Workshop on Promoting Decision Support System (DSS) Using Digital Data to Support Small Pelagic Fisheries Management in the APEC Region

Summary Report

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APEC Ocean and Fisheries Working Group

December 2025

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Asia-Pacific Economic Cooperation

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1. Background

Marine small pelagic fisheries is an important sector that supporting APEC developing economies through creating jobs thus income for coastal communities and small medium enterprises, fulfill nutrition adequacy and food security. However, in several APEC economies these small pelagic fisheries experienced declining stocks not only due to overfishing but also changing climate and therefore management measures need to be implemented. The use of electronic fishing logbook data or fishing e-logbook, especially as a support in decision making on small pelagic fisheries management has not been implemented optimally.

Those massive data in fishing e-logbook are not yet used for drafting policies but rather just to fill the fisheries statistic data. Therefore, there is a need to develop DSS using e-log book data to aid in management policies for small pelagic fisheries. This project will utilize the fisheries dependent data that collected directly from commercial fishing activities to formulate policy through DSS. Data and information obtained in the form of fishing effort, the number of fish catches, the number of fish landed, types of fish, and commercial fish biological data. Data was collected through capture logbooks, observers at sea, electronic reporting monitoring systems, interview surveys, and ship monitoring surveys. Fisheries dependent data is integral in sustainable fisheries management.

The lack of fisheries data causes uncertainty in determining the status of fish resource stocks and will have an impact on economic threats and food security for users of fish resources that are highly dependent on these fish resources and the possibility of increasing overfishing activities. Currently, the rapid development of technology makes it possible to collect, manage and analyze fisheries data as a solution to update and modernize fisheries data systems.

The problems that will be addressed in this project are stated in the form of questions as follows:

1. What is the current status of the use of small pelagic fisheries in the APEC region based on digital data? The utilization status includes (a) total catch, (b) catch per fishing gear, (c) composition of catch types per port, (d) composition of catch types per fishing gear, (e) fishing effort or catch per unit effort (CPUE), (f) analysis of CPUE trends per fishing gear and trends in fish resource utilization, (g) the composition of catch species classified as ERS (Ecological Related Species), and (h) the fishing season.
2. What is the condition of small pelagic fisheries in the APEC region based on several fishery biological parameters?
3. What is the vulnerability status of small pelagic fisheries in the APEC region?
4. How is the pattern of implementation of digital fisheries data in small pelagic fisheries in APEC region as a consideration for improving the application of digital data to obtain quality data from various stakeholders (harbormaster, fishermen, and port officers)?
5. How can a large number of fisheries digital data be used to assist managers or fisheries management authorities in formulating policy recommendations for small pelagic fisheries management in the APEC region using DSS application tools?

This project has some sustained benefits for APEC economies in continuing efforts to combat IUU fishing, fisheries products traceability and safety through the implementation of digital fishing data and subsequently using those fisheries data as DSS to improve management measures and policies.

2. Workshop Objectives

This project addresses challenges in making precise fisheries management decision for complex fisheries such as small pelagic fisheries. The objective of this project is to promote better fisheries management policies by enhancing the capacity of policy makers in term of management, analysis and utilization of digital fisheries data, and recommending a DSS design through exploring best knowledge, practice, and innovation in preliminary research and a technical workshop. Hence, this project will contribute to efforts on achieving Putrajaya Vison 2024 on 1) innovation and digitalization and (2) strong, balanced, secure, sustainable and inclusive growth, and APEC Roadmap in Combating IUU Fishing.

For APEC, this project ensures the sustainability of fisheries resources for sustainable use by all fisheries stakeholders particularly of those small and middle scale fishers. Moreover, this project

results will also ensure the goal of the OFWG to facilitate free and open trade in the region and promote the sustainable use of fisheries, aquaculture, and marine ecosystem resources and related goods and services.

The project will also strengthen the OFWG mission to promote cooperation among its members, governments, academia, private industry, and regional and international organizations to advance this process. As the first mission of OFWG is take continued action to end illegal, unreported and unregulated (IUU) fishing, build capacity to address the negative impacts of IUU fishing on APEC economies, sustainable fisheries, food security, and continue enacting measures to combat IUU fishing through further implementation of the Roadmap on Combating IUU fishing. The DSS enacting from e-log book data will definitely support the mission.

3.   Participants

The official attendance list for the APEC Workshop on Promoting Decision Support System (DSS) Using Digital Data to Support Small Pelagic Fisheries Management in the APEC Region recorded 84 participants from 14 APEC economies. The gender composition consisted of 44 male (52%) and 40 female (48%) participants, demonstrating strong gender balance. The majority of attendees were from Indonesia, followed by representatives from Australia; Brunei Darussalam, Chile; China; Malaysia; Peru; the Philippines; Russia; Singapore; Chinese Taipei; Thailand; the United States; and Viet Nam. The participants represented various sectors including government institutions, universities, research centers, and international organizations, reflecting broad, multi-sectoral engagement. The workshop successfully gathered a diverse pool of experts and stakeholders, strengthening regional collaboration and digital innovation in small-scale fisheries management within the APEC region.

