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Report of the National Workshop on

Strengthening the Science – Management Interface

Embedding Evidence and Technology in Marine Fisheries Governance

09–10 September 2025 | Chennai

In Collaboration with

CMFRI

ESSO- Indian National Centre for Ocean Information Services

National Workshop on

Strengthening the Science Management Interface Embedding Evidence and Technology in Marine Fisheries Governance

09-10 September 2025

Taj Vivanta, Chennai

Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO)
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About the Organizers

Bay of Bengal Inter Governmental Organisation (BOBP-IGO)

The BOBP-IGO is a regional fisheries advisory body with Bangladesh, India, Maldives and Sri Lanka as its contracting parties. It is mandated to enhance cooperation amongst its member countries and other countries (especially, Indonesia, Malaysia, Myanmar and Thailand) for sustainable fisheries management in the Bay of Bengal region. The BOBP-IGO Secretariat is located at Chennai.

Environmental Defense Fund

The Environmental Defense Fund (EDF) is an international non-profit environmental organization working across science, economics, and policy to address the world's most pressing environmental challenges. The organization is mandated to promote science-based, collaborative solutions that ensure healthy marine ecosystems and sustainable livelihoods. EDF has offices and program teams operating globally, with its headquarters located in New York, USA.

Environmental Defense India Foundation

Environmental Defense India Foundation (EDIF) is an independent, non-profit, tax-exempt legal entity established under Section 8 of the India Companies Act, 2013, is headquartered in Delhi, and operates charitable activities exclusively within India.

Preparation of Report

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The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of BOBP-IGO concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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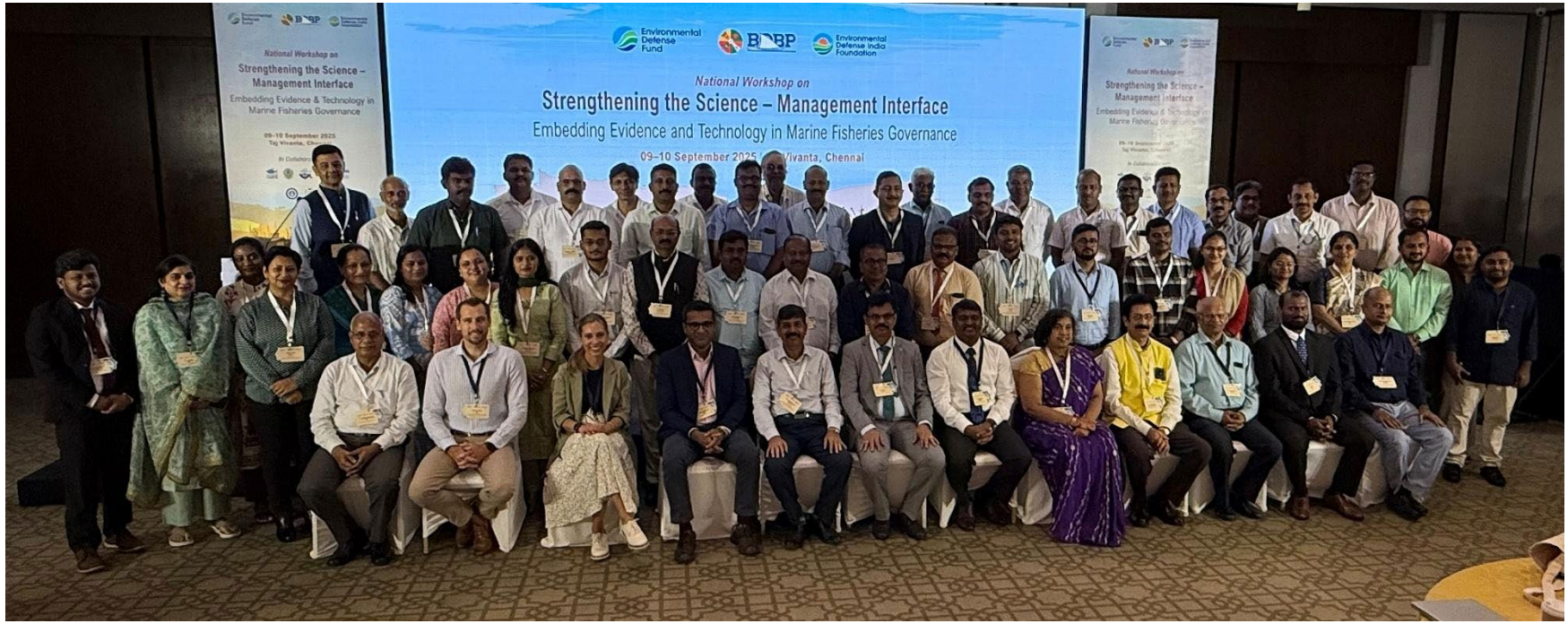

Participants at the Workshop

Executive Summary

The National Workshop on Strengthening the Science–Management Interface: Embedding Evidence and Technology in Marine Fisheries Governance was held on 09–10 September 2025 in Chennai, jointly organized by EDF, EDIF, and BOBP-IGO. The workshop addressed persistent gaps between scientific knowledge and fisheries decision-making in India, aiming to promote systematic use of evidence and technology in marine fisheries governance in line with the National Policy on Marine Fisheries (2017) and the FAO Code of Conduct for Responsible Fisheries. The workshop brought together fisheries managers, scientists, academicians, industry representatives, start-ups, and international experts. Technical sessions highlighted existing scientific and technological solutions, including stock assessment frameworks, ecosystem-based fisheries management, gear and vessel innovations, ocean information services, climate-informed decision tools, digital catch documentation systems, AI-based monitoring, and vessel-based ocean observing networks. While India has strong scientific capacity, discussions revealed that fragmented adoption, limited integration into policy processes, and weak communication and trust often reduce the effectiveness of these tools.

Interactive role-reversal and group exercises examined real-world governance challenges such as juvenile fishing, inequitable use of PFZ advisories, inter-state gear conflicts, port expansion impacts, protected species bycatch, and enforcement under wildlife laws. Common issues identified across these cases included weak monitoring and enforcement, limited stakeholder participation, livelihood pressures, institutional fragmentation, and inadequate science communication. The workshop converged on four priority pillars for strengthening the science–policy interface: institutional mechanisms, evidence packaging and communication, technology integration, and capacity building. Participants emphasized establishing formal scientific advisory bodies, improving translation of science for decision-making, integrating digital systems, and investing in structured capacity development for fishers, managers, and scientists. The workshop concluded with commitments to move from discussion to action, including a formal partnership between BOBP-IGO and EDF to pilot evidence-based and ecosystem approaches to fisheries management, strengthen catch documentation and stock assessment, and build institutional platforms anchored at the national and state levels. Overall, the deliberations reinforced a shared commitment to more inclusive, adaptive, and science-informed marine fisheries governance in India.

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Abbreviation and Acronyms

AI	Artificial Intelligence
BOBP-IGO	Bay of Bengal Programme Inter-Governmental Organisation
BOBLME	Bay of Bengal Large Marine Ecosystem
CCRF	Code of Conduct for Responsible Fisheries
CDS	Catch Documentation Scheme
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
DoF	Department of Fisheries
EAFM	Ecosystem Approach to Fisheries Management
EDF	Environmental Defense Fund
EDIF	Environmental Defense India Foundation
FAO	Food and Agriculture Organization of the United Nations
FVON	Fishing Vessel Ocean Observing Network
GIS	Geographic Information System
HRBA	Human Rights-Based Approach
IHH	Illuminating Hidden Harvests
ICSF	International Collective in Support of Fish workers
ICAR	Indian Council of Agricultural Research
IUU	Illegal, Unreported and Unregulated (fishing)
IOT	Internet of Things
INCOIS	Indian National Centre for Ocean Information Services
MMSM	Mahavir Machchhimar Sahakari Mandali
NGO	Non-Governmental Organization
PRISM	Platform for Resilient and Integrated Fisheries Systems Management
SDG	Sustainable Development Goal
SEAFDEC	Southeast Asian Fisheries Development Center
SOP	Standard Operating Procedure
SSF	Small-Scale Fisheries
TED	Turtle Excluder Device
TNJFU	Tamil Nadu Dr. J. Jayalalithaa Fisheries University

Introduction

The National Workshop on Strengthening the Science–Management Interface: Embedding Evidence and Technology in Marine Fisheries Governance was convened from 09 to 10 September 2025 in Chennai, India. The workshop was jointly organized by the Environmental Defense Fund (EDF), its Indian affiliate the Environmental Defense India Foundation (EDIF), and the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO). The objective of the workshop was to showcase promising technological tools for fisheries governance, reflect on lessons learned from both successes and failures, and develop a roadmap for embedding evidence and science more systematically into marine fisheries governance.

