responsibilities of the nodal agency overseeing the EEZ management.

xvi. The legislation is vital for ensuring fishers follow clear regulations; for empowering the Monitoring, Control, Surveillance and Enforcement (MCS&E) agencies to implement them effectively.

3. Challenges and opportunities

i. **Stock assessment:**

a. **Data deficiency:** Lack of a centralised database; insufficient integration of available data from different sources like fishermen's reports and satellite data; available data do not adequately cover the fishing area, effort, season, species aggregation and environmental conditions.

b. **Technological limitations:** Advanced technologies like satellite remote sensing, acoustic devices which can facilitate more precise stock assessments, have limited application due to high costs and capacity constraints.

c. **Regulatory and coordination issues:** Fragmented regulatory framework and inadequate inter-agency coordination presents obstacles to sustainable management; Variations in state-level policies challenge management.

State Maritime Security Coordinator (SMSC) has been recently developed for better coordination between various stakeholders and developing security architecture in the Coastal areas.

ii. **Infrastructure gaps:**

a. **Harvesting and Landing Infrastructure:**

- **Fishing harbours:** over 90 fishing harbours, but only a handful are equipped to handle larger vessels, with adequate draft, berthing facilities, and support services.
- **Landing centres:** The majority of the over 1547 fish landing centres are basic, lacking proper infrastructure for offloading, sorting, and preserving deep-sea and offshore catch.
- **Onboard infrastructure and handling:** lack of proper storage and freezing facilities leads to poor fish quality at landing, hampering export potential and resulting in lower market prices.
- **Vessel repair and maintenance facilities:** shortage of dry-docking facilities, slipways, and workshops with skilled manpower capable of servicing and repairing deep-sea and offshore fishing vessels.

b. **Post-harvest infrastructure:**

- **Processing Facilities:** Around 646 registered seafood processing units, but many lack specific equipment and technologies for handling and processing deep-sea and offshore fish species.
- **Cold Chain and Storage:** Inadequate cold storage and refrigerated transportation infrastructure result in quality degradation and post-harvest losses of deep-sea and offshore catch.

- **Value Addition and Byproduct Utilisation:** Limited facilities and technologies for value addition and byproduct processing units lead to suboptimal utilisation of deep-sea fishery resources. For instance, one million tonnes of myctophids could be used for fish meal with appropriate R&D support. Developing this value chain could reduce the pressure on juveniles of more valuable coastal fishery resources.

iii. **Technological gaps:**

a. **Fish Finding Technologies:** Vessels often lack access to advanced fish-finding technologies like sonar, echo sounders, and satellite-based tracking systems, making it challenging to locate and monitor fish stocks efficiently.

b. **Vessel Monitoring and Communication Systems:** Inadequate deployment of vessel monitoring and communication systems, Distress Alert Transmitter (DAT) on vessels hampers effective monitoring, safety, and coordination of operations. Fishermen increasingly using affordable Chinese-made instruments for vessel monitoring and communication, these are not officially recognized by the Department of Fisheries (DOF).

c. **Sustainable Fishing Gear and Techniques:** Limited adoption of selective fishing gear and techniques (circular hooks and turtle excluder devices); bycatch issues and unsustainable fishing practices. Gillnets are commonly used gear in the tuna fishery, landing large volumes of fish, but compromises fish quality due to rapid spoilage. Longlining is more sustainable and efficient method for catching tuna and tuna-like species, ensuring better fish quality while reducing bycatch.

iv. **High operational costs:**

a. **Fuel Costs:** Extended voyages and long distances travelled by deep-sea fishing vessels result in high fuel usage; fluctuations in fuel prices can exacerbate financial burden; exploring alternative energy-efficient options (green biofuels and renewable resources) could support the energy transition of small-scale fisheries.

b. **Crew Expenses:** Deep-sea and offshore fishing expeditions require larger crews compared to coastal fishing operations. Costs associated with crew wages, accommodations, provisions, and insurance can be substantial for longer voyages.

c. **Vessel Maintenance and Repair:** Harsh marine environment and extended periods at sea take a toll on fishing vessels, necessitating regular maintenance and repairs. Costs of spare parts, dry-docking, and specialized labour for vessel upkeep can be significant.

d. **Specialised Equipment and Technologies:** Deep-sea and offshore fishing often requires investment in advanced fish-finding technologies, such as sonar and satellite tracking systems, and specialized fishing gear and onboard processing facilities. Acquiring and maintaining these technologies can be cost-prohibitive.

v. **Financing, insurance, and capital access:**

a. **Limited Access to Institutional Financing:** Securing loans and credit from institutional lenders a hurdle, especially for small-scale and artisanal fishers. Factors include perceived high-risk nature of operations, lack of collateral or financial history, and limited understanding of the sector's dynamics among lenders.

b. **Inadequate Insurance Coverage:** Deep-sea and offshore fishing vessels and their crews face numerous risks, (adverse weather conditions, equipment failures, and potential accidents or injuries at sea). Access to comprehensive and affordable insurance coverage remains limited.

c. **Barriers to Capital Investment:** Modernising fleet and adopting advanced technologies require significant capital investment. Small-scale and artisanal fishers face barriers in accessing capital. Barriers include stringent lending criteria, high-interest rates, lack of awareness or support from government agencies and financial institutions. Banks would be reluctant to provide credit due to the absence of regulatory frameworks, proper licensing and effective governance in the sector.

vi. **Sustainability and conservation concerns:**

a. **Overexploitation of fish stocks:** Species such as tuna, billfish, and deep-sea shrimps, are highly migratory and vulnerable to overfishing due to their life histories and ecological characteristics.

b. **Bycatch and non-target species:** Deep-sea and offshore fishing operations often result in the unintentional catch of non-target species, such as sharks, marine mammals, sea turtles, and seabirds.

c. **Habitat degradation:** Certain deep-sea fishing practices, such as bottom trawling, can cause significant damage to sensitive marine habitats. Compliance with international standards such as the Code of Conduct for Responsible Fisheries (CCRF) is imperative for vessels engaged in deep-sea fishing.

d. **Ghost Fishing:** Lost or abandoned fishing gear, such as longlines, nets, and traps, can continue to catch and kill marine life indiscriminately.

e. **Marine pollution:** A global issue affecting the Indian EEZ and marine living resources and ecosystems. Though several schemes like the Clean Ocean mission (Swachhata Sagar) and awareness programs are available, they are not able to fully curb the litter from reaching the ocean.

f. **Climate Change Impacts:** The effects of climate change, including ocean warming, acidification, and changes in ocean currents and productivity, can profoundly impact deep-sea and offshore fish stocks and their migratory patterns.

4. Registration, licensing, and access rights

i. Registration as a fisherman is not legally compulsory. However, registration is undertaken by Coastal States and UTs to create a data repository for facilitating the Government schemes and benefits to the fishermen. Vessel registration and license issued by the state Department of Fisheries are for within 12 nmi territorial waters.

ii. Part XVA of the Merchant Shipping (MS) Act, 1958, provides detailed guidelines for the registration, survey, and certification of Indian-flagged fishing boats (Sec 435 A-X of MS Act). However, this provision is outdated and is meant to regulate commercial shipping. A separate Vessels Act would be required to cater to the needs of the modern fishing vessels and their development in the country.

iii. Registration and licensing of fishing vessels are governed by the respective Marine Fishing Regulation Acts (MFRAs) of coastal states and union territories. However, it pertains to only within the 12 nmi zone and not to deep-sea areas.

iv. Maritime Zones of India (Regulation of Fishing by Foreign Fishing Vessels) Act, 1981, regulates fishing activities by foreign vessels within India's EEZ. Indian-flagged vessels have the right to fish within the EEZ, subject to state/UT licensing conditions and adherence to conservation measures.

v. India is a member of various Regional Fisheries Management Organisations (RFMOs), such as IOTC. With regard to SIOFA, India is a Cooperating non-Contracting Party and not a full contracting party.

5. Incentives

Targeted incentivisation can play a crucial role in promoting the growth and sustainable development of India's deep-sea and offshore fishing industry. It is crucial to establish clear eligibility criteria, monitoring mechanisms, and periodic reviews to ensure that these incentives are effectively promoting the intended objectives while minimising potential misuse or unintended consequences. All subsidies should be kept to a minimum, applied for a limited period and phased out as soon as possible.

i. **Promoting green energy alternatives:** Encouraging the adoption of technologies (solar-powered systems, hybrid engines, and energy-efficient vessel designs) can reduce fuel dependency and operational costs. Mechanism needs to be developed to favour smaller vessels or those adopting fuel-efficient technologies.

ii. **Tax Benefits and Fiscal Incentives:** Offering tax incentives (reduced import duties on fishing equipment, gear, and vessels) can encourage fleet modernisation and the adoption of advanced technologies. Tax credits or deductions for investments in sustainable fishing practices, crew training programs, or research and development initiatives can incentivise responsible and innovative approaches.

iii. **Financial Support for Fleet Modernization:** Accessible financing options (low-interest loans or loan guarantee programs) in acquiring new vessels or upgrading their existing fleets. Prioritise vessels equipped with advanced fish-

finding technologies, sustainable fishing gear, and onboard processing facilities, promoting efficiency and responsible practices.

iv. **Infrastructure Development Incentives:** Incentives for the development of dedicated deep-sea fishing harbours, landing centres, and post-harvest infrastructure can include grants, tax incentives, or public-private partnership (PPP) models to attract private investment in building state-of-the-art facilities catering to the specific needs of the deep-sea fishing industry.

v. **Sustainable Fishing Practice Incentives:** To encourage the adoption of sustainable fishing practices, incentives can be offered for the use of selective fishing gear, bycatch mitigation technologies, and vessel modifications that minimize environmental impact. Incentives could take the form of subsidies, tax credits, or preferential access to fishing grounds for vessels demonstrating compliance with sustainability standards.

vi. **Insurance and Risk Management Support:** Providing subsidised or government-backed insurance schemes can mitigate the risks associated with deep-sea fishing operations (vessel accidents, crew safety, and potential losses due to adverse weather conditions or equipment failures).

6. Infrastructure development

India's fishing harbour infrastructure is predominantly geared towards shallow water and coastal fishing operations. Dedicated deep-sea fishing harbours and landing centres need to be developed along 11,098 km coastline.

i. **Fish harbours and landing centres:** Key features and facilities envisaged at the major deep-sea fishing harbours may include:

   a. Minimum draft of 8-10 m to accommodate large deep-sea trawlers/liners
   b. Berthing quays of at least 500 m in length
   c. Dedicated basins/wharfs for deep-sea vessel anchorage and operations
   d. Slipways and dry docks for vessel repair/maintenance
   e. Marine machinery and net mending workshops
   f. Cold storage and flake ice plants
   g. Auction halls, pack houses and pre-processing facilities
   h. Fuel bunkering and fresh water supply infrastructure
   i. Power backup and modern navigational aids
   j. Administrative buildings, crew accommodation and other amenities

   The minor deep-sea landing centres will have a basic enclosed harbour, wharfs/jetties, auction halls, cold storages, ice plants, boat repair yards and other localized facilities. Ministry of Fisheries, State fisheries departments, and agencies like FISCOPFED can be the nodal bodies for developing these harbour projects through public-private partnership (PPP) models.

ii. **Post-harvest and cold chain infrastructure:**

Fish Handling and Processing Centres: Hygienically designed, modern fish handling and processing centres must be established close to the proposed deep-sea fishing harbours and landing centres. Facilities should incorporate several key components:

a. Automated fish receiving, sorting, and weighing lines to ensure efficient and hygienic catch handling.
b. Insulated processing halls with smooth, easily cleanable floors and walls to maintain high hygiene standards.
c. Value-added product lines for processes such as canning, freezing, breading, and other forms of product diversification.
d. Byproduct plants for producing fish feed and fish oil from processing waste.
e. Support utilities like ice plants, cold storage, and refrigeration systems to maintain the cold chain.
f. Effluent treatment plants to ensure proper management of waste and compliance with environmental norms.
g. Quality control and analytical laboratories for ensuring adherence to food safety standards like HACCP.

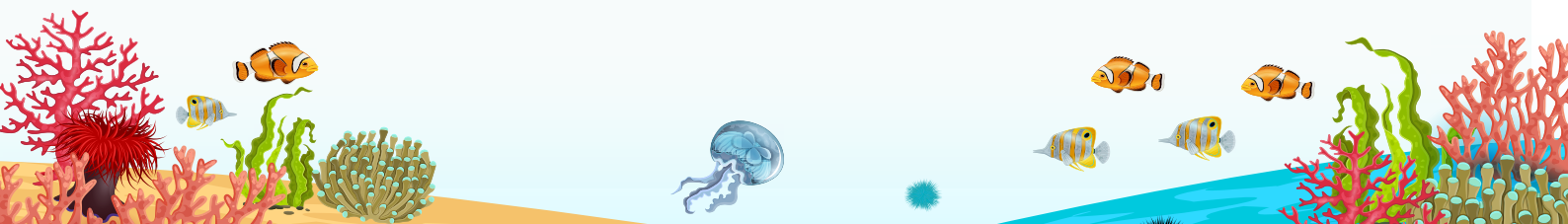
Cold Chain Infrastructure: Key components of this infrastructure should include:

a. Integrated cold storage with modern equipment like refrigerated/insulated vans and ample free storage capacity.
b. Refrigerated truck fleets and reefer vans for domestic distribution and transportation to export gateways.
c. Reefer container freight stations and terminals to facilitate the export of deep-sea and offshore catch.
d. Irradiation facilities for quarantine treatment, enabling compliance with phytosanitary norms of importing countries.

Other Support Infrastructure: Several ancillary infrastructure components are also essential for supporting deep-sea fishing operations and post-harvest activities like:

a. Ice plants and flake ice machines with substantial daily production capacity clustered near landing centres.
b. Insulated and refrigerated trucks for local distribution and transportation to processing facilities.
c. Cold chain power plants and energy-efficient systems to reduce operational costs.
d. Logistics parks and container freight stations for efficient handling and movement of catch.
e. Third-party pre-cooling facilities for specific product lines.

iii. **Fleet Modernisation and Skill Development:** Transition from coastal to deep-sea fishing would require targeted modernisation efforts focused on supporting existing fleet and enhancing their capabilities. Industrial deep-sea fishing can be



promoted for ABNJ and distant water fishing. The Department of Fisheries can play a key role to support these vessels by providing proper licenses, communication facilities, and on-board processing capabilities.

Deep-Sea Fishing Research Development:

a. Develop species-specific potential fishing zone advisories through habitat distribution modelling.

b. Collaboration between fisheries and oceanographic research institutions to undertake studies on underutilised resources (squid species).

c. Expanding research efforts on deep-sea fishing and value chain development.

Modification of Fishing Vessels for Deep-Sea Fishing and Offshore Fishing:

a. Vessels above 20 m in length need modifications/upgradation.

b. Equipping them with state-of-the-art technology for locating, catching, and processing target species.

c. Technical specifications for vessel construction may be finalised by a technical committee with experts from Department of Fisheries, ICAR-CIFT, FSI, CIFNET

d. New fishing vessels should be equipped with modern equipment for navigation, safety, and onboard fish handling.

e. Collaboration with the Ministry of Shipping may be explored for assistance in boat building and procurement of navigation equipment.

Introduction of New Fishing Vessels for Offshore, Distant Water Fishing: Vessels to be added to the fleet:

a. Offshore tuna longliners: 36-50 m in length for targeting tuna and other pelagic species using long-line gear.

b. Purse seiners: With lengths of 50-60 m, it employs a purse seine net to catch large schools of fish like tuna.

c. Offshore gillnetters: These 25-32 m long vessels use gillnets for catching demersal and pelagic species in deeper waters.

d. Midwater trawlers: can trawl from greater depths targeting myctophids and squids.

e. Squid jiggers: Specialized vessels for catching squid using jig machines and lures.

Financing Mechanisms: could include

a. low-interest boat loans,

b. subsidy-linked credit facilities,

c. lease-to-own models, and

d. promoting private investments through infrastructure funds.

iv. **Capacity Development and Stakeholder Engagement:**

Skill development programs: Complementing the fleet modernisation efforts, comprehensive skill development programs must be launched to train deep-sea and offshore fishermen in various technical aspects, including:

a. Navigation and communication systems
b. Sonar and fish-finding equipment operation
c. Hydraulic line haulers and power block handling
d. Safety equipment and emergency procedures
e. Deck operations and machinery maintenance
f. Cold chain management and preservation techniques

These training programs could be conducted through dedicated deep-sea and offshore fishing academies and vocational institutes, fisheries departments both in the public and private sectors.

Stakeholder engagement: In parallel with skill development, active participation of stakeholders is critical to ensure inclusive and sustainable growth in the sector. Stakeholder engagement to ensure inclusivity and fairness can be achieved through

a. Engaging stakeholders, including fishers, communities, and industry stakeholders in planning and decision-making, fostering ownership, inclusivity, and collaboration in implementing strategies.
b. Supporting fishermen cooperatives, SHGs and FFPOs with targeted funding, training, and access to modern technology and sustainable fishing techniques tailored to the local context to enable them to participate effectively in modernised deep-sea fishing programs.
c. Establishing a strong fisher-trader-exporter partnership based on mutual cooperation and trust. Fisher and trade associations, along with NGOs, can play a critical role in fostering and sustaining these partnerships.

7. Monitoring, Control, Surveillance and Enforcement (MCS&E):

i. **Vessel tracking and communication system**: ISRO developed a satellite-based VMS - NavIC for monitoring the coastal fishing fleet. It needs to be scaled up for the specific requirements of deep-sea and offshore fishing vessels.

VMS is increasingly used by fishermen for their safety but it is essential to establish control and monitoring units to fully operationalise the system. VMS is effective only when integrated with area-based (spatial) management. To achieve this, the Department of Fisheries must define deep-sea fishing zones, issue specific licenses and restrict access to these zones to vessels with appropriate licenses.

Implementing an effective deep-sea and offshore VMS requires addressing the following key considerations:

a. **Regulatory framework:** Mandating VMS installations on all deep-sea and offshore fishing vessels and ensuring proper maintenance. Establishing legal requirements and penalties for non-VMS compliance and tampering.

b. **Data management:** Setting up secure data centres and platforms, with optimal cyber security measures for VMS data integration, analysis, and reporting.

c. **Monitoring capabilities:** Developing expertise and infrastructure for real-time monitoring and response to VMS alerts. Develop land-based vessel monitoring stations in each maritime state.

d. **Integration with other MCS&E tools:** Integrating VMS data with other MCS&E components like observer programs and dockside monitoring.

e. **International coordination:** Aligning with international VMS standards and enabling data sharing with relevant regional fisheries bodies.

ii. **On-board observers:** On-board observers can be integrated with technology for efficient, effective and improved compliance and monitoring through the use of 1) mothership vessel programme; 2) autonomous ocean surveillance system technology and 3) FLIR camera for the vessels.

Successful implementation of an on-board observer program requires for addressing the following key considerations:

a. **Legal and regulatory framework:** Establishing legal requirements for observer coverage, rights, and responsibilities.

b. **Observer training and certification:** Developing comprehensive training programs and certification standards for observers.

c. **Observer safety and working conditions:** Ensuring safe working conditions, accommodation, and insurance coverage for observers.

d. **Data management and reporting:** Establishing robust data management systems, reporting protocols, and quality control measures.

e. **Stakeholder engagement:** Fostering cooperation and acceptance from the fishing industry through awareness campaigns and co-management approaches.

f. **Funding and cost-sharing mechanisms:** Securing sustainable funding sources and exploring cost-sharing models with the fishing industry.

g. **Regional and international coordination:** Aligning observer programs with regional and international standards for data sharing and harmonization.

iii. **Dockside Monitoring:** Successful implementation of dockside monitoring requires addressing the following key considerations:

a. **Legal and regulatory framework:** Establishing legal requirements and authorities for dockside monitoring, inspection, and enforcement actions.

b. **Infrastructure and logistics:** Developing designated landing sites with appropriate facilities, equipment, technology and logistics for monitoring activities.

c. **Training and capacity building:** Providing comprehensive training and certification programs for dockside inspectors and monitoring personnel.

d. **Data management and reporting:** Establishing robust data management systems, reporting protocols, and information-sharing mechanisms.

e. **Inter-agency coordination:** Fostering coordination and collaboration between relevant agencies, such as fisheries departments, marine police, coast guard, navy and customs authorities.

f. **Stakeholder engagement:** Promoting cooperation and compliance from the fishing industry through awareness campaigns and co-management approaches.

g. **Regional and international coordination:** Aligning dockside monitoring protocols with regional and international standards for data sharing and harmonisation.

iv. **Reporting and Compliance:**

Catch reporting requirement: Deep-sea and offshore fishing vessels should be mandated to maintain detailed catch and logbooks (both physically and digitally) which record information such as:

a. Fishing location (coordinates)

b. Fishing effort (number of sets, soak time)

c. Catch composition (species and quantities)

d. Bycatch and discards

e. Interactions with protected species

f. Gear and equipment used

The logbooks should be submitted to the relevant fisheries authorities at regular intervals (e.g., daily, weekly, or per trip) through electronic reporting systems or upon arrival at designated landing sites.

Vessel monitoring and reporting: Potential reporting requirements could include:

a. Real-time automatic vessel tracking and two-way communication.

b. Entry and exit reports when entering or leaving designated fishing areas

c. Catch and transshipment reports

d. Incident reports (e.g., gear loss, interactions with protected species)

v. **Security concerns in Deep Sea and offshore fishing:** Addressing the following challenges is crucial for ensuring maritime security and preventing potential threats.

a. **Support to State Marine Police (SMP) for Patrolling Inner Swathes:** Ineffective patrolling of vast patches due to non-parallel baselines. The critical areas are

Gulf of Kutch, Gulf of Khambhat, and Lakshadweep Islands. Small boats are inadequate for monitoring extensive nautical miles.

b. **Immediate Neighbourhood:** The Southern Sir Creek Line, Palk Strait, northern Andaman Islands, witness cross-border fishing activities leading to arrests of fishermen; it necessitates comprehensive monitoring and patrolling.

c. **Coordination among stakeholders:** Fishing is a state subject, while coastal security comes under the purview of the Union government. Effective coordination and intelligence sharing among Indian Navy, Coast Guard, and SMP are essential.

Recommendations for mitigating challenges:

a. **Robust legal framework:** Enacting national legislation or policy framework addressing

- fishing operations,
- security considerations,
- monitoring mechanisms, and
- penalties for non-compliance

b. **Amending State Fishing Laws:**

- Need for unified fishing laws and policies across India,
- States can have certain empowerment to adapt it in alignment with sustainable conservation principles specific to their local needs.

c. **Harmonising Best Practices:** Coastal security measures implemented by some states can be adopted by others

- Tamil Nadu model of operationalizing the ISRO-developed tracking system
- West Bengal's digital database mapping and coastal geospatial data analysis,
- Zonal operational coordination established by the southern states.
- Marine Enforcement Wing (MEW) established by Kerala and recently implemented by Tamil Nadu as part of the State Marine Police.

d. **Coordination Among Regional Nations:** As a member of Indian Ocean Tuna Commission (IOTC), a RFMO, India should advocate for a data-sharing mechanism among member nations, including a security advisory board, to enhance regional cooperation and intelligence sharing.

e. **Infrastructural Upgradation of State Marine Police:** Continued support through the Coastal Security Scheme (CSS) for infrastructural upgradation of marine police forces.

f. **Enhanced Maritime Domain Awareness (MDA):** Investing in advanced technologies such as maritime surveillance systems, satellite imagery, and data analytics.

8. Sustainable Development Goals aligned approach

While SDG 14 (Life Below Water) is most directly relevant, the deep-sea and offshore sector's growth has multidimensional effects that contribute to several other SDGs, including poverty reduction (SDG 1), zero hunger (SDG 2), decent work and economic growth (SDG 8), responsible consumption and production (SDG 12) and climate action (SDG 13). Key focus areas include ecosystem-based management, science-based catch limits, marine protected areas, research and innovation, fair access policies, and international cooperation. Regular monitoring, reporting, and review mechanisms will be essential to track progress and adapt strategies as needed.

9. Roadmap for harnessing deep-sea and offshore fisheries

Phase 1: Laying the foundation and fostering early growth - focuses on laying a solid foundation for the growth and development of India's deep-sea fishing sector through short-term interventions (3 years| 2025-28). The primary objectives and targets include:

i. **Regulatory Framework and Policy Interventions:**

a. Enact a comprehensive legislation to ensure responsible and sustainable fishing practices in deep-sea waters
   - Develop rules and regulations of fisheries governance for 12-200 nmi region and for enabling fishing in ABNJ.
   - Update the Maritime Zones Act, 1976 and state Marine Fishing Regulation Act (MFRAs).
   - Enact a separate Vessels Act to cater to the needs of modern fishing vessels.

b. Formulation of state-level deep-sea and offshore fishing policies along with incentive schemes tailored to regional needs.

c. Implementation of licensing and permit systems for deep-sea and offshore fishing vessels, providing a comprehensive legal framework for fishing operations.
   - Utilize ReALCRaft as a centralized digital platform for national-level registration and licensing of deep-sea and offshore vessels, in coordination with state and UTs.

d. Establishment of monitoring, control, surveillance and enforcement (MCS&E) mechanisms.
   - Scaling up of NAVIC to cater to the requirements of deep-sea and offshore fishing.
   - Develop land-based vessel monitoring stations in each maritime state equipped with state-of-the-art technology.
   - Implement an on-board observer program by integrating it with technology such as electronic monitoring, FLIR cameras.
   - The Department of Fisheries (DoF) can define deep-sea fishing zones and implement a zone-specific licensing system, to ensure access to these zones to vessels with appropriate licenses.

- Strengthen enforcement through interagency collaboration between DoF, marine police, coast guards, navy.

ii. **Infrastructure Development:**

a. Upgradation/ Construction of major deep-sea fishing harbours in the coastal states/UTs.

b. Establishment of 10-15 minor deep-sea landing centres in the coastal states/ UTs.

- Setting up integrated fish handling, processing and storage facilities near harbours and landing centres.
- Identify Fisherwomen's group and provide them training to operate and maintain these facilities.

c. Development of cold chain infrastructure, including pack-houses and strategically located cold storage facilities.

d. Establish vessel repair and maintenance facilities such as dry docking, slipways and workshops in the coastal states.

iii. **Fleet Upgradation and Capacity Building:**

a. Induction of deep-sea and offshore fishing vessels (longliners, trawlers, gillnetters, etc.)

b. Development of standardised fishing vessel designs and specifications at the national level with a particular focus on ensuring uniformity, safety, operational efficiency and energy efficiency.

- This could be incorporated into the new fishing Vessels Act.

c. Upgradation of onboard preservation facilities, including installation of equipment such as compressors, ice-making machines and refrigerated seawater (RSW) and modernisation of fish holds in existing vessels.

d. Establishment of domestic shipbuilding capacities for deep-sea and offshore vessels in existing shipbuilding destinations.

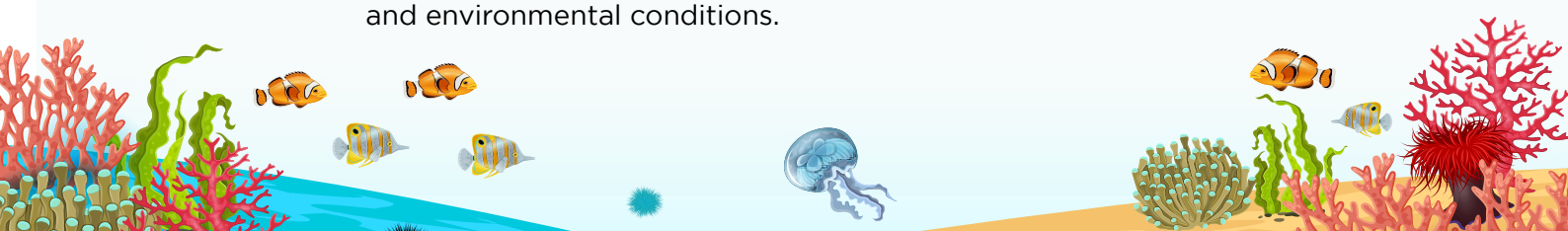
e. Launch of skill development programs for deep-sea and offshore fishers and crew in collaboration with national and international agencies.

f. Creation of dedicated deep-sea and offshore fishing training academies.

iv. **Research and Development:**

a. Mapping and scientific assessment of deep-sea and offshore fisheries resources to evaluate potential and sustainability.

- Leverage National Marine Fisheries Data Centre (NMFDC) to serve as a centralized database and reporting system for vessel logbooks, catch data and compliance records, focusing on segregation of deep-sea fishery catches.
- Enhance data collection on fishing area, effort, season, species aggregation and environmental conditions.



b. Replace outdated fishery research vessels with MoES, ICAR, DoF, etc; induct new deep-sea research vessels and formulate targeted scientific programs to support deep-sea fisheries research and sustainability.

c. Launch of pilot projects and feasibility studies for deep-sea and offshore fishing operations.

d. Collaboration with research institutions and international organisations to adopt best practices and advanced technologies in sustainable fishing.

e. Undertake R&D on myctophids as fish meal.

v. **Export Promotion:**

a. Strengthening engagement with fisher cooperatives to leverage collective resources and bargaining power for promoting exports through collaboration.

b. Promotion through export promotion councils and trade facilitation measures to access global markets, with a focus on quality and sustainability.

c. Implement traceability systems and eco-labeling for compliance with global standards.

Phase 2: Scaling up and achieving global competitiveness – through medium-term interventions (4 years| 2029-32) focuses on the following

i. **Fleet Modernization and Expansion:**

a. Large-scale induction of advanced deep-sea and offshore fishing vessels facilitated through cooperative ownership models, where fisher cooperatives jointly own and operate modern vessels.

b. Upgradation of existing vessels with modern gear and handling equipment to enhance efficiency and sustainability.

c. Strengthen shipbuilding capacities to support the production and maintenance of advanced vessels with updated technologies.

d. Promotion of fishing corporations and joint ventures, and support for fisher cooperatives in establishing deep-sea ventures.

ii. **Infrastructure Development and Upgradation:**

a. Construction of additional deep-sea fishing harbours and landing centres to accommodate growing fleet capacity.

b. Expansion of fish handling, processing, and cold chain infrastructure to reduce post-harvest losses and improve quality control.

c. Expansion of dedicated deep-sea and offshore vessel repair and maintenance facilities.

d. Promotion of sustainable and low-impact fishing practices through the integration of advanced technologies, such as modern fish-finding equipment (e.g., sonar, echo sounders, satellite-based systems) along with best practices.

iii. **Strengthening of Monitoring, Control, Surveillance and Enforcement (MCS&E):**

a. Expand comprehensive vessel monitoring systems (VMS) to cover 100% of deep-sea fleet.

b. Expansion of on-board observer programs to improve compliance with sustainability regulations.

c. Strengthening of dockside monitoring and inspection protocols.

iv. **Market Expansion and value-added processing:**

a. Facilitation of access to premium domestic and international markets through trade agreements and export facilitation.

b. Promotion of value-added and diversified deep-sea fishery products.

c. Integration of technology and automation throughout the value chain to enhance efficiency and transparency.

d. Promotion of Offshore mariculture as an alternate revenue stream and to diversify fish production.

v. **Capacity Building and Research:**

a. Continuing skill development programs for deep-sea and offshore fishers and crew, integrating global best practices.

b. Collaboration with research institutions for stock assessments, resource mapping, and sustainable fishing innovations.

c. Implementation and validation of the offshore/deep-sea fisheries advisories with the commercial fishing fleets.

d. Promotion of sustainable fishing practices through scaling up of traceability systems, eco-labelling initiatives, consumer awareness campaigns, and responsible fisheries management to ensure transparency, incentivize sustainable choices and foster long-term marine conservation and livelihoods.

Phase 3: Global leadership in sustainable deep-sea fisheries – the long-term interventions (8 years and beyond | 2033 onwards) would be geared towards consolidating the gains made through phases 1 and 2, ensuring long-term sustainability, and positioning India as a global leader in sustainable deep-sea and offshore fishing practices. The primary objectives and targets include:

i. **High-value product development:**

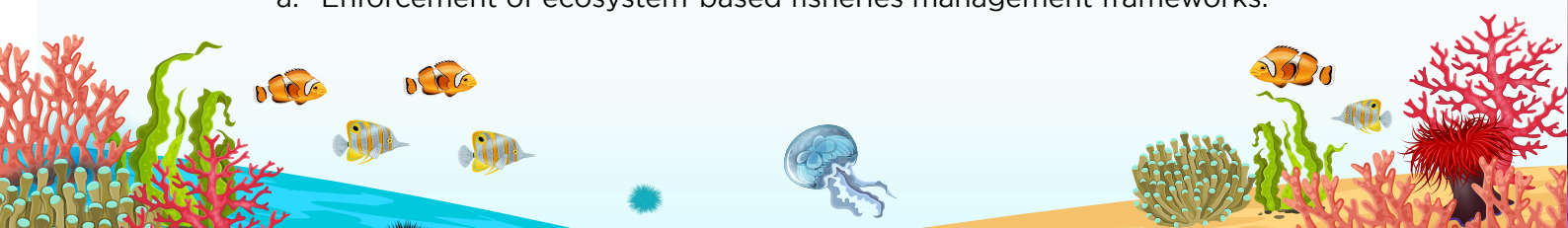
a. Expansion of dedicated value-addition and processing facilities to continuously enhance product quality and efficiency.

b. Development of niche and premium deep-sea and offshore fishery products targeted at high-end global markets.

c. Exploring alternative uses and byproduct utilisation to maximize resource efficiency.

ii. **Sustainability and Conservation:**

a. Enforcement of ecosystem-based fisheries management frameworks.



b. Strengthening of monitoring, control, and surveillance (MCS) measures.
c. Expansion of marine protected areas and marine spatial planning.
d. Assess the impact of climate change on deep-sea fisheries and adaptation strategies.

iii. **Market Access and Trade Facilitation:**

a. Compliance with international sustainability standards and certifications.
b. Harmonisation of regulations with regional and global norms.
c. Facilitation of access to premium global markets through trade agreements and branding initiatives.

iv. **Strengthening Research and Development:**

a. Collaboration with international research institutions and organizations for continuous innovation in sustainable fishing technologies and practices.
b. Continuous improvements in offshore/deep-sea fishery advisories for commercial fishing fleets.
c. Regular stock assessments and resource mapping to ensure data-driven fisheries management.

- An indicative costing framework for the three phases has also been provided by considering the convergence of centrally sponsored and central sector schemes related to fisheries – phase 1 (Rs 2430 crore); phase 2 (Rs 4210 crore), and phase 3 (Rs 1690 crore).

- **Indicative cost estimation for the Strategic Phases**

Phases	Components	Estimated Cost (Rs crore)	Relevant schemes
Phase 1: Laying the foundation and fostering early growth	Regulatory framework and policy interventions	260	PMMSY, Coastal Security Scheme (CSS)
	Infrastructure development	470	PMMSY, Fisheries and Aquaculture Infrastructure Development Fund (FIDF), Sagarmala Programme, Pradhan Mantri Kisan Sampada Yojana (PMKSY) of the Ministry of Food Processing Industries
	Fleet upgradation and capacity building	790	*PMMSY, Maritime Development Fund (MDF)*
	Research and Development[1]	610	*PMMSY, Deep Ocean Mission*
	Export promotion	300	PMMSY, NIRYAT SAHKAR (NCDC)
	Total	**2430**	
Phase 2: Scaling up and achieving global compe-titiveness	Fleet modernisation and expansion	1940	*PMMSY, MDF, Shipbuilding Financial Assistance Policy (SBFAP) 2.0, MDF*
	Infrastructure development and upgradation	1760	*PMMSY, FIDF, Sagarmala Programme*
	Strengthening of Monitoring, Control, Surveillance and Enforcement (MCS&E)	10[2]	PMMSY, CSS
	Market Expansion and value-added processing	460	PMMSY, PMKSY
	Capacity building and research	40	PMMSY

1 *The amount has been estimated based on allocation under 'Deep Ocean Mission'.*

2 *The figure corresponds to 'communication and/or tracking devices like VHF/DAT/NAVIC/transponders etc' for 1000 deep-sea vessels (Rs 5 crore) and for expanding onboard observer program to 50% of vessels (Rs 5 crore). Common infrastructure for MCS would be Detailed Project Report (DPR) based on PMMSY operational guidelines.*

Further, given the complexity and evolving nature of some interventions, certain activities within the components MCS&E, Sustainability and conservation, Capacity building, Research and Development etc. do not have standardized unit costs and are expected to be implemented through Detailed Project Reports (DPR) or Self-contained proposal. As such, these figures are indicative rather than definitive.