Among the total 84 participants recorded in the attendance list, 63 participants (approximately 75%) represented travel-eligible APEC economies, namely Chile; China; Indonesia; Malaysia; Peru; the Philippines; Thailand; and Viet Nam. This strong representation highlights that the workshop effectively engaged developing member economies, aligning with APEC's capacity-building objectives.

It is also important to note that Russia is officially categorized as a travel-eligible economy under APEC funding rules. However, the Russian participants were not able to travel to Jakarta at the last minute due to administrative constraints. As a result, their participation was represented by officials from the Embassy of the Russian Federation in Jakarta, who attended the workshop on their behalf.

The remaining participants (about 25%) came from non-eligible or self-funded economies, such as Australia; Brunei Darussalam; Singapore; Chinese Taipei; and the United States. Their presence reflected voluntary engagement and technical contributions to support cross-economy collaboration and knowledge exchange.

Overall, the participant composition demonstrated a balanced mix between travel-eligible and self-funded economies, ensuring both inclusivity and broad regional representation across APEC members.

4.   Workshop Agenda

A three-day workshop in Jakarta was conducted to share information about the research result and to build the capacity of economies in using DSS for sustainable management of small pelagic fisheries. The workshop format is a face-to-face workshop with interactive discussion methods. Target APEC funded-participants are fisheries managers and policy makers, as well as researchers and academics in fisheries and marine sciences from 11 APEC member economies with 2 participants from each economy, not including the non-funded APEC participants from the rest of 10 APEC economies.

The number of participants is 84 participants (including contractors, speakers and moderators). This workshop will use the advance knowledge from developed economies to learn on the using of a large number of fisheries digital data in assisting managers or fisheries management authorities in formulating policy recommendations for small pelagic fisheries management in the APEC region using DSS application tools.

In general, this three-day workshop covered the following agenda.

a. Day 1: Foundations of DSS and Digital Data in Fisheries
- Opening, keynote, participant introductions
- Core concepts: importance of DSS, types of digital fisheries data
- Breakouts: data-related management challenges; women's participation and DSS
- Panel on best practices and innovations; daily wrap-up

b. Day 2: Capacity Building and Practical Applications
- Hands-on workshop on DSS tools and information systems
- Participant case studies (e.g., Chile; Peru; and the Philippines)
- Addressing barriers and co-developing solutions
- Economy planning session and expert feedback; daily wrap-up

c. Day 3: Implementation Strategies and Future Directions
- Strategies for effective DSS implementation
- Interactive stakeholder engagement workshop (small pelagic DSS model)
- Workshop evaluation, closing remarks, and networking

The final agenda is attached.

5. Key Discussion Points

a. Summary of each session and issues raised

The workshop comprised several stages, including preliminary research presentations, a three-day technical capacity-building program, and a completion/reporting phase. Key issues raised included:
- The decline of small pelagic fish stocks due to overfishing and climate change.
- The underutilization of electronic fishing logbook data for fisheries management.
- The complexity of managing small pelagic fisheries through digital data integration.

Participants emphasized the need to develop a Decision Support System (DSS) based on digital fisheries data to assist policymakers in achieving sustainable fisheries management and combating illegal, unreported, and unregulated (IUU) fishing. The proposed DSS would integrate data on fishing effort, catch composition, biological parameters, and catch trends to inform evidence-based policymaking.

Summary - Day 1
Session 1:
- The first presentation provided expert insights into the importance of Decision SUPPORT Systems (DSS) in fisheries management, emphasizing how such systems can strengthen policy decisions and resource governance.
- The next presentation offered an overview of digital data applications in fisheries, describing various digital data types and their relevance to the management of small pelagic resources.

Session 2:
- The session continued with group discussions focusing on the current challenges in utilizing fisheries data for effective management and decision-making.
- A subsequent discussion highlighted the role of women in small pelagic fisheries management and showcased examples of how DSS can support inclusive and sustainable practices.

Conclusions from Day 1:
- Climate change significantly impacts small pelagic fisheries.
- Effective fisheries management relies on robust and well-structured data systems.
- Managing small pelagic fisheries data can positively contribute to domestic economic growth.
- Social networking and community engagement are vital for sustaining small pelagic fisheries.
- The main challenges in fisheries data management arise within fisheries communities themselves.
- While women's participation in fishing activities remains limited, their roles in marketing and processing are increasing.

3

Summary – Day 2
Session 3:
- The session explored the role of information systems in supporting capture fisheries data management and showcased practical applications of Decision Support Systems (DSS) in fisheries governance.
- Participants also presented case studies demonstrating the use of DSS in various economies, including examples from Latin America and Southeast Asia.