Effective fisheries management is critical for ensuring the sustainability of marine resources and securing the livelihoods of millions in India's coastal states. However, policy decisions in the fisheries sector have traditionally relied more on administrative prudence and historical practices than on scientific evidence. While this approach offers a degree of continuity and stability, it often limits opportunities for innovation, adaptive responses, and optimal resource use. A sustained and structured interface between science and management remains largely absent, with interactions often being informal, reactive, or event-driven, and scientific data rarely presented in formats suitable for decision-making. In many cases, scientific assessments are used retrospectively to justify decisions already taken on precautionary or political grounds, rather than to guide them proactively. The initiative aligns with India's National Policy on Marine Fisheries (2017), which emphasizes strengthening the science–policy interface, implementing a national fisheries data acquisition plan, and leveraging information and space technologies, and also resonates with Article 12 of the FAO Code of Conduct for Responsible Fisheries, which underscores the importance of research in achieving responsible fisheries.

The workshop brought together a diverse group of participants, including representatives from BOBP-IGO; senior fisheries officers from all coastal states; district-level fisheries officers from the coastal districts of Tamil Nadu and Maharashtra; scientists from ICAR fisheries institutions such as CIFE, CMFRI, and CIFT; faculty from fisheries colleges and universities in Tamil Nadu and Maharashtra; industry representatives including private companies and technology start-ups; as well as invited experts and organizers. The workshop provided a platform to highlight BOBP-IGO's regional experience in promoting cooperative fisheries governance, capacity building, and participatory management across South Asia, alongside EDIF/EDF's ongoing work in Tamil Nadu and Maharashtra and their global expertise in embedding technology into fisheries management. The Prospectus and Agenda of the Workshop are provided in Annex 1, and the List of Participants is provided in Annex 2.

Session I: Inaugural Session

Welcome Address

Dr. P. Krishnan, Director, BOBP-IGO, opened the workshop by welcoming the distinguished guests, state fisheries officials, scientists, academicians, NGOs, and start-ups, emphasizing that the event represented a collective effort of all participating organizations rather than a program led by a single agency. He highlighted persistent gaps in India's fisheries governance, noting that interactions between scientists and managers often took place only during crisis situations such as turtle strandings, whale beachings, and fish kills, rather than through continuous collaboration. He underscored the need to strengthen the long-term science management interface, particularly at a time when emerging technologies like AI were producing faster and more complex evidence that needed to be effectively integrated into decision-making processes. He outlined the structure of the two-day program, which included scientific presentations, role-reversal exercises to foster mutual understanding, hands-on case studies, and the co-creation of a national road map and standard operating procedures. He stressed that the workshop was not intended to conclude as a routine meeting; instead, it aimed to initiate actionable pilot projects with different states, with the potential to evolve into national and even regional models for strengthening fisheries governance.

Opening Remarks

Mr. Hisham Mondal, Chief Advisor EDF India and Director EDIF, addressed the participants by recognizing the collaborative role of EDIF and the EDF in co-hosting the workshop with the BOBP-IGO, praising BOBP's long-standing efforts in regional cooperation. He contextualized India's marine fisheries as integral to livelihoods, food security, climate resilience, and coastal economies, while outlining the mounting pressures of climate change, habitat degradation, declining stocks, and fragmented markets. He underscored that strong governance must be grounded in strong evidence, and that evidence depends on timely, usable data enabled by modern technologies such as real-time stock assessments, digital traceability systems, vessel-based ocean observation networks, and safety advisory tools. However, he stressed that technology succeeds only when it is trusted and co-created with managers and fishers, urging a shift from reactive, tradition-based decisions to proactive, adaptive science-driven governance. He called the workshop a rare opportunity for states to reimagine India's fisheries governance landscape and emphasized that participants, scientists, policymakers, entrepreneurs, and managers are the true change-makers who will shape a more sustainable and resilient future for the country's oceans and coastal communities.

Guest of Honour

Dr. N. Felix, Vice Chancellor, Tamil Nadu Dr. J. Jayalalithaa Fisheries University expressed his appreciation for being invited and praised the well-structured program and the relevance of its expert speakers, highlighting that marine fisheries face multiple challenges including illegal fishing, overexploitation, habitat destruction, and climate impacts, which require coordinated action among scientists, managers, and policymakers. He described the substantial contributions of the Tamil Nadu Dr. J. Jayalalithaa Fisheries University, including research across three fisheries colleges on resource management, aquatic environments, fishing technology, and engineering. He detailed ongoing projects such as stock and spawning assessments, gear innovation (including new trawler designs and eco-friendly traps), pollution impact studies associated with thermal power plants, artificial reef deployment, and Indo–Sri Lankan collaborative ecosystem assessments. He also highlighted work on invasive species management, e-modelling for sustainability certification, and infrastructure feasibility studies requested by the Tamil Nadu Fisheries Department. Beyond research, he emphasized the university's training initiatives for fishers and fisherwomen including sea-safety courses, boat-maintenance training, and livelihood development programs underscoring that workshops like this one provide essential platforms for integrating diverse scientific findings into actionable, unified solutions for sustainable marine fisheries governance in India.

Inaugural Address: Chief Guest

Dr. N. Subbaiyan, lAS, Secretary, Animal Husbandry, Dairying, Fisheries and Fishermen Welfare, Tamil Nadu, congratulated BOBP-IGO and its Director Dr. P. Krishnan for organizing an effective workshop and emphasized the need for translating workshop ideas into real action. He noted that many long-standing issues of fishermen remain unresolved and urged scientists, academicians and policymakers to introspect and provide coherent, evidence-based solutions, especially for coastal management. He highlighted the importance of reliable primary data and encouraged decentralized engagement with fishing communities to improve data accuracy. He proposed creating a state-level platform in Tamil Nadu to bring together all institutions working in the fisheries sector for regular collaboration. He stressed that science must offer both immediate and long-term practical solutions that directly benefit fishermen. He concluded by urging all stakeholders to work collectively to bring meaningful and lasting improvements to the fisheries sector.

Concluding Remarks

In his concluding remarks, Dr. P. Krishnan thanked the Secretary for setting a strong vision for the workshop and announced that BOBP-IGO, in partnership with EDF, will pilot

a multi-institutional fisheries governance network in India. This initiative will be anchored at CMFRI, and a similar model will be developed for Tamil Nadu under TNJFU, with BOBP-IGO as a knowledge partner. He acknowledged the participation of officers from nine coastal states and encouraged them to interact with experts from EDF headquarters, the Indian Maritime University, and the startup Odaku, which is piloting catch documentation tools.

Session II: Evidence for Governance: Science & Technology Solutions Currently in Practice

Scientific Evidence for Fisheries Management

Dr. J. Jayasankar, Principal Scientist and Head, FRAEED, ICAR-CMFRI, highlighted the role of the Central Marine Fisheries Research Institute (CMFRI) in India's fisheries management since 1947. He explained how the northern Indian Ocean, rich in biodiversity and dominated by small-scale fisheries, poses unique management challenges. CMFRI's scientific contributions, such as stratified sampling systems, stock assessments, and biodiversity surveys, have supported sustainable exploitation of over 90% of India's fish stocks. He highlighted the use of tools like Target Reference Points (TRPs), quotas, and ecosystem-based approaches to balance conservation with fisher livelihoods.

He further emphasized transitioning from basic sustainability to optimal exploitation to maximize socio-economic benefits. He underscored the importance of precautionary and expansion-first strategies, co-management practices with fishing communities, and advanced monitoring systems. Looking ahead, CMFRI plans to integrate digital technologies, conduct a Marine Fisheries Census, and adopt AI-driven monitoring systems, ensuring dynamic, data-driven, and equitable fisheries governance.

Technology Solutions in Fishing Craft and Gear

Dr. M.V. Baiju, Naval Architect, ICAR-CIFT, presented on technological innovations in fishing craft and gear aimed at enhancing sustainability, safety, and efficiency. He described advances such as hybrid solar-diesel vessels, LNG-powered boats, and solar fishing craft that reduce fuel costs and emissions. He also discussed responsible design features like buoyancy chambers and low-impact trawls, along with selective fishing technologies including Turtle Excluder Devices (TEDs), Nordmore grids, and square mesh cod ends. These were shown to reduce bycatch without significantly affecting target catches. He highlighted trials where innovative trawl designs cut bycatch drastically, gear accessories like improved otter boards, and NOAA-approved turtle excluder devices. He also showcased sustainable waste management innovations, including recycling fiberglass from abandoned boats into usable products like flower

pots. He emphasized how engineering solutions can reduce ecological damage while improving economic returns for fishers.