Phases	Components	Estimated Cost (Rs crore)	Relevant schemes
	Total	**4210**	
Phase 3: Global leadership in sustainable deep-sea fisheries	High-value product development	600	PMMSY
	Sustainability and conservation	210	PMMSY, Deep Ocean Mission
	Market access and trade facilitation	480	PMMSY, NIRYAT SAHKAR (NCDC)
	Strengthening Research and Development	400	PMMSY, Deep Ocean Mission
	Total	**1690**	

- A dedicated committee within the Department of Fisheries could oversee progress against the milestones, conducting annual reviews and adjusting timelines as necessary. Periodic assessments from third-party research and advisory organisations may be conducted to measure effectiveness and compliance.
- Several challenges and risks could be encountered during implementation of the programme. Challenges include availability of technical expertise, cooperation of the stakeholders and institutions, high cost of fishing etc. Potential risks include declining fish stocks, sea safety concerns, and the impact of climate change etc. It is essential to identify and prioritise challenges and risks and develop anticipatory mitigation measures.

10. Recommendations

Six key consolidated areas of intervention have been identified and recommendations under each have been proposed to transform the sector.

i. **Policy and Regulatory Overhaul**

a. Create clear rules to help everyone fish responsibly in deep waters and a Regulatory Act with a legal framework aligned to international laws (UNCLOS), standards, and guidelines.

b. Streamline licensing, registration, and access policies based on resource potential, stakeholder inclusion, and sustainability principles.

c. Revise subsidy and incentive schemes to tap the potential of deep-sea and offshore fishing.

d. Establish legal mandates and empower institutions for effective monitoring, control, and surveillance.

ii. **Institutional Strengthening and Capacity Building**

a. Creation of a dedicated agency/directorate under the Department of Fisheries for holistic governance of deep-sea and offshore fisheries.

b. Augment research, data collection, stock assessment, and reliable fisheries advisory capabilities through specialized vessels, skills, and infrastructure.

c. Export Promotion through cooperatives to leverage collective resources and bargaining power.

d. Develop institutional linkages with regional fisheries bodies, international agencies, and research institutions.

e. Implement capacity-building programs covering legal, policy, and technical aspects for regulatory personnel and industry stakeholders.

iii. **Fleet Modernisation and Infrastructure Upgradation**

a. Incentivize the adoption of larger and modernizing existing deep-sea vessels equipped with modern refrigeration systems and value-addition facilities.

b. Recognize the capital-intensive nature of deep-sea fishing and promote inclusive fleet development by supporting fisher cooperatives and cluster-based approaches, enabling collective ownership, operation, and access to technology.

c. Augment deep-sea fishing harbour infrastructure with berthing facilities, maintenance support, unloading equipment etc.

d. Develop an integrated network of deep-sea fishing ports and fish landing centres along the coastline.

e. Invest in post-harvest processing, cold chain infrastructure, and marketing channels to minimise wastage.

iv. **Sustainable Fisheries Management**

a. Operationalize marine spatial planning and designate deep-sea marine protected areas based on scientific assessments.

b. Develop and enforce total allowable catch limits integrating the ecosystem approach to fisheries.

c. Mandate the adoption of technologies to reduce bycatch, juvenile catch, and impacts on marine habitats.

d. Implement real-time digital monitoring systems through vessel tracking, observers, and e-logbooks.

e. Establish traceability systems to ensure transparency in the supply chain from catch to consumer, which would help in the identification of legal and sustainable fishing practices.

f. Promote eco-labelling initiatives to certify sustainable fisheries, encouraging market incentives for responsible practices.

v. **Resource Mobilisation and Financing**

a. Establish a dedicated Deep-Sea Fishing Development Fund through budgetary support under PMMSY and industry contributions.

b. Facilitate public-private partnerships in deep-sea fishing vessels and infrastructure.

c. Ease access to institutional credit and develop insurance and risk mitigation mechanisms customized to this sector.

d. Explore viability gap funding and soft loan assistance from multilateral agencies for green technologies.

vi. **Stakeholder Inclusion and Partnerships**

a. Develop co-management frameworks incorporating community institutions, fish worker unions and industry bodies.

b. Ensure representation and inclusion of small-scale, artisanal and indigenous fishers in access policies.

c. Promote responsible corporate stewardship and sustainable value chain practices by fishing companies.

d. Foster cross-sectoral coordination between maritime agencies, research bodies, coastal states/UTs, and international partners.

e. Launch of pilot projects in 2-3 coastal districts of Gujarat, Tamil Nadu, and Maharashtra focusing on demonstration of technologies, skills, and monitoring practices.

In addition to the aforementioned six key areas of intervention, successful delivery of the strategy would require a robust implementation mechanism.

vii. **Implementation Mechanism**

a. Create an overarching Deep-Sea Fishing Program (DSFP) with a dedicated Programme Management Unit in the Department of Fisheries, to design, coordinate, implement, and monitor the program.

b. The DSFP can have an advisory council consisting of all maritime states and other relevant agencies to advise the Programme Director.

CHAPTER-I

Introduction

1.1 Background and Rationale

India has a vast maritime area and a long coastline stretching over 11,098 kilometres[3] across nine coastal states and four union territories. While the country boasts a thriving fisheries sector that contributes significantly to the national economy and supports the livelihoods of millions[4], the full potential of its deep-sea fishery resources remains largely unexploited. The deep waters beyond the continental shelf, extending beyond the Exclusive Economic Zone (EEZ) boundary of 200 nautical miles (nmi), contain high-value fish stocks, including tuna, billfish, and shrimp species. The EEZ potential is 7.16 million tonnes (MT), including conventional and non-conventional resources (DADH, 2018). While this suggests significant expansion opportunities, it is crucial to consider that many of these resources have slow growth rates and high longevity, making them vulnerable to overexploitation. Harnessing these deep-sea fisheries can provide a much-needed economic boost to India's marine fisheries sector, augment seafood exports, enhance food security, and generate new employment opportunities in coastal regions while reducing the fishing pressure on coastal fishery resources.

To begin with, it is essential to clarify specific terms that are often used interchangeably but do not necessarily convey the same meaning, particularly in the context of deep-sea fisheries or globally recognised frameworks. In Indian marine fisheries literature, terms such as "high seas," "offshore," "offshore tuna fisheries," "oceanic fisheries," etc. are used synonymously with "deep sea," which is incorrect.[5] According to the FAO, deep-sea fisheries are defined as "fisheries that take place at great depths (between 200-2000 meters (m)), on continental slopes, oceanic seamounts, ridge systems banks. These fisheries target demersal/benthic species using a range of gears including bottom and mid-water trawls, pots, and longlines". Therefore, "deep-sea fisheries" can be described as any fishing activity occurring at depths greater than 200 m, typically targeting demersal/benthic species[6] using gears including bottom and mid-water trawls and longlines, etc, as shown in (Fig. 1.1).

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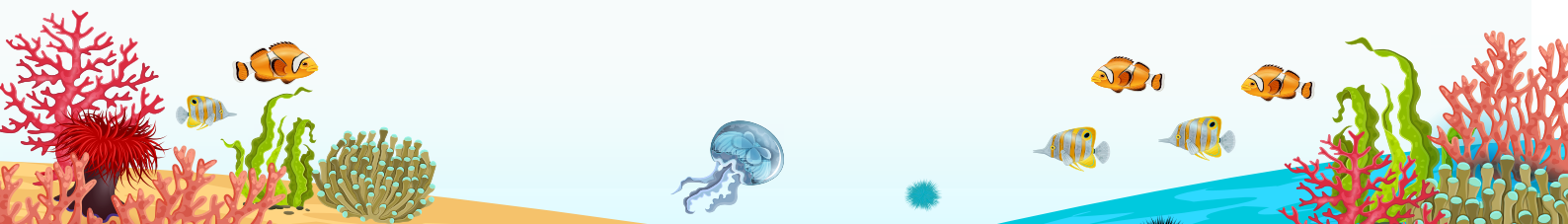
3 *The Indian coastline has expanded from 7516.6 km in 1970 to 11,098 km in 2023-24 based on new methodology that includes bays, estuaries, inlets and other geomorphological features that replaced the earlier straight-line measurement approach.*

4 *India is the second largest fish producing country in the world. In FY 2022-23, it accounted for 8% of global production and contributed 1.09% to GVA and over 6.7% to agricultural GVA. It provides livelihood to around 30 million people, particularly marginalised and vulnerable communities https://pib.gov.in/PressReleasePage.aspx?PRID=1986155, accessed on November 21, 2024). Further, in FY 2023-24, the export earnings from fish and fishery products were Rs 60,523 crore, which had seen a 100% increase as against Rs 30,213 crore in 2013-14 (https://pib.gov.in/PressReleasePage.aspx?PRID=2055709, accessed on November 21, 2024).*

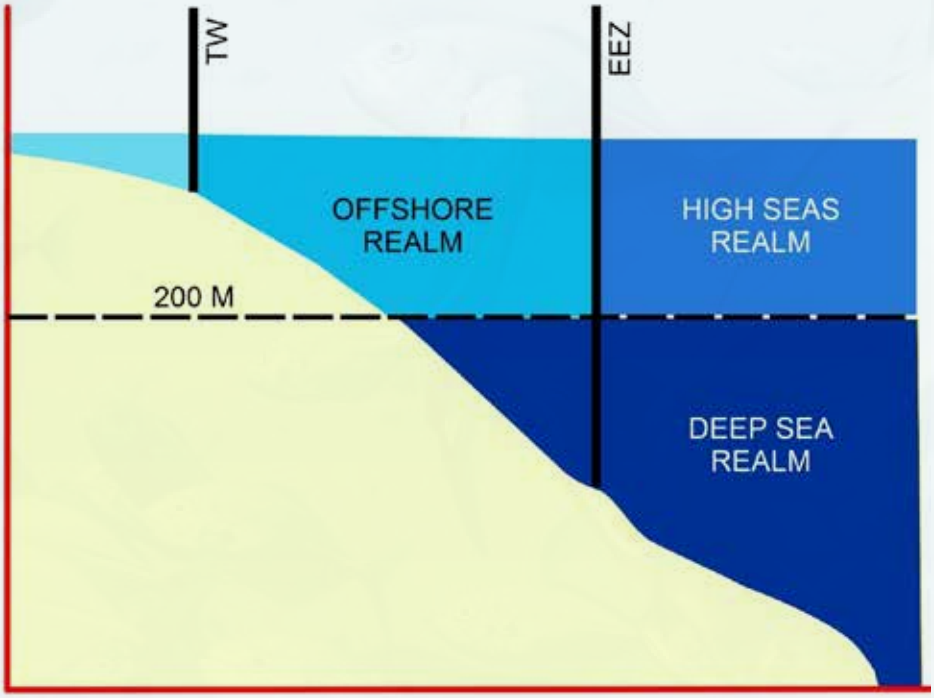
5 *Policy guidance for harnessing the deep-sea and offshore fishery potential of India, NITI Aayog*

6 *Note: Pelagic sources also contribute to deep sea resources.*



Deep-sea fisheries can occur within the EEZ and in Areas Beyond National Jurisdiction (ABNJ)/ High Seas. On the other hand, "offshore fishing", in the Indian context, may be considered as fishing beyond 12 nmi and up to 200 nmi within the Indian EEZ and is unrelated to the fishing activity's depth. "Distant water / high seas fishing" is any fishing activity beyond 200 nmi, i.e, fishing in ABNJ /the High Seas.

Fig 1.1: Delineation of the various realms of the ocean vis-à-vis fisheries terms



((TW=Territorial Waters up to 12 nmi, EEZ= Exclusive Economic Zone up to 200 nmi)

Deep-sea fishing operations present unique challenges and complexities that differ significantly from traditional coastal or inland fishing activities. It requires specialized vessels equipped with advanced technologies capable of undertaking extended voyages in often treacherous ocean conditions. Access to cutting-edge fish-finding equipment, sustainable harvesting techniques, and robust infrastructure for landing and processing the catch becomes paramount. Though Indian vessels engage in fishing in the ABNJ, many coastal states in India currently lack the necessary deep-sea fishing fleet, shoreside facilities, and well-established institutional frameworks to tap into these offshore marine resources effectively. Moreover, the deep-sea environment is more fragile and vulnerable to overexploitation and habitat degradation, necessitating stringent conservation measures and responsible fishing practices to maintain the long-term sustainability of these precious resources.

Given these challenges and opportunities, a comprehensive national strategy framework is crucial to promote the sustainable development of India's deep-sea, offshore, and high-seas fisheries sector. The strategy must address the multifaceted issues of infrastructural gaps, technological barriers, financing hurdles, and regulatory aspects while prioritising the long-term preservation of marine ecosystems and fish stocks. By strategically

unlocking the potential of deep-sea fisheries, India can diversify its marine catch, boost economic growth in coastal communities, enhance food security, and position itself as a global leader in sustainable marine resource management. This report aims to provide a strategic roadmap for harnessing India's deep-sea fisheries potential through a holistic and forward-looking approach that balances economic imperatives with environmental sustainability.

1.1.1 Governance of Marine Fisheries as per the Indian Law

- Fishing and Fisheries beyond Territorial waters: Sl 57 in the List-1 (Union list) of the 7th Schedule of the Indian constitution deals with the governance of fishing and fisheries beyond territorial waters (TW). Article 246(1) of the Indian Constitution empowers the Union (parliament) to enact laws pertaining to any matter enumerated in the 'Union List'.

- Fisheries: Sl 21 in the List-II (State List) of the 7th Schedule of the Indian Constitution deals with the governance of Fisheries. Article 246(3) of the Indian Constitution empowers the states to enact laws pertaining to matters enumerated in the 'State List'.

Article 297 of the Indian Constitution vests in the Union for all the resources within TW, the Continental Shelf, and the EEZ. Though the resources in the Maritime Zones of India mentioned above come fully under the control of the Union, it does not take away/supersede the legislative competence of the Centre and the State as defined under Article 246.

Effective collaboration and coordination between the Union and State governments are essential to address the challenges and maximize the benefits of the dual system of governance for marine fisheries in India. This can be achieved through joint planning, information sharing, and the development of shared standards and guidelines to ensure the long-term strength of India's marine ecosystems.

1.2 India's Untapped Deep-Sea Potential

EEZ covers an expansive area of over 2 million square kilometres (km^2) (Table 1.1), rich in marine living resources. However, the vast deep-sea areas beyond the continental shelf remain largely unexplored and underutilised for fishing activities. Preliminary assessments by the Fishery Survey of India (FSI) and other research organizations have revealed the immense potential of these deep-sea regions, both within the EEZ and in international waters.

The inshore waters of the Indian mainland are overly fished, placing significant pressure on several coastal fish species. This has raised concerns among coastal fishermen about their means of livelihood, given the current surge in fishing activity. Unlike the heavily exploited near-shore and coastal waters, the deep-sea and offshore waters remain largely untapped by traditional fishers. On the consumption side, India's monthly per capita fish consumption has increased from 2.9 kg in 1990-91 to 6.31 kg in 2020-21(Handbook on

Fisheries Statistics, 2022). With the population of India on the rise, the nation has to inevitably enhance the availability of fish to meet the increased nutritional demands. This can be achieved through the country's offshore and deep-sea fisheries, which have become the iconic last frontier for expanding marine fisheries and high-seas fishing.

Research suggests that the deep-sea zone holds significant potential for fish stocks, and most deep-sea fish are considered safe for human consumption (Gatto et al., 2023). In recent years, India's deep-sea fisheries have been recognised and gained attention as a latent matter. India produced about 4.13 MT of marine fish, mostly from depths of 200 m in 2021-22. The additional unconventional marine fish catch from oceanic waters that could supplement conventional resource landings was estimated at 1.84 MT (DAHD, 2018).

Harvesting marine resources beyond the continental shelf, in waters deeper than 200 m, provides an opportunity to increase seafood production, support economic growth, and meet the growing global demand for fish products[7]. Various methods, such as pole-and-line fishery using live baits, purse seining, gill netting, long lining, trawl, trolling hooks and lines, can effectively harvest deep-sea or oceanic resources.

Table 1.1: Coastal Geography and Demographics Summary

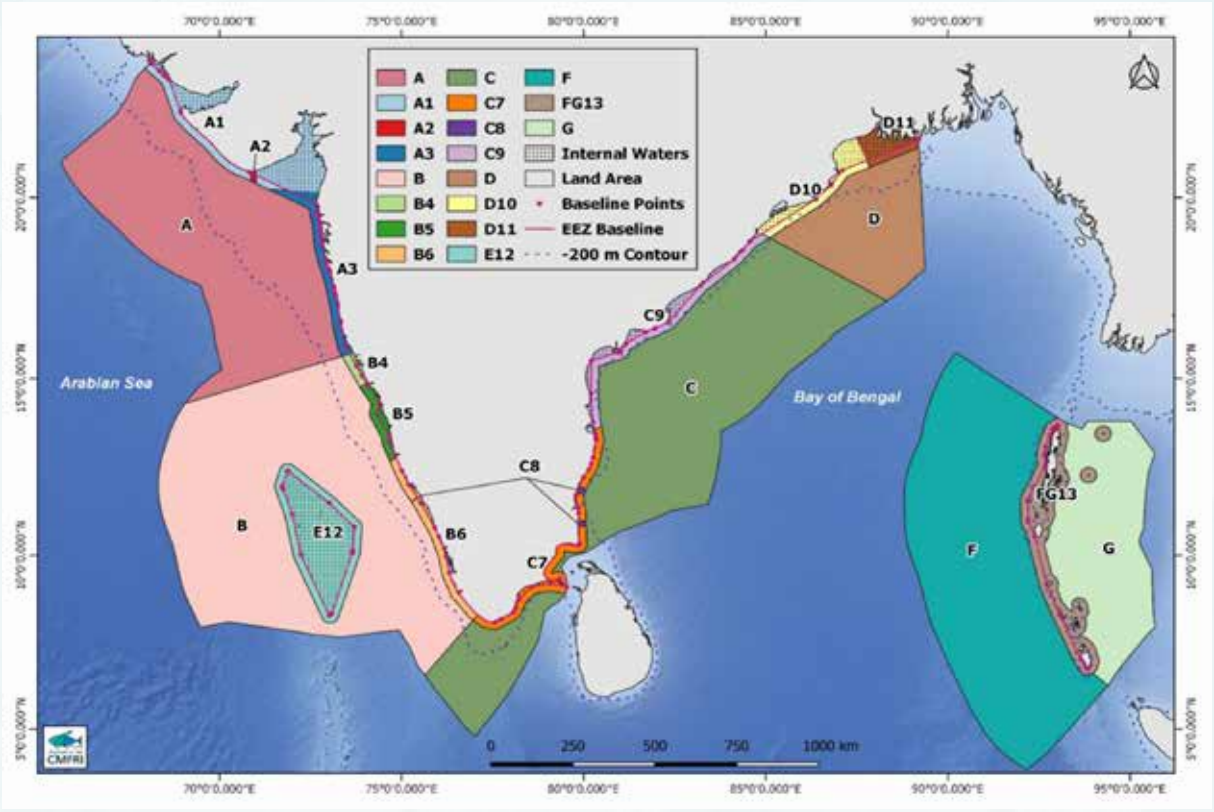
Coastal Data	
Length of coastline	11,098 km
Total land area	3,287,263 km^2
Area of the continental shelf	372,424 km^2
Territorial sea (up to 12 nautical miles)	193,834 km^2
Exclusive Economic Zone	2.02 million km^2
Coastal Geomorphology (Mainland)	
Sandy Beach*	43%
Rocky Coast*	11%
Muddy Flats*	36%
Marshy Coast*	10%
Population of the Coastal States and UTs	560 million
Population of Island Territories	0.44 million

Source: Compiled from https://surveyofindia.gov.in/webroot/UserFiles/files/Length%20of%20Coastline%20of%20India.pdf ; https://www.nccr.gov.in/sites/default/files/schangenew.pdf

Note '*': The figures correspond to the percentage of the Indian coast.

Fig 1.2: Indicative Map Showing Proposed Fishing Zones in the Indian (EEZ)

7 According to the State of World Fisheries and Aquaculture (2024), the global consumption of aquatic foods reached 162.5 million tonnes in 2021, which had increased nearly twice the rate of the world population since 1961. The global per capita annual consumption has risen from 9.1 kg in 1961 to 20.7 kg in 2022. (https://www.fao.org/newsroom/detail/fao-report-global-fisheries-and-aquaculture-production-reaches-a-new-record-high/en, accessed on November 21, 2024)



Source: Mohamed et al. (2018)

Note: The fishing zones consist of 13 Territorial Water (TW) zones: A1, A2, A3, B4, B5, B6, C7, C8, C9, D10, D11, E12, FG13; and six regional zones, namely A, B, C, D, F, G.

Maritime states like Gujarat, Kerala, and Tamil Nadu have skilfully caught deep-sea fish and oceanic resources within India's EEZ using vessels under 20 m Over All Length (OAL) without modernisation of fishing and craft gear.[8] This reflects the reliance of fishermen on traditional knowledge and skills passed down through generations and a deep understanding of local marine ecosystems. Deeper waters account for a small part of India's fish production.

In addition to the EEZ, the international waters and areas under regional fisheries management organizations (RFMOs) like the Indian Ocean Tuna Commission (IOTC) and the Southern Indian Ocean Fisheries Agreement (SIOFA) offer further opportunities for Indian deep-sea fishing vessels. These areas are rich in valuable pelagic and demersal species, and India's participation in these regional bodies can provide access to these resources, subject to sustainable fishing practices. Antarctic fisheries governed by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), one of the best RFMOs in the world, have huge potential to tap the cold fisheries like Krill, Tooth Fish, Ice Fish, etc. CMLRE, MoES[9], a nodal agency, is promoting this fishery for Indian entrepreneurs, and domestic regulatory mechanisms and policies are being worked out. This offers additional growth revenues for the Indian deep-sea fishing industry to utilise the opportunities in the Antarctic waters apart from the IOTC and SIOFA regions.

However, realising the full potential of India's deep-sea fisheries requires overcoming

8 *https://eprints.cmfri.org.in/17830/1/CMFRI%20Training%20Manual%20Series%20No.%2035_2023_AARDO.pdf (accessed on January 20, 2024).*

9 *Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences (MoES)*

several challenges, including the lack of a specialised deep-sea fishing fleet, inadequate infrastructure for landing and processing the catch, limited technological capabilities for locating and harvesting deep-sea resources, and gaps in regulatory frameworks and management systems. Additionally, ensuring the long-term sustainability of these resources through responsible fishing practices and effective conservation measures is crucial.

By addressing these challenges and implementing a comprehensive policy framework, India can unlock its deep-sea fisheries' immense economic and food security benefits. Harnessing these resources can contribute to the growth of the marine fisheries sector, enhance export earnings, create employment opportunities in coastal regions, and strengthen the nation's position as a global leader in sustainable marine resource management.

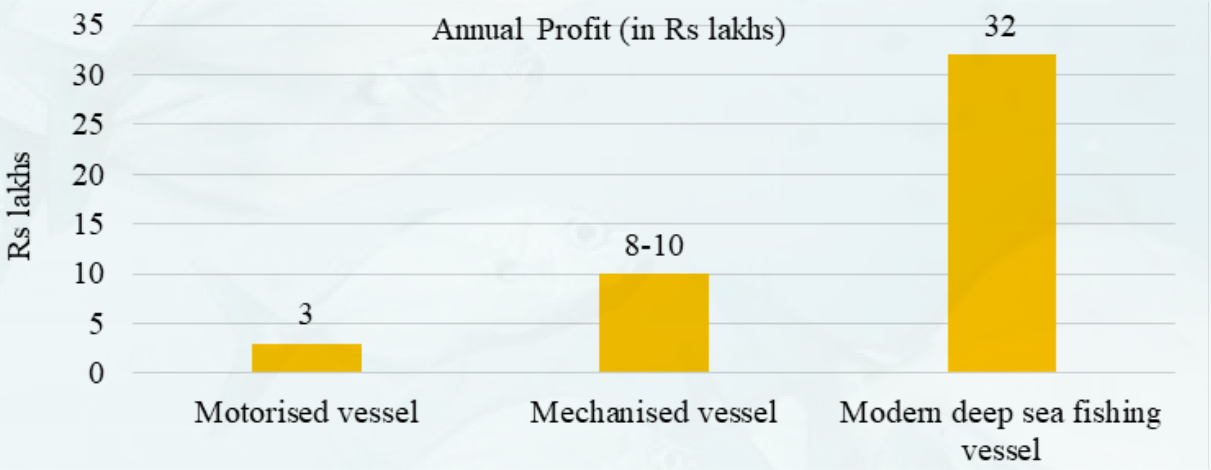
1.3 Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Significant investments in the fisheries sector to the tune of ₹ 38,572 crore have been made by the Government of India through various schemes/programs such as the Blue Revolution Scheme, Fisheries and Aquaculture Infrastructure Development Fund (FIDF), PMMSY and Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY)[10] since 2015. This financial outlay underscores the government's commitment to transforming the fisheries sector and unlocking its economic potential. Among these schemes, PMMSY is a five-year scheme from FY 2020-21 to FY 2024-25 that aims to bring about a Blue Revolution through sustainable and responsible development of India's fisheries potential. With an ambitious investment of ₹ 20,050 crores (cr), the highest-ever in the sector, the scheme received a substantial allocation of ₹ 2,248.77 cr, in the FY 2023-24 budget, marking a 38.45% increase compared to previous years. The total investment under PMMSY is divided into a Central share of ₹ 9,407 cr, a State share of ₹ 4,880 cr, and a beneficiary's contribution of ₹ 5,763 cr. Additionally, a new sub-scheme, PM-MKSSY, with a targeted investment of ₹ 6,000 cr, was introduced to enhance the earnings and incomes of those engaged in the fisheries sector. Since its launch by the Hon'ble Prime Minister on 10th September 2020, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying has effectively implemented PMMSY.

Further, concerning marine fisheries and particularly deep sea fishing vessels, the physical achievements under PMMSY (since 2020-21 till 14th December 2024) were as follows: 2259 bio-toilets in mechanized fishing vessels; 1338 upgradation of existing fishing vessels, 480 deep sea fishing vessels.[11] PMMSY also aims to promote 'Make in India' initiatives by modernising fishing vessels, low-cost Indigenous fishing vessels, and mother vessels.[12] This is the right step towards building the much-required basic infrastructure through modernisation and indigenisation of fishing vessels, which would help generate higher income for traditional fisher folks (Fig. 1.3). However, the cost component of operating these mechanized vessels must be considered to ensure positive earnings for the fisher folks.

Fig 1.3: Deep-sea Fishing Vessels: Driving Higher Incomes for Traditional Fishermen

10 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2074882 (accessed on November 21, 2024)
11 https://pib.gov.in/PressReleasePage.aspx?PRID=1986155 (accessed on November 21, 2024)
12 https://dof.gov.in/sites/default/files/2021-10/Reform_Booklet_English.pdf (accessed on November 21, 2024)



Source: https://dof.gov.in/sites/default/files/2021-10/Reform_Booklet_English.pdf

1.4 Objectives

The primary objective of this strategy report is to provide a comprehensive roadmap for harnessing the untapped potential of India's deep-sea fishery resources sustainably and responsibly. By addressing the multifaceted challenges and opportunities in this sector, the report aims to catalyze the growth of deep-sea fishing operations, thereby contributing to the overall development of the country's marine fisheries sector.

The report aims explicitly to achieve the following key objectives:

1.4.1 To assess the current status, techniques, and growth trends in India's deep-sea fishing sector, highlighting the existing gaps and untapped potential.

1.4.2 To identify the critical infrastructure, technological, and sustainability challenges inhibiting India's growth and development of deep-sea fishing activities.

1.4.3 To determine growth opportunities to be unlocked by harnessing the deep-sea fishery resources within the EEZ and international waters.

1.4.4 To improve the socio-economic condition of resource users, foster participatory management, ensure equity, and strengthen collaboration with regional fisheries organizations.

1.4.5 To recommend feasible policy interventions at the national and state levels to promote sustainable deep-sea fishing practices, addressing issues such as licensing, incentives, subsidies, and regulatory frameworks.

1.4.6 To establish robust monitoring, control, surveillance, and enforcement mechanisms to ensure the long-term sustainability of deep-sea fish stocks and marine ecosystems.

1.4.7 To examine global best practices in deep-sea fishing and sustainability measures that can be adopted in the Indian context, considering the unique challenges and opportunities.

1.4.8 To develop a roadmap for investments and infrastructure development required to build India's deep-sea fishing capacity, including fleet modernisation, skill development, and post-harvest facilities.

The scope of this strategy report encompasses a comprehensive analysis of the deep-sea

fishing sector, covering both the Indian EEZ and international waters accessible through regional fisheries agreements. It will delve into the economic, environmental, and social aspects of deep-sea fishing, addressing the concerns of various stakeholders, including coastal communities, industry players, policymakers, and conservation organisations. By providing a holistic and forward-looking approach, this strategy report aims to serve as a guiding framework for policymakers, industry stakeholders, and regulatory authorities to unlock the full potential of India's deep-sea fisheries while balancing economic imperatives with environmental sustainability and social equity.

Furthermore, the report will align the development of the deep-sea fishing sector with the United Nations Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water), ensuring that the proposed policies and strategies contribute to the sustainable use of marine resources and the conservation of ocean ecosystems.

1.5 Methodology

The methodology for developing this strategy report was comprehensive, involving secondary and primary research. A thorough literature review was conducted to collect global best practices, case studies, policies, and models from nations boasting well-established deep-sea fishing industries. This review encompassed relevant reports, publications, and data from government departments, research institutions, and online resources. An extensive analysis of government fisheries databases, reports from research institutions, the Marine Products Export Development Authority (MPEDA) and National Fisheries Development Board (NFDB), and published research papers was done. International conventions and cooperation mechanisms under Regional Fisheries Management Organisations (RFMOs) governing fishing access rights were also examined.

Primary activities included multi-stakeholder consultations with central and state government departments, exporters associations, and field visits to key fishing states. Two national workshops at Cochin, Kerala, and Visakhapatnam, AP, were organized in 2024 to gather further insights from various stakeholders. An inter-ministerial workshop on "Harnessing Deep Sea and Offshore Fishing Potential" was also held with participation from various ministries and organisations. Key participants included the representatives from the Department of Fisheries, the Ministry of Ports, Shipping and Waterways, and the Ministry of Earth Sciences. The Indian National Centre for Ocean Information Services (INCOIS), the National Institute of Oceanography (NIO), and the Centre for Marine Living Resources & Ecology (CMLRE) were also involved. The Ministry of Commerce was represented by the Marine Products Export Development Authority (MPEDA). The Indian Council of Agricultural Research (ICAR) was represented by the Central Marine Fisheries Research Institute (CMFRI) and the Central Institute of Fisheries Technology (CIFT). Additional stakeholders included the Indian Coast Guard, the National Security Council Secretariat (NSCS), the Bay of Bengal Program (BOBP), Cochin Shipyard Ltd, and the Sustainable Seafood Network India (SSNI). Furthermore, inputs from ICAR-CMFRI, CIFT, CMLRE, INCOIS, SSNI, and the Indian Coast Guard were received and incorporated into the document to provide feasible solutions for the sector. These interventions helped to understand the sector and develop practical

solutions. This participatory methodology ensured policy recommendations aligned with diverse stakeholder concerns and implementable feasibility solutions within India's federal governance system. A well-researched, evidence-based approach was adopted for developing pragmatic, tailored solutions.

1.6 The Need for a Dedicated Deep Sea Fishing Strategy in India

Deeper waters present unique opportunities, and management challenges are not adequately addressed. While India has a long history of marine fishing, the focus has traditionally been on coastal and inshore resources. With rising demand outstripping supply from overexploited coastal stocks, harnessing deep-sea resources becomes imperative to ensure food security. However, tapping the deep-sea potential requires shifting towards more capital-intensive offshore fishing through modern fleets. It also involves complex resource exploration, tracking, and harvesting technologies in a fragile ecosystem.

A streamlined legal and administrative setup must be developed to effectively regulate access, licensing and operations in the EEZ and high seas. There are gaps in safety and security standards, vessel monitoring, catch certification, Illegal, unreported and unregulated (IUU) fishing prevention, fleet modernisation, skill development, processing infrastructure, and sustainable financing, which requires coordinated long-term policy interventions. A unified fisheries control approach covering central and state agencies will facilitate effective planning and investment.

Further, as observed through stakeholder consultation, existing stock assessments using different approaches are limited due to data scarcity. Strict implementation of a vessel monitoring system (VMS) for all fishing vessels could help address this by providing more granular catch data to feed into stock assessments. This, in turn, would enable fixing sustainable catch quotas for vessels. Artisanal fleet integration merits special focus in a highly centralised sector dominated by mechanised boats. Compliance with international agreements is challenging without an empowered nodal body overseeing deep-sea activities, particularly the lack of databanks on resources beyond 200 nmi, with scientific management. Social safeguards are needed for vulnerable coastal communities exposed to industrialisation risks. Considering these complex and futuristic aspects of deep-sea fishing development, a dedicated long-term strategy and regulatory framework is indispensable. It should clarify issues pertaining to maritime zones, inter-state coordination, dispute redressal, and oversight mechanisms, which are presently in a grey area.

A holistic strategy framework will help to optimize the sustainable industrialisation of deep-sea resources for economic growth while addressing concerns through improved governance and inclusive small fisher participation in the journey. It can propel India as a leader in the Indian Ocean, responsibly harnessing its rich marine heritage. In summary, a need for a structured approach through a dedicated strategy framework has become imminent to unlock vast untapped Indian EEZ potential in a balanced and scientific manner.

CHAPTER-II

Global Deep-Sea Fishing Practices

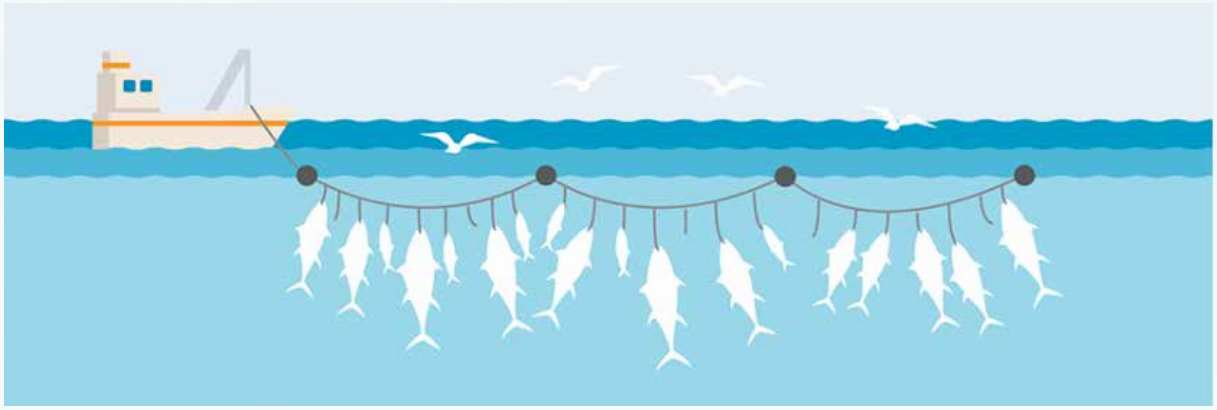
This section overviews the techniques, technologies, and vessels employed in global deep-sea fishing operations and their economic and sustainability considerations. In a worldwide context, deep-sea fishing, also called deep-sea trawling or deep-sea bottom fishing, involves harvesting marine resources from depths typically exceeding 200 m. The deep sea is the world's largest ecosystem, with deep-sea fishing fleets operating between 200 and 1800 m depth, where about 300 fish species are fished as either target species or bycatch (Priede, 2017).

2.1 Techniques, Technologies, and Vessels

Deep-sea fishing operations employ various specialized techniques and advanced technologies to locate, capture, and harvest fish stocks in the vast expanses of the open ocean. The choice of technique depends on the target species, vessel capabilities, and regulatory frameworks governing sustainable fishing practices (Annexure II provides a case study on fishing craft and gear used for offshore tuna fishing in Andhra Pradesh).

Longlining is one of the most widely used techniques in deep-sea and offshore fishing. It involves setting out a main line, often several miles long, with thousands of baited hooks attached regularly (Fig. 2.1). Longlines can be set at different depths to target specific species, such as tuna, swordfish, and halibut. Automated longlining systems have been developed to improve efficiency and reduce labour intensity.