Session 4:
- Focus Group Discussions were conducted to identify barriers and potential solutions for the effective implementation of DSS in fisheries management.
- The session concluded with an exercise in which participants developed preliminary action plans for integrating DSS approaches into their respective local fisheries management practices.

Conclusions from Day 2:
- Most capture fisheries business processes have begun digital data implementation.
- Interconnected information systems accelerate fisheries policy implementation.
- Data collection processes in capture fisheries management still require significant improvement.
- Economies such as Chile; Peru; and the Philippines have implemented DSS models, each with unique adaptations.
- Key action plans emphasize strengthening institutional capacity, ensuring sustainable funding, adopting appropriate technologies, and empowering fishing communities to promote sustainable fisheries management across APEC economies.

Summary – Day 3
Session 5:
- The session featured discussions on strategies to enhance the effectiveness of Decision support System (DSS) implementation, focusing on practical approaches and lessons learned from field experiences.
- An interactive workshop followed, emphasizing stakeholder engagement in fisheries management. Participants took part in role-playing exercises to stimulate real-world coordination and decision-making scenarios.

Conclusions from Day 3:
- Strong collaboration among stakeholders is essential.
- DSS implementation should start with a clear target plan and a well-structured data framework (e.g., ACCSP).
- Building trust through transparent and accessible data is key.
- The success of DSS depends as much on people and policies as on technology.
- DSS enhances decision quality, speed, and transparency.
- Case examples (ACCSP, Menhaden, Black Sea Bass) illustrate practical applications of DSS.
- Integration through DSS yields greater efficiency and success in fisheries management.
- The SiStok platform was introduced as a model supporting fisheries management through surplus production models, contributing to sustainable resource utilization and conservation balance.

b. Best Practices Shared Among Economies

Throughout the workshop, APEC economies actively exchanged experiences and shared best practices in the use of digital data, e-logbook systems, and Decision Support System (DSS) applications for small pelagic fisheries management. These exchanges highlighted that the transition toward digital and data-driven governance is well underway across the region, albeit at different stages of maturity. Economies such as Chile; Peru; and the Philippines presented noteworthy examples of DSS implementation, particularly in their ability to differentiate between industrial and small-scale fishing operations through distinct vessel permit systems. This distinction enables better monitoring of fishing activities, more accurate catch documentation, and tailored policy interventions suited to each sub-sector's characteristics.

Participants emphasized that successful DSS design and deployment must be context-specific. Adaptability to local realities, including variations in human resource capacity, geographic conditions, target species, and fishing gear types, is critical to ensuring that digital systems are both functional and sustainable. In many cases, systems that have succeeded are those that blend technological innovation with strong institutional coordination, stakeholder inclusion, and policy integration. Moreover, the sharing of these experiences demonstrated the value of South–South cooperation within APEC, where developing economies can learn from peers that have successfully implemented scalable and cost-efficient digital management tools. The cross-learning process reinforced the principle that no single model fits all; rather, DSS frameworks must evolve in line with local governance structures, ecosystem characteristics, and socioeconomic priorities.

c. Challenges Identified

Despite evident progress, several persistent challenges continue to constrain the optimal use of digital data in fisheries management across APEC economies. While significant amounts of electronic and satellite-based data are now available, their utilization remains sub-optimal due to fragmented systems, limited interoperability, and inconsistent data validation procedures. The lack of high-quality, systematic, and standardized datasets creates uncertainty in fish stock assessments, which in turn affects evidence-based policy-making, economic stability, and food security.

From an institutional perspective, technical and capacity limitations remain a major obstacle to the widespread adoption of DSS. Many economies face shortages of skilled personnel capable of analyzing complex datasets and translating analytical outputs into actionable policy. In some cases, fragmented governance structures and overlapping mandates among agencies further complicate data integration and decision-making processes. Financial constraints also limit the ability to invest in digital infrastructure, data management technologies, and sustained training programs.

Beyond institutional barriers, the ecological and environmental diversity across APEC economies adds another layer of complexity. The variability in marine ecosystems, fishing practices, and climatic conditions requires highly adaptive and flexible DSS models that can capture fine-scale dynamics while remaining scalable and user-friendly. These challenges underscore the importance of continuous innovation, targeted capacity building, and enhanced cross-economy collaboration to bridge technical, institutional, and resource gaps in digital fisheries management.

d. Innovative Approaches and Lessons Learned

In response to these challenges, workshop participants identified several innovative approaches and key lessons that can guide future APEC initiatives in fisheries data management and DSS implementation. One major recommendation is the development of a multi-criteria Decision Support System that integrates diverse datasets, including biological, environmental, socioeconomic, and operational data, into an adaptive, fine-scale management framework. Such a system would enable policymakers and managers to respond dynamically to changing resource conditions, market signals, and ecosystem variations.