Ocean Information Services for Fishers

Dr. Dhanya Mohal Lal, Scientist, MoES-INCOIS, presented about the Indian National Centre for Ocean Information Services (INCOIS) and its role in providing ocean data and advisories to fishers, industries, and coastal communities. She explained services like Potential Fishing Zone (PFZ) advisories, tuna and hilsa fishery advisories, and ocean state forecasts, all of which reduce search time, save fuel, and improve safety at sea. She also highlighted citizen science initiatives, the use of AI/ML in monitoring, and vessel tracking systems for better management and dissemination. She further discussed research into deep-sea PFZs, jellyfish aggregation advisories, and mariculture site selection using satellite and oceanographic data. She emphasized INCOIS' disaster services, including tsunami and storm surge warnings, as well as the Small Vessel Advisory System to prevent capsizing. She concluded with a vision for advanced, species-specific, and ecosystem-based advisories, supporting sustainable fisheries and India's blue economy goals.

FISHE: A Framework for making climate-and-informed management decisions

Dr. Jacob Eurich Small-Scale Fisheries Solutions Scientist, EDF, presented the Framework for Integrated Stock and Habitat Evaluation (FISHE), developed by the EDF to support science- and climate-informed fisheries management. He explained how climate change affects species distribution and productivity, posing challenges for small-scale and multi-species fisheries. The FISHE process uses stakeholder participation, ecosystem-based indicators, and adaptive co-management to guide decision-making in data-limited contexts.

He showcased global applications, including Belize's multispecies finfish plan, where 47 species were grouped into "fish baskets" with targeted harvest rules. He emphasized five climate-resilience principles: effective governance, forward planning, cooperation, ecosystem health, and equity. His presentation highlighted participatory tools, decision-making frameworks, and case studies that demonstrate how FISHE helps communities and governments build sustainable and climate-resilient fisheries.

Session II: Mutual Empathy and Problem Mapping

Group Work 1: Role-Reversal Exercise

Group 1: The Juvenile Fishing Conundrum

The group exercise examined the issue of juvenile fishing, which scientific stock assessments identified as a major cause of decline in a particular fishery. Excessive capture of juveniles has reduced spawning biomass and undermined long-term sustainability, creating serious ecological and economic risks. Based on these findings, scientists and managers recommended increasing net mesh sizes and enforcing Minimum Legal Size (MLS) regulations to reduce juvenile mortality, allow fish to reach maturity, and support stock recovery. However, fishers strongly opposed these measures, arguing that larger mesh sizes would reduce immediate catch and income by allowing target species to escape. Short-term livelihood pressures, demands for subsidies and fuel support, and the existence of a ready market for juvenile fish further encouraged continued non-compliance.

The discussion highlighted significant governance and implementation challenges, particularly weak Monitoring, Control and Surveillance (MCS) due to limited manpower, inadequate offshore infrastructure, fuel constraints, and insufficient patrol capacity. Political pressure and vote-bank considerations often dilute enforcement, allowing violations to go unpenalized and leaving many scientific advisories poorly implemented. Participants also noted that scientific advisories follow a top-down institutional flow from research institutions to state governments, district administrations, and fisheries officials, before reaching fishers, who frequently perceive them as imposed regulations rather than jointly agreed measures. Limited stakeholder consultation, lack of transparency in data use, and minimal involvement of fishers in decision-making have created a trust deficit, reinforcing the perception that regulations are “paper rules” disconnected from fishing realities

State-wise experiences further illustrated uneven governance outcomes. Kerala was cited as an example of relatively effective enforcement, supported by strong marine policing, higher penalties, and legislative amendments, resulting in better policy uptake. In contrast, states such as Karnataka, despite notifying MLS regulations, continue to face weak monitoring, strong market demand for juveniles, and adaptive practices by fishers to bypass controls. To address these challenges, the group emphasized the need for stronger stakeholder participation and co-management, enhanced MCS capacity, and the provision of appropriate incentives alongside regulations. Integrating scientific tools such as GIS-based juvenile hotspot mapping, seasonal and area closures, and combining MLS with gear and spatial measures were recommended. Continuous awareness creation, strengthened extension services, and transparent sharing of data

were identified as essential to rebuilding trust and ensuring effective implementation of juvenile fishing regulations.

Group 2: The PFZ Advisory Dilemma

The discussion highlighted the dilemma surrounding Potential Fishing Zone (PFZ) advisories. Although PFZs are intended to improve catch efficiency and reduce search time, they are often perceived as enabling resource interception, with benefits accruing mainly to larger and better-equipped fishing units. As a result, small-scale and traditional fishers tend to benefit less, leading to inequities, conflicts, and growing skepticism about the overall usefulness of PFZ advisories.

A major challenge identified was the gap between fishers' traditional ecological knowledge and scientific PFZ outputs. Fishers rely heavily on ancestral knowledge of fishing grounds and seasonal patterns, which does not always align with PFZ advisories, thereby reducing trust and adoption. Inaccuracies and delays in PFZ dissemination can also cause economic losses, discouraging further use. Additionally, an inherent contradiction was noted between the objective of promoting sustainable fishing and the simultaneous emphasis on increasing catch efficiency through PFZs, particularly in the absence of species-specific information.

Spatial and temporal limitations further constrain PFZ effectiveness. PFZ advisories are often generated for offshore areas beyond territorial waters due to satellite limitations near the coast, especially during cloudy conditions. This reduces their relevance for traditional and small-scale fishers who operate mainly in nearshore waters. Moreover, PFZ advisories are typically valid only for the same day and lack forecasting capability, providing insufficient lead time for fishers to plan their fishing operations.

The core issue identified was a persistent disconnect between PFZ advisories and end users. Limited two-way communication between scientists and fishers means that feedback on gains and losses from PFZ use is rarely shared or incorporated. Communication barriers such as language diversity, scattered and remote fishing communities, varying literacy levels, and limited outreach further restrict effective adoption. Consequently, PFZ advisories are primarily used by educated and technologically equipped fishers, reinforcing exclusion, low trust, and inconsistent usage.

Managers, who act as intermediaries between scientists and fishers, face significant institutional constraints in promoting PFZ adoption. Challenges in direct communication, outreach, and confidence-building at the field level limit effective implementation. The role-reversal exercise underscored the need for stronger coordination among scientists, managers, and fishers to ensure that technical outputs are aligned with practical fishing realities.

To address these challenges, the group recommended establishing a PFZ implementation committee with representation from fishers, managers, and scientists to promote participatory decision-making and continuous feedback. Integrating Indigenous and Traditional Knowledge Systems with scientific PFZ models was emphasized to improve local relevance and accuracy. Real-time dissemination of advisories combined with systematic feedback on catch gains and losses would help validate PFZ outputs and build trust. Prioritizing traditional and small-scale fishers by improving PFZ applicability within territorial waters, enhancing forecasting capability, and strengthening stakeholder participation were identified as key steps to bridge the disconnect and improve both equity and effectiveness of PFZ advisories.

Group 3: Prevent the operation of banned gear – Purse seine

The group exercise examined a governance conflict between two neighboring states (State A and State B) sharing a mixed fish stock. A particular fishing gear is legal in State A but banned in State B. Fishers from State B accused fishers from State A of operating in their fishing grounds using the legal gear, leading to protests and inter-state tensions. The core issue was how differing state-level regulations over a shared stock create conflict, compliance challenges, and enforcement difficulties.

From the managerial perspective, key problems identified included weak enforcement and inadequate Monitoring, Control and Surveillance (MCS). There was a lack of technological inputs for effective surveillance, insufficient scientific clarity on why the gear was banned in one state and not the other, and concerns over data accuracy. The absence of a common discussion platform between states and stakeholders further aggravated misunderstandings. Participants also noted that complete gear bans are often ineffective, and that periodic gear monitoring and inspection may be more practical. Political pressure, poor extension services, and lack of viable alternative livelihoods for affected fishers were recurring frustrations.

The group emphasized the need to strengthen communication, extension, and dialogue platforms. Regular interactions between scientists, managers, and fishers were seen as essential to build trust and ensure that scientific reasoning behind gear regulations is clearly understood. Strengthening fisheries extension systems and conducting sustained awareness programmes were considered critical, rather than relying on one-time consultations.

In terms of solutions, the group proposed a combination of enforcement and cooperative approaches. On the enforcement side, strengthening MCS through improved surveillance technologies such as drones, along with penalties and vessel seizure where required, was recommended. On the cooperative side, awareness programmes in State A were suggested to highlight stock depletion risks in State B. Gear licensing conditions could be introduced, specifying that legally licensed gear in State A should not be used

in State B waters. Joint patrolling by both states was proposed as a confidence-building and practical enforcement mechanism.