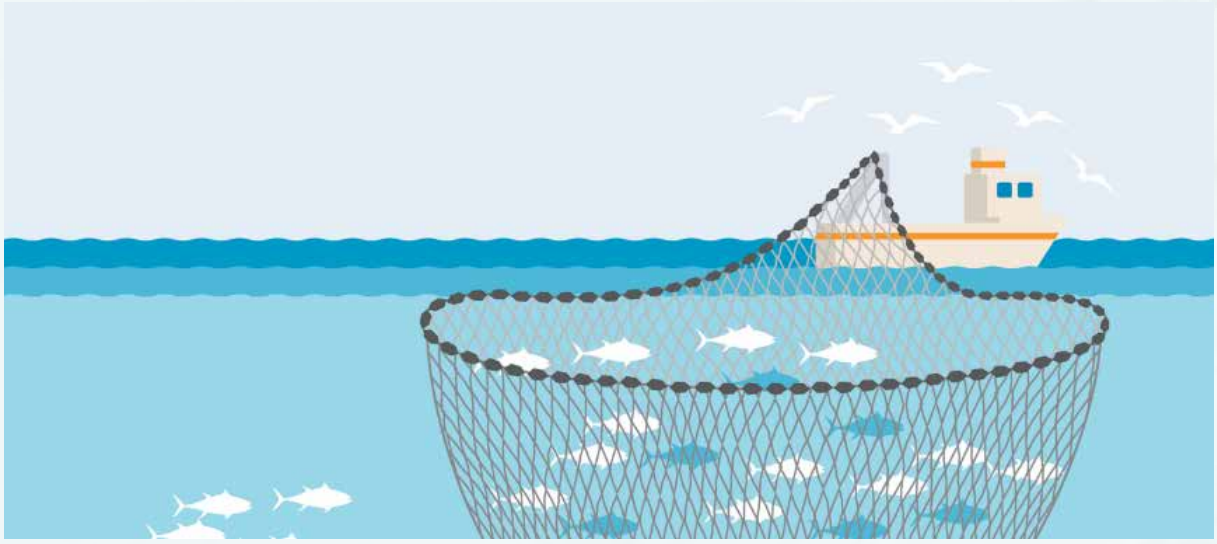
Fig 2.1: Longlining



Source: https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/longlines

Purse seining is another common method for catching pelagic species like tuna, mackerel, and sardines that travel in large schools. This technique involves encircling the school of fish with a large wall of netting, which is then closed at the bottom to form a purse, trapping the fish inside (Fig. 2.2).

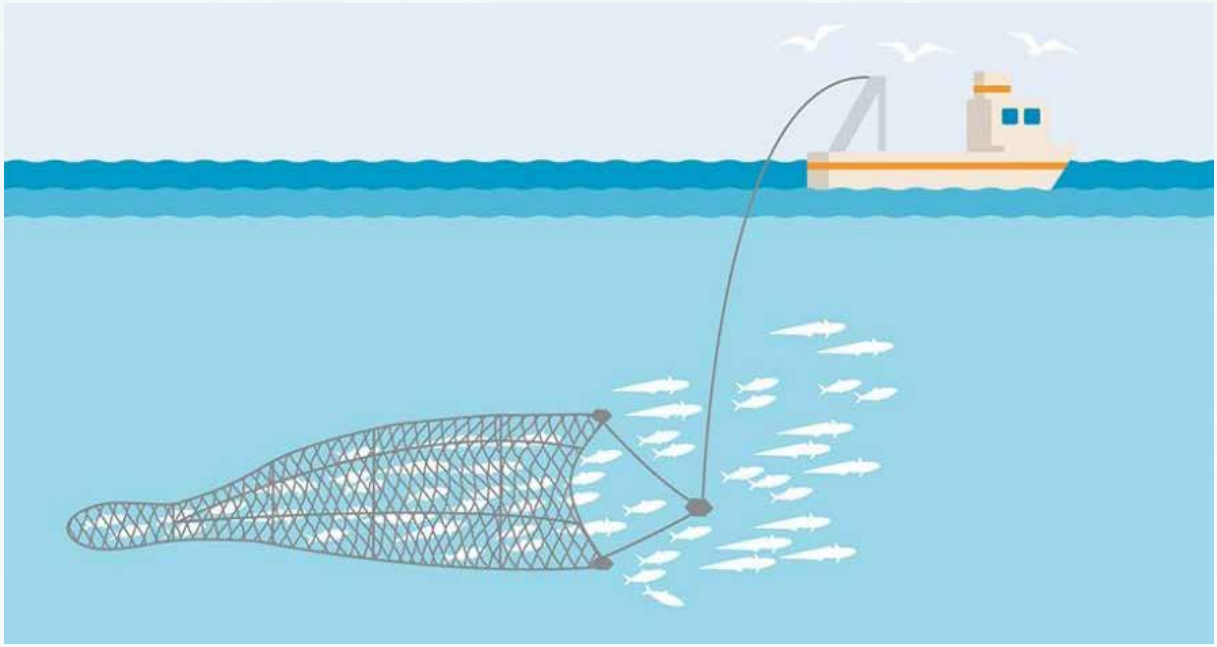
Fig 2.2: Purse seining



Source: https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/purse-seine

Trawling is employed to capture demersal species that live near the seafloor. Bottom trawlers drag large, funnel-shaped nets along the seabed, while midwater trawlers target species in the pelagic zone (Fig. 2.3). Advanced trawling systems incorporate sophisticated net monitoring and control technologies to improve catch selectivity and reduce bycatch.

Fig 2.3: Trawling



Source: https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/demersal-or-bottom-trawls

Techniques such as purse seining, longlining, and trawling are highly effective methods that improve profitability and address growing demands for seafood. However, these

methods can impose severe ecological consequences as well. As such, choosing fishing technology and vessels involves a critical balancing act. By prioritising sustainable techniques that balance economic gain and ecological preservation, the fishing industry can work towards a model that supports marine ecosystems and the communities that depend on them.

In addition to traditional fishing methods, using fish aggregating devices (FADs) has become increasingly common in offshore fisheries. FADs are floating objects that attract and concentrate pelagic fish, making them easier to locate and harvest using purse seines or other techniques. However, they must be used with strict regulations to ensure the sustainability of target fish stocks.

Deep-sea and offshore fishing operations rely heavily on advanced technologies for navigation, fish finding, monitoring, and information sharing. Global Positioning System (GPS) and electronic charts aid in precise navigation and tracking of fishing grounds. Sonar and acoustic technologies, such as echo sounders and multibeam sonars, detect and map fish aggregations, seamounts, and underwater features. Advanced deep-sea and offshore fishing technologies include Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) for mapping fish habitats and monitoring ecosystems. Landers and Crawlers provide stationary or mobile seabed monitoring, while adaptive sensor-equipped marine robotic platforms enable comprehensive fish stock assessments and habitat evaluations. These technologies improve fishing precision, reduce environmental impact, and support sustainable practices (Aguzzi et. al., 2024).

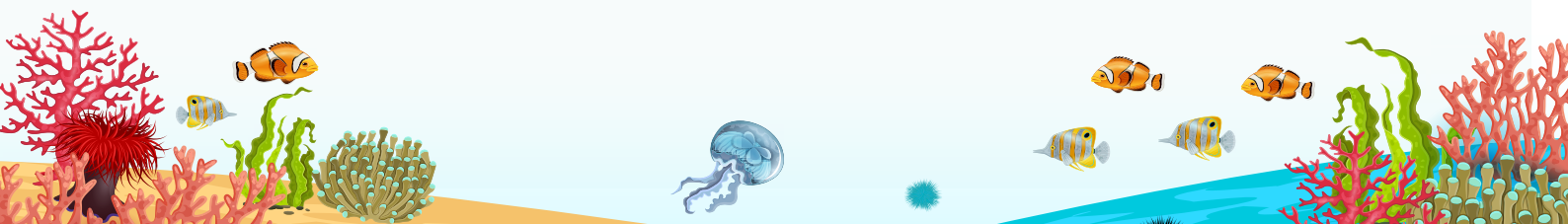
Specialized deep-sea fishing vessels are designed to withstand extended voyages and harsh ocean conditions. These small- to industrial-scale vessels have refrigerated holds, onboard processing facilities, and advanced communication and safety systems. Larger vessels may also have specialised equipment like hydraulic haulers, power blocks, and line haulers to handle the heavy fishing gear and catch.

Technological advancements have also led to the adoption of satellite-based vessel monitoring systems (VMS), Automatic Identification Systems (AIS), and electronic monitoring tools, which aid in tracking fishing activities, ensuring compliance with regulations, and supporting sustainable management efforts.

By employing these advanced techniques, technologies, and vessels, global deep-sea fishing operations aim to maximize efficiency, improve catch quality, and promote responsible fishing practices while minimising environmental impacts and ensuring the long-term sustainability of marine resources.

2.2 Economic Viability and Sustainability

Deep-sea and offshore fisheries play a vital role in the global seafood supply chain and contribute significantly to the economies of nations with access to offshore waters. However, the economic viability of these operations is closely intertwined with concerns over the long-term sustainability of deep-sea fish stocks and the health of marine ecosystems.



From an economic perspective, deep-sea and offshore fishing offer lucrative opportunities due to the high market demand and value of many targeted species, such as tuna, swordfish, and deep-sea shrimp. The total economic value of the deep-sea ecosystem is estimated at USD 267 billion per year, with fish landings from the deep sea contributing around USD 9.4 billion (Ottaviani, 2020). The total economic value of the deep sea was estimated by including the provision of deep-water fish, harvesting of precious corals, the use of marine-derived substances for pharmaceuticals, the extraction of deep and ultra-deep oil, and the potential mining of seafloor mineral resources. It also accounted for carbon sequestration performed by deep-sea ecosystems, the significance of scientific research in these environments, and tourism activities.

However, the high operational costs associated with deep-sea and offshore fishing pose significant challenges. Factors such as fuel consumption, vessel maintenance, specialised equipment, extended voyages, and crew expenses contribute to substantial overhead costs, undermining profitability and economic viability. Further, access to financing, insurance, and capital investment for fleet modernisation is often limited, particularly for small-scale operators.

Balancing the economic viability of deep-sea and offshore fishing with sustainability is crucial, as the marine ecosystems' long-term health directly influences the fishing industry's profitability and resilience. Sustainability concerns in deep-sea and offshore fisheries arise from the potential for overexploitation of fish stocks, bycatch issues, and habitat degradation. The remote and vast nature of deep-sea environments, combined with the migratory patterns of many targeted species, makes effective monitoring and management exceptionally challenging.

Illegal, unreported, and unregulated (IUU) fishing activities further exacerbate the depletion of deep-sea and offshore fish stocks, undermining conservation efforts and distorting market dynamics. Bycatch, including non-target species, marine mammals, and seabirds, significantly threatens marine biodiversity and ecosystem health.

In 2023, the Information Fusion Centre (IFC) recorded 708 Illegal, Unreported, and Unregulated Fishing (IUUF) incidents in the IFC's Area of Interest (AOI). This number was significantly higher than previous years, representing a 27% increase from 2022, when 559 incidents were recorded. The increase is even more dramatic compared to 2021, with the 2023 figure being 95% higher than the 364 incidents recorded that year. These statistics demonstrate a concerning upward trend in IUUF incidents within the IFC's AOI over the past three years (IFC, 2024).

The IUU Fishing Risk Index, which evaluates the exposure and effectiveness of 152 coastal countries in combating IUU fishing, further underscores the severity of this issue (Macfadyen and Hosch, 2023). The index assigns scores ranging from 1 (best) to 5 (worst). In 2023, the global average score across all state responsibilities and indicators was 2.28, reflecting a slight deterioration from 2.24 in 2021. Regionally, Asia and the Western Pacific exhibited the highest prevalence of IUU fishing. The North American region emerged as the most vulnerable region, while the Middle East performed the

worst in response to IUU fishing.[13] These trends highlight IUU fishing as a persistent global challenge with profound environmental, social, and economic consequences.

To address the sustainability challenges, several international and regional frameworks have been established, such as the United Nations Convention on the Law of the Sea (UNCLOS), the Food and Agriculture Organisation's Code of Conduct for Responsible Fisheries, and various regional fisheries management organizations (RFMOs). These frameworks promote sustainable fishing practices, establish catch limits, reduce bycatch, and protect vulnerable marine ecosystems. The review of the implementation of international guidelines for managing deep-sea fisheries in the high seas indicates that many of the voluntary measures for sustainable management proposed in the guidelines have been adopted by RFMOs (Thompson and Reid, 2024).

Further, climate change-induced shifts in fish stock distribution and migratory behaviour pose significant challenges to sustainable fisheries management (FAO, 2018). Adaptive strategies will be essential to ensure optimum utilization of fishery resources while safeguarding marine ecosystems. In this context, RFMOs must adopt flexible and adaptive decision-making frameworks to address these dynamic challenges (FAO, 2018). As deep-ocean climate change continues to impact habitats and fish populations, collaboration between scientists, managers, and the fishing industry will be critical.

Even as climate change threatens the distribution and abundance of fish stocks, innovative approaches, such as ecosystem-based fisheries management, marine protected areas, and selective fishing gear and techniques, can be promoted to balance economic interests with environmental considerations. Traceability systems, eco-labelling, and consumer awareness campaigns, along with improving market access, can also play a role in promoting sustainable deep-sea fisheries (Gatto et al., 2023).

Ultimately, the long-term economic viability of the deep-sea and offshore fishing industry hinges on its ability to adopt sustainable practices and effectively manage these valuable marine resources. Striking the right balance between economic incentives and environmental stewardship is crucial for ensuring the resilience of deep-sea ecosystems and the livelihoods of coastal communities that depend on these fisheries (Norse et al. 2012; Gatto et al. 2023).

2.3 Country-Specific Case Studies and Key Learnings

Examining the experiences of major deep-sea fishing nations can provide valuable insights and lessons for India as it seeks to develop its deep-sea fishing industry. This section highlights case studies from the country-specific & species-specific, analysing their practices, regulatory frameworks, and lessons learned in sustainable management, economic viability, and marine conservation.

2.3.1 **China:** China has become the world's undisputed leader in deep-sea fishing, accounting for around 36% of total global fish production and hauling around 15.2 MT of marine life annually, or 20% of the world's annual catch. China has

13 *https://iuufishingindex.net/report*

the world's largest distant water fishing fleet, numbering around 2701 vessels, compared to just 300 distant water vessels of the United States (EPRS, 2024).

i. The Chinese deep-sea fishing industry is characterized by the following factors:
   - Support for the construction and modernisation of deep-sea fishing vessels.
   - Ancillary fleets, including large trawlers, refueling ships, freezer vessels, and transport vessels, enabling extended operations at sea.
   - Substantial domestic market demand for fishery products, supporting a large-scale fishing industry.
   - Extensive presence in international waters, participating actively in global fisheries.

ii. Voyage of the Chinese Fishing Fleet: Recently, an enormous Chinese fishing fleet, with around 350-400 vessels, traversed from the South China Sea to the South Pacific Ocean, then to the South Atlantic Ocean, and back to the South China Sea, exploiting fishing resources along the way.[14]

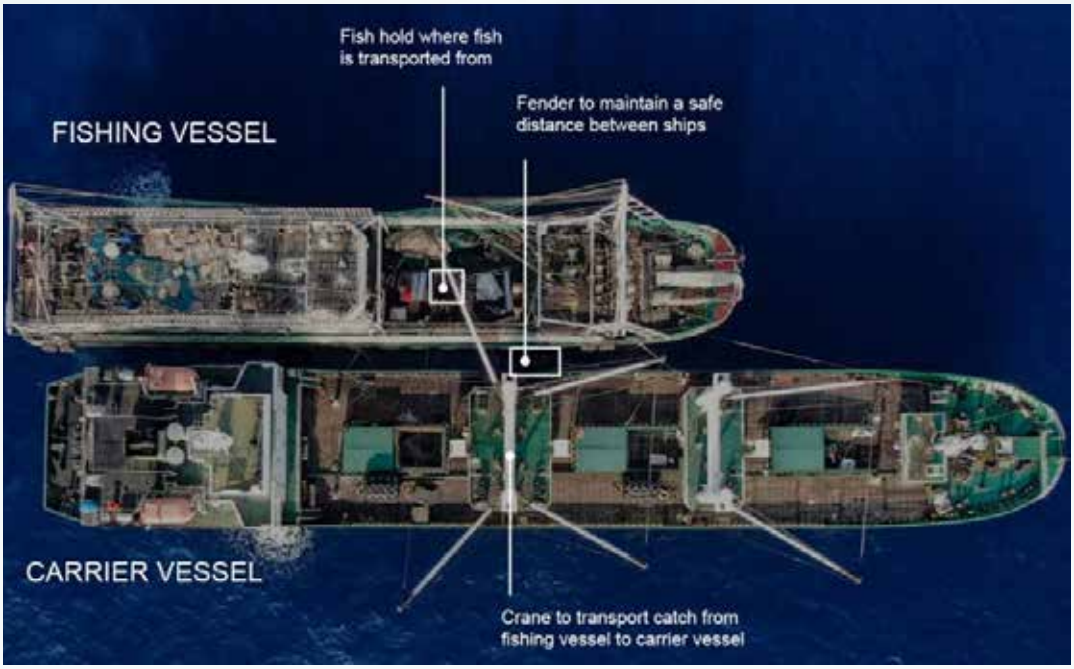
iii. Transhipment of Cargo: China can fish on a large industrial scale due to ancillary cargo ships called "motherships" accompanying the fishing fleet (Fig. 2.4). These motherships have refrigerated storage to hold and preserve the catch fuel and other supplies for smaller ships, which can unload their catch and resupply their crews at sea (Fig. 2.5 and 2.6) as a result, the fishing vessels need not visit ports regularly.

Fig 2.4: Chinese Mothership vessel Hai Feng 718

14 *https://www.defstrat.com/magazine_articles/china-expands-its-maritime-footprint-in-the-indian-ocean-through-its-fishing-fleet/ (accessed on September 21, 2024)*

Fig 2.5: Chinese Fishing Fleet with Mothership Vessel at South America

Fig 2.6: Trans-shipment between Mothership and Fishing Vessels



Source: Global-View-of-Transshipment-Preliminary-Findings-GFW.pdf (globalfishingwatch.org)

iv. Modernization in the Fishing Sector: China is expected to improve its management, technological equipment, and degree of systematisation of marine fisheries facilities. Efforts are ongoing to strengthen fishing village construction, optimising

the fishermen's employment structure, and effectively safeguard and improve people's livelihoods through the fishing sector (Cao et al., 2017).

2.3.2 **Japan**: As a leading nation in offshore fishing, Japan has a long history and extensive experience in harvesting tuna and other pelagic species from distant waters. The Japanese offshore fishing fleet is highly advanced, employing cutting-edge technologies and specialised vessels. However, Japan has faced challenges with overfishing and the depletion of certain fish stocks, leading to stricter catch limits and management measures. Key learnings include the importance of sound scientific data, effective monitoring and enforcement mechanisms, and the need for international cooperation through RFMOs.[15]

2.3.3 **Spain:** Spain is a major player in offshore fishing, focusing on tuna, swordfish, and other high-value species. The Spanish fleet operates globally, including in the Indian Ocean region. Spain has made significant strides in implementing sustainable fishing practices, such as using circular hooks to reduce bycatch and adopting VMS for better tracking and regulation. Key learnings include the benefits of fleet modernisation, investment in research and development, and the importance of stakeholder engagement in policymaking.[16]

2.3.4 **United States:** The United States has a well-established deep-sea and offshore fishing industry, particularly in the Pacific and Atlantic Oceans. The U.S. has implemented a comprehensive regulatory framework, including the Magnuson-Stevens Fishery Conservation and Management Act, which emphasizes science-based management, catch limits, and protecting essential fish habitats. Key learnings from the U.S. experience include the value of robust data collection and stock assessments, the role of marine protected areas, and the importance of capacity-building and training programs for fishers (Hildreth, 2008).

2.3.5 **Sri Lanka:** As a fellow Indian Ocean nation, Sri Lanka offers valuable insights into India's deep-sea fishing aspirations. Sri Lanka experienced significant growth in deep-sea fisheries after 2000 because of a rapid increase in new vessels with modern technology and the development of export market opportunities (Kariyawasam et al., 2010). Sri Lanka has made significant strides in developing its deep-sea fishing capabilities, particularly in tuna fishing. The country's multi-day fishing fleet consists of about 4,200 vessels, and the high seas fishing fleet is around 1,500 vessels, it targets high-value species like yellowfin tuna, bigeye tuna, and swordfish. Sri Lanka's success in accessing European markets for its tuna exports, despite initial challenges with (IUU) fishing, demonstrates the importance of robust monitoring and compliance systems. The country has implemented vessel monitoring systems (VMS) and strengthened its legal framework to combat IUU fishing. Sri Lanka's experience highlights the potential for smaller nations to compete in the global deep-sea fishing market while emphasizing the need for sustainable practices and international cooperation. India could learn from Sri Lanka's approach to fleet modernisation, export market access, and balancing artisanal and industrial fishing interests in the deep-sea sector.[17]

15 *https://www.fao.org/4/ac750e/AC750E08.htm*
16 *Spain and the Common Fisheries Policy. Published online 2010.*
17 *https://earthjournalism.net/stories/sri-lankan-government-to-expand-vessel-monitoring-as-fishers-continue-to-fish-in-foreign (accessed on September 21, 2024)*

China's extensive distant water fleet and global reach demonstrate
- *the potential scale of deep-sea operations*
- *concerns about overfishing and the need for responsible practices.*

Japan's experience emphasizes
- *importance of scientific data and*
- *international cooperation.*

Spain's adoption of
- *sustainable fishing practices and fleet modernization*
- *offers a model for technological advancement.*

USA's comprehensive regulatory framework showcases the
- *value of science-based management and*
- *stakeholder engagement.*

Sri Lanka's experience highlights
- *potential for smaller nations to compete in the global market*
- *need for sustainable practices and international cooperation.*
- *approach to fleet modernization, export market access, and balancing artisanal and industrial fishing interests in the deep-sea sector.*

2.3.6 **Other notable case studies include:**

- New Zealand successfully implemented a quota management system (QMS) and marine conservation efforts.
- Norway's sustainable management of its deep-sea fisheries, including cod and herring stocks.
- Chile's efforts to combat illegal fishing and promote traceability in its deep-sea fisheries.

2.4 Species-Specific Case Studies

2.4.1 **Orange roughy**, *Hoplostethus atlanticus* Collett, 1889 (Trachichthyidae) has a wide distribution. It is known from North West (NW) and North East (NE) Atlantic, throughout much of the eastern Atlantic, South Central Indian, and South West (SW) and South East (SE) Pacific at depths 500-1000 m. The fisheries were initiated from the catches by Soviet vessels in the 1970s around New Zealand. Currently, the species is targeted by fisheries in New Zealand, off Australia, NE Atlantic, off Namibia, off Chile, and in the Southern Indian Ocean. Overfishing has led to a significant decline in orange roughy populations, prompting governments to implement strict quotas and fishing restrictions to allow stocks to recover. Japan, New Zealand, and South Korea are the major countries that exploit orange roughy.

2.4.2 **Greenland halibut**, *Reinhardtius hippoglossoides* Walbaum, 1792 (Pleuronectidae), also known as Turbot, is a deep-sea halibut fishery, which employs demersal trawls (800-1,400 m) and takes place in both the North Atlantic and North Pacific Oceans. In the Atlantic, the best-known areas for Greenland halibut have been on the continental slopes and high seas. The fishery was developed in the 1960s in the Davis Strait, Denmark and has improved considerably since the identification of other fishing areas. Greenland halibut fishery received Marine Stewardship Council (MSC) certification in 2017.

2.4.3 **Slender armorhead** (Pentacerotidae) inhabits 400-1200 m seamounts and is found in all oceans. Three species are observed in the fishery, namely, the pelagic

armourhead (*Pseudopentaceros richardsoni*), the slender armourhead (*P. wheeleri*), and longfin (*P. pectoralis*). The fishery was started in the 1960s mainly by Japan and the erstwhile USSR by trawling in the Emperor Seamount area.

2.4.4 **Grenadier** (Macrouridae) is widespread in oceans and mainly exploited by bottom trawlers from 600-1500 m depths in the mid to upper continental slope. Roughead grenadier and round nose grenadier are the exploited species in the North Atlantic. Concerns about habitat destruction and bycatch of vulnerable species such as deep-sea corals and sponges have been raised regarding this fishery. Efforts are underway to mitigate these impacts through better fishing practices and area closures.

2.4.5 **Blue whiting** (*Micromesistius poutassou*), a bathypelagic species found at depths 150-3000, is exploited by trawls and purse seines in the North Atlantic, shared by Norway, EU, and Iceland. The fishery was initiated in the 1970s. Currently, it is managed using catch quotas to ensure resource sustainability.

2.4.6 **Patagonian toothfish:** Mostly exploited from the Southern Ocean; Illegal, unreported, and unregulated (IUU) has threatened the sustainability of this species. International cooperation and enforcement efforts, such as establishing the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), have been critical in combating IUU fishing and promoting sustainable management of toothfish stocks.

2.5 Key Learnings

Key learnings from these case studies highlight the importance of several critical factors in developing a sustainable and economically viable deep-sea fishing industry:

Science-based management:	**Regulatory frameworks:**	**Collaborative governance:**	**Capacity building:**	**International cooperation:**	**Ecosystem-based approach:**
Robust data collection, stock assessments, and research for informed decision-making and effective conservation measures.	Comprehensive state, national, and international regulations (catch limits, gear restrictions, and monitoring systems) for sustainable management.	Engagement with stakeholders for successful policy implementation.	Investment in modern fleets, infrastructure, and training programs for fishers and industry personnel for efficient and responsible operations.	Participation in Regional Fisheries Management Organisation (RFMOs) and adherence to international agreements for managing shared resources & combating illegal fishing.	Adopting an ecosystem-based fisheries management approach for long-term sustainability.

As India progresses in developing its deep-sea fishing sector, these insights from global practices can inform the creation of a robust, sustainable, and economically viable sector. By carefully adapting these lessons to its unique context, India can position itself to harness the potential of its deep-sea resources while ensuring their long-term conservation and the well-being of its coastal communities.

CHAPTER-III

India's Deep-Sea and Offshore Fishing Sector: Overview and Status

The evolution of Indian marine fisheries over the last 30 years is crucial to understanding the current landscape. India was traditionally a coastal fishing nation, with fishing concentrated within the territorial waters (TW) within 12 nmi from the coastline. Fishing durations were typically short, lasting only 1 to 2 days per voyage. However, in the last three decades, fishing has expanded beyond the TW into the offshore waters of the EEZ using larger mechanised boats and outboard motorboats. This shift has involved the adoption of various fishing techniques, such as strawling, gillnetting and seining, with fishing durations now averaging 3 to 15 days per voyage.

Offshore fishing in the EEZ is now practised by nearly 50,000 mechanised boats and a large number of outboard motorboats along the coastline, harvesting pelagic, midwater and bottom fish resources. While India has a well-established coastal fisheries sector, its deep-sea and offshore fishing industry remains relatively underdeveloped compared to its potential. This expansion into off-shore and high-sea fisheries presents a unique opportunity to further develop and organize the sector.

India's marine fish production has been around 2.7 MT per annum in the last decade (2001-2010), increased to 3.9 MT in 2012, and remained constant till 2020 (CMFRI, 2021). Finfishes constitute the major share of this, and the major share of Indian marine fisheries comes from operations within 200 m depth zones. India is the largest country in the Indian Ocean region, comprising a coastline of 11098 km (including Islands). With absolute rights on the EEZ, India has also acquired the responsibility to conserve, develop, and optimally exploit the marine resources up to 200 nm off our coastline (GoI, 2007).

This section provides the historical context and an overview of the current status, growth trends, fishing areas, infrastructure, and institutional and regulatory framework related to India's deep-sea and offshore fishing activities.

3.1 Sector Overview: Historical Context, Current Landscape, and Emerging Trends

In 1946, the Government of India initiated plans to identify potential fishery resources beyond the regular fishing area by establishing a Deep-sea Fishing Station in Mumbai, which established survey stations across the country and was later renamed the Fishery Survey of India (FSI) (FSI, 2024). In addition, other publicly funded agencies have also undertaken surveys to assess the deep-sea fisheries and diversity over the years. The surveys of FSI provided information on demersal and deep-sea resources within 500 m depth; the results also showed rich deep-sea diversity and potential resources (Sudarsan and Somavanshi, 1988; Somavanshi, 1998). Since 1976, after the declaration of the EEZ, the country's fisheries and marine biological research institutes were assigned to collect data on the distribution and abundance of deep-sea and offshore resources and develop techniques for their exploitation and utilisation (Reeves et. al., 1996).

The inception of the Fishery Oceanographic Research Vessel Sagar Sampada (FORV Sagar Sampada) in 1984 was the turning point in Indian deep-sea fisheries research. Since its inception, FORV Sagar Sampada has been surveying and supporting deep-sea fishery research (Venu, 2009; Rajasree, 2011; Hashim, 2012). Sagar Sampada surveys have reported the existence of fairly rich grounds of deep-sea fishery resources in the EEZ of India (Sivakami, 1990; Sivakami et. al., 1998; Venu and Kurup, 2002; James, 2014). Early exploratory surveys of Sagar Sampada conducted in 1985 pointed towards rich grounds of deep-sea prawns up to 800 m depths, which are being exploited now (James and Pillai, 1990; Pillai et. al., 2009). The deep-water shrimp fishery was one of the first to develop and commercialize. Since 1988, deep-water sharks have been exploited in Andaman waters, and since 2000, deep-water sharks have been exploited along southern India[36].

Over the past four decades, the Government of India has undertaken various initiatives to develop offshore and high-seas fisheries by introducing capital-intensive fishing techniques with foreign assistance in technology and expertise.

Key policy interventions include:

- Deep-Sea Fishing Policy (1977)
- Chartering of Fishing Vessels (1981)
- New Deep-Sea Fishing Policy (1991)
- Joint Ventures, and the import of foreign vessels under the Letter of Permit (LoP) scheme of the EXIM Policy (2002)
- Comprehensive Marine Fisheries Policy (2004)
- National Policy on Marine Fisheries (2017)
- Draft Indian Marine Fisheries Bill (2021) (to be ratified)
- Draft Guidelines for Regulation of Fishing by Indian Flagged Fishing Vessels in the High Seas (2022) (to be ratified)

However, these efforts primarily relied on capital-intensive fishing fleets and outsourced expertise. They also faced significant resistance from fishing communities, failing to achieve the desired outcomes (Parappurathu et. al., 2020). Consequently, many of these schemes were discontinued midway. Recognizing these challenges, expert committees were formed at various points to suggest measures for promoting high-seas fisheries. These included the Sudarshan Committee (1994) and the Murari Committee (1996), constituted in response to demands from the fishing community. This highlights the critical need to develop and explore indigenous capacity and expertise and ensure the active inclusion of fishing communities in the design and implementation of such initiatives.

Regardless, India's deep-sea fishing industry is still nascent, with significant untapped potential to be harnessed. The estimate for the overall EEZ potential in 2018 was 7.158 MT, including conventional (74%) and non-conventional resources (26%). The potential

of conventional resources was estimated at 5.31 MT in 2018 and 4.41 MT in 2010 (Table 3.1). Considering the depth-wise potential, in the 200-500 m depth zone, the estimate was 97,461 tonnes during 2018, constituting around 1.8% of the total conventional resources (Fig. 3.1). The resource potential in the 200-500 m depth zone was highest on the southwest coast (60%), followed by India's northwest coast (26%).

The estimate for non-conventional resource potential stood at 1.847 MT. Out of the non-conventional resources, the resource potential for deep-sea myctophids was 1 MT, followed by ocean squids (0.63 MT), jellyfish (0.2 MT), and marine algae (0.017 MT), indicating the additional resources that could be tapped for deep-sea fishing (Table 3.1). Notably, the strategy for harvesting and utilising high-sea non-conventional resources will completely differ from other offshore and high-sea resources. Some non-conventional resources are slow-growing and late to mature, resulting in very low resilience and are extremely susceptible to overfishing. They do not contribute huge volumes, and there are indications of declining biomass (for example, orange roughy exploited by bottom trawlers at great depths). On the other hand, flying squid and myctophids are large biomass resources but can be used for human consumption only after processing. Globally, myctophids are used for fish meal production.

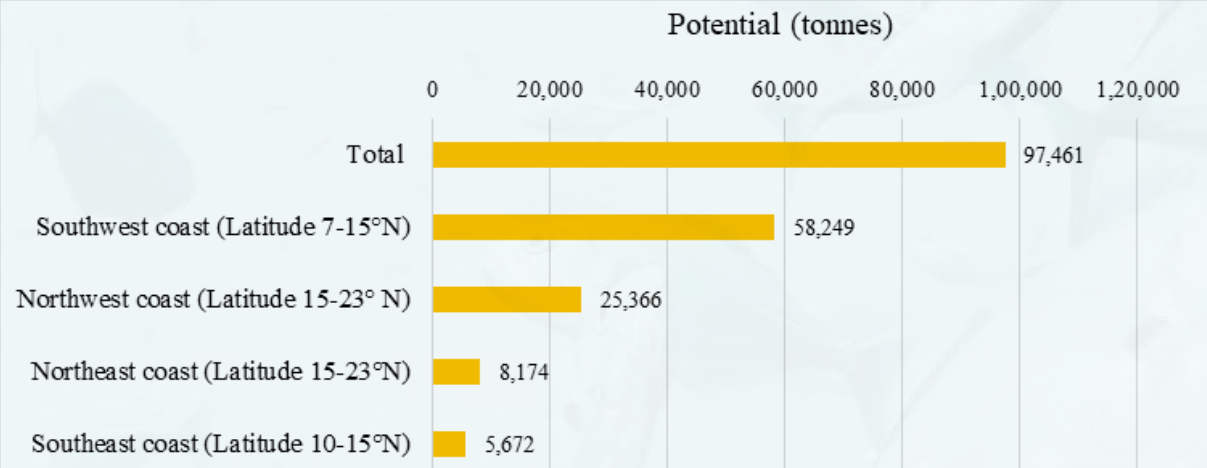
Table 3.1: The revalidated potential of the Indian marine waters, including EEZ

Conventional Resources	**Quantity (tonnes)**
Demersal resources (mainland)	22,98,281
Pelagic resources (mainland)	26,31,827
Lakshadweep (excluding oceanic resources)	14,490
Andaman & Nicobar (excluding oceanic resources)	43,794
Oceanic (for the entire EEZ)	2,30,832
Others	91,369
Sub-total	**53,10,593 (44, 11, 687*)**
Non-conventional resources	**Quantity (tonnes)**
Deep sea Myctophids	10,00,000
Ocean squids	6,30,000
Jellyfish	2,00,000
Marine macroalgae	17,775
Sub-total	**18,47,775**
Total	**71,58,368**

Source: Department of Animal Husbandry, Dairying, and Fisheries (DADF), 2018

(*) Please note that the figure in parenthesis is the potential yield estimate data corresponding to the year 2010, and it was obtained from the Report of the Expert Committee constituted for Comprehensive Review of the Deep Sea Fishing Policy and Guidelines. New Delhi: Department of Animal Husbandry, Dairying & Fisheries.

Fig 3.1: The resource potential in the deep-sea realm (200-500 m depth) of mainland Indian EEZ (*Including Wadge Bank and Gulf of Mannar)



Source: Department of Animal Husbandry, Dairying, and Fisheries (DADF), 2018

3.2 Deep-sea fisheries operated in potential locations

3.2.1 Southwest deep-sea prawn fishery:

- Operates primarily off Kerala, along the southwest coast of India.
- Began in 1999 with small and medium trawlers venturing into deep-sea fishing.
- The fishery has experienced growth, collapse, and recovery periods.
- Major fishing ground is off the Kollam area, with around 81% of deep-sea prawn trawlers operating there[37].
- The trawlers range from 15 to 40 m long and are well-equipped with modern fishing devices.
- Dominant species include *M. andamanensis*, *A. alcocki*, *P. quasigrandis, H. chani,* and *H. woodmasoni*[37].
- There is significant diversification in targeted species and areas of operation by the seasonal fishers due to economics and demand drivers

Fig 3.2: Deep-sea prawns landed at Cochin Fisheries Harbour

3.2.2 **Southwest deep-sea shark fishery:**

- Emerged rapidly along the west coast of India from 2000 onwards, driven by international demand for shark liver oil (squalene).
- Targets gulper sharks (Centrophoridae) using hook and line, longline, and bottom set gillnet fishing methods.
- Major landing centers include Cochin, Kollam (Kerala), and various ports in Tamil Nadu.
- The highest landing of 305 tonnes was recorded in 2008, but landings have decreased considerably over the years due to fluctuations in demand38.
- Concerns about stock sustainability and the need for regular monitoring due to potential depletion or collapse, as observed in other regions.

3.2.3 **Deep-water shark fishery of Andaman:**

- It is one of the oldest targeted deep-water shark fisheries in India, and it has been recorded since the 1980s.
- Targets Centrophorus spp. and Squalus spp. for liver oil extraction and meat utilization.
- Estimated landings varied from 2.8 to 4.6 t between 1988 and 1991[39].

3.2.4 **Deep-sea shrimp fishery off Tuticorin:**

- Trawlers have operated in deeper waters since the late 1980s, primarily during October to March.
- The main catch includes shrimps like Plesionika spinipes, Heterocarpus woodmasoni, Aristeus alcocki, Metapeneopsis andamanensis, and Solenocera hexti.
- Seasonal deep-water shrimp fisheries also exist in Nagapattinam and Chennai.

3.2.5 **Deep-water fisheries of Thoothoor Belt (Muttom, Thengapattinam, Colachel, Thoothoor):**

- This region is known for skilled fishers adept in deep-sea and offshore fishing.
- Besides offshore fishing, they also land-targeted deep-water shrimps, sharks, and deep-water bycatch from fisheries operating at greater depths.

These operations indicate that the deep-sea fisheries in India are diverse and regionally specialised, targeting species such as prawns, sharks, and shrimps.