The use of electronic logbooks and digital monitoring systems was widely recognized as a cornerstone of modern DSS architecture. These tools provide near real-time data on fishing effort, catch composition, and vessel activities, improving transparency and accountability across the supply chain. The integration of these data streams into centralized information systems can significantly enhance the accuracy and responsiveness of fisheries management decisions.

Another key lesson involves the capacity building of policymakers and technical personnel. Strengthening their ability to interpret and utilize digital data is crucial for ensuring that technological advancements are effectively translated into informed and timely policy responses. Participants emphasized the importance of continuous training programs, technical workshops, and inter-economy exchanges to maintain the relevance of skills in an evolving digital landscape.

Moreover, the workshop underscored the value of multi-stakeholder collaboration, involving governments, academic and research institutions, the private sector, and international organizations such as APEC. This collaborative ecosystem promotes innovation, fosters data sharing, and

accelerates the development of integrated DSS models that reflect the interconnected nature of modern fisheries governance. Finally, economies are encouraged to adopt technology-driven innovations aligned with APEC's overarching objectives, namely; **innovation, digitalization, sustainability, and combating illegal, unreported, and unregulated (IUU) fishing**. Together, these efforts will help build resilient, data-informed fisheries management systems that ensure long-term ecological balance, economic viability, and food security across the Asia-Pacific region.

APEC economies exchanged experiences on innovative digital data collection methods, e-logbook systems, and DSS applications. Notable examples include Chile; Peru; and the Philippines, which differentiate between industrial and small-scale fishing vessel permits. Participants emphasized the importance of adapting DSS designs to local contexts, accounting for human resource capacity, geographic diversity, targeted species, and fishing gear types.

6. Outcomes and Recommendations

a. Main Takeaways from the Workshop

The workshop underscored the importance of leveraging satellite and digital data technologies to support emergency preparedness, management, and response across the Asia-Pacific region. Participants highlighted disparities in technical capacity between developed and developing economies and stressed the need for enhanced knowledge transfer and practical application of digital data in policymaking.

The integration of digital data into DSS is crucial for sustainable resource management, including fisheries. Cross-sectoral collaboration among governments, international organizations, academia, and the private sector is key to advancing DSS development and utilization.

A proposed cooperative framework for DSS development includes:
- Ministry of Marine Affairs and Fisheries (policy management)
- Indonesian Agency for Meteorology, Climatology, and Geophysics (climate and oceanographic data)
- Geospatial Information Agency (mapping of resource potential)
- Ministry of Transportation / Port Authority (logistics coordination)
- Fishing communities
- Private partners such as Atlantic Coastal Cooperative Statistics Program (ACCSP) from the United States for data standardization and integration

The primary goal is to establish a comprehensive and interoperable data management system serving policymakers, scientists, and fishers, thereby improving efficiency and decision quality in fisheries management.

The ACCSP will be responsible for collecting data, which can then be used to formulate policy. One example of its use is when researchers used the data to create a depletion model for open populations.

A depletion model for open populations in ecology refers to a statistical approach used to estimate population size and dynamics when individuals can enter or leave the study area during sampling. Unlike closed population models, which assume no immigration, emigration, births, or deaths during the study period, open population models account for these changes - making them more realistic for many ecological applications.
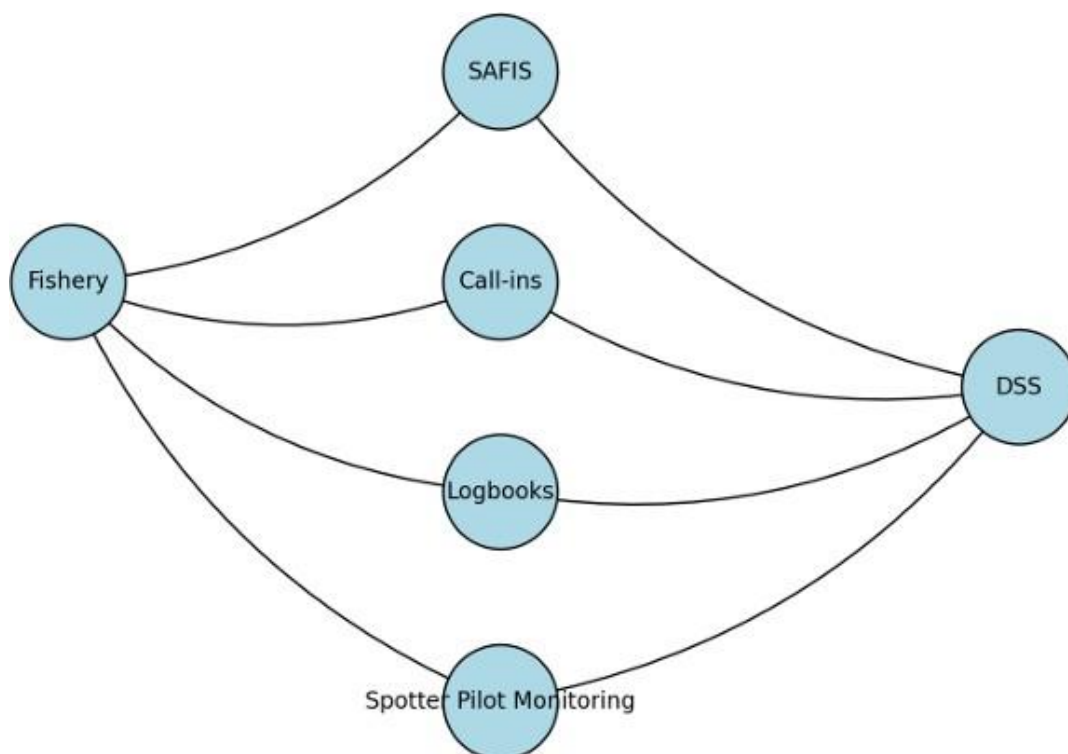
b. Policy Recommendations and Technical Guidance