The discussion also explored adaptive and sustainable management options. These included exploring innovative or modified gears that could harvest the resource sustainably, introducing seasonal and temporal closures, and addressing market issues related to inter-state fish landings. Since banning a gear leads to stranded investments, options for alternative utilization and gradual transition were emphasized.

At a higher level, the group recommended inter-state and national coordination, with the involvement of the Government of India and the Department of Fisheries. A zone-based management approach for the shared stock, supported by joint research funding and common operational procedures, was identified as a more scientific and equitable solution.

Finally, the group acknowledged several barriers and challenges. These included high costs of technological upgrades for MCS, budget and skill constraints, legal complexities, resistance from officials and fishers, livelihood concerns, slow adoption of new gears, and political factors between states. Overall, the exercise concluded that resolving inter-state fisheries conflicts over shared stocks requires harmonized regulations, strong science, participatory governance, cooperative enforcement, and sustained awareness and coordination across state and national levels.

Group 4: The Encroachment Pressure (Port Expansion vs. Fishing Grounds)

The group exercise examined a complex issue related to coastal encroachment pressures arising from port expansion projects and their conflict with fisheries. Given the breadth of the theme and the diverse composition of the group, the discussion moved beyond strict role separation and reflected a combined perspective of scientists and managers. There was considerable convergence in views, with scientists appreciating managerial constraints and managers acknowledging scientific concerns, enabling a synthesis of shared issues while noting differences only where they emerged. A key concern identified was the multi-layered and multi-sectoral nature of port-related conflicts, involving several departments at central, state, and regional levels, as well as multiple scientific disciplines such as fisheries, engineering, environmental science, social science, and political economy. While development imperatives and conservation needs are often viewed as conflicting, the group agreed that coastal infrastructure development is essential for social and economic growth. However, achieving a complete win–win outcome was seen as unrealistic, and the practical goal should instead be to maximize benefits and beneficiaries while minimizing losses, particularly for fisheries-dependent communities.

The discussion also highlighted differing perceptions regarding institutional coordination. Scientists initially felt that coordination mechanisms across departments and disciplines were weak or absent, whereas managers argued that such mechanisms do exist and function. Through dialogue and shared experiences, scientists later acknowledged that coordination frameworks are in place, though their effectiveness varies. Case studies from ports such as Vizhinjam, JNPT, Vadhavan, Karwar, Visakhapatnam, Thoothukudi, and Kochi illustrated recurring patterns of conflict, legal disputes, project delays, and limited long-term benefits to fisheries. From a scientific perspective, it was recognized that evidence available to guide policy on port–fisheries interactions is limited, fragmented, and often siloed. Existing studies are largely short-term and reactive, with very few comprehensive long-term impact assessments on fisheries and marine ecosystems. Although India's Environmental Impact Assessment system is robust and aligned with international norms, conflicting scientific reports have led to legal challenges and implementation delays without necessarily safeguarding fisheries interests.

To address these gaps, Marine Spatial Planning was proposed as a key tool to balance competing coastal and marine uses in a systematic and science-based manner. The group emphasized the need for dedicated budgets for generating long-term baseline data and continuous monitoring, with data made open-access, interoperable, and shareable to support transparent decision-making. The political economy of coastal development was also acknowledged, noting that lobbying by competing interest groups is inherent in democratic systems, but unequal power dynamics often result in selective use of limited scientific evidence. Rapid coastal development has outpaced the capacity of science to generate timely evidence, compounded by understaffing, limited budgets, and capacity gaps within government institutions. Technological infusion, process re-engineering, and capacity development for both managers and scientists were identified as critical to address these challenges, particularly in understanding and managing marine ecosystems. The discussion also noted growing uncertainty in decision-making due to limited comprehensive evidence, described metaphorically as managing with incomplete knowledge.

Finally, the group highlighted future challenges, including the declining interest of fisher youth in remaining in the sector. Retaining and attracting youth would require introducing transformational digital tools, skill development, and new opportunities within fisheries and allied sectors. Continuous, year-round research supported by sustained government funding, including collaboration with universities and research institutions, was identified as essential to strengthen the evidence base and enable more inclusive, informed, and balanced coastal development decisions.

Group 5: Protecting species bycatch quagmire

The group exercise examined a complex conservation challenge involving increasing bycatch of protected and endangered species in a highly productive gillnet fishery that supports a large number of fishers. International conservation bodies and NGOs are exerting pressure to declare large areas as protected zones, while managers must simultaneously safeguard livelihoods and sustain fishery productivity. Through a reverse role-play exercise, the discussion revealed that managers are required to balance species conservation with socio-economic realities, making feasibility and stakeholder support critical. Managers emphasized the need for clear, actionable scientific communication to design practical adaptation measures, such as guidance on net placement based on species migration patterns, and mitigation measures, including visual or acoustic deterrents to reduce bycatch. However, they face significant constraints, including potential economic losses to fishers from spatial or seasonal closures, political pressure from fisher unions, limited manpower and funding, and strong external pressure from NGOs and international agencies to act quickly.

From the scientific perspective, participants highlighted the need for accurate, long-term data on species distribution, migration, and seasonality to inform effective management plans. Scientists acknowledged that while managers often seek immediate solutions, conservation science typically requires longer timeframes, sustained resources, and continuous data collection, which are frequently constrained by bureaucratic delays, limited funding, and insufficient cooperation from fishers. Communication gaps further complicate implementation, as scientific outputs are often conveyed in technical language that is not easily accessible to managers or fishers, and scientists may lack a full understanding of local socio-political contexts and livelihood pressures.

The discussion identified poor coordination and weak trust among fishers, scientists, and managers as the central problem underlying ineffective bycatch management. Fishers are often reluctant to share data due to fear of legal repercussions or future restrictions, which reduces the effectiveness of conservation initiatives and prolongs threats to vulnerable species. Root causes of this disconnect include low awareness, financial insecurity, fear of income loss during closures, disagreement over conservation priorities versus livelihoods, legal anxieties, and perceived loss of autonomy in fishing activities.

To overcome these barriers, the group emphasized training and capacity building as key strategies. This includes creating awareness on conservation benefits, providing legal literacy, offering financial incentives, and supporting alternative livelihood options. Regular and continuous consultations, rather than one-time engagements, were seen as essential for consensus building. Simplifying scientific communication through visuals and non-technical language, involving community leaders and fisher unions early in the

process, and fostering partnerships through multi-stakeholder platforms were strongly recommended. The group concluded that co-management approaches, jointly developed compensation mechanisms, and participatory planning for closures or restrictions can build trust, improve data sharing, and ultimately enable effective protection of endangered species while sustaining fisheries livelihoods.

Group 6: Seizure of protected species catch

The group discussed an immediate crisis with long-term implications involving the seizure of a shark and detention of a merchant under the Wildlife Protection Act at an important tuna fishing harbour. As tuna fishing is central to the local economy, enforcement action led to a sudden halt in economic activity, creating urgency to balance legal compliance with livelihood continuity. The role reversal exercise revealed that managers struggled to identify immediate actions, clarify departmental jurisdiction, decide proportionate punishment, and at the same time restore confidence among fishers and traders so that normal economic activity could resume without undermining conservation objectives.

From the managerial perspective, key challenges included determining whether and how punishment should be imposed under existing rules, managing the perishable catch seized at the harbour, and coordinating between departments, particularly the fisheries and forest departments, to handle the situation. Managers emphasized the need for immediate de-escalation, confidence building with local stakeholders, and proportionate enforcement. They highlighted that fisheries authorities must actively engage with communities to reassure them that only the illegal catch was detained and that routine fishing and trade could continue safely.

From the scientific perspective, participants emphasized the difficulty of identifying protected shark and ray species, which often require expert examination of subtle morphological features and cannot always be reliably identified through photographs. Non selective fishing gears further complicate the issue, as bycatch is often unavoidable. Scientists stressed the urgent need for real time or near real time species identification tools, such as mobile applications or field ready identification guides, along with awareness programmes for fishers, traders, and enforcement agencies. Longer term scientific needs included improving gear selectivity, mapping critical habitats and fishing grounds, introducing region specific closures or no take zones, and regularly reviewing population status to reassess protection listings where appropriate.

While attempting to develop a Standard Operating Procedure, the group realized that overly complex processes could burden both enforcement agencies and fishers, potentially worsening economic impacts without improving outcomes. Instead, SOP development was identified as a follow up action requiring stakeholder consultation to

ensure speed, clarity, and minimal disruption. Focusing on enforcement as the immediate goal, the group identified key barriers such as unclear jurisdictional boundaries, inadequate departmental capacity due to understaffing, and weak communication between departments.