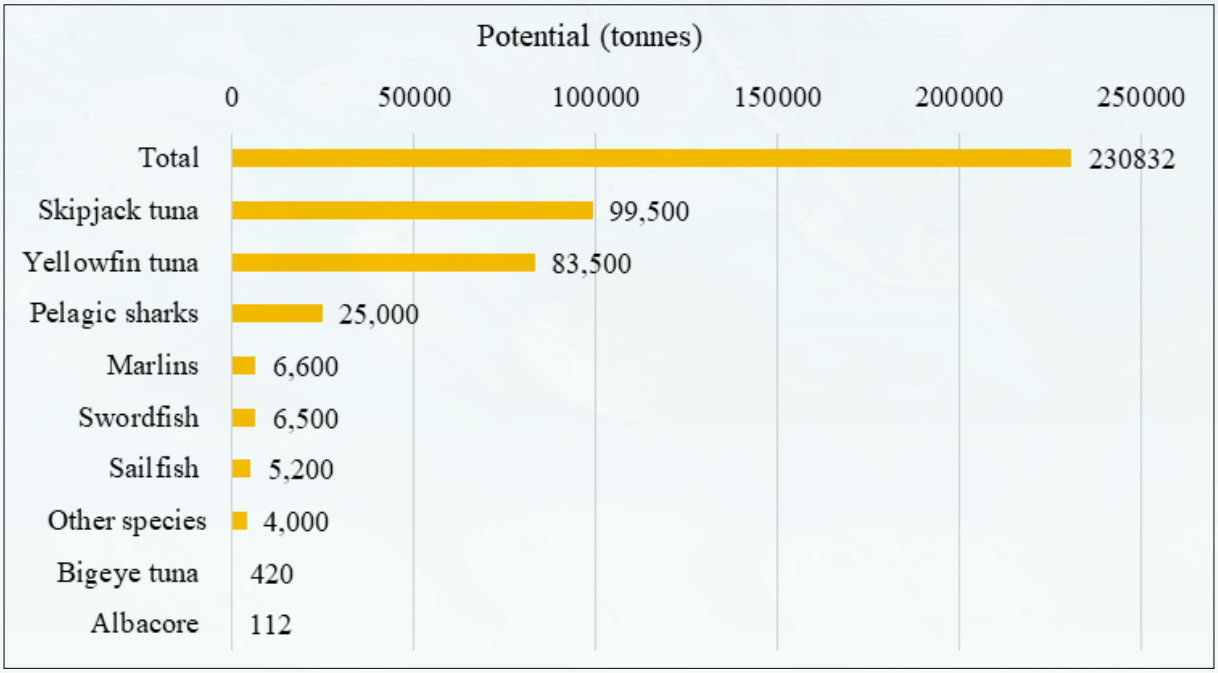
a. Offshore/oceanic fisheries of India

India possesses significant untapped offshore/oceanic fisheries potential within its EEZ. According to the Department of Animal Husbandry, Dairying, and Fisheries (DADF), the total conventional resource potential for the Indian EEZ, including the Andaman and Nicobar Islands, is estimated at 2,30,832 tonnes. The highest potential is estimated for

skipjack tuna (99,500 tonnes), followed by yellowfin tuna (83,500 tonnes) and pelagic sharks (25,000 tonnes) (Fig. 3.3) (Annexure I provides details of developing offshore tuna fisheries in India). The economic importance of tuna fisheries is indicated by the fact that the global tuna industry is valued at over $40 billion annually.[18] However, it is also important to note that the stock of yellowfin tuna in the Indian Ocean is currently subject to overfishing, and the Indian Ocean Tuna Commission (IOTC) has recommended rebuilding measures to ensure its long-term sustainability, which also has implications for India's tuna fisheries.[19] The potential for oceanic squids, too, is estimated at a staggering 6,30,000 tonnes, representing an underutilised resource (DADH, 2018).

Despite this significant potential, several challenges hinder its full exploitation. The migratory nature of oceanic tunas and allied resources often leads to these fish being harvested in the EEZs of neighbouring countries or the high seas by distant water fishing nations, highlighting the limitations Indian fishers face due to policy gaps and inadequate infrastructure support. Furthermore, areas like the Wadge Bank in the Northern Arabian Sea and Laccadive waters, which offer some of the best offshore fishing grounds within the Indian EEZ, have remained largely unexploited and are even subject to poaching.

Fig 3.3: Resource potential of oceanic resources in the Indian EEZ



Source: Department of Animal Husbandry, Dairying, and Fisheries (DADF), 2018

Other species include barracuda, dolphin fish, wahoo, pelagic rays etc.

The Indian Ocean Tuna Commission (IOTC) has estimated the potential of tuna fishery in the Indian Ocean. They have set the maximum sustainable yield (MSY) for Yellowfin tuna at 3.44 lakh tonnes (LT) and reported that exploitation should not exceed 3 LT for sustainable production.[20]

18 *https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2073291 (accessed on November 20, 2024)*
19 *https://www.seafoodsource.com/news/supply-trade/iotc-publishes-2022-yellowfin-tuna-catch-limits*
20 *https://mpeda.gov.in/?page_id=633 (accessed on 8th March, 2024)*

Studies from the Indian National Centre for Ocean Information Services (INCOIS) involving satellite tagging of yellowfin tuna have provided valuable insights into the habitat and migratory patterns of important pelagic species within Indian waters. The tagging research showed that yellowfin tuna predominantly remains within the India EEZ and does not undertake long migrations as previously believed. Their habitat was also mapped in detail, including preferred depth ranges. This scientific knowledge helps better understand yellowfin tuna distribution in offshore regions targeted by domestic fleets. It indicates the potential for expansion of yellowfin tuna fisheries if fishing is concentrated in these identified offshore habitat areas based on guidance from habitat distribution models developed using such tagging data (Bright et. al., 2016).

Offshore/Oceanic Fisheries Case Studies

India's offshore fisheries are widespread and diverse, targeting a range of tuna and other abundant pelagic resources. The fishing activities have expanded spatially, with vessels of varying sizes and technologies employed, from small traditional crafts to large mechanised boats equipped with modern fishing gear. The transition from single-species target gears to combination gears has enabled exploiting multiple available resources within the same fishing trip or season.

One of the major offshore fisheries in India is the oceanic tuna and large pelagic fishery. Four tuna species contribute significantly to this fishery, namely, *Thunnus albacares*, *Katsuwonus pelamis, Gymnosarda unicolor*, and *Thunnus obesus*. Gillnets, hooks and lines are the primary gears used, with the southeast coast, particularly Andhra Pradesh, being the leading contributor (Abdussamad, 2012) (Fig. 3.4).

Fig 3.4: Yellowfin tuna landed by offshore fleets at Cochin Fisheries Harbour

The Thoothoor fishermen of Kanyakumari district in Tamil Nadu are renowned for their indigenous expertise in offshore fishing for tuna and tuna-like species. With a fleet of over 500 vessels, ranging from 12 to 22 m in length, these artisanal fishermen contribute

a significant share of offshore fish landings in India. Their fishing grounds extend not only within the EEZ but also into ABNJ, targeting a variety of offshore resources including sharks, tunas, rays, seer fish, and billfishes (Parappurathu et. al., 2020; Surya et. al., 2023).

In the north of Andhra Pradesh, traditional fishermen from Visakhapatnam and Pudimadaka have been engaged in offshore tuna fishing for a long time. Using motorised fishing craft and employing troll lines or hook and lines, they primarily target yellowfin tuna and other large pelagics like kingfish, marlin, sailfish, wahoo, and dolphinfish. Approximately 1500 traditional vessels participate in this fishery, with an average catch[21] of 2-3 yellowfin tunas, 1-2 billfishes, 3-4 dolphinfish, and a few coastal tunas per trip.[22]

Thus, India's offshore fisheries are characterised by regional expertise, technological diversity, and significant contributions from artisanal and traditional fishermen. However, maximising the human utilisation of offshore resources requires addressing post-harvest management, market values, and processing alongside sustainability concerns to fully capitalise on these valuable resources' nutritional and economic benefits.

b. High seas and ABNJ fishing

India, a nation with an extensive coastline, has yet to establish a significant presence in the high seas and ABNJ, despite the vast opportunities these areas present. While the structure of ocean usage by mankind has changed significantly in recent years, with the high seas and ABNJ accounting for more than 64% of the global oceans[23], India has not been able to capitalise on this common pool resource.

The exploitation of the high seas has increased by 400% since the 1950s[24], with several nations taking advantage of technological advancements, capacity, and policy gaps to exploit a significant share of these resources, often unaccounted for (Fig. 3.5). This unchecked exploitation significantly threatens the oceans, creating geopolitical complications and challenges. The United Nations Agreement on Biodiversity Beyond National Jurisdiction or BBNJ Agreement, also referred to by some stakeholders as the High Seas Treaty or Global Ocean Treaty, is a recent legally binding instrument for the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, aimed at protecting the high seas from pollution, climate change, and overfishing.

The IOTC monitors the high seas area, which has been exploited by at least 30 contracting party countries and IOTC-registered vessels ranging from 10 to 80 m in overall length[25]. Smaller neighbouring countries, such as Iran and Sri Lanka, have exploited the high seas for high-value resources with their artisanal fleets for decades[26]. However, India has yet to exploit these common pool resources effectively.

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21 These are average quantities of each species caught by a single fishing vessel.
22 https://www.fao.org/fishery/en/publications/25574 (accessed on 22nd April 2024)
23 https://globaloceanforum.com/areas-of-focus/areas-beyond-national-jurisdiction/ (accessed on 21st September, 2024)
24 https://www.iied.org/it-time-control-fishing-high-seas-protect-life-ocean-coastal-people-who-depend-it (accessed on 21st September, 2024)
25 www.fao.org/publications (accessed on 21st September, 2024)
26 https://iotc.org/vessels (accessed on 17th September, 2024)

In 2017, the last Indian Letter of Permit (LoP) vessel ceased operations. As of 2023, only four Indian-flagged vessels owned by the Fishery Survey of India (FSI), Government of India, are available for high-seas fishing (Table 3.2)[49]. This number is significantly lower compared to countries with the most significant number of authorized fishing vessels, such as Sri Lanka (1,883) and Iran (1,216) in the IOTC region (Fig. 3.5). The stark disparity highlights India's limited participation in high-seas fisheries, particularly given its vast coastline and strategic position in the Indian Ocean. This limited presence could be attributed to operational, regulatory, and infrastructural challenges, including the cessation of LoP vessels.

To address this gap, the proposed "*Guidelines for Regulation of Fishing by Indian Flagged Fishing Vessels in the High Seas, 2022*" are critically needed. As per the guidelines, permits can be issued to "any Indian citizen; Indian entrepreneur; Partnership firm; Private Ltd Company; Public Ltd. Company; Corporation; and Registered Cooperative Society". This could help to promote Indian vessel participation in high seas fisheries, thereby increasing national earnings and ensuring a fair share in the common pool of marine resources of the high seas.

Table 3.2: Number of Authorized Fishing Vessels by Country in the IOTC Region/High Seas (2013-2023)

Flag	Years										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Australia	9	4	2	2	3	3	3	3	2	2	4
Belize	3	4									
China	31	36	46	54	71	75	74	72	70	70	67
France (EU)	8	28	29	29	29	30	28	55	24	27	23
Italy (EU)			1	1	1		1	1	1	1	1
Portugal (EU)				1							
Spain (EU)	36	25	35	33	29	28	26	26	24	23	27
United Kingdom (EU)			1	1		2	2				
France (Territories)	5										
Guinea											
India	15	25					4	4	4	4	4
Indonesia			584	271	246	324	315	382	435	462	567
Iran		1228	1195	1205	1236	1221	1213	1210		1213	1216
Japan	73	53	56	46	42	49	48	60	53		41
Kenya				1			3	10		6	7
Madagascar	8	7	7	7	7	5	5		5		5
Malaysia		10	10	10	19	19	17	17	20	20	16
Maldives	318	344	367	372	400	391	393	373	372	375	354
Mauritius	2	7	7	7	7	10	15	3	3	17	20
Mozambique		2	9	11	2	2	4	14	6	6	

Flag	Years										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Oman	5	3	1	1	1		1	1		4	5
Pakistan											
Philippines	9	4									
Republic of Korea	13	14	19	18	18	14	12	14	7	7	6
Senegal											
Seychelles	43	37	50	77	71	83	92	87	95	92	101
South Africa	16	4	9	8	17	24	17	15	14	20	19
Sri Lanka	2241	1609	1577	1367	1371	1094	1004	832	1046	1336	1883
Tanzania	5	3	3	3			1	1			
Thailand	2	6	6								
Uruguay											
Vanuatu											
Grand total	2842	3453	4014	3525	3570	3374	3278	3180	2181	3685	4366

Source: https://iotc.org/vessels, as of 18/04/2024

Fig 3.5: Number of authorised vessels in the IOTC region in 2023

Source: https://iotc.org/vessels, Indian Ocean Tuna Commission (IOTC)

Developing distant water fisheries in ABNJ is a major suggestion in the "Blue Economy" initiative for developing nations' marine fishing sectors. Although these fisheries in the high seas form only a small portion of the world's fisheries, they represent a high-value

group. Untapped resources are available in the ABNJ near Indian waters, but they are often exploited by vessels from Taiwan, Thailand, and China due to limited information and awareness among Indian entrepreneurs regarding the availability, distribution, and abundance of these resources.

The exploitation trends of foreign vessels in the Indian Ocean, Southern Ocean, Central Indian Ocean, and Arabian Sea suggest significant potential for the Indian fishing industry. In the Southern Ocean, the Southern Indian Ocean Deepsea Fishers Association (SIODFA) harvests high-value commercial fish species such as Orange roughy, Alfonino, Oreo Boarfish, and Cardinal fish (Kaplan et. al., 2014; Palomares et. al., 2021).

The recent expansion of the Indian fishing fleet into the central Arabian Sea, within the EEZ and close to international waters, has resulted in good fish catches. However, the initial search time for locating suitable fishing grounds was significantly high, reducing economic viability. With technological and policy support, these artisanal fishers can ensure additional fish catch for India.

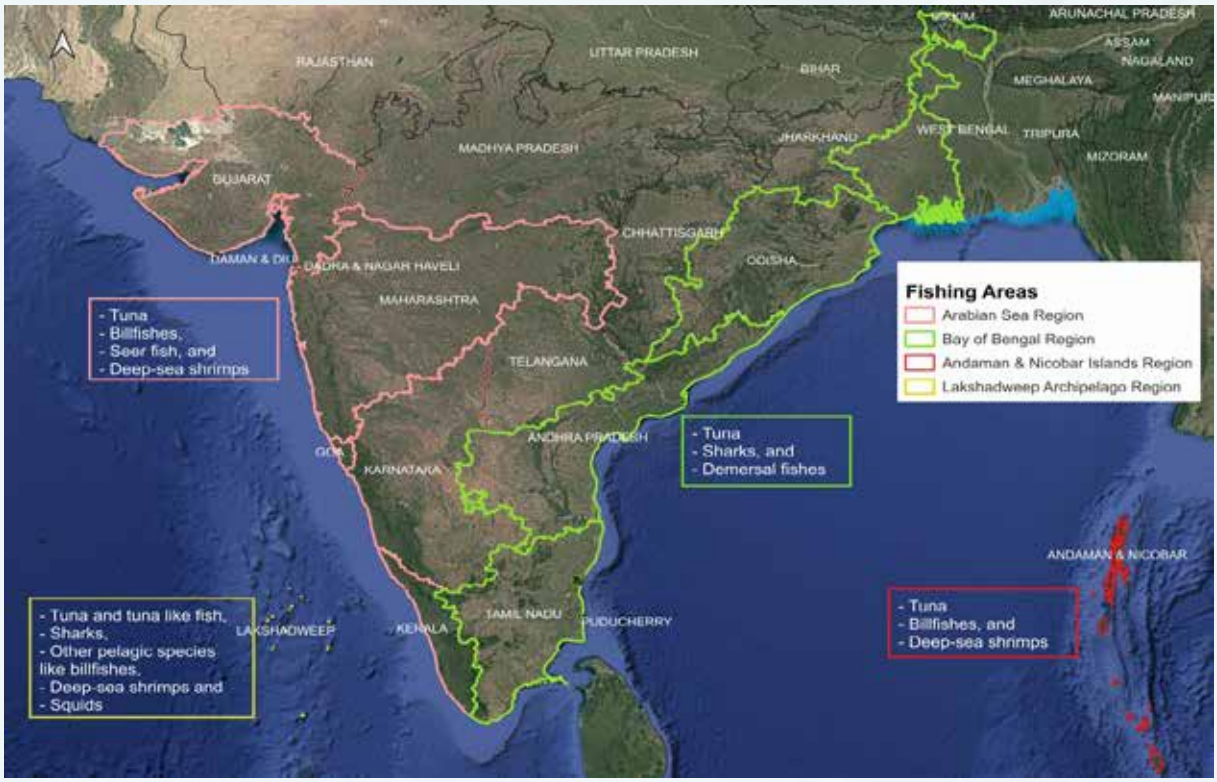
India's offshore fishing fleet consists primarily of small to medium-sized vessels, with limited capabilities for extended voyages and advanced fish-finding technologies. The fleet is dominated by traditional wooden and fiber-reinforced plastic (FRP) boats/ motorised non-mechanical boats, with only a handful of larger steel vessels equipped for deep sea operations. However, there has been an increase in investments and efforts to modernise the fleet and enhance offshore fishing capabilities in recent years, driven by rising demand for seafood and the recognition of the economic potential of this sector.

The current situation in these waters indicates a promising scope for ventures by Indian fishermen in the high seas and ABNJ. However, it requires addressing information gaps, technological advancements, and regulatory gaps to facilitate sustainable and profitable exploitation of these valuable resources while preserving marine ecosystems. By resolving these specific challenges, India can enhance its presence in the high sea, securing a fair share of common pool marine resources while contributing to national economic growth. At the same time, integrating sustainable practices aligned with global frameworks like the Biodiversity Beyond National Jurisdiction (BBNJ) agreement will ensure the long-term conservation of marine diversity.

3.3 Fishing Areas, Key Species and Seasons

India's deep sea and offshore fishing activities are primarily concentrated within the country's EEZ, which extends up to 200 nmi from the coastline. The major fishing areas and key species are given in Fig. 3.6.

Fig 3.6: Major Fishing Areas and Key Species



The key deep-sea and offshore fish species targeted by Indian vessels include:

3.3.1 Tuna and tuna-like species: Yellowfin tuna, skipjack tuna, bigeye tuna, and frigate tuna are among the most valuable and sought-after species.

3.3.2 Billfish: Swordfish, marlins, and sailfish are highly prized for their meat and recreational fishing value.

3.3.3 Deep-sea shrimps: Species like the deep-sea lobster and deep-sea shrimp are in high demand for export markets.

3.3.4 Sharks: Various shark species, such as silky sharks and thresher sharks, are harvested for their meat, fins, and other products.

An important aspect to highlight is that resources such as migratory tunas, tuna-like fishes and pelagic sharks, deepwater snappers, deepwater shrimps and flying squids move between the EEZ and the high sea, whereas orange roughy, myctophids and toothfish are found mostly in the high-seas. As environmental conditions and stock characteristics of these resources are different, developing and managing the fishery for these resources will be different. While developing and managing the fisheries in the EEZ is the responsibility of the nations, international conventions, agreements, and guidelines provide governance and management frameworks for high-sea fisheries in areas beyond national jurisdiction. In addition, a number of transboundary stocks move between the EEZ of neighbouring countries and are shared by two countries or more. These resources need cooperative management between the countries that have harvesting opportunities.

Fishing seasons and patterns

The fishing seasons and patterns for deep-sea species vary based on their migration and aggregation behaviours, which are influenced by factors such as water temperature, currents, and food availability. Generally, the peak fishing seasons align with the following patterns:

i. **Tuna and billfish:** The prime seasons are typically during the inter-monsoon periods (March-May and September-November) when the ocean conditions are more favourable for these pelagic species.

ii. **Deep-sea shrimps:** The best seasons for deep-sea shrimp fishing are often during the post-monsoon months (October-January) when nutrient-rich waters ascent brings essential nutrients to the surface, promoting shrimp abundance.

It's important to note that these fishing seasons and patterns are not fixed and can vary based on environmental conditions, climatic changes, and other factors. Continuous monitoring and adaptive management strategies are necessary to ensure sustainable fishing practices. By understanding the fishing areas, key species, and seasonal patterns, the deep-sea and offshore fishing sector in India can optimize its operations, improve catch efficiency, and develop targeted management strategies for different regions and resources.

3.4 Institutions and Regulatory Framework

India's deep sea and offshore fishing sector is governed by a multi-layered institutional and regulatory framework involving various agencies and stakeholders at the national, state, and regional levels. This framework aims to regulate and manage fishing activities, ensure sustainable resource utilization, and address conservation, safety, and economic development issues.

However, it is important to recognise that India currently does not have specific regulatory laws for fisheries in the 12-200 nmi of its EEZ. The absence of such laws means Indian fishing vessels operate in the EEZ and in ABNJ without proper legal authorisation or protection from the country. This regulatory gap has contributed to issues of illegal, unreported, and unregulated (IUU) fishing. Further, maritime states are currently limited to issuing licenses only for fishing activities within the 12 nmi territorial waters. Addressing these regulatory gaps is crucial for the sustainable development of India's deep-sea fisheries sector. There is an urgent need to enact comprehensive legislation for the regulation of fishing in the EEZ, which would clearly define the responsibilities of the nodal agency overseeing the EEZ management. This legislation is vital not only for ensuring that fishers follow clear regulations but also for empowering the Monitoring, Control, Surveillance and Enforcement (MCS&E) agencies to implement them effectively.

a) Institutional Framework:

Maritime agencies (state marine police, Indian Coast Guard, and Navy) for monitoring, controlling, surveillance. Coordination limited; need for a central agency to facilitate better information flow.

FSI subsidiary body under MoFAHD; conducts resource surveys, stock assessments, and research on marine fisheries, including deep-sea resources.

Fishery Research Institutes under ICAR CMFRI and CIFT contribute to R&D efforts. 8 institutes but only a few focus specifically on deep sea fisheries.

Ministry of Fisheries, Animal Husbandry, and Dairying (MoFAHD) responsible for formulating policies, regulations, and development programs

State Fisheries Departments implementing central policies, managing fishing activities within territorial waters, and developing state-level regulations and schemes.

CMLRE under MoES contributing to deep-sea resources biodiversity and mapping with their habitat/ecosystem assessment, and coordinating BBNJ activities

Marine Products Export Development Authority (MPEDA) promotes and regulates seafood exports, including those from deep sea fishing.

b) Regulatory Framework:

01 **Maritime Zones of India (Regulation of Fishing by Foreign Fishing Vessels) Act, 1981:** regulates fishing activities by foreign vessels within India's EEZ and TW vessels within India's EEZ and TW.

Marine Fishing Regulation Acts (MFRAs) Each coastal state has MFRA governing fishing activities within TW, (licensing, gear restrictions, & conservation measures) conservation measures) 02

03 **Coastal Aquaculture Authority Act, 2005** regulates coastal aquaculture activities, and coastal area management

National Plan of Action for the Conservation and Management of Shark Fisheries promotes sustainable and responsible shark fishing practices, including in deep-sea fisheries. 04

05 **Regional Fisheries Management Organisations** UNCLOS and UNFSA specifies the need for RFMO's for effective conservation and optimum utilisation of migratory fish stock. India is a member of RFMOs (IOTC, CCAMLR)CCAMLR)

CHAPTER-IV

Challenges And Opportunities

While India's deep-sea and offshore fishing sector holds immense potential, it faces several challenges that have hindered its growth and development. Simultaneously, addressing these challenges presents significant opportunities for economic growth, employment generation, and sustainable resource utilization (Sinha et. al., 2017).

4.1 Stock Assessment of Deep-Sea Resources

Effective stock assessment is critical for managing deep-sea fisheries sustainably and preventing overexploitation of resources. However, conducting regular stock assessments of deep-sea fish stocks poses unique challenges in the Indian context.

4.1.1 Stock assessment challenges

Data deficiency

1. Lack of **centralized database**
2. Insufficient **integration of data** (fishermen's reports and satellite data)
3. **Fishing area, effort, season, species aggregation** and **environmental conditions** not adequately covered.

Regulatory and coordination issues

1. Fragmented regulatory framework for deep-sea fishing inadequate **inter-agency coordination** obstacle to sustainable management.
2. Variations in **state-level policies** challenge management.
   State Maritime Security Coordinator (SMSC) recently developed for better coordination and security in the Coastal areas.

Technological limitations

1. **Advanced technologies** (satellite remote sensing, acoustic devices) facilitate precise stock assessments, limited application due to high costs and capacity constraints.

Environmental factors

1. Dynamic influences of climate change on fish distributions and ocean conditions introduce **uncertainties in stock predictions.**
2. **Knowledge** of deep-sea ecosystem functions limited.

Resource and capacity constraint

1. Limited technical proficiency constrains regular stock assessments and monitoring of population trends.

Communication gaps

1. Gaps in communication of assessment needs and outputs between scientists, managers, and fishermen compromise evidence-based decision-making.

4.2 Infrastructure and Technology Gaps

One of the most significant challenges hindering the growth of India's deep-sea and offshore fishing industry is the lack of adequate infrastructure and access to advanced technologies. Many of the existing fishing fleets comprise aging and inefficient boats with limited capacity, storage, and refrigeration. This constrains their ability to access deeper fishing grounds and undertake long voyages. These gaps manifest themselves across various aspects of the value chain, from vessel operations, harvesting, catch handling to post-harvest operations such as storage, processing and distribution, and pose substantial hurdles to efficient and sustainable deep-sea fishing practices.

Harvesting and Landing Infrastructure

1. Only a handful of 90 fishing harbours equipped to handle larger vessels, with adequate **draft, berthing facilities, and support** services.
2. Majority of 1547 landing centres basic, lacking proper infrastructure for **offloading, sorting, and preserving**.
3. **Infrastructure and handling:** lack proper storage and freezing facilities, leading to poor fish quality at landing, hampering export potential and hence lower
4. **Vessel repair and maintenance facilities:** shortage of dry-docking facilities, slipways, and workshops with skilled manpower for servicing and repairing vessels.

Post-harvest infrastructure

1. Many of the 646 seafood processing units lack specific equipment and technologies for handling and processing
2. Inadequate cold storage and refrigerated transportation infrastructure
3. Limited facilities and technologies for value addition and byproduct processing units.
   - For eg. 1 million tonnes of myctophids could be used for fish meal with R&D support.
   - Developing this value chain could reduce pressure on juveniles.

Fish Finding Technologies

1. Vessels lack access to **advanced fish-finding technologies** (sonar, echo sounders, and satellite-based tracking systems)
2. Challenging to **locate** and **monitor** fish stocks efficiently.

Vessel Monitoring and Communication Systems

1. Inadequate deployment of **vessel monitoring and communication systems, Distress Alert Transmitter** on vessels hampers effective monitoring, safety, and coordination.
2. Fishermen increasingly using **affordable Chinese-made** instruments, **not officially recognized** by the DoF.

Sustainable Fishing Gear and Techniques

1. Limited adoption of selective fishing gear and techniques (circular hooks and turtle excluder devices); bycatch issues and unsustainable fishing practices.
2. Gillnets commonly used in tuna fishery, landing large volumes of fish; compromises fish quality due to rapid spoilage.
3. Longlining sustainable and efficient method ensuring better fish quality while reducing bycatch.

Addressing these infrastructure and technology gaps is crucial for the sustainable growth and development of India's deep-sea and offshore fishing sector. Investments in deep-sea fishing harbours, landing centres, fleet modernization, onboard infrastructure and handling post-harvest facilities, and the adoption of advanced technologies can enhance operational efficiency, reduce post-harvest losses, and promote responsible fishing practices.

Moreover, fostering adoption of advanced deep-sea and offshore fishing technology, equipment, and research institutions efforts can facilitate knowledge transfer and access to cutting-edge solutions tailored to India's specific needs and challenges.

4.3 High Operational Costs

Deep-sea and offshore fishing operations are inherently capital-intensive and involve substantial operational costs, posing a significant challenge for the Indian fishing industry, particularly for small-scale operators. These high costs stem from various factors, including fuel consumption, crew expenses, vessel maintenance, and the need for specialized equipment and technologies.

Fuel costs

1. Extended voyages and long distances travelled by deep-sea fishing vessels result in **high fuel usage.**
2. Fluctuations in **fuel prices** can exacerbate financial burden.
3. Exploring alternative **energy-efficient** options (green biofuels and renewable resources) could support the energy transition of small-scale fisheries.

Crew Expenses

1. Deep-sea and offshore fishing expeditions require **larger crews** compared to coastal fishing operations.
2. Costs associated with **crew wages, accommodations, provisions**, and **insurance** can be substantial for longer voyages.

Vessel Maintenance and Repair

1. Harsh marine environment and extended periods at sea take a toll on fishing vessels, necessitating **regular maintenance** and **repairs**.
2. Costs of **spare parts, dry-docking**, and **specialized labour** for vessel upkeep can be significant.

Specialized Equipment and Technologies

1. Deep-sea and offshore fishing often requires investment in **advanced fish-finding technologies**, such as sonar and satellite tracking systems, and specialized **fishing gear** and **onboard processing** facilities.
2. Acquiring and maintaining these technologies can be **cost-prohibitive**.

4.4 Financing, Insurance, and Capital Access

Developing a specialized deep-sea fishing fleet requires significant investments that small-scale fishermen may find difficult to mobilize independently. The cost of a deep-sea fishing vessel can range from ₹50 lakh to ₹1 crore (US$67,000 to US$134,000) in India. Many fishermen cannot afford these costs without substantial financial assistance. Accessing institutional credit for marine ventures also poses challenges due to higher perceived risks. Furthermore, deep-sea operations involve greater risks of accident or damage to vessels and gear in hostile sea conditions. Higher insurance premiums compound the financial burden. At present, most banks are reluctant to lend for marine fishing or provide insurance due to the sector's irregular income patterns and inherent risks.

The Govt. of India, under the PMMSY scheme, has brought deep-sea under focus for development through financial support. Under the scheme, the government is extending

up to 60% of financial assistance to traditional fishermen for converting their vessels into deep-sea and offshore fishing boats. Additionally, loan facilities are available to facilitate this transformation. Further, financial assistance is being provided to traditional fishermen for the acquisition of deep-sea and offshore fishing vessels under PMMSY at a subsidy rate of 40% for the General Category and 60% for SC/ST/Women beneficiaries.[27]

Access to adequate financing, insurance coverage, and capital investment is crucial for the growth and development of any industry, including deep-sea fishing.[28] However, in India, these factors pose significant challenges, impeding fleet modernization, technological upgradation, and the overall competitiveness of the deep-sea and offshore fishing sector.

Limited Access to Institutional Financing

1. Securing **loans** and **credit** from institutional lender hurdle for **small-scale and artisanal fishers**.
2. Perceived **high-risk** nature of operations, lack of **collateral** or financial history, and limited understanding of the sector's dynamics among lenders.

Inadequate Insurance Coverage

1. Deep-sea and offshore fishing vessels and their crews face numerous **risks**, (adverse weather conditions, equipment failures, and potential accidents or injuries at sea).
2. Access to comprehensive and **affordable insurance coverage** remains limited.

Barriers to Capital Investment

1. Modernizing fleet and adopting advanced technologies require significant capital investment.
2. **Small-scale** and **artisanal fishers** face **barriers** in **accessing capital.**
3. **Barriers** - stringent lending criteria, high-interest rates, lack of awareness or support from government agencies and financial institutions.
4. Banks would be reluctant to provide credit due to the absence of **regulatory frameworks, proper licensing** and **effective governance**.

Addressing these challenges related to financing, insurance, and capital access is crucial for the sustainable growth and competitiveness of India's deep-sea fishing industry.

27 *https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2042662 (accessed on 17th September, 2024)*
28 *https://oursharedseas.com/impact-investing-in-a-sustainable-ocean-and-global-fisheries/ (accessed on 11th March, 2024)*

Potential solutions and measures include:

4.4.1 **Dedicated Financing Schemes:** Establishing dedicated financing schemes or credit lines specifically tailored to the needs of deep-sea and offshore fishing operators can improve access to institutional financing. These schemes could involve collaboration between government agencies, banks, and industry stakeholders to create favorable lending terms and conditions.

4.4.2 **Risk Mitigation Mechanisms:** Developing risk mitigation mechanisms, such as government-backed insurance programs or risk-sharing models, can enhance the availability and affordability of insurance coverage for deep-sea and offshore fishing operations. This can provide financial security and encourage investment in the sector.

4.4.3 **Capacity Building and Awareness Programs:** Conducting capacity-building and awareness programs for financial institutions and lenders can enhance their understanding of the deep-sea and offshore fishing sector's dynamics, risks, and potential. This can facilitate more informed decision-making and tailored financing solutions. Besides, traditional fisher folks' capacity and capability building can help effectively adopt deep-sea fishing techniques and harness the deep-sea resources with due regard to sustainability concerns.

4.4.4 **Incentives and Tax Benefits:** Offering targeted incentives, such as tax benefits for investments in deep-sea and offshore fishing vessels, equipment, and technologies, can encourage capital inflow and support fleet modernization efforts.

4.4.5 **Micro-financing and Cooperative Models:** Exploring micro-financing options and cooperative models can provide access to capital for small-scale and artisanal deep-sea fishing operators, enabling them to invest in their operations and adopt sustainable practices.

4.5 Sustainability and Conservation Concerns

While deep-sea and offshore fisheries present significant economic opportunities, their exploitation must be balanced with responsible management practices to ensure the long-term sustainability of marine ecosystems and fish stocks. Failure to address conservation concerns could lead to overexploitation, habitat degradation, and irreversible damage to these valuable resources.

Overexploitation of fish stocks

1 Species such as tuna, billfish, and deep-sea shrimps, highly **migratory** and **vulnerable** to overfishing due to their life histories and ecological characteristics.

Bycatch and non-target species

1 Deep-sea and offshore fishing operations often result in the **unintentional catch** of non-target species.

Ghost Fishing

1. **Lost** or **abandoned fishing gear** (longlines, nets, and traps) continue to catch and kill marine life indiscriminately.

Climate Change Impacts

1. The effects of climate change **(ocean warming, acidification, and changes in ocean currents and productivity)** can impact deep-sea and offshore resources and their migratory patterns.

Habitat degradation

1. Certain fishing practices, **(bottom trawling)** cause damage to marine habitats.
2. **Compliance** with international standards such as the Code of Conduct for Responsible Fisheries imperative.

Marine pollution

1. Global issue affecting the Indian EEZ and marine living resources and ecosystems.
2. Several schemes like Clean Ocean mission (Swachhata Sagar) and awareness programs available, but not able to fully curb the litter from reaching the ocean.

To address these sustainability and conservation concerns, a comprehensive approach is necessary, involving:

4.5.1 **Robust Monitoring and Data Collection**: Enhancing data collection, stock assessments, and scientific research to better understand deep-sea fish populations, their dynamics, and the impacts of fishing activities. Stock assessment based catch quota system could be permitted to avoid overexploitation and sustainably harvest deep sea resources.

4.5.2 **Ecosystem-Based Fisheries Management:** Adopting an ecosystem-based approach that considers the broader marine environment, including non-target species, habitats, and ecosystem interactions, when developing management strategies.

4.5.3 **Offshore mariculture**: Harnessing resources through artificial propagation, such as promoting offshore mariculture, is essential. The infrastructure proposed for deep-sea fisheries can significantly support the mariculture industry. This approach not only reduces pressure on wild fish stocks but also establishes a parallel industry, generating an additional economic value chain.

4.5.4 **Gear and Fishing Method Regulations:** Technological innovations in fishing gear design, such as selective fishing nets, escape panels, and turtle excluder devices (TEDs), minimize bycatch and reduce environmental impacts associated with deep-sea fishing operations. Additionally, implementing regulations on fishing gear and methods to minimize bycatch, reduce habitat damage, and promote selective and sustainable fishing practices.

4.5.5 **Establishment of Marine Protected Areas:** UN Act, designates strategically located marine protected areas and no-take zones to safeguard critical habitats, nursery grounds, and spawning areas for deep-sea and offshore species.

4.5.6 **Compliance and Enforcement:** Strengthening compliance and enforcement mechanisms, including vessel monitoring systems, observer programs, and penalties for illegal, unreported, and unregulated (IUU) fishing activities. Combating IUU fishing is essential for ensuring the sustainability and integrity of deep-sea and offshore fisheries, as well as promoting responsible resource management.

4.5.7 **Regional and International Cooperation:** Collaborating with regional and international organizations, such as RFMOs, to ensure coordinated management and conservation efforts for shared deep-sea and offshore resources; while ensuring that national interests are not compromised.

4.5.8 **Stakeholder Engagement and Awareness:** Involving stakeholders, including fishers, coastal communities, conservation organizations, and the public, in decision-making processes and raising awareness about the importance of sustainable deep-sea and offshore fishing practices.