Building upon the findings and outcomes of the workshop, several key policy recommendations and technical guidance points were identified to support the effective adoption of Decision Support Systems (DSS) and enhance the utilization of digital and satellite data for sustainable fisheries and resource management across APEC economies.

At the domestic level, Indonesia is encouraged to promote robust inter-agency partnerships for integrated fisheries data management within and across Fisheries Management Zones (FMZs). Such cooperation frameworks are vital to ensuring that diverse datasets, ranging from landing statistics and biological observations to fishing effort records, are systematically collected, harmonized, and shared among relevant institutions. These partnerships would aim to integrate landings, biological, and effort data, while simultaneously working to standardize and centralize fisheries data management processes. A coordinated system would improve data consistency, eliminate redundancy, and facilitate evidence-based decision-making. Establishing this kind of data interoperability is essential to ensure that fisheries management policies are aligned with sustainability objectives, and that they effectively balance resource utilization with conservation.

At the regional level, APEC is advised to continue strengthening technical capacity among its member economies, particularly in the application of satellite and digital data technologies for both resource management and emergency preparedness. The workshop emphasized that many economies, especially developing ones, still face challenges in accessing, processing, and interpreting large-scale digital datasets. Targeted capacity-building initiatives, including technical workshops, peer-learning exchanges, and expert missions, should therefore be expanded to address these disparities and foster greater regional coherence in digital governance.

To institutionalize these efforts, participants recommended the establishment of a specialized APEC Working Group on Applied Satellite Technologies, which would consolidate technical expertise and coordinate multi-sectoral applications of satellite data across areas such as fisheries, agriculture, forestry, disaster risk management, and environmental monitoring. This working group could serve as a regional platform for sharing technological innovations, standardizing methodologies, and promoting interoperability among data systems used by different economies.

Further, economies are encouraged to provide regular reports detailing their progress in data

utilization, challenges encountered, and measures taken to improve governance and technical performance. These periodic reports would strengthen transparency, allow for peer review, and contribute to the continuous improvement of digital data policies within the APEC framework. Complementary to this, annual workshops and training programs should be organized to bring together both technical experts and decision-makers, ensuring that technology development is matched by policy understanding and institutional support. Such multidisciplinary engagement is critical to bridge the gap between data science and policy implementation.

In addition, APEC should promote the creation of Centers of Excellence (CoEs) and collaborative online platforms to facilitate data sharing, research cooperation, and knowledge exchange among economies. These CoEs can act as hubs for regional innovation, supporting joint research projects, demonstration pilots, and training on emerging digital technologies. The online platforms, meanwhile, would enhance accessibility to standardized datasets, analytical tools, and policy references, creating a shared knowledge base for continuous learning and improvement.

Lastly, APEC economies are encouraged to adopt open data policies and establish sustainable funding mechanisms to ensure that critical information remains accessible during emergency situations. Such frameworks should be supported by appropriate legal and institutional arrangements to protect data integrity, privacy, and sovereignty while still facilitating cross-border cooperation. In doing so, APEC can strengthen its role as a global leader in promoting transparent, technology-driven, and resilient resource management systems that are responsive to both environmental and socio-economic challenges in the Asia-Pacific region.

c. Suggestions for Future APEC Work or Follow-up Activities

Looking ahead, the workshop outcomes highlight several strategic directions for APEC to consider in ensuring the continuity, relevance, and regional impact of efforts related to digital and satellite data utilization, Decision Support Systems (DSS), and sustainable resource management. One of the key suggestions is for APEC to sponsor pilot projects that specifically address high-priority challenges in resource management and emergency preparedness. These pilot initiatives should rotate among member economies, allowing diverse regional contexts, such as archipelagic, coastal, and continental systems, to serve as case studies. Each pilot project would function as a testbed for applying and refining DSS tools, data integration methods, and real-time monitoring approaches in support of effective policy decisions and sustainable management outcomes.