To address these barriers, the group proposed practical solutions including the development of clear and simple SOPs, establishment of a joint response cell involving relevant departments for urgent cases, strengthened awareness programmes, and enhanced capacity through recruitment or interim community based reporting mechanisms. Community participation was seen as a way to improve compliance and early reporting. The group also emphasized the importance of developing reliable real time identification guides, triangulating rapid field identification with other verification mechanisms, and embedding appropriate technologies at critical points. Overall, the discussion highlighted systemic communication gaps between departments as a key challenge and concluded that improved coordination, technology enabled identification, proportionate enforcement, and confidence building with stakeholders are essential for effective management of protected species bycatch without disrupting critical fisheries livelihoods.

Session IV: Emerging concepts and technologies in fisheries governance

Advisories for Disaster and Safety of Fishers - Pilot projects

Dr. S.K. Dash, Scientist F, MoES-NCCR presented on Thoondil, a mobile application developed by the National Centre for Coastal Research (NCCR) in collaboration with the Tamil Nadu Department of Fisheries, aimed at enhancing sea safety and operational efficiency for fishermen. Since its launch in Tamil Nadu (2018) and Kerala (2019), it has seen 16,000 installations, 170 SOS alerts, and 218 incident reports. Recognized as the second-best practice by NITI Aayog among 150 entries, Thoondil empowers fishers through tools like real-time boat tracking, compass navigation, weather updates, PFZ access, and SOS alerts. It supports rescue planning with offline coastal maps, provides cyclone alerts, and centralizes incident reporting. It also allows the Department of Fisheries (DoF) to track all fishing operations in real time and communicate with users directly. The app workflow enables registration of boats and crew, trip declarations, and real-time tracking up to territorial waters. Features like geo tagging, live/past trip data, and messaging enhance decision making and safety. Integrated with NAVIC for location accuracy, Thoondil supports daily operations such as assigning trips, updating status, and reporting emergencies. For fishers, it provides accurate location, weather safety alerts, and access to INCOIS PFZ data. For administrators, it offers a dashboard to monitor and manage state wide fishing activities. By combining digital empowerment

with safety and sustainability, Thoondil stands out as a transformative decision-support tool for India's coastal fishing communities.

Innovations in catch documentation, resource assessment & reporting for effective fisheries governance

Dr. P. Krishnan, Director, BOBP-IGO presented on the topic Innovations in Catch Documentation, Resource Assessment & Reporting for Effective Fisheries Governance systems. He highlighted the urgent need to take robust catch documentation system to tackle IUU fishing, ensure traceability, and support fisheries governance in South Asia and Southeast Asia. India's current system, managed by MPEDA, was discussed as largely manual, inefficient, and vulnerable to malpractices. Challenges included infrastructure gaps, high costs of technology, weak policy harmonization, and low trust among fishers. Case studies, such as South Africa's ABALOBI app, were used to demonstrate how digital, community-led approaches can improve traceability and fisher participation while balancing governance with socio-economic concerns. The proposed solutions included electronic catch documentation schemes (e-CDS), GPS-enabled vessel monitoring, mobile apps for participatory reporting, AI-based stock assessments, and training programs for digital literacy. A fisher-led data pipeline was emphasized as a method to integrate local knowledge with institutional science, providing near-real-time indicators. The presentation concluded with BOBP's ongoing regional initiatives, including ecosystem-based fisheries management, anti-IUU frameworks, and PRISM 2.0 – an AI-powered decision-support system planned for piloting in 2025–26.

SmartPass: Innovative Fishing Monitoring Using Shore-Based Cameras and Artificial Intelligence

Dr. Karly Kelso, Senior Director, Global Ocean Strategies, Environmental Defense Fund, presented on "SmartPass". She introduced SmartPass as a cost-effective monitoring innovation that uses cameras, AI, and human review to estimate fishing effort and total catch. Deployed initially in Indonesia's Lampung Province, the system tracks vessel entries/exits at coastal passes and combines this with enumerator catch data to produce more accurate fisheries estimates. It is designed to overcome the chronic challenge of underreporting in small-scale fisheries, especially in the blue swimming crab sector. The presentation outlined technical challenges, including maintaining cameras under harsh conditions, ensuring accuracy in poor weather, and avoiding miscounts due to occlusion. Despite these issues, SmartPass demonstrated strong performance, proving to be more reliable and scalable than traditional approaches. The tool is open-source and adaptable, with its future vision focused on refining vessel classification algorithms and expanding to diverse geographies. Its insights stress the

importance of clear camera placement, balanced cost-effectiveness, and the value of AI-assisted monitoring in modern fisheries management.

Digital solutions for strengthening value chain

Mr. Bharat Kumar, Founder and CEO, Threshold Software, presented on“Catch the Future”. He explored inefficiencies in the fisheries supply chain that contribute to high wastage, low fisher incomes, and weak consumer trust. It critiqued conventional reliance on subsidies, export-oriented policies, and fragmented digital solutions, which fail to uplift small-scale fishers or serve domestic markets effectively. The presentation argued that India could save 1–1.5 million tonnes of fish annually by reducing wastage through better logistics, storage, and retail innovations. The proposed model integrates fish landing points, processing and storage units, logistics, and consumer delivery systems into a digital-first, demand-driven chain. Refrigeration and waste management solutions, combined with household-level access via phone, app, or web, would ensure fair prices and fresh seafood. The vision emphasized “small, smart shifts” leveraging policies, proven models, and existing technologies, showing how incremental reforms could transform fisher livelihoods and consumer confidence simultaneously.

The Fishing Vessel Ocean observing Network (FVON): A New Paradigm for Ocean Observing

Dr. Jacob Eurich, PhD, Small-Scale Fisheries Solutions Scientist, Environmental Defense Fund, presented FVON- Fishing Vessel Ocean Observing Network. He explained that FVON was presented as a novel approach to closing critical data gaps in coastal ocean observation by equipping fishing vessels with automatic sensors. Unlike satellites or buoys, FVON captures subsurface and nearshore ocean data at scale without disrupting fishing operations. The approach provides real-time insights for early warning systems, climate forecasting, fisheries stock assessments, and improved catch efficiency, making it beneficial for science, management, and fishers alike. The initiative has already been tested on 700 vessels, generating open-access data used globally by entities like the Coast Guard, tuna fisheries, and hurricane forecasting models. Case studies from Japan, the Pacific Islands, the Bahamas, and the US demonstrated its proven impacts, including reduced costs for fishers and improved disaster preparedness. With relatively low costs and scalability, FVON positions itself as a coastal complement to the global ARGO system, bridging science, governance, and community needs under an international consortium.

Innovative Solutions for Fisheries and Aquaculture Industry

Dr. (Cdr.) Arnab Das, Founder & Director, Maritime Research Center, presented on Innovative Solutions for Fisheries and Aquaculture Industry. His presentation addressed

tropical opportunities and challenges in fisheries and aquaculture, highlighting biodiversity potential but also governance, technology dependence, and situational awareness issues. It stressed that unchecked aquaculture expansion has caused mangrove loss and ecosystem degradation, while capture fisheries face IUU pressures and stagnant growth. Aquaculture, though increasingly dominant, still struggles with low yields, climate risks, and unsustainable practices, necessitating innovative interventions under schemes like PMMSY. The solutions proposed included an Area, Production & Yield (APY) Tool, Potential Fishing Zones (PFZ) Tool, and AI-based Real-Time Fish Identification models. These digital tools use data analysis, modeling, and IoT integration to boost productivity, guide fishing decisions, and support sustainable aquaculture. Ground validation through outreach programs in Veraval and Ratnagiri, along with engagement in hackathons and academic exchanges, reinforced the emphasis on user-driven innovation. Overall, the presentation argued for indigenous, technology-enabled, and inclusive strategies to strengthen India's fisheries and aquaculture resilience.

Session V: Co-Creation and Planning

Group 1: Science–Policy Mechanisms

The key problem highlighted was the absence of a formal scientific advisory mechanism attached to State Departments of Fisheries, comprising adequate experts and scientists to systematically support policymakers in formulating, reviewing, and amending marine fisheries policies. This gap was attributed to several root causes, including the lack of prioritization by policymakers, a predominantly reactive approach to management where action is taken only after major crises arise, limited deliberation of complex fisheries issues between managers and scientific experts, and insufficient proactive initiative from concerned stakeholders to institutionalize such a mechanism.