4.5.9 **Marine Litter and Pollution Management:** Developing and implementing a National Marine Litter Policy and Management Plan, as recommended by the National Action Plan on Marine Plastic Litter from Sea-based Sources (2024). Addressing marine litter and pollution is crucial for protecting the integrity of deep-sea habitats and ensuring the long-term health of marine ecosystems. The United Nations Agreement on Biodiversity Beyond National Jurisdiction or BBNJ Agreement, also talks about preventing pollution in the oceans, specially International waters.

In conclusion, this chapter highlights India's deep-sea and offshore fishing sector which stands at a critical juncture, facing significant challenges but also poised for tremendous growth opportunities. The sector grapples with issues ranging from inadequate stock assessment and infrastructure to high operational costs and sustainability concerns. However, these challenges also present avenues for innovation, investment, and sustainable development. By addressing data deficiencies, onboard and post-harvest handling, embracing advanced technologies, improving access to financing, and prioritizing conservation efforts, India can transform its deep-sea and offshore fishing industry. This transformation has the potential to not only boost the economy and create employment but also ensure long-term food security and contribute to India's blue economy aspirations. By prioritising sustainability and conservation concerns, India can unlock the full potential of its deep-sea and offshore fisheries while safeguarding the long-term health and resilience of marine ecosystems, ensuring the availability of these resources for future generations.

CHAPTER-V

Policy Framework

A comprehensive policy and regulatory framework is essential for India's deep-sea and offshore fishing industry to grow sustainably and responsibly. This chapter addresses the sector's multifaceted challenges, aiming to harness its potential while prioritising environmental sustainability. It explores critical elements necessary to achieve these goals, balancing economic opportunities with ecological considerations in the management of deep-sea and offshore fisheries

5.1 Registration, Licensing, and Access Rights

Effective management and regulation of deep-sea and offshore fishing activities require a comprehensive framework for vessel registration, licensing procedures, and the allocation of access rights to fishing grounds within EEZ and international waters. This section outlines the existing regulations and proposes measures to streamline and strengthen this critical aspect of sustainable resource management.

5.1.1 Current Regulations:

(i) **Fishermen / Fishing Boat Registration Procedures in India are given below-**

- In India, fishing activities can be undertaken by any individual whether he/she is a fisher by birth or by profession. Registration as a fisherman is not legally compulsory, however registration is undertaken by Coastal States and UTs to create a data repository for facilitating the Government schemes and benefits to the fishermen. Further, vessel registration and license issued by state DoFs are for within 12 nmi territorial waters.

- Part XVA of the Merchant Shipping (MS) Act, 1958 provides detailed guidelines for the registration, survey, and certification of Indian-flagged fishing boats (Sec 435 A-X of MS Act). However, this provision is outdated and is meant to regulate commercial shipping. Hence, a separate Vessels Act would be required to cater to the needs of the modern fishing vessels and their development in the country.

- Fishing boat registration can be done by Section 435 G of the MS Act, 1958 (Central Act 44 of 1958). As per 435G, M.S. (Amendment) Act, 1983, the owner of every Indian fishing boat shall make an application to the Registrar for grant of a 'Certificate of Registry' in respect of the fishing boat.

- GSR-594 (E) [F. No. SR- 19014/01/2009-MG] of DG Shipping dated 14.08.14 has made provisions for the appointment of Surveyors applicable to Part XVA [fishing boats].

- Mercantile Marine Department (MMD) of DG Shipping undertakes tasking related to registration, survey, and certification of Indian fishing boats of length 24 m and above, whereas fishing boats below 24 m in length may be registered by the Fisheries Department of Coastal States and UTs.

(ii) **Vessel Registration and Licensing:**

- The registration and licensing of fishing vessels in India are governed by the respective Marine Fishing Regulation Acts (MFRAs) of coastal states and union territories.[29] However, it pertains to only within the 12 nmi zone and not to deep-sea areas.
- Deep-sea fishing vessels must be registered with the respective state/UT fisheries department and obtain a valid license to operate within the territorial waters and EEZ.
- The licensing process involves submitting details such as vessel specifications, gear types, crew information, and adherence to safety and operational standards.

(iii) **Access Rights within the EEZ:**

- The Maritime Zones of India (Regulation of Fishing by Foreign Fishing Vessels) Act, 1981, regulates fishing activities by foreign vessels within India's EEZ.
- Indian-flagged vessels have the right to fish within the EEZ, subject to state/UT licensing conditions and adherence to conservation measures.

(iv) **Access to International Waters and Regional Fisheries Bodies:**

- India is a member of various RFMOs, such as IOTC. With regard to SIOFA, India is a Cooperating non-Contracting Party and not a full contracting party.
- Indian vessels require specific permits or authorizations to fish in international waters and areas under the jurisdiction of these RFMOs, subject to their regulations and quota allocations.

5.1.2 **Proposed Measures:**

(i) **Vessel Construction:**

- Standardized fishing vessel designs and specifications should be established nationally, especially for deep-sea, offshore, and distant water fishing vessels. This could be a part of the new fishing vessel

29 *https://krishi.icar.gov.in/jspui/bitstream/123456789/78263/1/3_Fishing%20Regulations%20in%20India.pdf (accessed on 14th March, 2024)*
https://eprints.cmfri.org.in/9871/1/Rajesh_8.pdf (accessed on 14th March, 2024)

regulations as the current Merchant Shipping (MS) Act has no provision for such development. Vessel construction needs to adhere to safety standards and undergo inspections by trained officials.

- Guidelines for fishing vessel construction and maintenance should be developed at the state and national levels. All licensed vessel construction firms should be listed in a central registry (ReALCRaft) [30].

(ii) **Centralized Vessel Registration and Licensing System:**

- Leverage ReALCRaft as a centralized, digitized system for the registration and licensing of deep-sea and offshore fishing vessels at the national level, in collaboration with state/UT authorities.
- This system would streamline the application process, ensure standardized data collection, and facilitate monitoring and compliance.

(iii) **Allocation of Access Rights and Quota Management:**

- Develop a transparent and science-based mechanism for allocating access rights and catch quotas for deep-sea and offshore fishing within the EEZ, taking into account aspects such as historical catch records, vessel capacities, and sustainability considerations.
- Implement a system of transferable fishing quotas or effort-based management regimes to promote economic efficiency and prevent overcapitalization.

(iv) **Enhanced Monitoring and Compliance:**

- While Indian deep-sea fishing vessels use VMS voluntarily, there is currently no monitoring by the DoF. Strengthening oversight mechanisms is necessary to ensure compliance and effective monitoring. Further, installation of VMS should not be limited only to the deep sea and offshore regions but must be implemented in all the fishing vessels across India including those operating in the territorial and coastal waters.
- Implement a robust observer program integrated with technology deploying trained observers on board vessels to monitor catch composition, bycatch, and adherence to regulations.
- India currently employs a landing-centre-based observer system, managed by CMFRI (Central Marine Fisheries Research Institute), which records catches at landing sites. However, separate catch statistics for deep-sea fishing is not recorded. Addressing this gap is urgently needed to ensure effective monitoring of deep-sea fisheries which can improve management and conservation efforts.

30 *RealCraft is a web enabled workflow based online application system for issuing Registration Certificate (RC) Under MS Act (Merchant Shipping) and Fishing License Certificate (LC) to fishing vessels operating along the Indian Coast under MFR (Marine Fisheries Regulation)Act. https://fishcraft.nic.in/web/new/index/*

- Enhance the National Marine Fisheries Data Centre (NMFDC) at CMFRI to serve as a comprehensive centralized database and reporting system for vessel logbooks, catch data, and compliance records. Improvements should focus on better segregation of deep-sea fishery catches to ensure more effective data management and monitoring. Strengthening deep-sea research capabilities is critical for continued exploration and assessment of deep-sea resources. There is a need to replace existing aged research vessels (with various bodies such as MoES, ICAR, DoF etc) with modern tools for the non-invasive digital collection of biodiversity data.

(v) **Traceability**

- India's deep-sea and offshore fishing industry should adhere to comprehensive standards and regulations covering sustainability, quality, and safety throughout the supply chain. Compliance is ensured through inspections and enforcement.
- A robust seafood traceability system tracks products from harvest to consumer, promoting transparency, combating illegal fishing, preventing fraud, ensuring food safety, and enabling sustainable resource management. Traceability strengthens consumer confidence and both domestic and international market access.

(vi) **International Cooperation and Access Agreements:**

- Strengthen collaboration with RFMOs and explore bilateral or multilateral access agreements with other nations to facilitate responsible deep-sea and offshore fishing in international waters and shared maritime zones.
- Ensure compliance with international laws, regulations, and conservation measures governing deep-sea and offshore fishing activities in these areas.
- Attain full membership of SIOFA, leverage India's membership in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), sign the FAO Agreement on Port State Measures (FAO-PSMA) to combat IUU fishing and adhere to scientific advisories of IOTC.
- While India is already engaged with RFMOs such as IOTC, these agreements do not fully cover the entire Indian Ocean region. Given the increasing challenges posed by Illegal, Unreported, and Unregulated (IUU) fishing, it is crucial to establish a comprehensive RFMO for the broader Indian Ocean. Strengthening regional cooperation through such an organization would enable better management of fisheries, ensure sustainability, and enhance India's role in international fisheries governance.

(vii)**Capacity Building and Stakeholder Engagement:**

- Conduct regular training and capacity-building programs for fishers, vessel operators, and regulatory authorities on licensing procedures, access rights, and compliance requirements.

- Engage stakeholders, including fishing communities, industry associations, and conservation organizations, in the decision-making processes related to licensing and access rights allocation.

By implementing these measures, India can establish a robust and transparent system for registering and licensing deep sea and offshore fishing vessels, allocating access rights based on scientific principles, and ensuring compliance with national and international regulations. This will promote sustainable resource management, prevent overcapitalization, and facilitate responsible deep-sea and offshore fishing practices within India's EEZ and in international waters.

5.2 Incentives

Providing targeted incentivisation can play a crucial role in promoting the growth and sustainable development of India's deep-sea and offshore fishing industry. These measures can address various challenges, such as high operational costs, fleet modernization, infrastructure development, and adopting sustainable fishing practices. However, designing and implementing these incentives and subsidies judiciously is essential to avoid unintended consequences like overcapitalization, overfishing, or distortions in the market (Sala et. al., 2018).[31]

Promoting green energy alternatives

(solar-powered systems, hybrid engines, and energy-efficient vessel designs) to reduce fuel dependency and operational costs.

Tax Benefits and Fiscal Incentives

(reduced import duties on fishing equipment, gear, and vessels) to modernize fleet and adoption of advanced technologies.

- tax credits for investments in sustainable fishing practices, crew training, R&D

Financial Support for Fleet Modernization

- Accessible financing (low-interest loans or loan guarantee programs) for acquiring new vessels/ upgrading fleets.
- prioritize vessels with advanced fish-finding technologies, sustainable fishing gear, and onboard processing facilities

Infrastructure Development Incentives

(Grants, tax incentives, or PPP models) for the development of dedicated deep-sea fishing harbours, landing centres, and post-harvest infrastructure.

Sustainable Fishing Practice Incentives

- Incentivize gear minimizing bycatch and environmental impact.
- Reward compliance: subsidies, tax breaks, priority fishing access.

Insurance and Risk Management Support

- Providing subsidized or government-backed insurance schemes to mitigate the risks.

31 *https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=710ed314e09285f4054b-13031b3a06d7747e4329 (accessed on 17th September, 2024)*

Establishing clear eligibility criteria, monitoring mechanisms, and periodic reviews is crucial to ensure that these incentives and subsidies effectively promote the intended objectives while minimizing potential misuse or unintended consequences. Moreover, all subsidies should be kept to a minimum, applied for a limited period, and phased out as soon as possible.

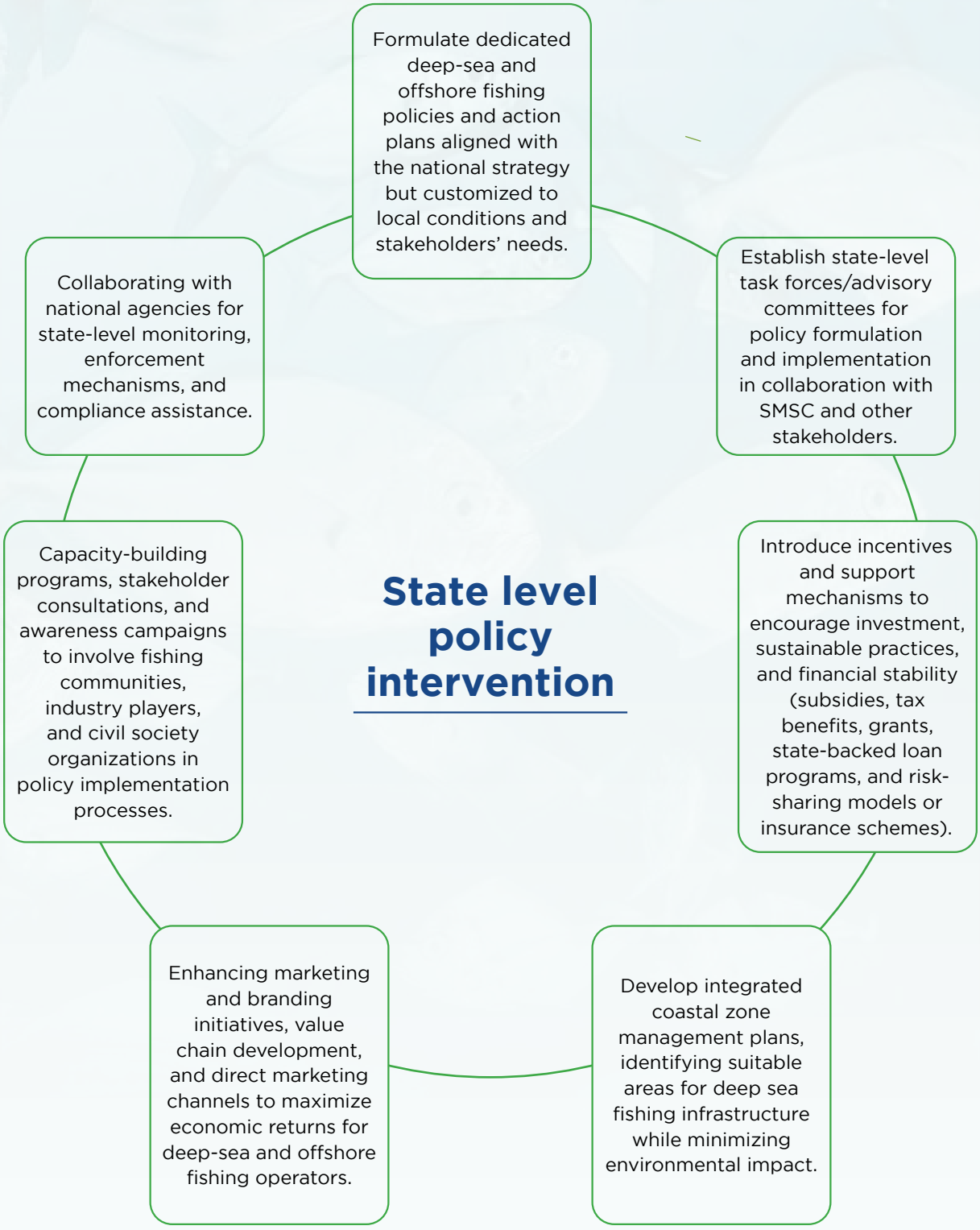
5.3 Policy Intervention

5.3.1 National Level

At the national level, it is imperative to steer the sustainable development of India's deep-sea, offshore, and distant water fishing sector.

5.3.2 **State Level**

State governments play a pivotal role in tailoring policies to address state-specific challenges and priorities.



CHAPTER-VI

Infrastructure Development

This chapter outlines the key investment areas and infrastructure upgradation required to build India's deep-sea and offshore fishing capacity and capitalise on the lucrative economic opportunities this sector presents. It covers the development of deep-sea fishing harbours with support facilities, establishing integrated supply chains with efficient logistics and cold storage, employing modern deep-sea and offshore fishing fleets, and institutionalising training programs for upskilling the workforce.

A roadmap is provided to systematically upgrade infrastructure, attract private investments through conducive policies, and develop a thriving deep-sea and offshore fishing sector. The investments proposed will not only boost India's marine fish production but also generate employment, enable export opportunities, and contribute to food security. Sustainable financing models leveraging public-private partnerships have been explored to mobilise the required capital outlays.

6.1 Fishing Harbours and Landing Centres

India's fishing harbour infrastructure is predominantly geared towards shallow water and coastal fishing operations. To facilitate the growth of deep-sea and offshore fishing, dedicated deep-sea fishing harbours and landing centres need to be developed along the country's 11,098 km coastline. As of 2021, India had several designated deep-sea fishing harbours located at Vizhinjam (Kerala), Cochin (Kerala), Chennai (Tamil Nadu), Visakhapatnam (Andhra Pradesh), Paradip (Odisha), and Poompuhar (Tamil Nadu).[32] Additionally, around 87 fish landing centres can potentially handle deep-sea catches. However, most lack adequate draft, shipyard facilities, and other amenities required for efficient deep-sea operations.[33] More such infrastructure is needed to improve India's capacity for deep-sea fishing activities.

To address these infrastructure gaps and support the growth of the deep-sea and offshore fishing industry, the following measures can be considered:

6.1.1 **Upgrading existing harbours and landing centres:** Selected harbours and landing sites can be identified for modernisation, equipped with deep-water berths, offloading facilities, and other amenities tailored for deep-sea and offshore fishing vessels.

6.1.2 **Developing dedicated deep-sea fishing harbours:** In strategic coastal locations, new dedicated deep-sea fishing harbours can be developed, incorporating state-of-the-art infrastructure, logistics support, ship repair facilities and auxiliary services.

6.1.3 **Enhancing processing and value addition facilities:** Specialised processing units, equipped with advanced technologies for handling deep-sea species, can be established in proximity to major landing centres or harbours.

32 *https://mpeda.gov.in/fishers/wp-content/uploads/2021/08/007-MARINE-FISH-LANDINGS-JULY-2021.pdf (accessed on 18th September, 2024)*

33 *https://eprints.cmfri.org.in/18344/1/Marine%20Fish%20Landings%20in%20India_2023.pdf (accessed on 18th September, 2024)*

6.1.4 **Strengthening cold chain infrastructure:** Investments in refrigerated transportation, modern cold storage facilities, and integrated supply chain logistics can help to minimise post-harvest losses and maintain the quality of deep sea catch.

6.1.5 **Promoting byproduct utilization:** Establishing fish feed/meal plants, biorefinery facilities, and other byproduct processing units can optimise resource utilisation and generate additional revenue streams from deep-sea and offshore fishing operations.

6.1.6 **Facilitating public-private partnerships:** Encouraging collaboration between government agencies, private investors, and industry stakeholders can attract investments and expertise in developing comprehensive deep-sea fishing infrastructure.

Key features and facilities envisaged at the major deep-sea fishing harbours

- Minimum **draft** of 8-10 m to accommodate large deep-sea trawlers/liners
- **Berthing quays** of at least 500 m in length
- Dedicated **basins/wharfs** for deep-sea vessel anchorage and operations
- **Slipways and dry docks** for vessel repair/maintenance
- Marine **machinery** and **net mending** workshops
- **Cold storage** and flake ice plants
- **Auction halls, pack houses** and **pre-processing** facilities
- **Fuel bunkering** and **fresh water supply** infrastructure
- **Power backup** and modern **navigational** aids
- Administrative buildings, crew **accommodation** and other **amenities**

The minor deep-sea landing centres will have a basic enclosed harbour, wharfs / jetties, auction halls, cold storages, ice plants, boat repair yards and other localised facilities. Existing fishing harbours like Visakhapatnam, Paradeep, Veraval etc. may also require modernisation to handle additional deep-sea vessel traffic safely. Ministry of Fisheries, State fisheries departments and agencies like and FISCOPFED can be the nodal bodies for developing these harbour projects through public-private partnership (PPP) models. Funding can also be mobilised from multi-lateral agencies like the World Bank, Asian Development Bank (ADB) as well as private investment through Design, Build, Finance, Operate and Transfer (DBFOT) modes for construction and operations of the fishing harbours. A cluster-based approach should be adopted for developing ancillary industries like ice plants, vessel repair facilities and cold storage in the vicinity of these harbours. With the strategic development of modern deep-sea fishing harbours providing safe anchorage and support utilities, India can unlock its vast underutilised deep-sea fishing potential in the EEZ and beyond.

6.2 Post-Harvest and Cold Chain Infrastructure

Efficient post-harvest handling, processing, and cold chain infrastructure is critical for ensuring quality, reducing wastage, enabling value addition, and accessing premium markets for India's deep-sea and offshore fish catch. However, there are significant gaps in this area currently. As per 2020 estimates, India has only around 250 food processing plants approved for exports, with a combined handling capacity of just 25,000 t/day. The installed cold storage capacity is also limited to around 37 MT. Lack of integrated cold chain logistics from harvest to consumption leads to high wastage levels of over 20% annually.[34]

To capitalise on the economic opportunities from deep-sea fishing, investments in upgrading and scaling up the following post-harvest infrastructure are essential:

6.2.1 **Fish Handling and Processing Centres:** Hygienically designed, modern fish handling and processing centres must be established close to the proposed deep-sea fishing harbours and landing centres.[35]

34 *https://www.kenresearch.com/industry-reports/india-agricultural-cold-storage-industry (accessed on 26th April, 2024)*

https://pib.gov.in/PressReleasePage.aspx?PRID=1658114 (accessed on 26th April, 2024)

35 *https://www.fao.org/3/y5718e/y5718e09.htm (accessed on 18th March, 2024)*

These facilities should incorporate several key components:

- **Automated fish receiving, sorting,** and **weighing lines** to ensure efficient and hygienic catch handling.
- **Insulated processing halls** with smooth, easily cleanable floors and walls to maintain high hygiene standards.
- **Value-added product lines** for processes such as canning, freezing, breading, and other forms of product diversification.
- **Byproduct plants** for producing fish feed and fish oil from processing waste.
- Support utilities like **ice plants, cold storage,** and **refrigeration systems** to maintain the cold chain.
- **Effluent treatment plants** to ensure proper management of waste and compliance with environmental norms.
- **Quality control** and **analytical laboratories** for ensuring adherence to food safety standards like HACCP.

These processing centres should be designed to handle significant volumes of deep-sea and offshore catch, with the larger facilities. A network of such major and minor processing centres will need to be established across the country's coastal clusters.

6.2.2 Cold Chain Infrastructure

An efficient and integrated cold chain infrastructure is pivotal for preserving the quality of the deep-sea and offshore catch and enabling access to distant markets, both domestic and international.[36] As part of the PMMSY, 586 new ice plants and cold storage units have been sanctioned to be established in proximity to the deep-sea fishing harbours and landing centres.

36 *https://www.fao.org/3/y5718e/y5718e09.htm (accessed on 18th March, 2024)*

Key components of cold chain infrastructure should include:

- **Integrated cold storage** with modern equipment like refrigerated/insulated vans and ample free storage capacity.
- **Refrigerated truck** fleets and **reefer vans** for domestic distribution and transportation to export gateways.
- **Reefer container freight stations** and **terminals** to facilitate the export of deep-sea and offshore catch.
- **Irradiation facilities** for quarantine treatment, enabling compliance with phytosanitary norms of importing countries.

Significant expansion of cold storage capacity, both at the harbours and inland locations, is required to handle the expected surge in deep-sea and offshore catch volumes. A network of integrated pack-houses equipped with sizable cold storage facilities could be established across coastal areas.

Recognizing the importance of an efficient cold chain, the PMMSY has focused on developing an integrated cold chain infrastructure. As of 2024, this includes[37]:

(i) Establishment of 1,091 new fish feed mills and plants to support the industry's growth.

(ii) Provision of 27,189 units of fish transportation facilities, including 373 refrigerated trucks, 1,377 insulated trucks, 1,243 live fish vending centres, 3,860 auto-rickshaws, 10,924 motorcycles, and 9,412 bicycles with ice boxes.

(iii) Development of 6,733 units of fish retail markets (188 units) and fish kiosks, including 6,896 ornamental kiosks, to facilitate last-mile distribution and marketing.

6.2.3 Other Support Infrastructure

Several ancillary infrastructure components are also essential for supporting deep-sea fishing operations and post-harvest activities like:

37 *https://pib.gov.in/PressReleasePage.aspx?PRID=2083813 (accessed on Jan 21, 2025)*

- **Ice plants** and **flake ice machines** with substantial daily production capacity clustered near landing centres.
- **Insulated** and **refrigerated trucks** for local distribution and transportation to processing facilities.
- **Cold chain power plants** and **energy-efficient systems** to reduce operational costs.
- **Logistics parks** and **container freight stations** for efficient handling and movement of catch.
- Third-party **pre-cooling facilities** for specific product lines.

6.2.4 **Potential Investment Areas**

Post-harvest and cold chain infrastructure upgradation presents significant opportunities for private investment across various segments, including integrated pack-house facilities, controlled atmosphere cold storages, irradiation facilities, refrigerated transport fleets, processing and value-addition plants, and third-party cold chain logistics services.

Conducive policies, incentives, and financing mechanisms will be crucial for attracting investments in this capital-intensive domain. Public-private partnership models, viability gap funding, and infrastructure funds can be explored to operationalise post-harvest cold chain projects on a large scale.

Overall, strategic interventions in developing robust post-harvest and cold chain infrastructure will play a pivotal role in reducing wastage, improving value realisation, enabling product diversification, and catalysing the growth of India's deep-sea and offshore fishing sector.[38]

6.3 Fleet Modernisation and Skill Development

The existing deep sea fishing fleet lack the necessary capabilities required for venturing into deeper waters and conducting multi-day fishing voyages in the EEZ and beyond.

38 *https://www.fao.org/3/y5718e/y5718e09.htm (accessed on 18th March, 2024)*

This transition from coastal to deep-sea fishing would require targeted modernisation efforts focused on supporting existing fleet and enhancing their capabilities. Industrial deep-sea fishing can be promoted for ABNJ and distant water fishing. The Department of Fisheries can play a key role to support these vessels by providing proper licenses, communication facilities and on-board processing capabilities.

6.3.1 Deep-Sea Fishing Research Development

Given the underexploited nature of many oceanic and deep-sea resources, focused research efforts are required to improve knowledge of these stocks. Developing species-specific potential fishing zone advisories through habitat distribution modeling can be explored. Such modeling utilises available catch data as well as oceanographic and biological parameters that influence habitats. The outputs can guide fishing vessels towards optimal areas for different target species, improving catch rates and economic returns. The policy will promote collaboration between fisheries and oceanographic research institutions to undertake studies on underutilised resources like certain squid species. Habitat models developed from such work will aid fleet modernisation by facilitating conversion of vessels to gears suitable for deep and offshore target fisheries.

Further, expanding research efforts on deep-sea fishing and value chain development is essential. More studies and evaluation programs, including deep-sea fishing cruises, should be conducted to explore the harvesting potential of oceanic resources such as myctophids, squids and other identified species. These programs should emphasise on assessing the economic viability of such fisheries to support sustainable expansion and technological adaptation in the sector.

6.3.2 Modification of Fishing Vessels for Deep-Sea Fishing and Offshore Fishing:

Vessels above 20 m in length may need modifications/upgradation to make them suitable for deep-sea fishing and offshore fishing. This includes equipping them with state-of-the-art technology for locating, catching, and processing target species. The technical specifications for vessel construction may be finalised by a technical committee comprising experts from relevant institutions such as the Department of Fisheries, ICAR-CIFT, FSI, CIFNET and others. New fishing vessels should be equipped with modern equipment for navigation, safety, and onboard fish handling. Collaboration with the Ministry of Ports, Shipping and Waterways may be explored for assistance in boat building and procurement of navigation equipment.

6.3.3 Introduction of New Fishing Vessels for Offshore, Distant Water Fishing:

New deep-sea fishing vessels with modern material and technology should be introduced as replacements for existing crafts, designed specifically for offshore fishing targeting tuna and similar species. These vessels should have adequate onboard storage, navigation equipment, and facilities for handling tuna catches.

Combination vessels made of steel, capable of tuna longlining and gillnetting, may be introduced in restricted numbers to enhance fishing capabilities. Modified vessels with advanced technology should be designed for high-sea and distant water fishing.

Key types of vessels to be added to the fleet for commercial purposes

- **Offshore tuna longliners**: 36-50 m in length; targeting tuna and other pelagic species using long-line gear.
- **Purse seiners**: 50-60 m in length, employs a purse seine net to catch large schools of fish like tuna.
- **Offshore gillnetters**: 25-32 m in length; use gillnets for catching demersal and pelagic species in deeper waters.
- **Midwater trawlers**: trawl from greater depths targeting myctophids and squids.
- **Squid jiggers**: Specialized vessels for catching squid using jig machines and lures.

The current deep-sea and offshore fishing fleet strength is highly inadequate to extract the estimated deep-sea catch potential sustainably. A multi-pronged strategy may require direct purchase of vessels from overseas shipyards, establishing domestic shipbuilding capacities, and upgrading existing boatyards. In parallel, enabling policies and financial incentives could be instituted to promote the domestic shipbuilding industry, the leasing of deep-sea fishing vessels, and the formation of fishing corporations/companies to acquire and operate these capital-intensive assets.

6.3.4 Financing Mechanisms and Subsidies

Considering the high capital costs of procuring deep-sea fishing vessels, dedicated financial schemes and subsidies will play a crucial role. This could include low-interest boat loans, subsidy-linked credit facilities, lease-to-own models, and promoting private investments through infrastructure funds.

6.3.5 Capacity Development and Stakeholder Engagement

To ensure the successful modernisation of the fishing fleet and promote sustainable deep-sea and offshore fishing, capacity development must be prioritised through comprehensive skill development and stakeholder engagement initiatives.

Skill development programs: Complementing the fleet modernisation efforts, comprehensive skill development programs must be launched to train deep-sea and offshore fishermen in various technical aspects

Technical aspects include:

- Navigation and communication systems
- Sonar and fish-finding equipment operation
- Hydraulic line haulers and power block handling
- Safety equipment and emergency procedures
- Deck operations and machinery maintenance
- Cold chain management and preservation techniques

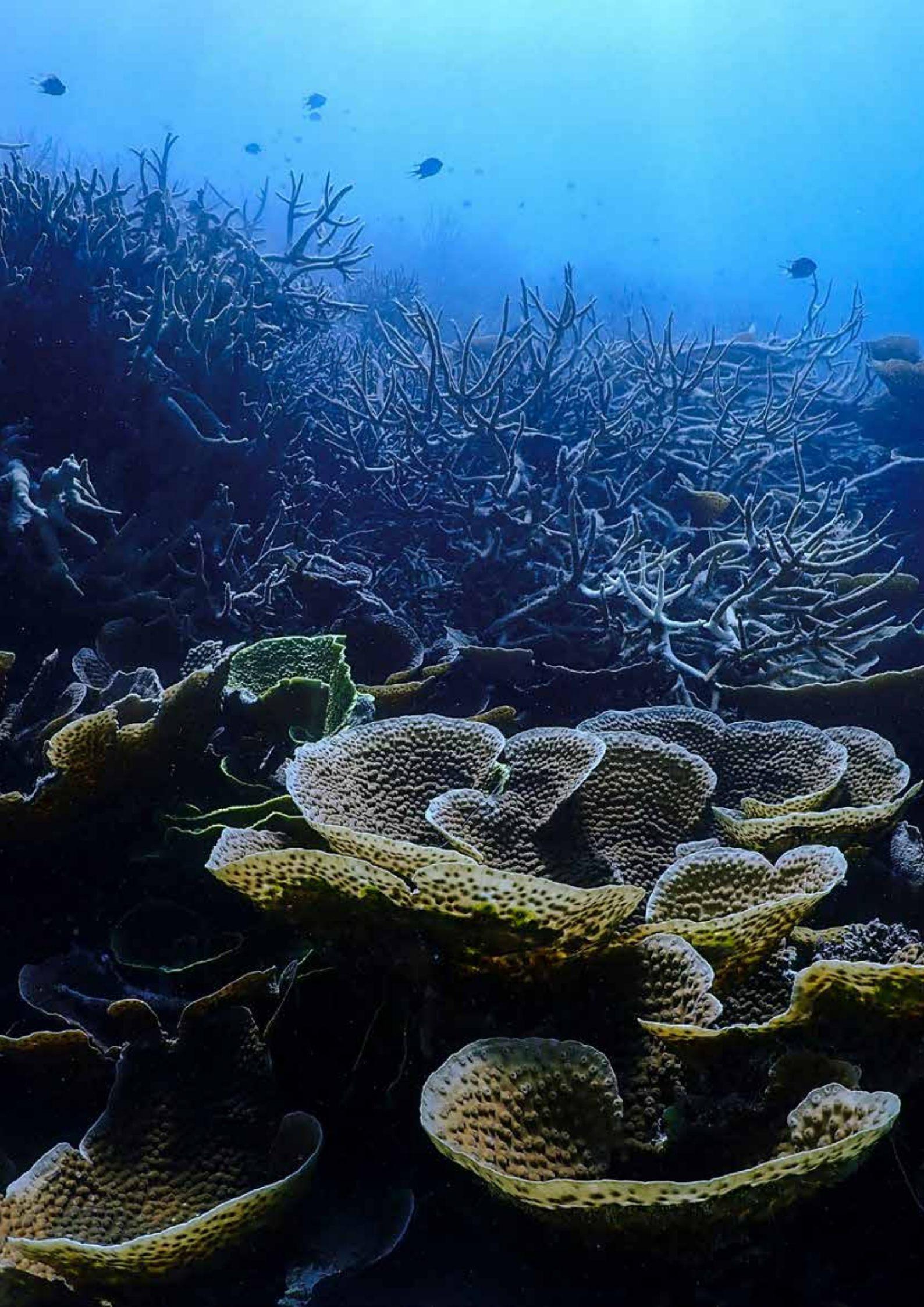
These training programs could be conducted through dedicated deep-sea and offshore fishing academies and vocational institutes, fisheries departments both in the public and private sectors. Attracting and retaining youth in deep-sea and offshore fishing careers may require additional incentives such as scholarships, subsidising insurance, and social security schemes. Upgrading the existing workforce's skills and developing a pipeline of skilled deep-sea and offshore fishers is crucial for safe and efficient deep-sea and offshore fishing operations. This capacity building must be prioritising alongside investments in modernising the fishing fleet.

Stakeholder engagement: In parallel with skill development, active participation of stakeholders is critical to ensure inclusive and sustainable growth in the

sector. Stakeholder engagement to ensure inclusivity and fairness can be achieved through

- Engaging stakeholders, including fishers, communities, and industry stakeholders in planning and decision-making, fostering ownership, inclusivity, and collaboration in implementing strategies.
- Support fishermen cooperatives, SHGs, and FFPOs with targeted funding, training, and access to modern technology and sustainable fishing techniques tailored to the local context to enable them to participate effectively in modernised deep-sea fishing programs.
- Establishing a strong fisher-trader-exporter partnership based on cooperation and trust. Fisher and trade associations, along with NGOs, can play a critical role in fostering and sustaining these partnerships.

By addressing these key areas - physical infrastructure, technological upgrades, and human resource development - India can position itself to fully harness the potential of its deep-sea and offshore fishing resources, boost marine fish production, generate employment, and contribute to food security while ensuring sustainable practices in the sector.



CHAPTER-VII

Monitoring, Control, Surveillance and Enforcement (MCS&E)

Sustainable management and long-term conservation of deep-sea and offshore fisheries resources are contingent upon implementing robust monitoring, control, surveillance and Enforcement (MCS&E) measures. These measures are integral to the development of rules and regulations for fisheries management, particularly in the EEZ and ABNJ, where such rules currently do not exist. As India expands its deep-sea and offshore fishing operations, a comprehensive regulatory framework supported by modern MCS&E tools becomes imperative to combat illegal, unreported, and unregulated (IUU) fishing practices.

This chapter outlines the key components of an effective MCS&E regime tailored for the deep-sea and offshore fishing sector. It covers vessel tracking and communication systems, onboard observer programs, dockside monitoring protocols, and reporting and compliance mechanisms. The proposed MCS&E measures aim to ensure fishing activities remain within permissible areas, catch volumes conform to sustainable limits, and all operations adhere to national and international regulations.

Using satellite-based Vessel Monitoring Systems (VMS), electronic reporting, and integrated MCS&E data platforms can enable real-time monitoring and response capabilities. However, this has to be complemented by adequate law and enforcement mechanisms, stringent penalties for deterrence, and co-management approaches[39] involving stakeholders.