In parallel, APEC is encouraged to promote joint scientific research programs among its economies, focusing on the harmonization of monitoring methodologies and data standardization. Coordinated scientific collaboration will allow for the development of compatible indicators, uniform reporting systems, and interoperable digital data platforms. This joint approach not only facilitates comparability across regions but also strengthens the collective scientific basis for policymaking. It will further enhance the region's ability to conduct ecosystem-based management and respond effectively to emerging challenges, such as overfishing, marine pollution, and climate-induced changes in resource distribution.

Another essential component for future APEC work is the expansion of training and capacity-building programs that actively involve both policymakers and technical experts. By ensuring that decision-makers have a clear understanding of technological tools and that technical staff comprehend policy priorities, economies can close the gap between technology and governance. These programs should focus on practical skill-building, applied research, and the translation of digital innovations into actionable policy measures. Workshops, online courses, and exchange programs among APEC economies can serve as effective platforms for sharing expertise, strengthening institutional capacity, and promoting mutual learning.

To further enhance cooperation and responsiveness, APEC should also prioritize the strengthening of institutional networks and technology platforms that enable real-time data exchange. Establishing secure, interoperable digital systems across economies would significantly improve data transparency, consistency, and timeliness, critical elements for both routine resource management and emergency response. Such systems could build on existing frameworks within regional organizations and international partners, ensuring that data flows seamlessly from collection to analysis and decision-making levels.

Lastly, APEC is encouraged to foster cross-border cooperation mechanisms to improve access to emergency data and facilitate integrated resource management. This includes developing formal arrangements and protocols that allow for the timely sharing of satellite imagery, fisheries data, and environmental monitoring information during crises such as extreme weather events or ecological disruptions. By institutionalizing these cooperative mechanisms, APEC economies can enhance collective resilience, reduce duplication of efforts, and ensure that all member economies, regardless of technological capacity, can benefit from the region's shared data and expertise. Such cross-border collaboration embodies APEC's core principles of inclusivity, innovation, and shared prosperity, aligning closely with its long-term vision for a digitally interconnected and sustainable Asia-Pacific region.

7. Next Steps

a. Planned Follow-up Activities

To ensure the long-term impact and continuity of the workshop outcomes, participating economies and relevant partners agreed on a set of planned follow-up activities aimed at strengthening the application of digital and satellite-based data in fisheries and resource management. Annual specialized workshops will continue to be organized under the APEC Ocean and Fisheries Working Group (OFWG), focusing on space-based tools, digital data access, and their applications for emergency preparedness, environmental monitoring, and sustainable marine resource management. These workshops will provide ongoing opportunities for economies to share progress, challenges, and new technological developments, ensuring that capacity building and innovation remain continuous processes rather than one-time efforts.

In parallel, APEC-sponsored pilot projects will be implemented on a rotational basis, targeting priority areas such as hydro-meteorological, geohazard, and technological disasters. Each pilot project will aim to test, demonstrate, and refine the integration of digital data systems, particularly Decision Support Systems (DSS) in addressing local and regional challenges. The lessons learned from these pilots are expected to inform policy recommendations and serve as replicable models for other economies facing similar issues in fisheries and marine resource management.

To strengthen the scientific foundation of these initiatives, joint research programs will be promoted among scientific institutions and academic networks across APEC economies. This collaborative research will enhance the development of standardized monitoring methodologies, data collection protocols, and DSS modeling approaches that account for diverse ecological, socioeconomic, and governance contexts. Moreover, targeted education and capacity-building programs will be developed for both technical experts and policymakers, recognizing that sustainable DSS implementation requires not only technological know-how but also strong policy ownership and institutional coordination.

A key element of these follow-up activities is the establishment of a cooperative DSS framework involving multiple domestic and international stakeholders. In Indonesia, for instance, the framework will include the Ministry of Marine Affairs and Fisheries (MMAF) as the lead policy and regulatory body, the Agency for Meteorology, Climatology, and Geophysics (BMKG) responsible for providing real-time climate and oceanographic data, the Geo-spatial Information Agency (BIG) for spatial data and natural resource mapping, and the Port Authority to ensure integration with logistics and maritime infrastructure. Active participation from fishing communities is also crucial, as they represent both data providers and beneficiaries of improved management decisions. Internationally, collaboration with the Atlantic Coastal Cooperative Statistics Program (ACCSP, The United States) will be explored to leverage its expertise in data standardization, system interoperability, and integrated fisheries information management. The ACCSP model demonstrates how biological, landings, and effort data can be harmonized across agencies to support evidence-based decision-making, an approach highly relevant for APEC's ongoing efforts to develop robust DSS platforms.

b. Dissemination of Outcomes Among APEC Economies

To ensure that the knowledge, methodologies, and innovations emerging from this initiative are widely accessible and utilized, a clear dissemination strategy will be adopted across APEC

economies. Each economy is encouraged to submit annual reports detailing their progress in utilizing satellite and digital data, including the identification of barriers, emerging needs, and strategies for improvement. These reports will not only promote accountability and transparency but also foster a continuous exchange of experiences and lessons learned among economies at varying levels of technological advancement.