As a feasible solution, the group proposed establishing a state-level scientific advisory body attached to the Department of Fisheries, comprising scientists and experts from research institutions, NGOs, IGOs, and civil society, while also accommodating existing informal advisory arrangements within states. Such a body would provide multidisciplinary perspectives and evidence-based inputs to support informed policymaking. Comparable real-world examples cited included the National Marine Fisheries Service in the United States, advisory and research committees under ICAR and CMFRI, State and National Biodiversity Boards, and advisory bodies under the Ministry of Environment, Forest and Climate Change, all of which draw expertise from diverse backgrounds.

The group identified the current workshop itself as an opportunity for piloting this idea, noting the expressed openness of senior policymakers to receive concrete and actionable scientific inputs. With growing consensus between the scientific community

and policymakers, the present context was seen as conducive to initiating such an advisory mechanism as a priority action. To ensure relevance and implementability, the proposed body was envisioned with a broad and flexible mandate, covering all science-related fisheries issues, including emerging challenges such as IUU fishing, and extending its support to interstate coordination where necessary. In conclusion, although the proposal emerged from a brief discussion, the group viewed it as a strong and practical action plan that merits further exploration and formal development.

Group 2: Evidence Packaging

The group discussion focused on packaging evidence and effective communication, emphasizing that information generated through science, policy, and development processes must be communicated in a manner tailored to the intended audience. Communication was recognized as context-specific, requiring sensitivity to who is being addressed, the issue at hand, the timing, and the medium used. The group agreed that communication should be demand-driven, addressing felt needs, while also helping convert unfelt needs into felt needs through awareness. For communication to be effective, it must reach a critical minimum audience, use understandable and relevant language, and deliver content that is meaningful to the target group.

Several key challenges were identified. A major issue is the lack of connection among researchers, managers, and field-level officials, combined with inadequate staffing and limited institutional capacity to translate technical knowledge for large and diverse audiences. The fisheries sector suffers from weak public extension systems, thin budget allocations compared to agriculture and animal husbandry, and limited investment in translational research. As a result, high-quality scientific information often fails to reach fishers and other stakeholders in usable forms, while private extension increasingly fills the gap.

To address scaling challenges, the group highlighted the strategic use of social media and mass communication tools, such as WhatsApp, Instagram, short videos, and reels, supported by modest but dedicated budgets and technical capacity. Traditional extension tools like posters in harbours, local FM radio, and engagement with community institutions such as religious bodies and local leaders were also seen as highly effective for outreach. A recurring concern was that scientific and departmental communications are often laden with technical jargon, making them inaccessible to fishers and the public. The group stressed the need to simplify language, employ professional content developers, and prioritize translation of scientific findings into local and vernacular languages, especially after formal publication.

Another critical gap identified was the one-way nature of communication, where information flows only from scientists or departments to communities. The group

strongly advocated for a two-way and participatory approach, highlighting citizen science as a powerful mechanism. Examples from Kerala demonstrated how citizen movements, schools, and science festivals have successfully translated complex scientific issues into public action across generations. Promoting scientific temper, especially among students and coastal communities, was viewed as a long-term investment in sustainable fisheries and conservation.

Weak fisheries extension mechanisms were acknowledged as a structural issue arising from understaffing, multiple mandates, and institutional rigidities. As a solution, the group emphasized synergy with NGOs, community organizations, and other government departments, rather than treating extension as a standalone responsibility of fisheries departments. Real-world examples such as incentivized retrieval of abandoned fishing gear and plastic waste from harbours illustrated how collective action, awareness, and modest incentives can lead to tangible environmental outcomes. Similar approaches were proposed for marine mammal and endangered species conservation, including community-based reporting and awareness-led pilots.

Finally, the group proposed adopting a mission-mode approach for issues that cut across institutional mandates. Instead of confining responsibilities to individual organizations, mission or mini-mission frameworks could enable convergence, clear role definition, and coordinated action across public and private actors. Such an approach would allow evidence to be packaged, communicated, and implemented more effectively at scale. Overall, the discussion underscored that effective evidence packaging and communication require audience-centric design, participatory methods, institutional collaboration, and a balance between modern digital tools and traditional outreach mechanisms.

Group 3: Tech Integration

The group discussion focused on technology integration in fisheries and was intentionally approached as a broad and flexible theme rather than addressing a single, narrowly defined problem. Recognizing that different stakeholders across the fisheries value chain have diverse needs, the group proposed an adaptable concept called FITS, the Fisheries Integrated Tech Stack, designed as a modular and role based digital ecosystem that can serve multiple users and functions. The key issue identified was not the absence of data, but the fragmentation of data across institutional silos, where information exists but is scattered and difficult to access or use in an integrated manner.

The group emphasized that users require different types and depths of information depending on their role. A fisher, boat owner, fisheries manager, and policymaker all seek different insights from the same underlying data. Therefore, FITS was envisioned as a single integrated platform with differentiated access, similar to role-based systems

such as e office, where users can view only the information relevant to them. This approach allows comprehensive data to be housed within one system while avoiding unnecessary technical complexity for end users.

The root cause of fragmentation was attributed to organic, mandate driven development of multiple independent digital solutions. Agencies typically develop tools limited to their specific responsibilities, such as PFZ advisories, licensing, subsidies, or compliance, due to funding and institutional constraints. While these standalone systems are useful, the lack of integration results in multiple platforms that users must navigate. FITS was therefore proposed as an integration layer that connects existing systems into a one stop access point without replacing them.

The group noted that feasibility has already been demonstrated at smaller scales. Examples such as Diu show that integrating PFZ data, vessel movement, landings, and subsidies into a single system is possible. Scaling to larger states presents challenges primarily related to awareness, enforcement, and institutional capacity rather than technical limitations. Existing pilot initiatives such as vessel management dashboards further support the practicality of this approach.

For piloting, the group recommended starting in locations with fewer vessels or higher technology readiness, such as union territories, island systems, or select fishing villages and harbours. Successful pilots could then be expanded gradually. Institutional mandates were also highlighted, noting that fisheries being a state subject requires leadership from State Fisheries Departments, with technical and scientific agencies contributing modular inputs based on their respective roles. Overall, the group concluded that FITS provides a scalable and inclusive framework for integrating technology across the fisheries value chain, supporting governance, science, and livelihoods through a unified digital system.

Group 4: Capacity Building

The group discussion emphasized that strengthening capacity building is essential to bridge existing gaps in fisheries governance and management. Five key problems were identified, each with distinct causes and solutions. First, a significant skill gap exists among fishers, largely due to unstructured training programmes and poor participation. Fishers often lose income when attending training, and programmes are not sufficiently aligned with their real-time, practical needs. To address this, the group recommended developing structured, need-based capacity development programmes tailored to specific stakeholder groups and their livelihood realities.

Second, limited competency levels were identified among managers and scientists. This was attributed to understaffing, the need for multidisciplinary expertise, lack of dedicated verticals for capacity building, and inadequate funding for staff development.

As a solution, the group proposed creating a separate vertical focused on capacity building and bringing multidisciplinary experts under one umbrella to design and deliver appropriate training modules. Third, the lack of follow-up and hand-holding before and after training was highlighted as a major weakness. While trainings are conducted, post-training engagement and assessment are minimal. The group recommended introducing structured post-training surveys, goal-based evaluations, and sustained hand-holding to ensure that training translates into practice.

Fourth, inadequate training infrastructure was identified, driven by low prioritization of capacity building and limited financial resources, despite the large number of stakeholders requiring training. The group suggested adopting IT-based solutions to reach larger audiences efficiently and developing effective, audience-specific training content. Fifth, the group noted insufficient research on capacity-building needs, recommending structured evaluation frameworks after training programmes to better understand skill and knowledge gaps and refine future interventions.

Real-world consequences of these gaps were observed in issues such as loss of life at sea, IUU fishing, cross-border conflicts, sea piracy, and poor compliance with regulations. As opportunities for piloting, the group proposed modular, structured training programmes packaged under the broader framework of "Responsible Fisheries," with focused modules on conflict resolution, sea safety, MCS systems, catch documentation, and emerging technologies. Existing regional models, such as those developed by SEAFDEC, were cited as useful references. Finally, the group stressed the need for strong institutional mandates to support curriculum development, gap analysis, strengthened R&D, sustained follow-up and hand-holding, and dissemination of technical advisories in regional languages to ensure inclusive and effective capacity building in the future.