A judicious balance between harmonising with global best practices and contextualising solutions to India's unique requirements is explored in this chapter. Effective implementation of the recommended MCS&E framework is paramount for promoting responsible and sustainable deep-sea fishing while safeguarding the nation's marine ecosystems and biodiversity for future generations.[40]

7.1 Vessel Tracking System

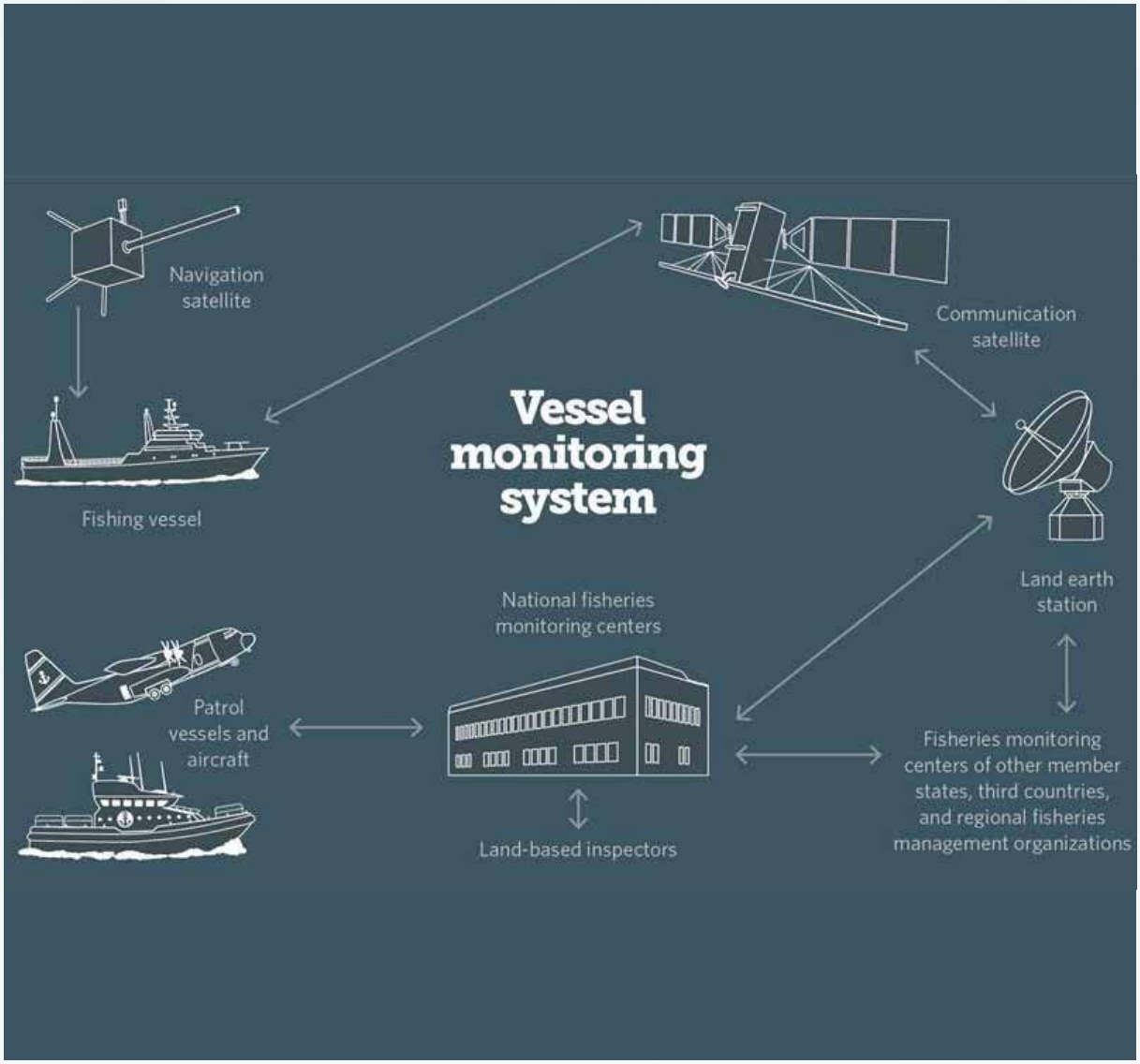
A robust VMS is critical to an effective MCS&E framework for deep-sea and offshore fishing operations. A VMS enables remote monitoring of vessel positions, movements, and activities, allowing regulatory authorities to track compliance. The Indian Space

39 *Guidance for fisheries co-management in the Indian context has been given in the following documents*
https://eprints.cmfri.org.in/11873/
https://eprints.cmfri.org.in/13929/
This is practised in the state of Kerala (law amended) and partially in Tamil Nadu.

40 *https://media.mcsuk.org/documents/GFG_Wild_ratings_methodology_Version_2_June_2018.pdf (accessed on 18th September, 2024)*
https://openknowledge.fao.org/server/api/core/bitstreams/5ebb9e01-34ab-4e64-9651-1f96e5f59636/content#:~:text=Fisheries%20and%20aquaculture%20legislation%20guarantees,duties%20in%20a%20judicial%20or (accessed on 18th March, 2024)

Research Organisation (ISRO) has developed a satellite-based VMS called NavIC for monitoring the coastal fishing fleet.[41] However, this system needs to be scaled up and enhanced to cater to the specific requirements of deep-sea and offshore fishing vessels (Fig. 7.1). Further, as VMS is increasingly used by Indian fishermen for their safety, it is essential to establish the necessary control and monitoring units to fully operationalise the system for deep-sea and offshore fishing.

Fig 7.1: Vessel Monitoring System



Source: https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2017/04/tracking-fishing-vessels-around-the-globe (accessed on 18th March, 2024)

41 *https://www.aiet.org.in/isro-navic-fishermen-project/ (accessed on 18th March, 2024)*

Features of an ideal deep-sea and offshore VMS

Satellite-based tracking

Integration with global navigation satellite systems (GNSS) (GPS, GLONASS, IMARSAT, and NavIC) for accurate position tracking.

National Maritime Domain Awareness (NMDA) project, National Command, Control, Communication, and Intelligence (NC3I) network, ensures pictures of maritime activities are accessible to security stakeholders.

Automatic Identification System (AIS)

AIS transceivers for collision avoidance and vessel identification.

Two-way communication

strengthening the ability to send and receive real time data, position reports, distress signals and instructions to/from vessels.

In 2023, Nabhmitra App for two-way communication from/to sea and crew list updation/regulation introduced for the safety of fishermen.

Tamper-proof and robust design

Ruggedized and tamper-evident designs to prevent tampering or disabling of VMS units.

Continuous and frequent reporting

Capability for position reporting at frequent intervals (e.g., every 30 minutes or less) and continuous tracking.

Data security and encryption

Secure data transmission and encryption to prevent spoofing or interference.

Backup power and data logging

Backup power sources and data logging capabilities in case of power/ communication failures.

Alert and notification system

Ability to generate alerts for violations, unauthorized entry into restricted areas, and other predefined events.

Potential VMS technologies

Various technological solutions can be explored for implementing a deep-sea and offshore VMS (Table 7.1), including:

7.1.1 Satellite-based VMS: Utilise satellite networks like INMARSAT, Iridium, or NavIC for position tracking and data communication.

7.1.2 Cellular-based VMS: Leverages cellular networks (GSM/CDMA) for position reporting when vessels are within coverage range.

7.1.3 Hybrid VMS: Combines satellite and cellular technologies for seamless tracking and communication.

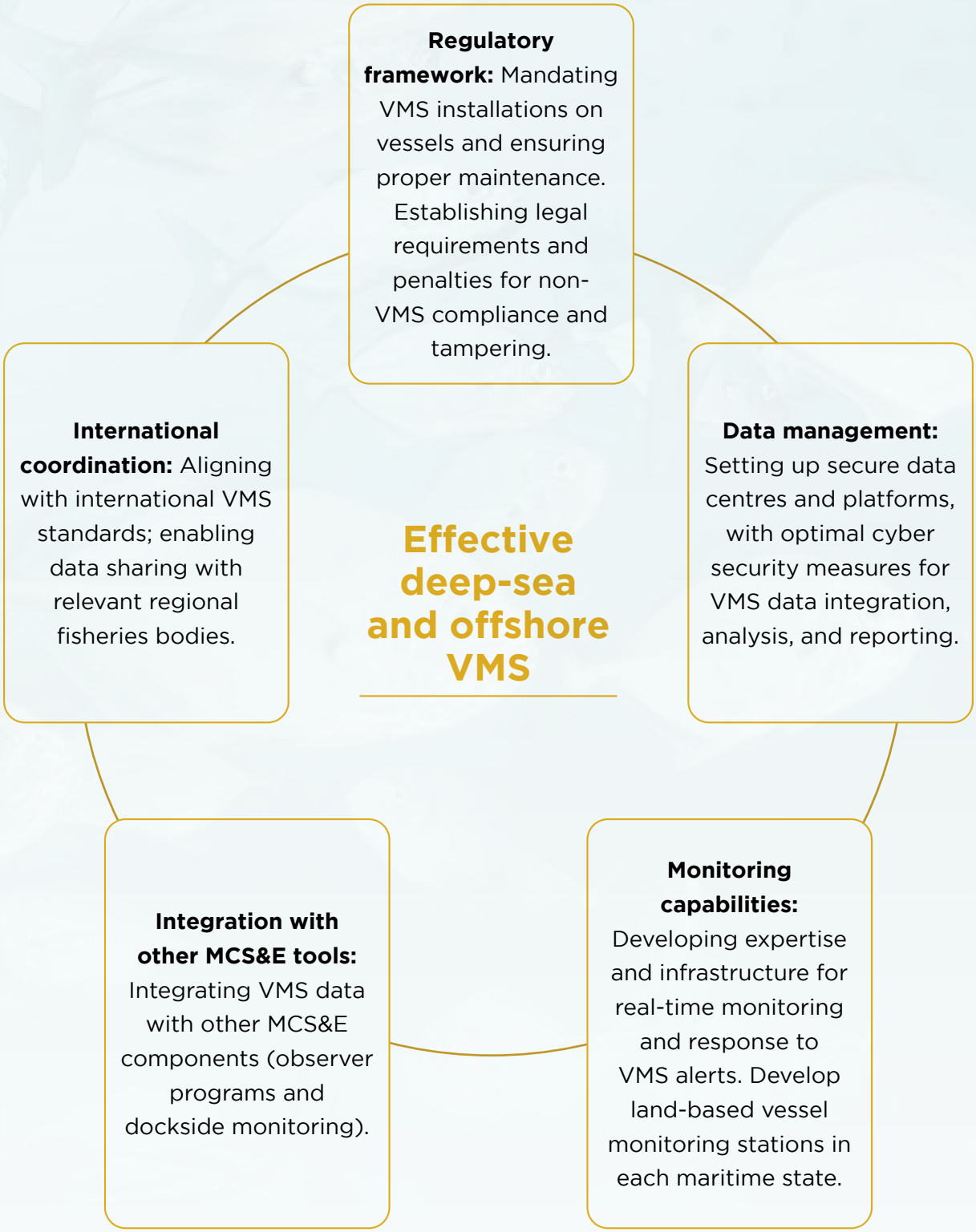
However, VMS is effective only when integrated with area-based (spatial) management. To achieve this, the Department of Fisheries (DoF) must define deep-sea fishing zones, issue specific licenses, and restrict vessels with the appropriate permits to access these zones.

Table 7.1: Comparison of the key features of different VMS technologies

Feature	Satellite VMS	Cellular VMS	Hybrid VMS
Coverage	Global	Coastal / Near-shore	Global and Coastal
Reliability	High	Medium (dependent on network coverage)	High
Position Accuracy	High	Medium to High	High
Data Transfer	Low bandwidth	High bandwidth	High bandwidth
Tamper Resistance	High	Medium	High
Costs	Higher initial and operating costs	Lower costs but limited range	Moderate costs with combined advantages

Implementation Considerations

Implementing an effective deep-sea and offshore VMS requires addressing the following key considerations:

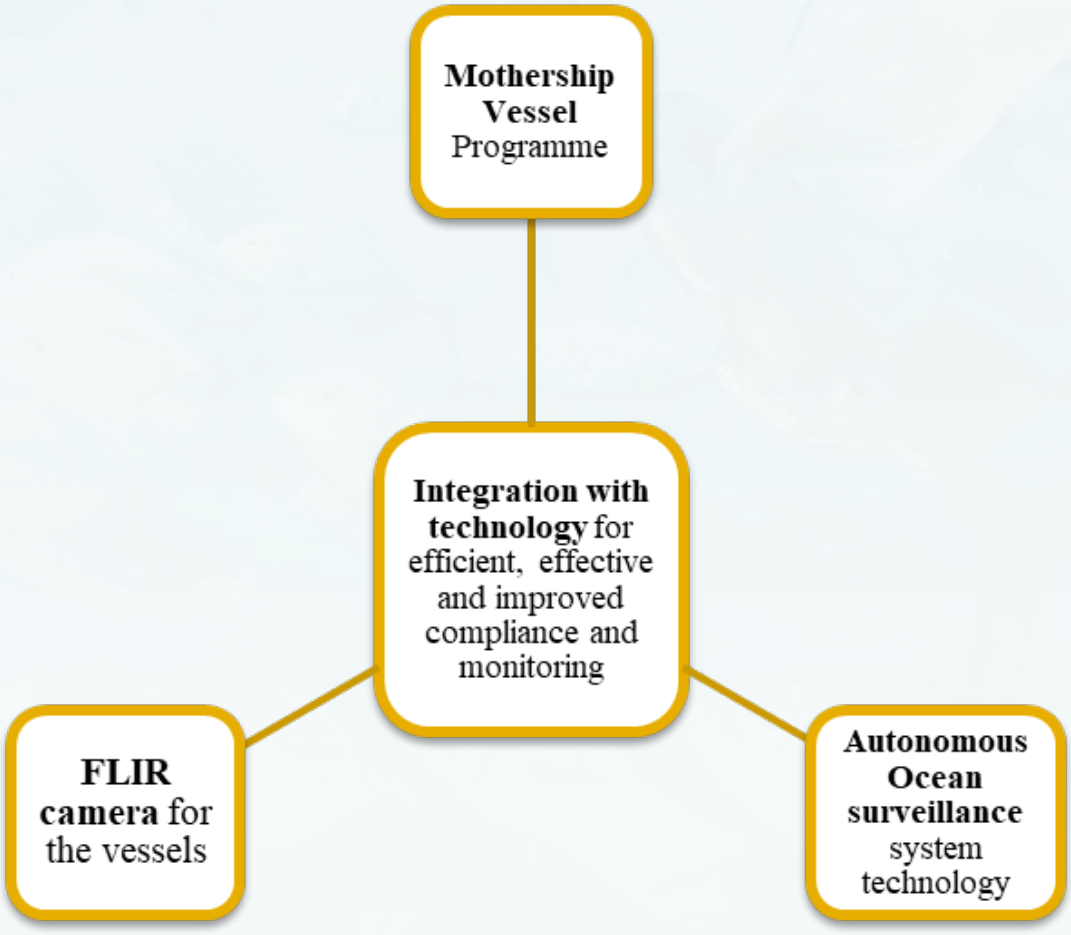


Overall, a well-designed and rigorously implemented VMS is a crucial tool for monitoring deep-sea and offshore fishing activities, deterring IUU fishing, and enabling sustainable management of marine resources.

7.2 On-board Observers

On-board observer programs are an essential element of a comprehensive MCS framework for deep-sea and offshore fishing operations. These programs involve deploying trained observers on fishing vessels to directly monitor and document various aspects of fishing activities, catch composition, and compliance with regulations. RFMOs, especially CCAMLR, mandates the deployment of neutral observers with strict protocols to avoid any bias with the vessel operators/owners. On-board observers play a crucial role in collecting reliable and accurate data, which is vital for effective fisheries management, stock assessments, and ensuring the sustainability of deep-sea and offshore fisheries resources.[42]

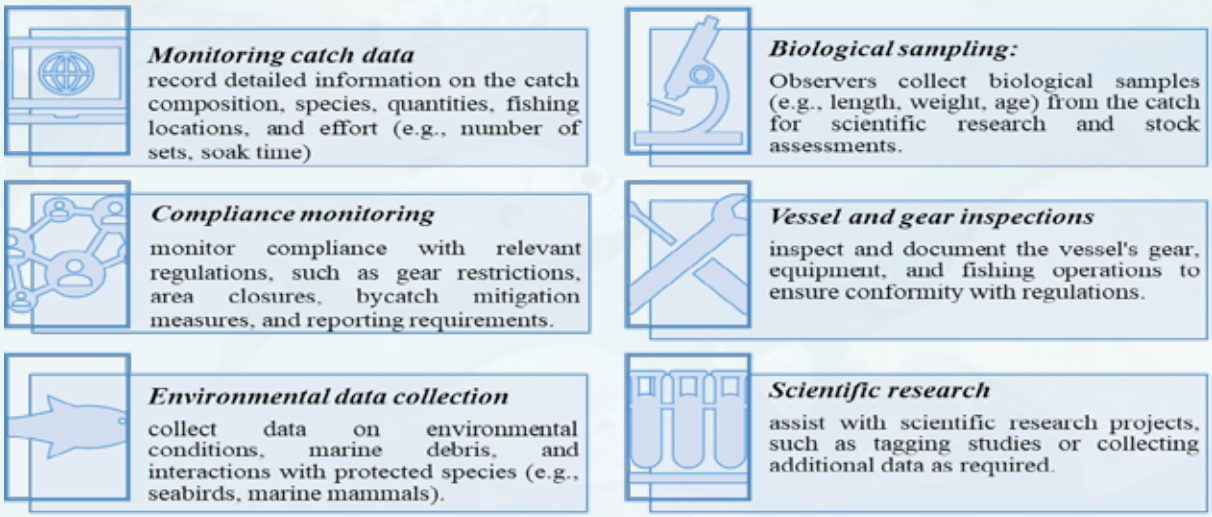
On-board observers can also be integrated with technology for efficient, effective and improved compliance and monitoring through the use of[43]:



42 *https://mrag.co.uk/services/observer-programmes (accessed on 18th March, 2024)*

43 *Mothership Vessel Programme: involves using a larger, well-equipped vessel (mothership) as a centralised monitoring, processing and support hub for smaller deep-sea vessels. Instead of assigning an observer to each vessel, a single observer or monitoring team stationed on the mothership can oversee multiple smaller vessels remotely. Small vessels can transfer catch data, surveillance footage and operational logs to the mothership in real time. Mothership can have advanced monitoring systems (such as AI-driven surveillance, e-logbooks and automated catch monitoring) to validate compliance.*

Functions of On-board Observers



On-board Observer Coverage

The level of observer coverage (i.e., the percentage of fishing trips or vessels with observers) is a critical factor in the effectiveness of the program. Higher coverage levels generally provide more comprehensive and representative data, but also come with increased costs and logistical challenges.[44] International best practices and guidelines from RFMOs often recommend observer coverage levels ranging from 20% to 100% for different fisheries, depending on the level of risk and management needs (Table 7.2).

Table 7.2: Observer coverage levels for various fisheries managed by RFMOs

Fishery	Observer Coverage Level (%)
Tuna Longline	20 -100
Tuna Purse Seine	100
Demersal Trawl	20-50
Gillnet	20-50
Squid Jiggers	20-50

Implementation Considerations

Successful implementation of an on-board observer program requires for addressing the following key considerations:

44 *www.mrag.co.uk (accessed on 18th March, 2024)*

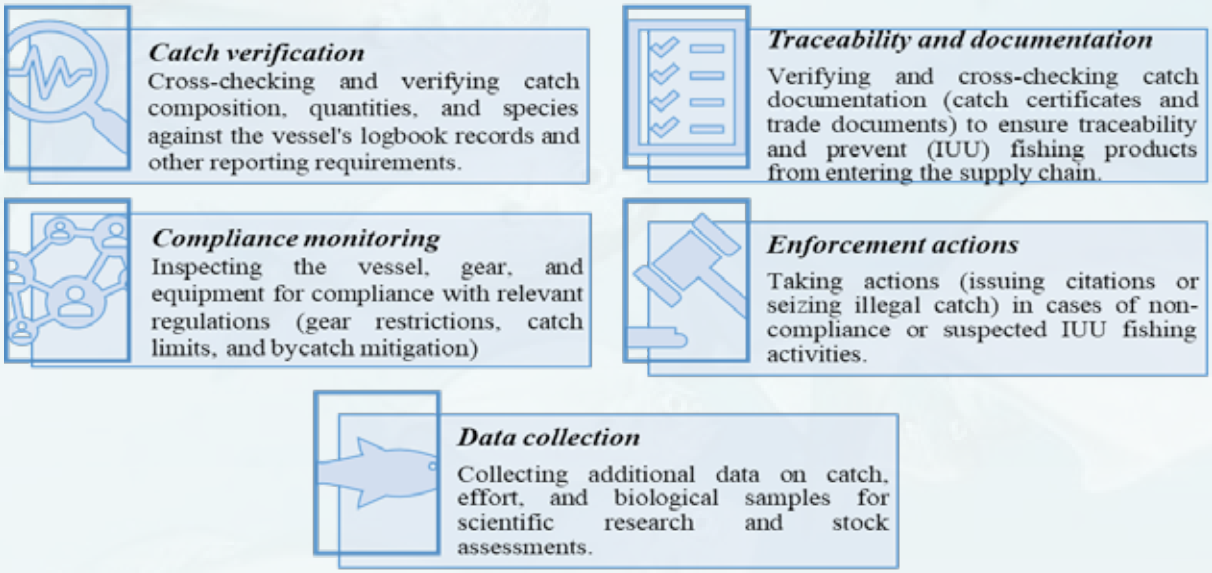
By deploying well-trained observers on deep-sea and offshore fishing vessels, India can significantly enhance its ability to monitor fishing activities, collect valuable scientific data, and ensure compliance with regulations, ultimately contributing to the sustainable management of its deep-sea fisheries resources.

7.3 Dockside Monitoring

Dockside monitoring is an essential component of an effective MCS&E framework for deep-sea and offshore fishing operations. It involves monitoring fishermen and inspecting fishing vessels, their catch, and related documentation upon arrival at designated landing sites or ports (James et al. 2018)[45]

45 *https://www.msc.org/what-we-are-doing/our-approach/at-sea-monitoring-and-surveillance (accessed on 19th March, 2024)*

Dockside monitoring serves several critical purposes, including:



7.3.1 Dockside Monitoring Protocols

Effective dockside monitoring protocols should include the following key elements:

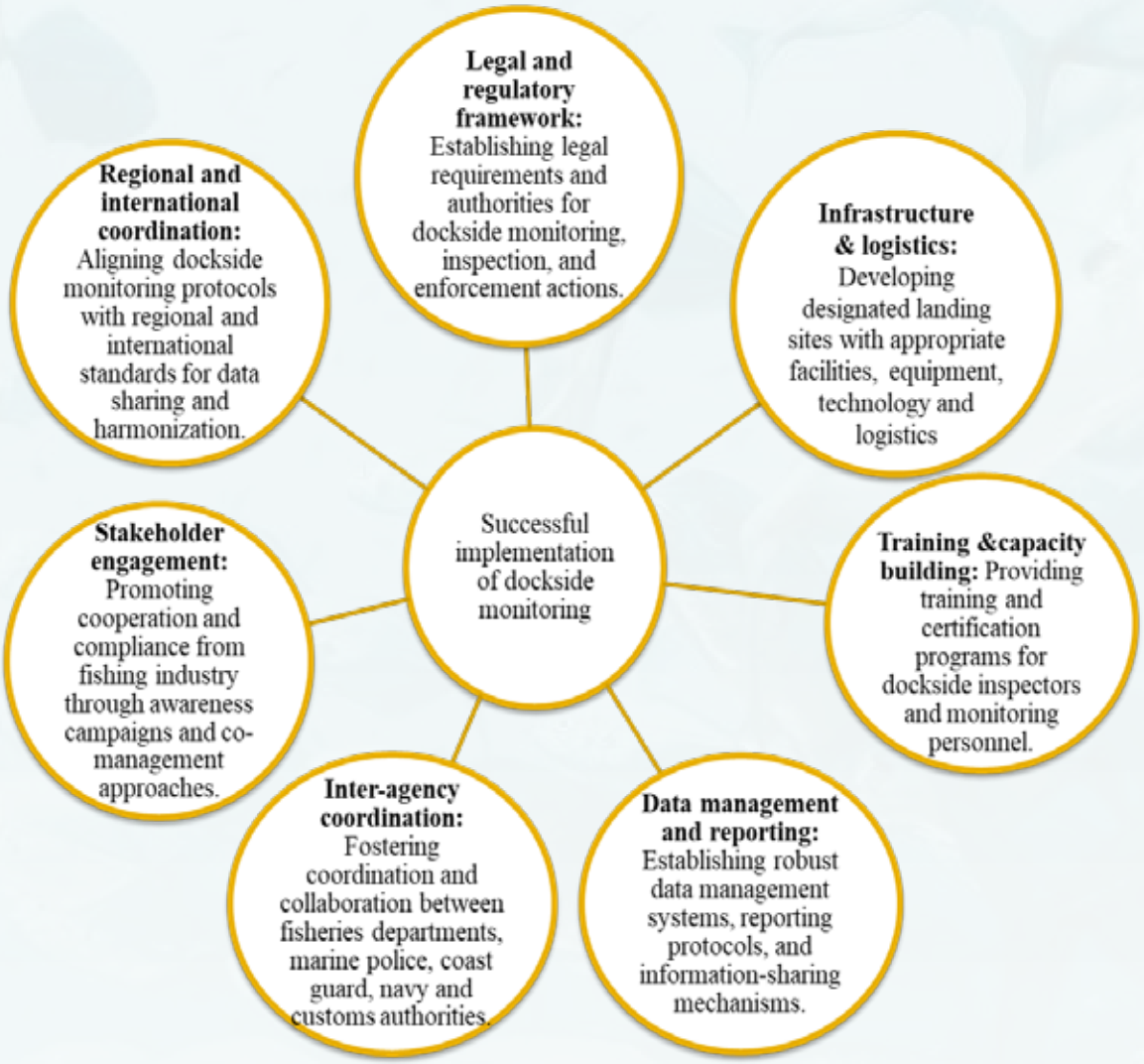
- **Designated landing sites:** Identifying and designating specific landing sites or ports where deep-sea and offshore fishing vessels are required to offload their catch for monitoring purposes.
- **Inspection procedures:** Establishing standardised procedures for inspecting vessels, catch, gear, and documentation upon arrival.
- **Sampling protocols:** Defining protocols for representative catch sampling, biological sampling, and data collection.
- **Documentation requirements:** Specifying the required catch documentation and logbook reporting requirements for deep-sea fishing vessels.
- **Trained inspectors:** Deploying trained inspectors with the necessary expertise and authority to conduct dockside monitoring activities.
- **Risk-based approach:** Adopting a risk-based approach to prioritise and target inspections based on factors such as vessel history, fishing areas, and catch composition using data analytics.

7.3.2 Dockside Monitoring Coverage

The level of dockside monitoring coverage (i.e., the percentage of landings inspected) can vary depending on the available resources, risk levels, and management priorities. Higher coverage levels generally provide more comprehensive monitoring and deterrence against non-compliance, but also require greater resources and capacity.

7.3.3 Implementation Considerations

Successful implementation of dockside monitoring requires addressing the following key considerations:



By implementing robust dockside monitoring protocols, India can strengthen its ability to verify catch data, detect non-compliance, and prevent IUU fishing products from entering the supply chain, ultimately contributing to the sustainable management of its deep-sea fisheries resources.

7.4 Reporting and Compliance

Effective reporting and compliance mechanisms are crucial components of a comprehensive MCS&E framework for deep-sea and offshore fishing operations. These mechanisms ensure that fishing activities are conducted in accordance with relevant regulations, catch data is accurately reported, and appropriate enforcement actions are taken in case of non-compliance.[46]

46 https://assets.wwf.org.uk/downloads/fisheriesmanagement__2_.pdf (Accessed on 19th March, 2024)

Given that many offshore fishing operations operate beyond the range of coastal communication networks, enabling effective communication at sea is vital for monitoring such activities. Potential fishing zone advisories and other oceanographic information disseminated to offshore fleets need to reach fishermen in real-time for improved planning and resource utilisation. It has been recommended that offshore communication systems be established through coordination among relevant stakeholders. This will allow vessels fishing distant grounds to receive timely updates and alerts. It could also facilitate reporting of catch and operational data back to authorities. Establishing reliable offshore communication in phases will be an integral part of the regulatory framework for deep-sea MCS. This will aid compliance monitoring as well as search and rescue operations for fishing vessels operating beyond coastal waters. Key reporting and monitoring bodies in India for offshore fishing activities include the Department of Fisheries for policy formulation, INCOIS for disseminating Potential Fishing Zone advisories and oceanographic data, and the Directorate General of Shipping for safety and compliance monitoring. The NMDA Project and NC3I Network enhance maritime situational awareness, while the Indian Coast Guard ensures search and rescue operations and legal enforcement. ISRO and the Space Applications Centre support satellite-based communication and tracking, with State Fisheries Departments and specialised groups like the Coastal Security Group aiding local implementation. Coordinated efforts among these entities are crucial for effective offshore communication, compliance, and resource management.

Catch Reporting Requirements and Vessel Monitoring and Reporting

Catch reporting requirements

Deep-sea and offshore fishing vessels to be mandated to maintain detailed catch and logbooks, (physically and digitally) which record information on:

- *Fishing location (coordinates)*
- *Fishing effort (number of sets, soak time)*
- *Catch composition (species and quantities)*
- *Bycatch and discards*
- *Interactions with protected species*
- *Gear and equipment used*

Vessel monitoring and reporting

Potential reporting requirements could include:

- *Real-time automatic vessel tracking and two-way communication.*
- *Entry and exit reports when entering or leaving designated fishing areas*
- *Catch and transshipment reports*
- *Incident reports (e.g. gear loss, interactions with protected species)*

The logbooks should be submitted to the relevant fisheries authorities at regular intervals (e.g., daily, weekly, or per trip) through electronic reporting systems or upon arrival at designated landing sites.

In addition to catch reporting, deep-sea and offshore fishing vessels should be required to report their positions, movements, and activities through the Vessel Monitoring System (VMS). This allows regulatory authorities to track vessel locations and ensure compliance with area restrictions, closed seasons, and other regulations.

Table 7.3: Potential compliance monitoring and enforcement mechanisms for deep-sea and offshore fishing operations

Mechanism	Description
At-sea inspections	Inspections conducted by authorised officers aboard deep-sea and offshore fishing vessels during fishing operations.
Dockside inspections	Inspections conducted at designated landing sites or ports upon arrival of deep-sea and offshore fishing vessels.
Observer coverage	Deployment of trained observers on deep-sea and offshore fishing vessels to monitor and report on fishing activities and compliance.
Safety Protocol	Uniform safety protocol and equipment onboard the fishing vessels for effective Search and Rescue (SAR) Operations.
Vessel monitoring system (VMS)	Satellite-based tracking and monitoring of vessel positions and movements.
Electronic monitoring (EM)	Use of sensors, and other electronic monitoring tools for remote monitoring.
Trade monitoring	Monitoring and verification of catch documentation and trade flows to detect IUU products.
Port State measures	Implementation of port State measures, such as port entry restrictions and inspections, to combat IUU fishing.

Effective implementation of these reporting and compliance mechanisms requires a robust legal and regulatory framework, adequate resources and capacity for monitoring and enforcement, as well as cooperation and collaboration among relevant agencies, stakeholders, and regional organisations.[47]

7.5 Security Concerns in Deep Sea and Offshore Fishing

In the aftermath of the 2008 Mumbai terror attack, strengthening coastal security became a top priority for India. The demarcation of coastal security is modelled on a three-tiered architecture, with responsibilities assigned as follows:

47 *https://www.msc.org/what-we-are-doing/our-approach/at-sea-monitoring-and-surveillance (accessed on 19th March, 2024)*

https://assets.wwf.org.uk/downloads/fisheriesmanagement__2_.pdf (Accessed on 19th March, 2024)

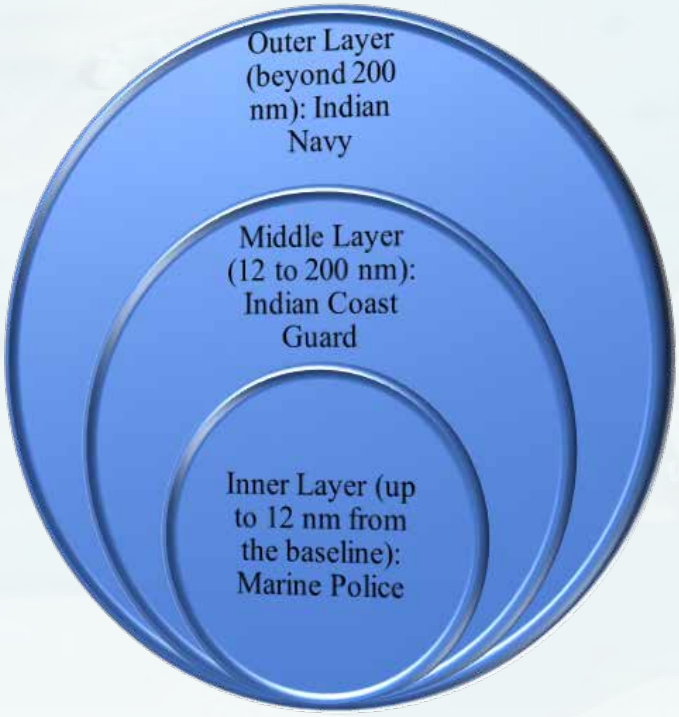
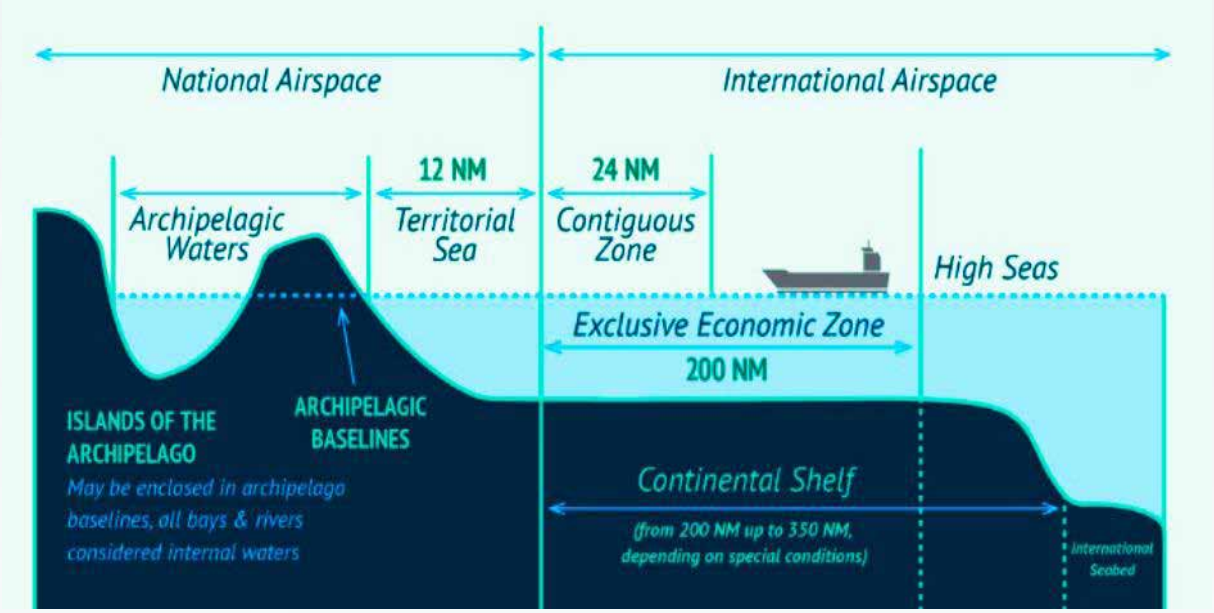


Fig 7.2: Demarcation Diagram for Maritime and International Waters



Source: https://iilss.net/legal-status-of-the-territorial-sea-international-law-of-the-sea-losc-cases/ (accessed on 2nd December, 2024)

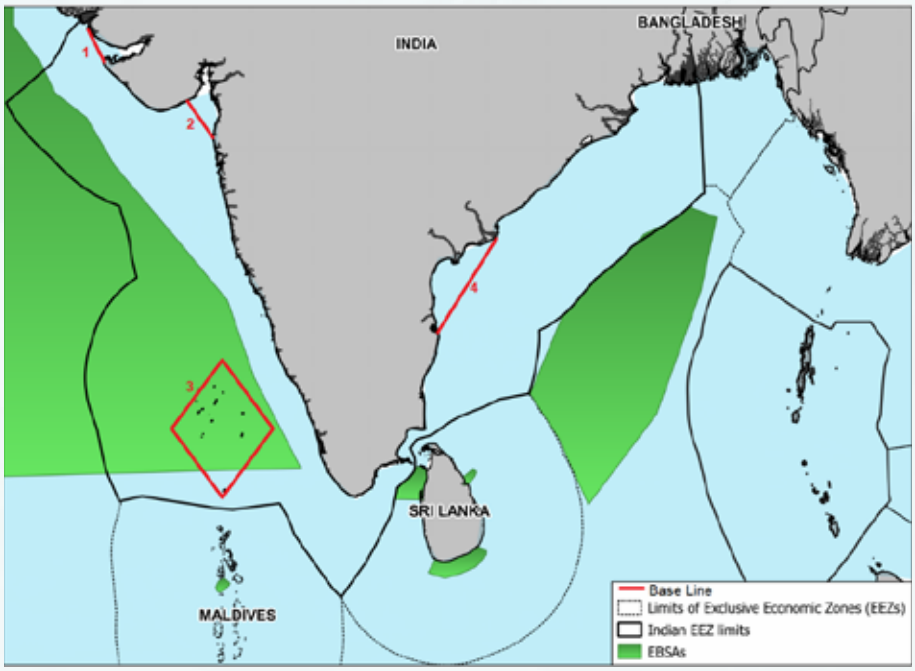
While the Indian Navy holds the overall operational responsibility for coastal security, various initiatives have been undertaken post-2008, such as the establishment of the Coastal Security Network (CSN), National Automatic Identification System (NAIS) chain, National Command Control Communication and Intelligence (NC3I) Network, and the appointment of a National Maritime Security Coordinator (NMSC).