The establishment of Centers of Excellence (CoEs) and online clearinghouses is also recommended. These platforms will serve as centralized repositories for standardized datasets, analytical tools, training materials, and documented best practices related to digital data integration and DSS implementation. Through these CoEs, APEC economies will be able to collaborate more effectively in developing compatible systems, harmonized methodologies, and interoperable data frameworks.

Moreover, the creation of web-based platforms will further facilitate cross-economy collaboration by providing user-friendly access to data archives, research outputs, and policy briefs. These digital platforms will be designed to enable both technical and non-technical users, ranging from data scientists to policymakers, to utilize information for informed decision-making. In line with APEC's principles of openness and cooperation, economies are encouraged to promote open data frameworks and explore cross-border funding mechanisms to support joint projects, enhance data accessibility, and improve coordinated responses during emergencies or environmental crises. By adopting a transparent and collaborative approach, the dissemination process will ensure that the outcomes of this initiative continue to support the broader APEC goals of innovation, sustainability, and resilience.

c. Recommendations for APEC Consideration

Building on the lessons and priorities identified during the workshop, several key recommendations are proposed for consideration by APEC to further institutionalize and scale up these initiatives. Firstly, it is recommended that APEC reorganize the existing Global Navigation Satellite System (GNSS) Subgroup into a fully operational Working Group on Applied Satellite Technologies, with an expanded mandate that includes emergency management, agriculture, forestry, and marine resource management. Such an institutional mechanism would strengthen coordination, avoid duplication of efforts, and ensure that APEC's work on satellite and digital data applications benefits multiple sectors in an integrated and synergistic manner.

Secondly, APEC economies are encouraged to pool financial, technical, and human resources to enhance data reception, processing, and analytical capacities at both the regional and economy levels. This shared resource model would allow for cost-effective technology transfer and knowledge exchange, especially benefiting developing economies with limited technical infrastructure. In addition, the introduction of an annual reporting and evaluation mechanism on the use of digital and satellite data is recommended to monitor progress, identify emerging trends, and continuously improve policy and operational practices.

Lastly, it is strongly advised that future APEC workshops adopt an inclusive approach by involving both policymakers and technical experts. The active engagement of decision-makers will ensure that technological advancements in DSS and digital data management are fully integrated into policy formulation and implementation processes. Such cross-sector collaboration will enhance policy coherence, foster innovation, and strengthen the institutional frameworks needed to achieve APEC's long-term objectives of sustainable, science-based, and digitally empowered resource management across the Asia-Pacific region.

8. Workshop Evaluation

a Participant Overview
The pre-workshop survey gathered responses from 35 participants, while the post-workshop evaluation recorded 68 respondents, reflecting a notable increase in engagement and participation after the event. This increase suggests that the workshop successfully attracted broader involvement during implementation and that participants were motivated to contribute feedback after experiencing the full program.

Respondents represented a wide range of institutions and economies, encompassing both

government and research sectors. The gender distribution was well-balanced, particularly in the post-workshop data-set, indicating inclusivity in participation and alignment with APEC's commitment to gender equity in capacity-building initiatives.

b. Pre-Workshop Assessment

The pre-workshop assessment collected participants' initial perceptions of the workshop's objectives, content, materials, time allocation, gender inclusiveness, and relevance to their economies. Overall, responses indicated a moderate to high level of expectation and preparedness among participants. The highest ratings were observed for the clarity of objectives and relevance of the workshop content, suggesting that participants entered the program with a clear understanding of its purpose and potential value.

However, relatively lower scores were noted in the areas of gender perspectives and adequacy of time allocation, indicating areas that participants anticipated might require further attention during implementation. These results provided valuable insights into participants' baseline perceptions and served as a benchmark for post-workshop comparison.

c. Post-Workshop Assessment

Post-event data reflect a strong consensus that the workshop successfully achieved its intended objectives. Participants consistently rated the content as well-organized, relevant, and accessible, noting that both the structure and delivery supported effective learning. The duration and time allocation were considered adequate, allowing sufficient engagement with materials and experts.

Furthermore, participants expressed significant improvement in knowledge and skills, with post-training self-assessments shifting prominently toward the 4–5 range, indicating high confidence in applying newly acquired competencies.