Session VI: Plenary: Commitments & Next Steps

Discussion to converge on shared commitments

Dr. P. Krishnan, Director, BOBP-IGO presented the way forward emerging from the workshop, highlighting that the deliberations brought together scientists, managers, and practitioners to review existing and emerging technological and scientific solutions and to examine how the science–policy interface in fisheries can be strengthened to improve management efficiency. Through technical presentations and active group exercises, including role-reversal sessions, participants developed a better appreciation of the constraints faced by each stakeholder group and collectively worked towards a shared understanding. He emphasized that the workshop was not an endpoint, but the beginning of a sustained process to strengthen collaboration and evidence-based decision-making. He noted that a key outcome of the workshop would be the

development of a comprehensive roadmap for strengthening the science–policy interface, structured around four core pillars: institutional mechanisms, evidence packaging and communication, use of technology to improve interfaces, and capacity development. Under each pillar, the roadmap would clearly articulate the key issues, their root causes, possible solution pathways, and illustrative case studies. This roadmap is envisaged as a practical guideline and reference document to support further action by governments, institutions, and other stakeholders.

He further explained that to take these outcomes forward, BOBP-IGO has entered into a formal partnership with the Environmental Defense Fund (EDF) through the signing of a MoU. The partnership aligns the mandates of both organizations and aims to work closely with national and state governments to mainstream evidence and the Ecosystem Approach to Fisheries Management (EAFM). He outlined three broad areas of joint work: centering evidence through pilots on community-led catch documentation and near real-time stock assessment; operationalizing EAFM in selected pilot states, moving from planning to implementation and adaptive management; and building an institutional framework for EAFM, anchored at the national level with CMFRI and supported by a wider network of partners and practitioners. He emphasized that these initiatives would be undertaken in close collaboration with coastal states, research institutions, NGOs, and international partners, with flexibility to expand based on state interest and readiness. He concluded by noting that the partnership also envisions regular knowledge exchanges, including annual or biannual platforms, and alignment with major national and international events, thereby ensuring continuity of dialogue and action. Overall, he presented the workshop outcomes as a clear pathway towards more coherent, evidence-informed, and ecosystem-based fisheries governance in India and the region.

Guest of Honour

Dr. Grinson George, Director, ICAR–CMFRI in his Guest of Honour address, reflected on the significance of the national workshop on strengthening the science and management interface in fisheries. He noted that over the two days, participants moved beyond identifying long standing systemic challenges to collectively co creating practical solutions. He highlighted that traditionally, the link between science and fisheries management has been largely linear and reactive, with scientific data not always translated into actionable decision making. Through interactive sessions such as role reversal exercises and visual mapping, the workshop successfully challenged this paradigm and fostered a shared understanding between scientists and managers of each other's constraints and responsibilities.

He emphasized ICAR-CMFRI's commitment to a holistic, ecosystem-based approach to fisheries management that integrates conservation of marine habitats, biodiversity, and sustainable harvest strategies. He underlined CMFRI's ongoing work on understanding

ecosystem structure and function, assessing climate change impacts on marine fisheries, and developing mitigation and adaptation strategies. He also acknowledged the importance of emerging tools and technologies, including climate informed fisheries frameworks, AI based monitoring, and smart decision support systems, in strengthening governance and policy implementation.

He expressed strong confidence that the partnerships and collaborations forged during the workshop would play a critical role in advancing India's national marine fisheries policies and aligning them with the FAO Code of Conduct for Responsible Fisheries. He welcomed the formalization of collaboration through the MoU between EDF and BOBP-IGO, describing it as a clear signal of sustained commitment to evidence-based fisheries governance. Looking ahead, he reiterated that the true success of the workshop would lie in continued action, including forthcoming initiatives such as the launch of the EAFM platform at the MECOS conference. He concluded by reaffirming ICAR-CMFRI's readiness to work with all partners to translate workshop outcomes into tangible and sustainable benefits for marine resources and fishing communities.

Closing Session: Chief Guest

Dr. N. Ramaswami, IAS Secretary, Animal Husbandry, Dairy Development & Fisheries Govt. of Maharashtra, thanked the organizers for convening a diverse and high level gathering to deliberate on embedding evidence and technology in marine fisheries governance. He highlighted Maharashtra's long-standing leadership in marine fisheries, supported by its extensive coastline and vibrant fishing communities. He noted that recent marine landings reflect both the resilience of the sector and the benefits of improved management practices, while also underscoring the need for progressive policies to ensure sustainable growth. He outlined several pioneering initiatives undertaken by the Government of Maharashtra, including the Marine Cage Culture Policy 2021, the Minimum Legal-Size notification in 2022, and the Compensation Policy for Fishers Affected by Coastal Infrastructure Projects in 2023. He observed that fisheries governance has traditionally relied on administrative experience and historical practices, which, while ensuring continuity, has sometimes limited the uptake of innovation and optimal resource use. In this context, he described the workshop as timely and important for advancing a structured science policy interface.

From the Maharashtra state perspective, He identified three key priorities. The first is strengthening data and evidence systems through near real time stock assessments, improved catch documentation, and vessel-based observation networks. The second is the integration of technology into governance, including AI enabled monitoring, digital traceability, and smart value chain solutions, noting that Maharashtra has already initiated AI based approaches in inland fisheries. The third priority is building capacity and partnerships through continuous training of scientists, fishers, and managers,

supported by strong institutional platforms for dialogue and collaboration. He reiterated that, as emphasized in the National Policy on Marine Fisheries 2017, science and technology must be embedded across all levels of governance, and that innovations must effectively reach fishing communities, enterprises, and value chain actors. On behalf of the Government of Maharashtra, he assured strong commitment to supporting the roadmap emerging from the workshop and to fostering collaborations that promote inclusion, sustainability, innovation, and equity. He concluded by emphasizing the shared responsibility to safeguard marine resources for future generations and expressed confidence that the workshop would meaningfully shape the future of fisheries governance in India.

Question and Answer Session

Your studies reported fuel savings and gear modifications. Do these studies apply to larger commercial vessels with powerful engines and different hulls, and is there cost benefit analysis for adoption in those real-world conditions?

Yes. Most studies were conducted in Indian waters at multiple centres, including Gujarat, Visakhapatnam and Kutch, and included trials with commercial vessels. For example, square mesh codends were trialled with commercial fleets and later adopted in some harbours. Fuel savings observed in practice were modest, around 0.5 to 1 percent per operation in some commercial trials. Adoption is influenced by many factors beyond technology, including social and economic considerations, so cost benefit must take those broader factors into account.

You recommended species specific mesh sizes, but how do these work in multispecies, non-target trawl fisheries?

Recommendations are region and gear specific. Three mesh size categories have been prescribed for different waters. For Gujarat a 40 mm square mesh codend is recommended. In Cochin waters two sizes, 35 mm and 25 mm, are used to balance fish and shrimp catches. These are optimised based on biological data and economic considerations. They are not perfect for every catch composition but represent a pragmatic balance.

Can small fishing boats be fitted with radar reflectors and what is the cost?

Yes. Radar reflectors are simple devices made of aluminium and are inexpensive. Basic reflectors or reflective stickers can be produced locally at low cost. They must have a non-smooth surface to reflect radar effectively. Simple designs can be fabricated in local workshops.

Minimum legal-size rules can be extensive. Should implementation focus on a phased list of commercially important species rather than a very large list immediately?

Yes. A phased approach is practical. Start with a manageable list of commercially important or high priority species, monitor compliance and impacts, and then expand. Kerala's experience illustrates this: a smaller initial list was expanded in phases and subsequently reviewed. Impact assessment and performance evaluation must accompany roll out to identify implementation challenges and unintended consequences.

Are there practical low carbon or alternative fuel solutions for existing fishing craft such as solar, battery or gas engines?

Alternatives are under testing. Battery electric and solar assisted systems are promising for inland and near shore boats but face challenges for larger offshore vessels because of power density and battery size. LPG conversion is being advanced through a government supported SOP and is entering the commercial market for many petrol and diesel engines. Large scale adoption for ocean going trawlers remains constrained by power requirements and cost, but pilot demonstrations and company partnerships are in progress.

What explains earlier unsuccessful trials of solar boats and are there new developments?

Earlier trials faced issues of high initial cost, insufficient panel area for required power, large battery requirements and user acceptance. Marine specific solar panels and battery technology have improved, and new private and public pilots are underway. Inland applications remain more feasible at present.

There are concerns about inexpensive imported engines that may have unclear fuel consumption ratings. How should this be handled?

There is variation in claimed versus actual performance among some imported engines. This affects fuel use and carbon footprint calculations. Policy and procurement should emphasise verified performance standards, testing and certification. A trend toward local assembly and stricter standards is helping, but vigilance and testing remain important.

Can PFZ advisories and ocean forecast information be provided earlier than the current timing? Fishers request 36 to 48 hours lead time.