However, the large number of fishing vessels operating in deep-sea and offshore areas and the absence of a comprehensive tracking system pose significant challenges in identifying and monitoring these vessels, raising security concerns. Addressing these challenges is crucial for ensuring maritime security and preventing potential threats.

7.5.1 Challenges

i. **Support to State Marine Police (SMP) for Patrolling Inner Swathes:** The baseline does not run parallel to the coastline, resulting in vast patches that the marine police cannot effectively patrol with their current capabilities. Areas such as the Gulf of Kutch, Gulf of Khambhat, Lakshadweep Islands, and the mouths of the Krishna and Godavari rivers cover extensive nautical miles, which cannot be adequately monitored and patrolled by small boats alone (Fig. 7.3).

Fig 7.3: Diagram showcasing Baseline



Source: https://iilss.net/india-claim-about-points-defining-the-baselines-of-india-straight-baseline/ (accessed on 2nd December, 2024)

ii. **Immediate Neighbourhood:** The southern part of the Sir Creek Line, Palk Strait, and the northern part of the Andaman Islands often witness the movement of fishermen from neighbouring nations. These areas are prone to incidents of fishermen being arrested for violating international waters, necessitating 360-degree monitoring and patrolling due to security concerns.

iii. **Coordination Among Various Stakeholders:** Fishing is a state subject, while coastal security falls under the purview of the Union government. Effective coordination and intelligence sharing among various stakeholders, including the Indian Navy, Coast Guard, and State Marine Police, are essential when dealing with deep-sea and offshore fishing operations from a security perspective.

7.5.2 **Recommendations for Mitigating Challenges**

Robust legal framework

- Enacting national legislation or policy framework addressing
  - » fishing operations,
  - » security considerations,
  - » monitoring mechanisms, and
  - » penalties for non-compliance

Amending State Fishing laws

- Unified fishing laws and policies across India
  - » states can have certain empowerment to adapt it in alignment with sustainable conservation principles specific to their local needs.

Harmonizing Best practices

- Coastal security measures implemented by states can be adopted
  - » Tamil Nadu model of operationalizing the ISRO-developed tracking system
  - » West Bengal's digital database mapping and coastal geospatial data analysis
  - » zonal operational coordination established by southern states
  - » Kerala's Marine Enforcement Wing (part of State Marine Police)

Coordination Among Regional Nations

- As a member of Indian Ocean Tuna Commission (IOTC),
  - » India should advocate for a data-sharing mechanism among member nations, including a security advisory board, to enhance regional cooperation and intelligence sharing.

Infrastructural upgradation of State Marine Police

- Continued support through the Coastal Security Scheme (CSS) for
  - » infrastructural upgradation of marine police forces

Enhanced Maritime Domain Awareness (MDA)

- Investing in advanced technologies
  - » maritime surveillance systems,
  - » satellite imagery, and
  - » data analytics

By implementing these MCS&E measures, India can combat illegal, unreported, and unregulated fishing, ensure compliance with regulations, and ultimately safeguard its marine resources for future generations while promoting responsible and sustainable deep-sea fishing practices.

CHAPTER-VIII

Sustainable Development Goals (SDGs)

The development of India's deep-sea and offshore fishing sector must be pursued in an environmentally sustainable, economically viable, and socially inclusive manner. Aligning this sector's growth with the United Nations Sustainable Development Goals (SDGs) is crucial for ensuring long-term success and impact.[48]

The 2030 Agenda for Sustainable Development, adopted by all UN member states in 2015, provides a comprehensive blueprint spanning 17 interconnected global goals. Harnessing India's underutilized deep-sea and offshore fisheries potential has profound relevance for achieving multiple SDGs, particularly SDG 14 (Life Below Water), which focuses on conserving and sustainably using the oceans, seas, and marine resources.

SDG 14 emphasizes the need to effectively regulate harvesting and end overfishing and destructive fishing practices. Developing India's deep-sea and offshore fishing capacity through responsible policies and sustainable management practices is critical for protecting marine biodiversity.

However, the deep-sea and offshore fishing sector's role extends beyond SDG 14. It is inextricably linked to other goals such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). A thriving yet sustainable deep-sea and offshore fisheries sector can enhance food security, create employment opportunities, enable inclusive economic growth, and contribute to climate change mitigation and adaptation strategies.

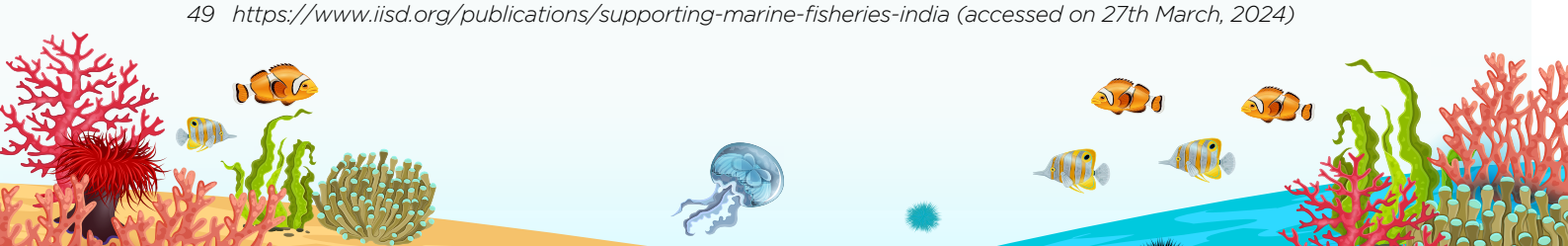
Consequently, it is imperative that India adopts an integrated approach guided by the core principles of the SDGs - environmental protection, economic development, and social inclusion. Establishing an overarching policy framework that harmonises efforts across multiple goals and targets will be vital. International guidelines, best practices, and cross-sectoral partnerships must be leveraged for effective monitoring, implementation and achieving long-term sustainability in this sector.[49]

This chapter examines the deep-sea and offshore fishing sectors contributions to achieving SDG 14 and other interconnected goals. It proposes a comprehensive SDG roadmap with specific targets, indicators, and implementation strategies to guide India's progress on this front until 2030 and beyond.

8.1 Contribution to SDG 14 - Life Below Water

SDG 14 aims to "conserve and sustainably use the oceans, seas and marine resources for sustainable development." As a maritime nation with a vast EEZ of over 2 million sq. km, India has a vital stake in realising the targets under this goal. Proper management of deep-sea and offshore fisheries is pivotal for progressing on multiple SDG 14 targets:

48 *https://eprints.cmfri.org.in/17088/ (accessed on 19th March, 2024)*
https://www.iisd.org/publications/supporting-marine-fisheries-india (accessed on 27th March, 2024)
49 *https://www.iisd.org/publications/supporting-marine-fisheries-india (accessed on 27th March, 2024)*



8.1.1 **Target 14.2: Sustainably manage and protect marine and coastal ecosystems**

- Deep-sea ecosystems like seamounts, cold-water corals, hydrothermal vents, etc., are highly vulnerable to disturbances from fishing activities.
- Adopting precautionary and ecosystem-based approaches to deep-sea fishing will be essential for conserving these habitats and biodiversity hotspots.

8.1.2 **Target 14.4: Effectively regulate harvesting and end overfishing**

- Many deep-sea fish stocks like orange roughy, toothfish, grenadiers, etc., have faced depletion globally due to overfishing.
- Implementing science-based catch limits, reducing bycatch through better technologies, and enforcing regulations will aid stock recovery.

8.1.3 **Target 14.5: Conserve 30% of coastal/marine areas[50]**

- Designating deep-sea marine protected areas (MPAs) to safeguard vulnerable ecosystems and fish spawning/breeding grounds.
- India has recently notified 130 Marine Protected Areas[51] across the Coastal States and Islands.[52]

8.1.4 **Target 14.6: Prohibit certain forms of fisheries subsidies**

- Harmful subsidies that contribute to overcapacity, overfishing, and illegal fishing need to be eliminated.
- Economic incentives should instead be aligned to promote sustainable fishing practices.

8.1.5 **Target 14.7: Increase economic benefits to small island developing states (SIDS)**

- Sustainable utilisation of deep-sea and offshore resources can provide economic opportunities for coastal communities.
- Requires technology transfer, training, equitable access rights, value addition etc.

8.1.6 **Target 14.A: Increase scientific knowledge, research and marine technology**

- Deep-sea ecosystems are still poorly researched and understood compared to coastal areas.
- Investments in research vessels, deep-sea surveys, mapping of fishery resources and ocean observations are vital.
- Induction of new deep-sea research vessels and replacement of outdated research vessels.

8.1.7 **Target 14.C: Implement and enforce international sea law**

- Key international instruments like UNCLOS, UN Fish Stocks Agreement need to be implemented nationally.
- Cooperation with regional fishery bodies and reporting on deep-sea and offshore stocks is imperative.

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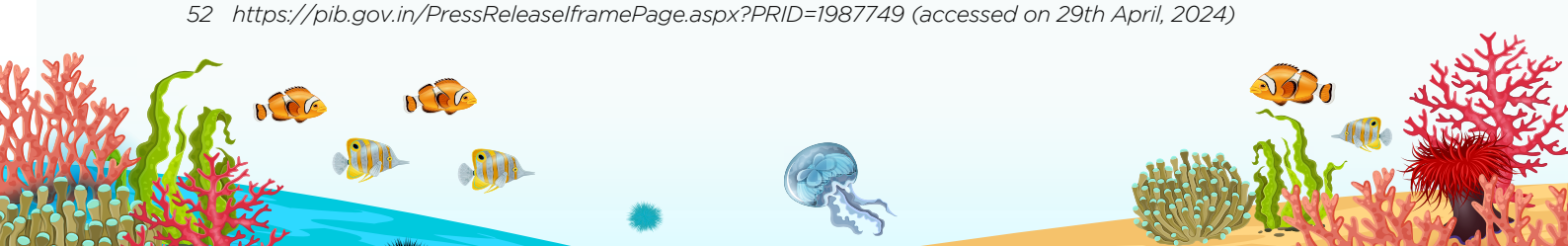
50 *As per the Kunming-Montreal Global Biodiversity Framework (KM-GBF) which was adopted by Convention on Biological Diversity (CBD) in 2022, 30% of every country's EEZ has to be conserved as MPA by 2030. Though achieving this target by 2030 may not be feasible, it is important to adopt the 30% target as a commitment to compliance with the framework.*

51 *Most of these (around 104) are in Andaman & Nicobar Islands. https://wii.gov.in/images/images/documents/GIZ/Reference.pdf*

52 *https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1987749 (accessed on 29th April, 2024)*



Several international guidelines specifically focus on ensuring sustainable deep-sea fisheries:

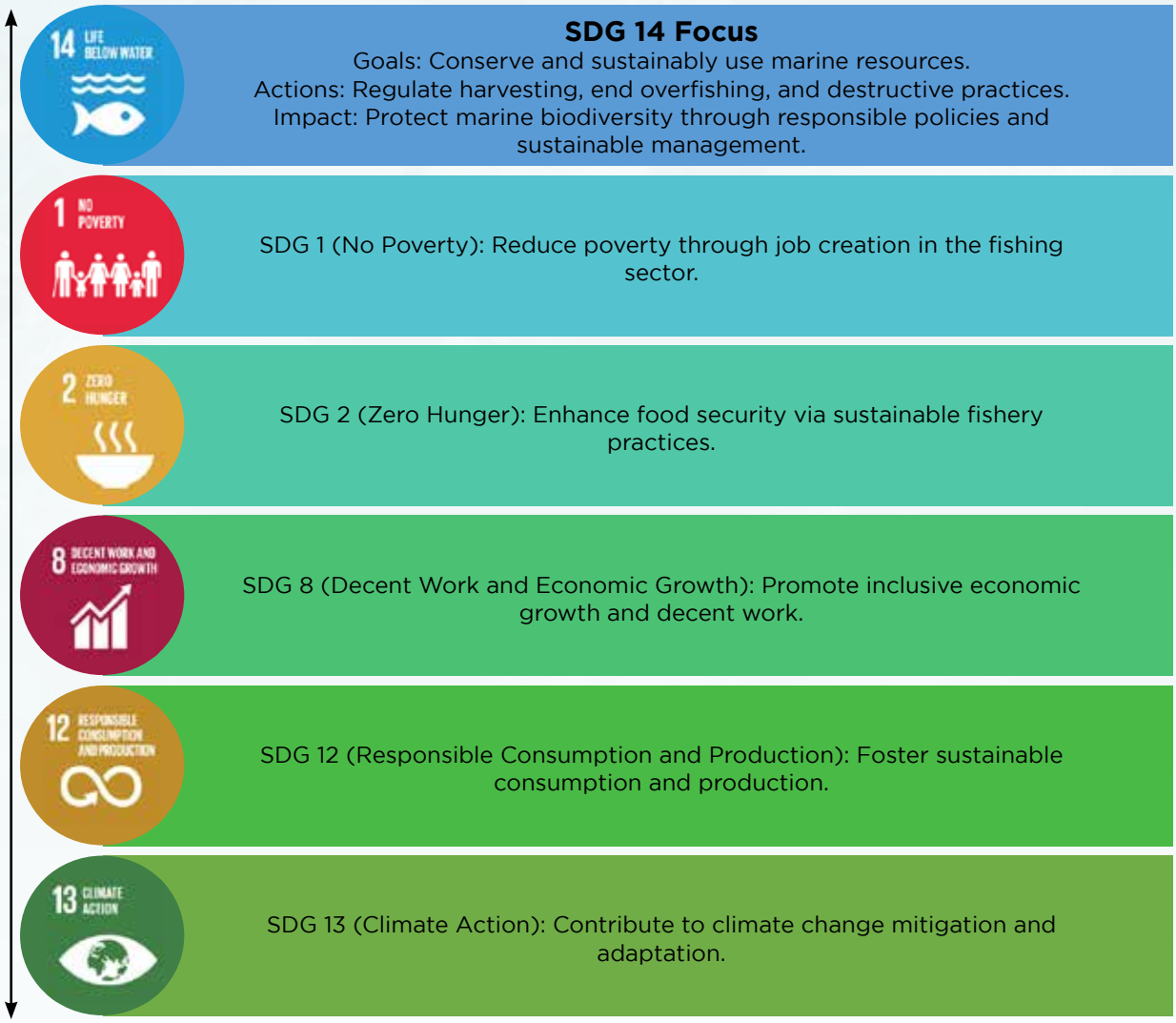
- FAO International Guidelines for Management of Deep-Sea Fisheries in the High Seas.[53]
- UNGA Resolutions on Sustainable Fisheries[54]
- Regional Fisheries Management Organisations' regulations[55]

Alignment with these guidelines through domestic legislation, impact assessments, precautionary management, biodiversity protection strategies and compliance monitoring will aid the conservation of India's deep-sea and offshore living marine resources.

8.2 Interlinkages with other SDGs

While SDG 14 is the most directly relevant, developing a sustainable deep-sea and offshore fishing sector has multi-dimensional impacts that contribute to achieving several other SDGs. The 2030 Agenda highlights the integrated and indivisible nature of the SDGs, requiring a coherent approach to implement the economic, social and environmental dimensions.

Interconnected SDGs



53 *https://openknowledge.fao.org/handle/20.500.14283/i0816t (accessed on 21st September, 2024)*
54 *https://documents.un.org/doc/undoc/gen/n06/500/73/pdf/n0650073.pdf (accessed on 21st September, 2024)*
55 *https://www.cbd.int/doc/meetings/mar/soiom-2016-01/other/soiom-2016-01-fao-19-en.pdf (accessed on 21st September, 2024)*

8.2.1 **SDG 1 - No Poverty**

- Deep-sea and offshore fisheries can provide alternative livelihoods and income sources for coastal communities.
- However, this requires ensuring equitable access, benefitting small-scale fishers and preventing elite capture.

8.2.2 **SDG 2 - Zero Hunger**

- Marine fish are a rich source of protein, micronutrients and healthy fatty acids like omega-3s.
- Sustainably managing these resources enhances food security, nutrition and food availability.

8.2.3 **SDG 8 - Decent Work and Economic Growth**

- The deep-sea and offshore fishing sector can generate substantial employment opportunities both at-sea and on-shore.
- Decent working conditions, occupational safety, social security and regulated labor practices need to be ensured.

8.2.4 **SDG 12 - Responsible Consumption and Production**

- Sustainable fishing methods, minimising bycatch and discards, and efficient utilisation align with SDG 12 targets.
- Moving towards a circular economy through waste reduction and value-addition is key.

8.2.5 **SDG 13 - Climate Action**

- The fishing sector's energy use and emissions contribute to climate change impacts on oceans.
- Transitioning to low-carbon operations and renewable energy sources on vessels can reduce the carbon footprint.

Other Goals:

- SDG 5 (Gender Equality) by involving women across value chains.
- SDG 9 (Industry, Innovation) through R&D in fishing gear and technologies
- SDG 10 (Reduced Inequalities) by supporting small-scale fishermen
- SDG 17 (Partnerships) for mobilising finance, capacity building and policy coherence

Table 8.1: Alignment of Sustainable Development Goals (SDGs) with Relevant Targets

SDG	Relevant Targets
SDG 1- No Poverty	Eradicate extreme poverty Equal rights to economic resources
SDG 2 - Zero Hunger	2.1 End hunger and ensure access to food 2.3 Increase productivity of small food producers - Supporting small-scale deep-sea and offshore fishing enterprises 2.4 Sustainable food production systems
SDG 5 - Gender Equality	5.a Give equal rights to economic resources 5.c Adopt policies for the promotion of gender equality
SDG 8 - Decent Work and Economic Growth	8.2 Diversify, innovate, and upgrade for economic productivity 8.3 Promote policies to support job creation 8.4 Improve resource efficiency in production - Optimising utilisation and reducing waste/discards 8.7 Eradicate forced labour, end modern slavery - Regulated labour practices in this sector
SDG 9 - Industry, Innovation and Infrastructure	9.4 Upgrade infrastructure for sustainability - Modernising fishing fleets, port infrastructure etc 9.5 Enhance scientific research - R&D on deep-sea and offshore species, mapping, innovative fishing gear 9.b Support domestic technology development - Indigenous capabilities in deep-sea and offshore technologies
SDG 10 - Reduced Inequalities	10.2 Promote universal social, economic, and environmental inclusion - Supporting small-scale fishermens 10.b Encourage development assistance and investment - Access to finance, technology for deep-sea and offshore fishing
SDG 12 - Responsible Consumption and Production	12.2 Sustainable management and use of natural resources 12.3 Halve global food waste and reduce losses - Reducing bycatch, discards, and post-harvest losses 12.4 Achieving environmentally sound management of wastes - Waste management in fishing operations 12.c Rationalise fossil fuel subsidies - Aligning incentives for sustainable deep-sea and offshore fishing
SDG 13 - Climate Action	13.2 Integrate climate change plans/policies - Factoring Ocean impacts 13. Implement the UNFCCC commitments - Transitioning to low-carbon fishing operations
SDG 17 - Partnerships for the Goals	17.6 Knowledge sharing and coordination for SDGs 17.7 Promote sustainable technologies 17.9 Enhance capacity support for developing countries - Capacity building support from international agencies

Integrated policies, coordinated actions, multi-stakeholder partnerships, and robust monitoring frameworks are essential to leverage these synergies. The sustainable development of deep-sea and offshore fisheries transcends SDG 14 and has wide-ranging impacts if managed holistically.

8.3 SDG Framework for the Deep-Sea Fishing Sector

Establishing a comprehensive policy and governance framework anchored in the Sustainable Development Goals is critical for realising the full potential of India's deep-sea and offshore fisheries in an economically, socially, and environmentally sustainable manner.

Table 8.2: Means of Implementation for Sustainable Deep Sea Management and Fisheries Development

SDG Target	Indicator	Means of Implementation
14.2 Sustainable management of marine ecosystems	- Coverage of marine protected areas (%) [Proportion of fish stocks within biologically sustainable levels (%)][56]	- Spatial management plans [Environmental impact assessments] [Ecosystem approach to fisheries management]
14.4 Ending overfishing and restoring fish stocks	- Fish stock biomass (tons) [Catch within Maximum Sustainable Yield (MSY) limits]	- Science-based catch limits [Bycatch mitigation technologies] [Monitoring, control, and surveillance]
14.6 Prohibiting Harmful Fisheries Subsidies	- Subsidy types and amounts (Rs.) [Fishing effort capacity]	- Sustainable subsidy policies [Fuel, vessel buyback programs] [Rights-based management]
14.7 Economic benefits for SIDS and LDCs	- Value of deep-sea and offshore fish trade (Rs in Crores) [Access agreements in place]	- Fair access policies [Value addition facilities] [Technology transfer and training]

56 *This is already a continuing process by CMFRI. https://eprints.cmfri.org.in/15423/ ; https://eprints.cmfri.org.in/18242/*

SDG Target	Indicator	Means of Implementation
14.A Research and marine technology	- Research vessel capacity [Deep-sea surveys and mapping coverage]	- National research programs [Regional/global collaborations] [Open data and knowledge sharing] [inducting new fishery deep-sea research vessels]
14.C Implementing international sea law	- Membership in regional fishery bodies [Legislation consistent with UNCLOS]	- Harmonising national laws [Implementing reporting obligations] [Cross-border cooperation]
1.1, 2.1 Poverty and hunger reduction	- Incomes and livelihoods generated [Fish protein supply and availability]	- Inclusive policies and access [Social security and worker welfare]
5.a, 5.c Gender equality and empowerment	- Women's participation across the value chain	- Gender-responsive policies [Targeted support programs]
8.2, 8.3 Economic growth and employment	- Jobs created [GDP contribution]	- Skill development programs [Financing and insurance schemes]
9.4, 9.5 Infrastructure and innovation	- Fleet modernization [Technologies adopted]	- Public and private investments [Technology incubation]
12.2, 12.3 Sustainable production and waste	- Fish losses and waste reduced [Bycatch rates]	- Cold chains and value addition [Circular economy practices]
13.2 Climate Action Integration	- Emissions from fishing operations	- Energy efficiency [Renewable energy transition]
17.6, 17.7 Partnerships and tech cooperation	- Collaborative projects/ initiatives [Technology access and transfer]	- Public-private partnerships [Development assistance programs]

This framework aims to provide an end-to-end roadmap covering the ecological sustainability of deep-sea stocks, inclusive economic opportunities, research and innovation, climate change mitigation, partnerships and means of implementation.

While linkages between research bodies have been emphasised the strategies will also promote formal agreements and standardised protocols to facilitate ongoing collaboration and exchange of catch, effort, oceanographic, and other fishery-dependent data to continually refine sustainable management approaches for deep sea and offshore fisheries over time.

Thus, the chapter emphasises the need for an integrated approach that balances environmental protection, economic development, and social inclusion. Key focus areas include ecosystem-based management, science-based catch limits, marine protected areas, research and innovation, fair access policies, and international cooperation. By adopting this SDG-aligned approach, India can harness the full potential of its deep-sea and offshore fisheries while ensuring their long-term viability and contributing to broader sustainable development objectives. Regular monitoring, reporting, and review mechanisms will be essential to track progress and adapt strategies as needed.

CHAPTER-IX

Roadmap for Harnessing Deep-Sea and Offshore Fisheries

Harnessing the full potential of India's deep-sea and offshore fisheries requires a well-planned, multi-layered and adaptive implementation approach spanning multiple years. This chapter presents a comprehensive roadmap outlining key initiatives, milestones and timelines for developing the country's thriving deep-sea and offshore fishing sector.

The roadmap is structured around three strategic phases: (1) laying the foundation and fostering early growth; (2) scaling up and achieving global competitiveness; and (3) establishing global leadership in sustainable deep-sea fisheries. Each phase highlights specific objectives and targets aligned with the overarching goals of sustainably harnessing deep-sea and offshore resources, enhancing production and economic contributions. The approach recognises deep-sea fisheries development as a dynamic and evolving process. This would ensure that critical enablers – such as cold chain infrastructure, market access, modern vessels, and fishers' skill development– develop concurrently across all phases, supporting sustainable growth at every stage.

Successful implementation would require a strong commitment to sustainable development principles, effective governance mechanisms, and strategic deployment of financial and human resources. A coordinated effort by multiple stakeholders, including central and state governments, fisher communities, industry players, research institutions, and international organisations is crucial. The Department of Fisheries, Government of India, along with the State Governments, should play a nodal role from the planning stage itself.

By adhering to this roadmap, India can unlock the immense economic potential of its deep-sea and offshore fisheries while ensuring the long-term sustainability of these valuable marine resources for future generations.

9.1: Phase 1: Laying the foundation and fostering early growth

Phase 1 focuses on laying a solid foundation for the growth and development of India's deep-sea fishing sector through short-term interventions (3 years | 2025-28) by establishing regulatory frameworks, addressing critical infrastructure gaps, initiating capacity-building efforts, promoting Research and Development, and exports. It aims to create an enabling environment for the deep-sea and offshore fishing sector to take off.

The primary objectives and targets in phase 1 include:

9.1.1 **Regulatory Framework and Policy Interventions:**

i. Enact a comprehensive legislation to ensure responsible and sustainable fishing practices in deep-sea waters

- Develop rules and regulations of fisheries governance for 12-200 nmi region and for enabling fishing in ABNJ.
- Update the Maritime Zones Act, 1976 and the state Marine Fishing Regulation Act (MFRAs).
- Enact a separate Vessels Act to cater to the needs of modern fishing vessels.

ii. Formulation of state-level deep-sea and offshore fishing policies along with incentive schemes tailored to regional needs.

iii. Implementation of licensing and permit systems for deep-sea and offshore fishing vessels, providing a comprehensive legal framework for fishing operations.

- Utilise ReALCRaft as a centralised digital platform for national-level registration and licensing of deep-sea and offshore vessels, in coordination with state and UTs.

iv. Establishment of monitoring, control, surveillance and enforcement (MCS&E) mechanisms.

- Scaling up of NAVIC to cater to the requirements of deep-sea and offshore fishing.
- Develop land-based vessel monitoring stations in each maritime state equipped with state-of-the-art technology.
- Implement an on-board observer program by integrating it with technology such as electronic monitoring, FLIR cameras.
- The Department of Fisheries (DoF) can define deep-sea fishing zones and implement a zone-specific licensing system to ensure access to these zones for vessels with appropriate licenses.
- Strengthen enforcement through interagency collaboration between DoF, the marine police, the coast guards, navy.

The lead implementation agencies/departments for 'regulatory and policy interventions' could include the Department of Fisheries (DoF), State Fisheries Departments, CMFRI, ISRO, the marine police, the coast guards, and the navy etc.

9.1.2 **Infrastructure Development:**

i. Upgradation/Construction of major deep-sea fishing harbours in the coastal states/UTs.

ii. Establishment of 10-15 minor deep-sea landing centres in the coastal states/UTs.
   - Setting up integrated fish handling, processing and storage facilities near harbours and landing centres.
   - Identify the Fisherwomen's group and provide them with training to operate and maintain these facilities.

iii. Development of cold chain infrastructure, including pack-houses and strategically located cold storage facilities.

iv. Establish vessel repair and maintenance facilities such as dry docking, slipways and workshops in the coastal states.

The lead implementation agencies/departments for 'infrastructure development' could include DoF, Ministry of Ports, Shipping and Waterways (MoPSW), National Fisheries Development Board (NFDB), National Cooperative Development Corporation (NCDC), National Federation of Fishers Cooperatives Ltd. (FISHCOPFED), Ministry of Food Processing Industries (MoFPI), State Maritime Boards etc.

9.1.3 **Fleet Upgradation and Capacity Building:**

i. Induction of deep-sea and offshore fishing vessels (longliners, trawlers, gillnetters, etc.)[57]

ii. Development of standardised fishing vessel designs and specifications at the national level with a particular focus on ensuring uniformity, safety, operational efficiency and energy efficiency.

57 *The number of vessels to be inducted can be planned based on the availability of quantum of resources, efficiency of vessels catch per unit effort (CPUE) and how much can be fished economically without leading to resource depletion. The number of fleet induction must follow the standard conservation principles and scientific basis to avoid over fishing.*

iii. This could be incorporated into the new Fishing Vessels Act.

iv. Upgradation of onboard preservation facilities, including installation of equipment such as compressors, ice-making machines and refrigerated seawater (RSW) and modernisation of fish holds in existing vessels.

v. Establishment of domestic shipbuilding capacities for deep-sea and offshore vessels in existing shipbuilding destinations.

vi. Launch of skill development programs for deep-sea and offshore fishers and crew in collaboration with national and international agencies.

vii. Creation of dedicated deep-sea and offshore fishing training academies.

The lead implementation agencies/departments for 'fleet upgradation and capacity building' could include DoF, MoPSW, Indian Register of Shipping, Ministry of Skill Development and Entrepreneurship (MSDE), and NFDB etc.

9.1.4 **Research and Development:**

i. Mapping and scientific assessment of deep-sea and offshore fisheries resources to evaluate potential and sustainability.

- Leverage National Marine Fisheries Data Centre (NMFDC) to serve as a centralised database and reporting system for vessel logbooks, catch data and compliance records, focusing on segregation of deep-sea fishery catches.
- Enhance data collection on fishing area, effort, season, species aggregation and environmental conditions.

ii. Replace outdated fishery research vessels with MoES, ICAR, DoF etc; induct new deep-sea research vessels and formulate targeted scientific programs to support deep-sea fisheries research and sustainability.

iii. Launch of pilot projects and feasibility studies for deep-sea and offshore fishing operations.

iv. Collaboration with research institutions and international organisations to adopt best practices and advanced technologies in sustainable fishing.

v. Undertake R&D on myctophids as fish meal.

The lead implementation agencies/departments for 'research and development' could include Indian National Centre for Ocean Information Services (INCOIS), MoES; ICAR-CMFRI (Central Marine Fisheries Research Institute), FSI, ICAR-CIFT (Central Institute of Fisheries Technology), National Institute of Ocean Technology (NIOT), Private feed manufacturers etc.

9.1.5 **Export Promotion**

i. Strengthening engagement with fisher cooperatives to leverage collective resources and bargaining power for promoting exports through collaboration.

ii. Promotion through export promotion councils and trade facilitation measures to access global markets, with a focus on quality and sustainability.

iii. Implement traceability systems and eco-labelling for compliance with global standards.

The lead implementation agencies/departments for 'export promotion' could include DoF, FISHCOPFED, State Fisheries Departments, Marine Products Export Development Authority (MPEDA), NCDC, Export Inspection Agency (EIA), Directorate General of Foreign Trade (DGFT) etc.

Key initiatives and milestones under Phase 1

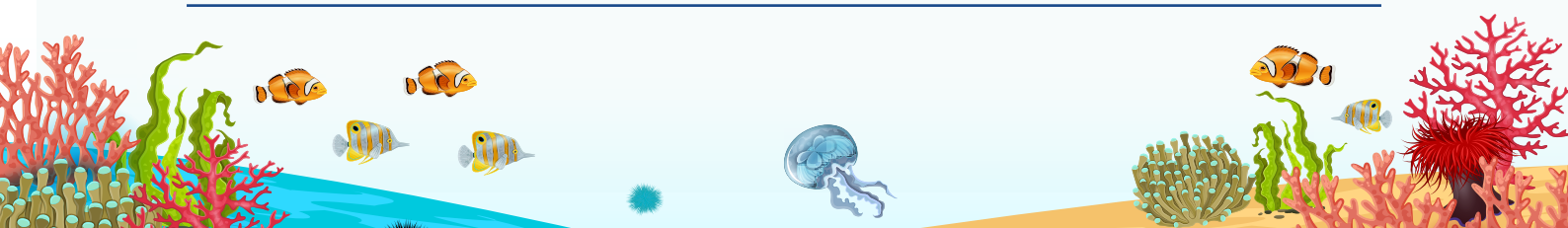
	Milestones	Requirements	Indicators of progress
Regulatory framework	» Enact fisheries governance rules for 12-200 nmi & ABNJ. » Update Maritime Zones Act & MFRAs. » Enact separate Vessels Act. » Implement licensing & permit systems via ReALCRaft. » Strengthen enforcement through interagency collaboration.	» Legal and policy reforms. » Coordination with State/ UT governments. » Digital registration systems.	» New regulations enacted, implemented. » Percentage of deep-sea vessels registered under ReALCRaft. » No. of enforcement actions taken against IUU fishing.
Infrastructure development	» Upgrade/construct major harbours. » Establish 10-15 minor landing centers. » Set up 5-7 major fish processing facilities. » Develop 50-60 pack-houses & cold storage units. » Establish vessel repair & maintenance facilities.	» Investment in infrastructure. » Clusterbased approach for developing ancilliary industries (ice plant, vessel repair facilities, cold storage near the harbours) » Fisherwomen's training for processing facilities.	» No. of harbors, landing centers, vessel repair and maintenance facilities operational. » Processing capacity (tons/ day). » Cold storage capacity (MT). » No. of fisherwomen trained.
Fleet upgradation & capacity building	» Induct deep-sea vessels (longliners, trawlers, gillnetters). » Upgrade onboard preservation (compressors, RSW). » Develop 2-3 domestic shipyards » Train 10,000-15,000 deep-sea fishers. » Establish dedicated deep-sea training academies.	» Financing mechanisms for vessel procurement. » Collaboration with shipbuilding industry.	» No. of deep-sea vessels inducted. » No. of fishers trained & certified. » No. of shipyards operational.

Key initiatives and milestones under Phase 1 (contd..)

	Milestones	Requirements	Indicators of progress
Research and Development	» Conduct resource mapping & scientific stock assessments. » Replace outdated fishery research vessels and launch targeted scientific programs » initiate pilot projects for deep-sea fisheries. » Collaborate with research institutions for technology adoption. » Undertake R&D on myctophids as fish meal.	» Strengthening National Marine Fisheries Data Centre (NMFDC). » Integration with oceanographic data for improved PFZ advisories.	» No. of stock assessments conducted. » No. of research vessels replaced and inducted. » No. of pilot projects initiated. » Adoption of PFZ advisories by commercial fleets.
Export Promotion	» Strengthen fisher cooperatives for export promotion. » Expand global market access via export councils. » Implement traceability, eco-labeling and certifications.	» Compliance with international market standards and certifications.	» Increase in deep-sea fishery exports. » No. of export-certified processing units. » No. of traceability-certified products.

Phase 1 focuses on addressing critical infrastructure bottlenecks and creating an enabling policy and regulatory environment. As part of capacity-building efforts, efforts should be made to improve the resolution and reliability of potential fishing zone (PFZ) advisories through the incorporation of additional oceanographic parameters like primary productivity forecasts, as suggested by experts. Potential Fishing Zone advisories are a proven mechanism for forecasting epipelagic fishery resources. However, for mesopelagic and demersal resources, further research is required, involving modern tools and techniques. Further, parallel efforts should also be directed towards building the necessary human capital and institutional capacities to support the growth of deep-sea fishing operations.

A dedicated committee within the Department of Fisheries could oversee progress against the milestones, conducting annual reviews and adjusting timelines as necessary. Periodic assessments from third-party research and advisory organisations may be incorporated to measure effectiveness and compliance. Successful implementation of initiatives under phase 1 will lay the groundwork for the subsequent phases, enabling India to unlock its deep-sea fisheries potential while ensuring long-term sustainability.



9.2: Phase 2: Scaling up and achieving global competitiveness

Building upon the foundation laid in phase 1, phase 2 of the implementation roadmap aims to accelerate the growth and development of India's deep-sea fishing sector through medium-term interventions (4 years | 2029-2032). It focuses on scaling up operations, rapid expansion and modernisation of the fishing fleet, strengthening monitoring and surveillance mechanisms, expanding market access, and capacity building and research.

The primary objectives and targets for phase 2 include:

9.2.1 **Fleet Modernisation and Expansion:**

i. Large-scale induction of advanced deep-sea and offshore fishing vessels facilitated through cooperative ownership models, where fisher cooperatives jointly own and operate modern vessels.
ii. Upgradation of existing vessels with modern gear and handling equipment to enhance efficiency and sustainability.
iii. Strengthen shipbuilding capacities to support the production and maintenance of advanced vessels with updated technologies.
iv. Promotion of fishing corporations and joint ventures, and support for fisher cooperatives in establishing deep-sea ventures.

The lead implementation agencies/departments for 'fleet modernisation and expansion' could include DoF, FISHCOPFED, NCDC, NABARD, ICAR-CIFT, MoPSW, Ministry of Micro, Small and Medium Enterprises (MSME), NFDB, Private partners/investors etc.

9.2.2 **Infrastructure Development and Upgradation:**

i. Construction of additional deep-sea fishing harbours and landing centres to accommodate growing fleet capacity.
ii. Expansion of fish handling, processing, and cold chain infrastructure to reduce post-harvest losses and improve quality control.
iii. Expansion of dedicated deep-sea and offshore vessel repair and maintenance facilities.

iv. Promotion of sustainable and low-impact fishing practices through the integration of advanced technologies, such as modern fish-finding equipment (e.g., sonar, echo sounders, satellite-based systems) along with best practices.

The lead implementation agencies/departments for 'infrastructure development and upgradation' could include DoF, MoPSW, Sagarmala Development Company Ltd. (SDCL), MPEDA, Ministry of Food Processing Industries (MoFPI), State Maritime Boards, ICAR-CIFT etc.

9.2.3 **Strengthening of Monitoring, Control, Surveillance and Enforcement (MCS&E):**

i. Expand comprehensive Vessel Monitoring Systems (VMS) to cover 100% of deep-sea fleet.
ii. Expansion of on-board observer programs to improve compliance with sustainability regulations.
iii. Strengthening of dockside monitoring and inspection protocols.

The lead implementation agencies/departments for 'Strengthening of Monitoring, Control, Surveillance and Enforcement (MCS&E)' could include DoF, the Directorate General of Shipping, FSI, and the State Fisheries Department etc.

9.2.4 **Market Expansion and Value-Added Processing:**

i. Facilitation of access to premium domestic and international markets through trade agreements and export facilitation.
ii. Promotion of value-added and diversified deep-sea fishery products.
iii. Integration of technology and automation throughout the value chain to enhance efficiency and transparency.
iv. Promotion of offshore mariculture as an alternate revenue stream and to diversify fish production.

The lead implementation agencies/departments for 'Market expansion and value-added processing' could include MPEDA, DGFT, ICAR-CIFT, MoFPI, NFDB, DoF, ICAR-CMFRI etc.

9.2.5 **Capacity Building and Research:**

i. Continuing skill development programs for deep-sea and offshore fishers and crew, integrating global best practices.
ii. Collaboration with research institutions for stock assessments, resource mapping and sustainable fishing innovations.
iii. Implementation and validation of the offshore/deep sea fisheries advisories with the commercial fishing fleets.
iv. Promotion of sustainable fishing practices through scaling up of traceability systems, eco-labelling initiatives, consumer awareness campaigns, and responsible fisheries management to ensure transparency, incentivise sustainable choices and foster long-term marine conservation and livelihoods.

The lead implementation agencies/departments for 'Capacity building and research' could include DoF, NFDB, FISHCOPFED, MSDE, Central Institute of Fisheries Nautical and Engineering Training (CIFNET), ICAR-CMFRI, NIOT, INCOIS, MPEDA etc.

Successful implementation of initiatives under phase 2 aims to position India as a significant player in the global deep-sea and offshore fishing industry, contributing substantially to domestic fish production, export earnings, and the overall blue economy.

Key initiatives and milestones under phase 2

	Milestones	Requirements	Indicators of progress
Fleet Moderni-zation & Expansion	» Large-scale induction of advanced deep-sea vessels (500). » Upgrade existing fleet with modern gear & handling systems. » Strengthen shipbuilding capacity with 5-7 shipyards. » Support fisher cooperatives & deep-sea ventures.	» Financing & credit access for vessel ownership models. » Expansion of cooperative & private sector participation.	» No. of modernized vessels in operation. » Share of deep-sea catch in total marine production. » Increase in fisher incomes.
Infrastructure development	» Construct 5-7 additional deep-sea harbors. » Establish 20-30 new minor landing centers. » Expand fish handling & processing facilities (10-15 major centres). » Enhance cold chain network (100-150 pack-houses/cold stores)	» Public-private partnerships for infrastructure investment.	» No. of harbors and facilities commissioned. » Processing capacity utilization rate. » Reduction in post-harvest losses.
Strength-ening MCS&E	» Expand satellite-based VMS for 100% of fleet. » Deploy on-board observers on 30-50% of vessels. » Strengthen dockside inspection protocols.	» Advanced monitoring technologies (electronic monitoring, AI-based surveillance).	» Percentage of fleet monitored by VMS. » Compliance rate with sustainability regulations. » No. of IUU fishing incidents detected & prevented.
Market Expansion & Value-Added Processing	» Facilitate access to high-value domestic & international markets. » Promote value-added fishery products. » Integrate automation in fish processing.	» R&D on product diversification. » Adoption of processing innovations.	» No. of new value-added fishery products developed. » Share of value-added products in exports. » Growth in domestic market consumption
Capacity Building & Research	» Expand collaborations with research institutions. » Implement deep-sea fisheries advisories with commercial fleets	» International knowledge-sharing programs.	» No. of fishers certified in advanced deep-sea fishing. » No. of international R&D collaborations. » Adoption of deep-sea advisories by commercial fleets.

9.3: Phase 3: Global leadership in sustainable deep-sea fisheries

Phase 3 is geared towards consolidating the gains made through Phases 1 and 2, ensuring long-term sustainability, and positioning India as a global leader in sustainable deep-sea and offshore fishing practices. The long-term interventions (8 years and beyond | 2033 onwards) within phase 3 would emphasise high-value product development, aligning with international standards and best practices and leveraging technological advancements through research and development.

The primary objectives and targets for phase 3 include:

9.3.1 **High-value product development:**

i. Expansion of dedicated value-addition and processing facilities to continuously enhance product quality and efficiency.

ii. Development of niche and premium deep-sea and offshore fishery products targeted at high-end global markets.

iii. Exploring alternative uses and byproduct utilisation to maximise resource efficiency.

The lead implementation agencies/departments for 'High-value product development' could include MoFPI, MPEDA, ICAR-CIFT etc.

9.3.2 **Sustainability and Conservation:**

i. Enforcement of ecosystem-based fisheries management frameworks.

ii. Strengthening of monitoring, control, surveillance and enforcement measures.

iii. Expansion of marine protected areas and marine spatial planning.
iv. Assess the impact of climate change on deep-sea fisheries and adaptation strategies.

The lead implementation agencies/departments for 'Sustainability and conservation' could include DoF, ICAR-CMFRI, FSI, State Marine Enforcement Wings, Ministry of Environment, Forest and Climate Change (MoEFCC), MoES etc.

9.3.3 **Market Access and Trade Facilitation:**

i. Compliance with international sustainability standards and certifications.
ii. Harmonisation of regulations with regional and global norms.
iii. Facilitation of access to premium global markets through trade agreements and branding initiatives.

The lead implementation agencies/departments for 'Market access and trade facilitation' could include MPEDA, Food Safety and Standards Authority of India (FSSAI), DoF, Ministry of Commerce and Industry (MoCI) etc.

9.3.4 **Strengthening Research and Development:**

i. Collaboration with international research institutions and organisations for continuous innovation in sustainable fishing technologies and practices.
ii. Continuous improvements in offshore/deep-sea fishery advisories for commercial fishing fleets.
iii. Regular stock assessments and resource mapping to ensure data-driven fisheries management.

The lead implementation agencies/departments for 'Strengthening research and development' could include ICAR-CMFRI, MoES, FSI etc.

Key initiatives and milestones under phase 3

	Milestones	Requirements	Indicators of progress
High-Value Product Development	» Establish 10-15 dedicated value-addition & processing facilities. » Launch 20-30 niche deep-sea fishery products for global markets. » Maximize byproduct utilization.	» Advanced R&D on deep-sea fish processing. » Global branding & market positioning.	» Number of high-value niche products launched. » Market share in premium seafood categories. » Growth in international brand recognition.
Sustainability & Conservation	» Implement ecosystem-based fisheries management frameworks. » Strengthen marine spatial planning & MPAs (5-10 designated areas). » Enhance MCS&E measures.	» Legislative & regulatory alignment with global norms. » Data-driven fisheries management systems.	» Number of MPAs established & managed. » Percentage reduction in fishing pressure on sensitive stocks. » Sustainability certification adoption rate.
Market Access & Trade Facilitation	» Achieve compliance with international sustainability certifications. » Harmonize regulations with global standards (EU, USA, Japan).	» Engagement with international fisheries bodies	» Number of deep-sea products certified under sustainability labels. » Growth in export revenues from deep-sea products.
Strengthening Research & Development	» Foster continuous innovation in sustainable fishing practices. » Improve deep-sea fishery advisories for commercial fleets. » Conduct regular stock assessments.	» Long-term research collaborations with international agencies.	» Improvement in stock sustainability indicators. » Adoption of R&D-based fishing techniques.

Indicative costing framework for the three Phases

Costs related to each of the phases have been calculated by considering the convergence of centrally sponsored schemes and central sector schemes related to fisheries.[58] It is an indicative estimate based on the unit costs of different activities drawn from the PMMSY operational guidelines, alongside inputs from other relevant schemes.

Given the complexity and evolving nature of some interventions, certain activities within the components MCS&E, Sustainability and conservation, Capacity building, Research and Development etc. do not have standardised unit costs and are expected to be implemented through Detailed Project Reports (DPR) or Self-contained proposal. As such, these figures are indicative rather than definitive. Further, inflation and cost escalation over time have not been factored into the current estimates. These will need to be adjusted based on the year of implementation and funding cycles.

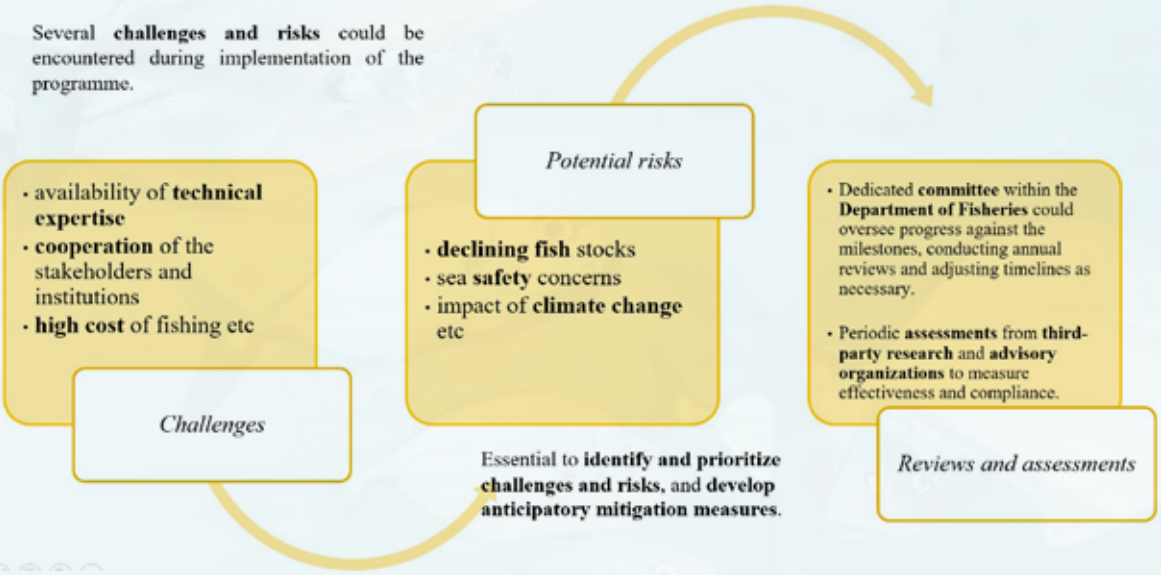
Table 9.1: Indicative cost estimation for the Strategic Phases

Phases	Components	Estimated Cost (₹ crore)	Relevant schemes
Phase 1: Laying the foundation and fostering early growth	**Regulatory framework and policy interventions**	260	PMMSY, Coastal Security Scheme (CSS)
	Infrastructure development	470	PMMSY, Fisheries and Aquaculture Infrastructure Development Fund (FIDF), Sagarmala Programme, Pradhan Mantri Kisan Sampada Yojana (PMKSY) of the Ministry of Food Processing Industries
	Fleet upgradation and capacity building	790	PMMSY, Maritime Development Fund (MDF)
	Research and Development[59]	610	PMMSY, Deep Ocean Mission
	Export promotion	300	PMMSY, NIRYAT SAHKAR (NCDC)
	Total	**2430**	

58 *https://nfdb.gov.in/PDF/PMMSYG/04.pdf*
59 *The amount has been estimated based on allocation under 'Deep Ocean Mission'.*

Phases	Components	Estimated Cost (₹ crore)	Relevant schemes
Phase 2: **Scaling up and achieving global competitiveness**	**Fleet modernisation and expansion**	1940	PMMSY, MDF, Shipbuilding Financial Assistance Policy (SBFAP) 2.0, MDF
	Infrastructure development and upgradation	1760	PMMSY, FIDF, Sagarmala Programme
	Strengthening of Monitoring, Control, Surveillance and Enforcement (MCS&E)	10[60]	PMMSY, CSS
	Market Expansion and value-added processing	460	PMMSY, PMKSY
	Capacity building and research	40	PMMSY
	Total	**4210**	
Phase 3: Global leadership in sustainable deep-sea fisheries	**High-value product development**	600	PMMSY
	Sustainability and conservation	210	PMMSY, Deep Ocean Mission
	Market access and trade facilitation	480	PMMSY, NIRYAT SAHKAR (NCDC)
	Strengthening Research and Development	400	PMMSY, Deep Ocean Mission
	Total	**1690**	

60 *The figure corresponds to 'communication and/or tracking devices like VHF/DAT/NAVIC/transponders etc' for 1000 deep-sea vessels (Rs 5 crore) and for expanding onboard observer program to 50% of vessels (Rs 5 crore). Common infrastructure for MCS would be Detailed Project Report (DPR) based as per PMMSY operational guidelines.*



9.4 Recommendations

Based on the detailed phase-wise strategic interventions presented in the earlier sections, six key consolidated areas of intervention have been identified, and recommendations under each have been proposed to transform the sector. The areas of intervention include: 1) Policy and regulatory overhaul; 2) institutional strengthening and capacity building; 3) Fleet modernisation and infrastructure upgradation; 4) Sustainable Fisheries Management; 5) Resource mobilisation and financing; 6) Stakeholder inclusion and partnerships.

By addressing policy, institutional capacity, infrastructure, sustainable management practices, financing, and stakeholder engagement, India can unlock the full potential of its deep-sea and offshore resources while ensuring their long-term viability.

9.4.1 Policy and regulatory overhaul

i. Create clear rules for responsible fishing in deep waters and a regulatory act aligned to international laws (UNCLOS), standards and guidelines.

ii. Streamline licensing, registration, and access policies based on resource potential, stakeholder inclusion, and sustainability principles.

iii. Revise subsidy and incentive schemes to tap the potential of deep-sea and offshore fishing.

iv. Establish legal mandates and empower institutions for effective monitoring, control, surveillance and enforcement.

9.4.2 Institutional Strengthening and Capacity Building

i. Creation of a dedicated agency/directorate under the Department of Fisheries for holistic governance of deep-sea and offshore fisheries.

ii. Augment research, data collection, and stock assessment capabilities through specialised vessels, skills, and infrastructure.

iii. Export Promotion through cooperatives to leverage collective resources and bargaining power.

iv. Develop institutional linkages with regional fisheries bodies, international agencies, and research institutions.

v. Implement capacity-building programs covering legal, policy, and technical aspects for regulatory personnel and industry stakeholders.

9.4.3 **Fleet Modernisation and Infrastructure Upgradation**

i. Incentivise the adoption of larger and modernising existing deep-sea vessels equipped with modern refrigeration systems and value-addition facilities.

ii. Recognise the capital-intensive nature of deep-sea fishing and promote inclusive fleet development by supporting fisher cooperatives and cluster-based approaches, enabling collective ownership, operation, and access to technology.

iii. Augment deep-sea fishing harbour infrastructure with berthing facilities, maintenance support, unloading equipment etc.

iv. Develop an integrated network of deep-sea fishing ports and fish landing centres along the coastline.

v. Invest in post-harvest processing, cold chain infrastructure, and marketing channels to minimise wastage.

9.4.4 **Sustainable Fisheries Management**

i. Operationalise marine spatial planning and designate deep-sea marine protected areas based on scientific assessments.

ii. Develop and enforce total allowable catch limits, integrating the ecosystem approach to fisheries.

iii. Mandate the adoption of technologies to reduce bycatch, juvenile catch and impacts on marine habitats.

iv. Implement real-time digital monitoring systems through vessel tracking, observers and e-logbooks.

v. Establish traceability systems to ensure transparency in the supply chain from catch to consumer, ensuring transparency and legality.

vi. Promote eco-labelling initiatives to certify sustainable fisheries, encouraging market incentives for responsible practices.

9.4.5 **Resource Mobilisation and Financing**

i. Establish a dedicated Deep-Sea Fishing Development Fund through budgetary support under PMMSY and industry contributions.

ii. Facilitate public-private partnerships in deep-sea fishing vessels and infrastructure.

iii. Ease access to institutional credit and develop insurance and risk mitigation mechanisms customised to this sector.

iv. Explore viability gap funding and soft loan assistance from multilateral agencies for green technologies.

9.4.6 **Stakeholder Inclusion and Partnerships**

i. Develop co-management frameworks incorporating community institutions, fish worker unions and industry bodies.

ii. Ensure representation and inclusion of small-scale, artisanal and indigenous fishers in access policies.

iii. Promote responsible corporate stewardship and sustainable value chain practices by fishing companies

iv. Foster cross-sectoral coordination between maritime agencies, research bodies, coastal states/UTs and international partners

v. Launch of pilot projects in 2-3 coastal districts of Gujarat, Tamil Nadu and Maharashtra focusing on the demonstration of technologies, skills and monitoring practices.

In addition to the aforementioned six key areas of intervention, successful delivery of the strategy would require a robust and coordinated implementation mechanism.

9.4.7 **Implementation Mechanism**

i. Create an overarching Deep-Sea Fishing Program (DSFP) with a dedicated Programme Management Unit in the Department of Fisheries to design, coordinate, implement and monitor the program.

The DSFP can have an advisory council consisting of all maritime states and other relevant agencies to advise the Programme Director.

Annexure

Annexure-I: A Roadmap to Develop Offshore Tuna Fisheries in India

EEZ, spanning 2.02 million square kilometers, offers vast potential for tuna fishing, with abundant tuna and tuna-like species in both the Arabian Sea and the Bay of Bengal. Currently, the tuna resources in the Indian EEZ are underexploited, with only a fraction of the potential catch harvested annually.

There is an opportunity to significantly increase tuna harvests in the next 3-5 years, potentially doubling the current levels. Additionally, there is a growing demand for premium quality sashimi-grade tuna in international markets such as Japan and China, with the increasing popularity of sashimi in China presenting a lucrative opportunity for Indian tunas.

Expanding tuna fisheries will create employment opportunities in harvesting and post-harvest sectors. To unlock the full potential of India's tuna resources, meet market demand, and contribute to economic growth in the fisheries sector, a comprehensive roadmap is proposed:

1. **Developing an Indigenous Tuna Fishing Fleet:**

    a. Fleet Development: Invest in developing a tuna/deep-sea fishing fleet, including intermediate-range tuna longliners with an endurance of 7-10 days and a crew complement of 8-10, for sustainable tuna fishing in the Indian EEZ.

    b. Market Expansion: Introduce suitable carrier boats to transport catches to landing ports, supporting multiple fishing vessels and improving economic viability and market access.

    c. Modernisation and Replacement: Modernise existing fishing vessels or replace them with new offshore crafts equipped with modern technology for locating, catching, and processing tuna, including state-of-the-art facilities for storage, transportation, safety, and navigation.

    d. Support for Small-Scale Fishers: Provide technology interventions such as onboard chilled storage (fish holds or ice boxes) for small-scale fishers engaged in offshore tuna fishing using motorised crafts, improving catch quality and enhancing returns.

    e. Collaboration with Research Institutes: Collaborate with institutes to develop suitable prototypes of intermediate-range tuna fishing vessels tailored to industry needs.

2. **Post-Harvest Infrastructure Improvements for Sashimi Grade Tuna:**

   a. Upgrade harbours and landing facilities with dedicated jetties for tuna landings to maintain hygiene and sanitation standards necessary for handling sashimi-grade tuna.

   b. Upgrade processing units to ensure hygienic handling of tuna before export, adapting existing facilities for processing tuna steaks and loins while maintaining freshness and quality.

   c. Establish cold chain infrastructure at key points from tuna catch to processing, including onboard chilling, chill rooms at landing centres, and air cargo facilities for efficient shipment of chilled tuna to export markets, maintaining temperature control throughout.

   d. Invest in equipment such as chill rooms, flake ice machines, water treatment plants, sump tanks, and overhead tanks to preserve tuna quality and meet export standards.

3. **Training and Capacity Building in Offshore Sea Fishing:**

   a. Engage master trainers from leading tuna fishing nations like Japan and Taiwan to address the shortage of trained manpower in offshore fishing.

   b. Plan and execute training programs by central and state governments, focusing on tuna fishing, onboard handling, and processing for export markets.

   c. Include training components such as hiring training vessels, experts, and operational expenses, covering harvesting techniques (longlining, vertical lines, offshore gillnets) and post-harvest techniques (onboard handling for sashimi-grade tuna).

   d. Organise overseas exposure visit-cum-training programs for resource persons and stakeholders to countries leading in tuna exports, providing firsthand knowledge on handling sashimi-grade tuna and best practices in offshore fishing.

4. **Forward and Backward Linkages for Value Addition, Post-Harvest, Marketing, and Exports:**

   a. Develop post-harvest facilities for tuna processing, including cleaning, removal of gills and guts, wiping dry, and packing in airtight cartons, with processing halls maintaining appropriate temperature and equipped with necessary amenities.

   b. Explore value-added products from tuna for promotion in domestic markets.

c. Improve domestic consumption of fish through strategies such as promoting hygienic handling and marketing, constructing hygienic fish markets and mobile vending units, addressing fish adulteration, diversifying market forms (gutted fish, steaks, fillets, ready-to-cook products), offering marinated and value-added products, improving convenience and accessibility, conducting awareness programs on health benefits, providing capacity-building programs for stakeholders, offering credit assistance for small-scale value-added product units, establishing fish kiosks near tourist attractions, and implementing online fish marketing platforms.

d. Strengthen cold chain management for packaging and transportation, utilising refrigerated vehicles and rail for transportation, proper packaging techniques, and improving infrastructure facilities such as cold storage, ice plants, processing units, roads, and transportation networks.

e. Develop export markets, with Japan being the preferred market for sashimi-grade tuna (accounting for 75-80% of the global market), and explore emerging markets like the USA, Korea, China, Taiwan, the EU, South America, Eastern Europe, Australia, and New Zealand, focusing on bluefin, southern bluefin, bigeye, and yellowfin tuna varieties.

By implementing this comprehensive roadmap, India can unlock the full potential of its offshore tuna fisheries, capitalise on the lucrative market for sashimi-grade tuna, contribute to economic growth in the fisheries sector, and create employment opportunities in both the harvesting and post-harvest sectors.

Annexure-II: Case Study on Fishing Craft and Gear Used for Offshore Tuna Fishing in Andhra Pradesh

Offshore fishing for tuna and tuna-like species is currently being carried out by both the motorised and mechanised sectors in India. Artisanal fishermen have traditionally been fishing for tuna by trolling from non-motorised catamarans and plank-built boats. Over the last two decades, however, structural changes have taken place in the crafts in terms of material and design. Presently, offshore fishing for tuna is being done using FRP (Fibre Reinforced Plastic) motorised boats.

Along the Andhra coast, mechanised trawlers have been conducting demersal trawling between 30-80 m depth. However, due to declining demersal catch in the coastal waters, fishermen have recently started venturing into offshore waters targeting tuna by line fishing or gillnetting. The details of these offshore fishing operations are as follows:

1. **Line Fishing from Non-mechanised/Motorised Fishing Vessels**

Trolling with multiple lines: This method is mostly operated from non-mechanised and motorised traditional craft catamarans and fibre catamarans of 7-11 m overall length (OAL) and 1–1.2 m width, powered by outboard engines

of 8-21 HP. A troll line consists of a main line made of 2 mm diameter polyamide (PA) monofilament of 150-200 m length with 10-20 hooks. The branch lines, each made of 1.5mm diameter PA monofilament, are attached to the main line at intervals of 2-12 m to prevent entangling. Mustard round bend hooks (number 7-9) are tied at the end of the branch lines. The troll lines are operated at depths of 30-500m, using sardines and Stolephorus spp. as bait, and sometimes plastic thread from rice bags as artificial baits to attract tuna. The peak fishing season for troll lining is from August to February, when wind conditions are favourable. Troll line fishing has been the most efficient method for exploiting predatory large pelagic fish like tuna, seer, and marlin.

Trolling with mono lines: This line fishing method is mainly used to catch fast-moving large pelagic fish. Monolines can be towed from traditional motorised/ non-mechanised fiber catamarans by 2-5 fishermen at depths of 25-500 m. Fibre catamarans of 7-11 m OAL and 1-1.2 m width, powered by outboard engines of 8-21 HP, are used for operating individual lines. A line of 45 m length has a loop attached with a 5 m length 4mm polypropylene (PP) rope on the front side, connected by a swivel to a 2 mm diameter PA monofilament of 40 m length with two round bent hooks at the end, used for catching marlin. For tuna and other large pelagic fish, a PA monofilament of 40 m in length with a mustard round bend hook number 9 is tied at the end of the line. Artificial baits made of plastic strips and natural baits like mackerel and sardines are used to lure the fish. After reaching the fishing ground, individual lines are tied to poles with loops of the mono line, and the lines are dropped into the water and dragged continuously. The average fuel consumption is 2 litres/day.

Drift Long lines operated in fibre boats: Small-scale long lines are operated from fibre boats of 9-12 m OAL and 2-3 m width, powered by 21 HP Kirloskar engines. Around 400 hooks are operated on a single main line of 2-3mm diameter PA monofilament. Branch lines made of 1.8mm diameter PA monofilament of 40-45 m length are attached to the main line by making loops at intervals of every 50 m, with 2.5 circle hooks fixed at the end of each line. Every 5-7 hooks have one buoy, and every 8 buoys have one flag attached. After reaching the fishing ground, the baited lines with buoys and flags are dropped into the sea and allowed to drift for 5-6 hours. Hauling is done by lifting the flags and then each line. The gutted fish are stored in fish holds with ice. Around 3 voyages of 7-10 days each are performed in a month at depths of 50-600 m, with a fuel consumption of around 300 liters per voyage.

2. **Line Fishing from Mechanised Boats**

Drift Long lines in small trawlers: The good returns from the tuna fishery have encouraged the mechanised sector to diversify trawlers to long lines for venturing into offshore tuna fishing. These lines are operated in small trawlers of 12-15 m OAL powered by 102-180 HP engines. Around 500-600 hooks are operated on a single main line of 3 mm diameter PA monofilament. Branch lines made of 1.5-2 mm diameter PA monofilament of 25-50 m length are attached

to the main line by making loops at intervals of 27-52m, with 4-9 circle hooks fixed at the end of each line. For every 10 hooks, one thermocol buoy tied with a 4mm PP rope of 16-20m length is attached, and for every 10 buoys, one flag is attached. After reaching the fishing ground at depths of 100-500 m, the baited lines with buoys and flags are dropped at 1500rpm speed into the sea by manual method and allowed to drift for 5-6 hours. Hauling is done by lifting the flags and then each line. After gutting, the fish are stored in fish holds with ice. Small trawlers carry 20 tonnes of ice per voyage and perform around 2 voyages of 12-15 days each per month. The fuel consumption per voyage of 15 days is around 1000-1200 liters of diesel.

Bottom set long lines in small trawlers: These lines are operated in small trawlers (Sona boats) of 12-15 m OAL powered by 102-180 HP engines at depths of 50-90 m. Around 1000 hooks are operated on a single main line of 1.5 mm diameter PA monofilament. Branch lines made of 0.8-1.0 mm diameter PA monofilament of 1.5 m length are attached to the main line by making loops at intervals of 3-4 m, with 8 circle hooks fixed at the end of each line. For every 150 hooks, one stone is attached, and for every 200 hooks, one thermocol buoy tied with a 6 mm PP rope of 50-150 m length is attached. Two flags are tied at both ends of the line. The baited hooks, along with weights and floats, are dropped on the seabed at night, and the lines are hauled in the early morning. The fuel consumption is around 35 liters per day.

Long lines in mini trawlers: These lines are operated in mini trawlers of 16 m OAL powered by 180 HP engines. Around 700-1000 hooks are operated with the help of a spool. The main line is a 3 mm diameter PA monofilament. Branch lines made of 1.5-2.0 mm diameter PA monofilament of 25-50 m length are attached to the main line by a snap at intervals of 27-52 m, with 9 circle hooks fixed at the end of each line. Every 10 hooks have one thermocol buoy tied with a 4mm high-density polyethylene (HDPE) rope of 16-20 m length, and every 10 buoys have one flag attached. Carangid, mackerel, and sardine fish are used as baits. The spool releases the main line, and the baited branch lines with snaps are attached to the main line at certain intervals. The lines are operated at depths of 500-1000 m. Hauling is done with the spool by lifting each line from 1 AM to 5 AM before sunrise. The fuel consumption per voyage of 25-30 days is 3000-4000 liters, and the vessel carries 30 tonnes of ice per voyage.

Long lines in large trawlers: Branch lines made of 1.5-2 mm diameter PA monofilament of 25-50 m length are attached to the main line by snaps through swivels attached with 6 mm PP rope at intervals of 27-52 m, with 4-9 circle hooks fixed at the end of each line. The main line is released from a winch spool. The baited branch lines (snoods) are attached to the main line with snaps at certain intervals. The shooting (setting of the line) takes around 1-5 hours. Live milkfish and sardines are used as baits. The lines are operated at depths of 500-2000 m. The fuel consumption is 14,000 liters for a 20-30 day voyage. The gutted fish are stored in refrigerated fish holds.

3. **Gillnetting from Motorised and Mechanised Fishing Vessels**

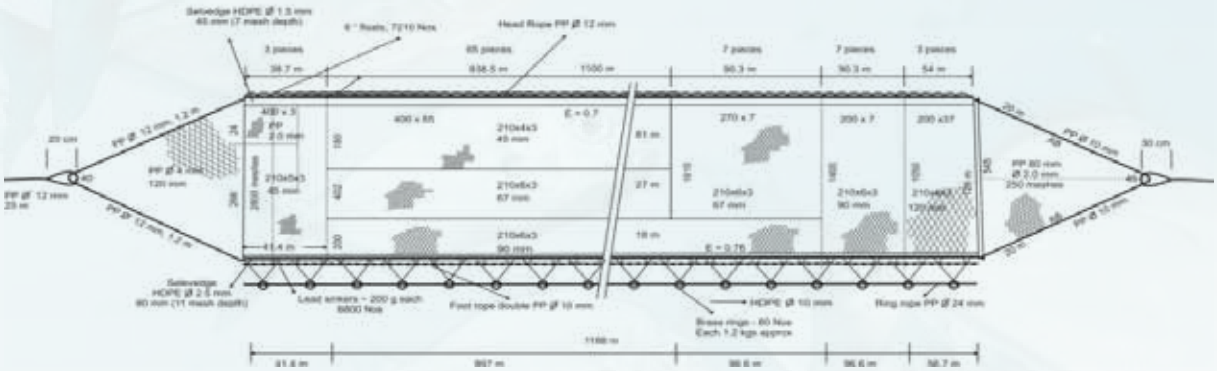
Gillnetting from Motorised Crafts: Gillnet operations are carried out from FRP motorised boats of up to 9-13 m OAL, 4m width, and 1-2 m depth, powered by 20-28 HP engines. Large gillnets targeting tuna, called Panduvala, are fabricated from nylon multifilament twine. They are operated as surface-set drift gillnets with a mesh size of 120 to 160 mm. Generally, the net length is 80-100 m, with 35-50 units deployed to cover a total length ranging from 3000-5000 m with a depth of 15 meters. Synthetic or thermocol floats and cement sinkers (1-1.5 kg) are used for every 9 to 10 meters and 5 to 6 meters of net, respectively. The net is operated from a single fishing craft with a crew of 6 to 8 fishermen. These boats operate in areas like Kakinada, Kumbabisekham, Dummulapeta, Uppada, Visakhapatnam, Machilipatnam, and Nizampatnam. The hauling or retrieval time for a 5000 m net takes approximately 4 hours. However, these boats lack sufficient space for storing ice to maintain the catch quality. Long soaking hours ranging from 10-12 hours, coupled with insufficient ice for preservation, result in landing a huge quantity of poor-quality fish sold at very low prices. This kind of fishing practice with very long gillnets, often referred to as a "Wall of Death," should not be encouraged. There is a need to regulate the length of gillnets and soaking time to maintain quality and ensure resource sustainability. Crafts designed with insulated fish holds and sufficient ice storage capacity, along with regulating the length of the gillnet, would help maintain catch quality and fetch better prices.

Gillnetting from Mechanised fishing boats: Gillnet operations are carried out from mechanised fishing vessels of 13-18 m OAL with 102-180 HP engines. The nets are fabricated from nylon multifilament twine and operated as surface-set drift gillnets with a mesh size of 120 to 160 mm. Generally, the net length is 80-100m, with 35-50 units deployed to cover a total length ranging from 3000-5000 m with a depth of 15-18 meters. The net is operated from a single fishing craft with a crew of 8 to 10 fishermen. The shooting and hauling operations are done manually in Kakinada and Visakhapatnam, while gillnet winch haulers are installed in fishing vessels operating gillnets in Machilipatnam.

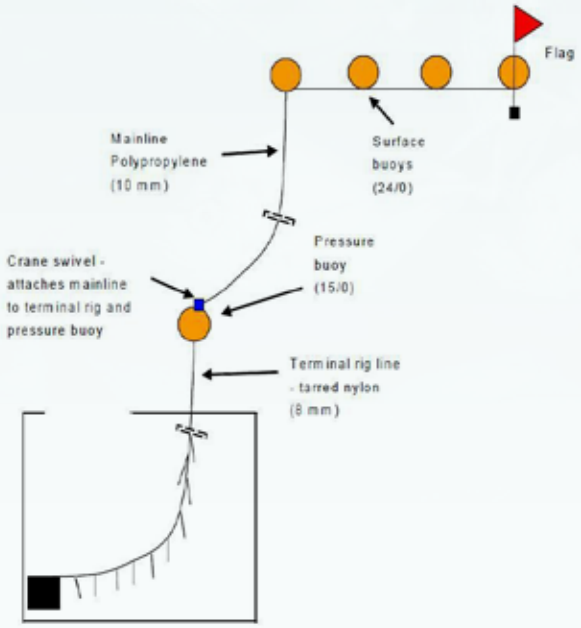
4. **Other methods of offshore fishing that can be promoted/explored:**

Large mesh purse seines: Purse seining is an aimed fishing method for catching dense, mobile schools of pelagic fish and includes all the elements of searching, hunting, and capture. A purse seine is made of a long wall of netting framed with a float line and lead line, with purse rings hanging from the gear's lower edge, through which a purse line allows the pursing of the net. The mesh sizes of conventional purse seine nets (operated at shallower depths) can be replaced with larger mesh sizes (45mm-120mm) for targeting larger species such as mackerel, horse mackerel, pomfrets, seerfish, and offshore resources like tuna and other large pelagics. The length of the net is 1000m, and the depth is 72 m. The main webbing comprises polyamide multifilament 210d x 4 x 3 of 45 mm mesh size. A total of 6000 spindle-shaped plastic floats of 15 mm in length and lead sinkers of 200 g each, totalling 1000 kg, are evenly distributed on the head and foot ropes, respectively. Sixty-five circular brass rings weighing 1.3 kg are used as purse rings.

Design of large mesh purse seine



Vertical long lines: Longlining has gained importance over the past couple of years. Among the pelagic resources, Scomberomorus spp., Acanthocybium solandri, Makaira indica, and Istiophorus platypterus were the major groups contributing to the catch of large pelagics, which significantly contribute to the marine fish landings as well as the export market of this state. However, the deep-sea bottom resources are practically unexploited. These resources are found on or very close to the sea bottom. The way to exploit these resources is by line fishing with baited hooks. Some styles of bottom fishing are from boats using handlines, fishing rods, bottom longlines, etc. Deep-bottom drop line fishing for bottom species using multi-hook rigs is done in waters over about 100m. This depth zone includes reef slopes and seamount areas, where the sea floor may descend to a depth of several thousand meters. The fishable zone is usually down to about 300m, although 400m or more may sometimes be possible. Deep-bottom drop line fishing is a laborious and difficult fishing method, but modern types of fishing gear and equipment are available to make deep-bottom fishing easier, and the technique is spreading more widely in many parts of the world.



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Glimpses of Workshops and Stakeholders Consultation

Workshop held at the Central Marine Fisheries Research Institute (CMFRI), Kochi, Kerala.

Workshop held at the Central Marine Fisheries Research Institute (CMFRI), Kochi, Kerala.

Stakeholders' consultation held at NITI Aayog

Visit to quality fish export industry, Goa

Visit to quality fish export industry, Goa

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NITI Aayog