Forecast frequency has already moved from once every three days to daily advisories. The main limitation is availability of real time data and validation needs for forecasts. As data inflows improve and validation processes are streamlined, lead times can be extended. The agencies are working on better data collection and faster processing.

Annexure I **Programme Agenda**

Detailed Programme (Provisional)

Day 1: Setting the Context and Building Shared Understanding

Time	Activity	Responsibility
08:45 – 09:30	Registration	**BOBP**
09:30 – 10:15	**Session 1: Inaugural Session** **Facilitator: D. Vijai**, *Senior Manager, Climate Resilient Fisheries, EDF*	
09:30 – 09:40	Welcome Address & Context Setting	**Dr. P. Krishnan** *Director, BOBP-IGO*
09:40 – 09:50	Opening remarks: Vision and Commitment from EDF	**Dr. Hisham Mundol** *Chief Adviser, EDF-India & Director, EDF*
09:50 – 10:00	Guest of Honour	**Dr. N. Felix** *Vice Chancellor, Tamil Nadu Dr. J. Jayalalithaa Fisheries University*
10:00 – 10:15	Chief Guest	**Dr.N.Subbaiyan**, IAS *Secretary, Animal Husbandry, Dairying, Fisheries and Fishermen Welfare, Tamil Nadu*
10:15 – 10:50	**Group Photo / Tea Break**	
10:50 – 13:00	**Session 2: Evidence for Governance: Science & Technology Solutions Currently in Practice** **Facilitator: Dr. R. Venkatesan**, *Professor of Practice, IDM Anna University & Adjunct Professor, University of Massachusetts Dartmouth, USA & IIT Madr* *This session introduces participants to the various scientific inputs and technological solutions which have been developed and piloted by the national research organizations in India and currently accessed/ used/ adopted by the fisheries managers for governance. Participants will understand practical use-cases, challenges, and potential for improvements.*	
1100 – 1115	Scientific evidence for Fisheries Management	**Dr. J. Jayasankar** *Head, FRAEED, ICAR-CMFRI*
1115 – 1130	Guidance on Fishing Technology (Gear and Craft modifications)	**Dr. M.V. Baiju** *Naval Architect, ICAR-CIFT*
1130 – 1145	Ocean Information Services for Fishers	**Dr. Dhanya Mohan Lal** *Scientist, MoES-INCOIS*
1145 – 1200	Advisories for Disaster and Safety of Fishers-Pilot projects	**Dr. S.K. Dash** *Scientist F, MoES-NCCR*
1200 – 1230	Lessons from success and failure: Case studies	**BOBP & EDF**

Time	Activity	Responsibility
1230 – 1245	Slido Poll: Profiling perceptions on readiness and relevance of technologies	**BOBP & EDF**
1245 – 1300	Introduction to Group Exercises	**BOBP-IGO**
13:00 – 14:15	**Lunch Break & Tech Walk** ***Tech Demo Booths*** *Leading Institutions and Tech solution providers display their tools and solutions in designated booths where the participants walk through and interact for details / partnerships / collaborations*	
14:15 – 17:30	**Session 3: Mutual Empathy and Problem Mapping** **Coordination: BOBP/EDF & Facilitators** *This session is meant to build mutual understanding between scientists and fisheries managers by reflecting on real-world constraints, communication gaps, and institutional bottlenecks in applying scientific evidence to fisheries policy. Participants will work in mixed-role groups to explore their lived experiences—where science has succeeded or failed in influencing decisions—and identify systemic barriers to collaboration.* ***Through structured breakout discussions, participants will surface both operational frustrations and shared aspirations.***	
14:15 – 15:30	**Group Work 1: Role-Reversal Exercise** *Mixed-role groups explore experiences, challenges, and gaps in science–policy collaboration. Managers and scientists switch roles to better understand expectations.*	
15:30 – 15:45	**Tea Break**	
15:45 – 16:45	**Group Work 2: Live Visual Mapping** *Facilitators compile group insights into a Science–Policy Ecosystem Map.*	
16:45 – 17:15	**Open Forum** *Group reflection on institutional barriers, bottlenecks in evidence use and opportunities for collaboration Group reflection on institutional barriers and bottlenecks in evidence use.*	
17:15 – 17:30	**Announcements for Day 2**	
18:30 – 20:30	**Cultural Evening and Networking Dinner**	

Day 2: Profiling Innovations and Planning Future Action

Time	Activity	Responsibility
09:00 – 09:10	Recap and Synthesis of Day 1 Summary of key insights from Day 1	**Mr. Rajdeep Mukherjee** *Policy Analyst, BOBP-IGO*
09:10 – 11:00	**Session 4: Emerging concepts and technologies in fisheries governance** **Facilitator: Dr. E. Vivekanandan**, *Sr. Scientific Consultant, BOBP-IGO* *This session introduces participants to selected cutting-edge, field-tested tools designed to strengthen evidence-based decision-making in marine fisheries. Each tool targets a different bottleneck in the science–management continuum—from lack of timely effort data to gaps in coastal ocean monitoring, to challenges in managing data-limited fisheries. Participants will gain hands-on exposure to the technologies, engage directly with the developers, and understand practical use-cases, challenges, and potential for adaptation in Indian fisheries contexts.*	
09:10 – 09:40	FISHE: A Framework for making climate- and science-informed management decisions	**Dr. Jacob Eurich** *Small-Scale Fisheries Solutions Scientist, EDF*
09:40 – 10:00	Innovations in catch documentation, resource assessment & reporting for effective fisheries governance	**Dr. P. Krishnan** *Director, BOBP-IGO*
10:00 – 10:15	SmartPass: Innovative Fishing Monitoring Using Shore-Based Cameras and Artificial Intelligence	**Dr. Karly Kelso** *Senior Director, Global Oceans Strategies, EDF*
10:15 – 10:30	Digital solutions for strengthening value chain	**Mr. B. Bharath Kumar** *CEO, Threshold Software; ZEROCODE*
10:30 – 10:45	The Fishing Vessel Ocean observing Network (FVON): A New Paradigm for Ocean Observing	**Dr. Jacob Eurich** *Small-Scale Fisheries Solutions Scientist, EDF*
10:45 – 11:00	Underwater Domain Awareness; Opportunities for Fisheries	**Dr. Arnab Das** *CEO, Marine Research Centre*
11:00 – 11:30	**Tea Break**	
11:30 – 13:00	**Panel Discussion** *Identified panellists discuss strategies for leveraging technologies and strengthening science-policy interface across various domains.* **Facilitator: Dr. P. Krishnan**, *Director, BOBP-IGO, Chennai*	
13:00 – 14:00	**Lunch**	

Time	Activity	Responsibility
14:00 – 15:15	**Session 5: Co-Creation and Planning** **Facilitator: Dr. P.S. Ananthan**, *Principal Scientist, ICAR-CIFE, Mumbai* *Building on the diagnostics and shared understanding developed during Day 1 and merging concepts and technologies on Day 2, this session shifts from analysis to action. Participants will work in thematic working groups to co-design practical roadmaps that strengthen the science–management interface in marine fisheries governance. Drawing from the Science–Policy Ecosystem Map, survey data, and earlier discussions, each group will focus on one of four strategic areas—institutions, communication, technology, and capacity—and use structured templates to identify key problems, root causes, and feasible solutions.* *Groups will be encouraged to build on real-world examples, pilot opportunities, and institutional mandates to ensure relevance and implementability.*	
14:00 – 14:45	**Thematic Working Groups Discussion** Participants co-develop actionable roadmaps across 4 streams: 1) Science–Policy Mechanisms 2) Evidence Packaging 3) Tech Integration 4) Capacity Building	
14:45 – 15:15	**Group Presentations** Each group shares roadmap outputs and peer feedback.	
15:15 – 15:30	**Tea Break**	
15:30 – 16:15	**Session 6: Plenary: Commitments & Next Steps**	
15:30 – 16:00	**Way Forward** Discussion to converge on shared commitments	• State Governments • Research Organizations • Organizers
16:00 – 16:10	**MoU Signing** Formalize EDF/EDIF and BOBP collaboration and working arrangements with partnering states	**BOBP-IGO & EDF**
16:10 – 16:25	**Chief Guest Remarks**	**Dr. N. Ramaswami**, IAS *Secretary, Animal Husbandry, Dairy Development & Fisheries Govt. of Maharashtra*
16:25 – 16:30	**Vote of Thanks & Close of Workshop**	**D. Vijai** *Senior Manager, Climate Resilient Fisheries, EDF*

Annexure II

Participant List

National Workshop on

Strengthening the Science–Management Interface: Embedding Evidence and Technology in Marine Fisheries Governance

09-10 September 2025

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