Participants highlighted the acquisition of new practical skills, including the ability to apply digital data tools in fisheries management, to develop structured work plans, and to foster inter-economy collaboration for integrated data systems.

The expertise of trainers and the overall organization of the event received consistently positive feedback, reinforcing the workshop's quality and professionalism. Common suggestions for future improvements included providing more hands-on sessions and extending the workshop duration to allow deeper practical engagement.

d. New Skills and Knowledge Gained

The post-workshop survey results indicate that participants acquired a broad range of new skills and knowledge related to digital data application and Decision Support Systems (DSS) in fisheries management. The responses highlight both technical and conceptual learning outcomes, reflecting the workshop's dual emphasis on capacity building and regional knowledge exchange.

A majority of participants reported gaining a deeper understanding of the concept, structure, and implementation of DSS for fisheries management. This included exposure to various frameworks, models, and analytical tools that support evidence-based decision-making processes. Many respondents specifically mentioned that they now possess improved knowledge in using digital data for stock assessment, resource monitoring, and management decision processes.

Participants also emphasized that the case studies and experiences shared by other APEC economies provided valuable insights and comparative perspectives. Through these exchanges, they gained a broader understanding of how different economies apply DSS, manage data integration, and address challenges in promoting data transparency and stakeholder engagement. This comparative learning strengthened participants' appreciation of the importance of regional collaboration and knowledge sharing within the APEC framework.

In addition to technical competencies, participants identified several soft skills and strategic insights gained from the workshop. These include improved ability to communicate data-driven findings to policymakers, enhanced understanding of stakeholder engagement strategies, and

recognition of the need for cross-sectoral cooperation to build trust in data sharing and management systems. A few respondents also noted learning about collaborative approaches to improve digital platforms and dashboards, as well as how to reduce information gaps through improved data collection and analysis methods.

Participants further highlighted new capabilities in:
- Applying DSS models and toolkits to fisheries management planning;
- Designing or improving data visualization systems, including digital dashboards;
- Integrating risk-based and stock assessment data for better policy and operational decision-making; and
- Understanding future directions for DSS development and digital transformation in the fisheries sector.

Overall, the responses reflect a strong outcome of the workshop in enhancing participants' technical expertise, analytical capacity, and regional awareness. Beyond knowledge acquisition, many participants expressed increased motivation to apply DSS concepts in their own institutional contexts, contribute to domestic digitalization efforts, and foster cooperation with other APEC economies.

This demonstrates that the workshop effectively achieved its primary learning objectives; to strengthen participants' technical understanding of DSS, promote cross-economy knowledge sharing, and support data-driven approaches to sustainable fisheries management.

e. **Level of Knowledge Improvement**
A comparison between the pre- and post-workshop self-assessments demonstrates a clear and measurable improvement in participants' knowledge and confidence regarding the application of Decision Support Systems (DSS) and digital data for fisheries management.

A total of 68 respondents provided valid scores for both the pre- and post-workshop evaluations.
- The average knowledge rating prior to the workshop was 3.0 on a 5-point scale, indicating that most participants entered the event with a *moderate* level of understanding.
- After the workshop, the average rating increased to 4.2, reflecting a substantial enhancement in knowledge and skills.
  This corresponds to an average gain of 1.2 points, equivalent to a 39% improvement in self-assessed knowledge levels.

Distribution analysis shows that:
- Prior to the event, a large portion of participants rated themselves between levels 2–3, suggesting limited exposure to DSS tools and frameworks.
- After the workshop, the majority shifted to levels 4–5, demonstrating stronger comprehension and confidence in applying DSS concepts, interpreting digital data, and utilizing data-driven decision-making approaches.

This significant increase confirms that the workshop effectively met its capacity-building objectives. Participants not only gained theoretical understanding but also reported improved ability to translate knowledge into practice, such as applying DSS in stock assessment, designing digital dashboards, and improving policy coordination within their institutions. The observed upward trend underscores the workshop's success in strengthening regional technical capacity and enhancing participants' readiness to implement digital innovation in fisheries management across APEC economies.

Figure 1. Bar chart illustrating the perceived change in participants' knowledge before and after the workshop. The blue bars indicate perceptions prior to the workshop, while the red bars show perceptions afterwards.

f. Application of Workshop Knowledge

The post-workshop responses demonstrate participants' strong commitment to applying the knowledge and insights gained from the APEC Workshop on Promoting Decision Support Systems (DSS) Using Digital Data to Support Small Pelagic Fisheries. A wide range of planned follow-up actions was identified, reflecting both institutional and individual-level initiatives across participating economies.

A significant number of participants indicated plans to develop or refine work plans and strategies to strengthen fisheries management and data-driven decision-making. Several participants emphasized aligning their new work plans with domestic priorities, research agendas, and stock assessment activities, particularly to enhance data utilization and management efficiency within their agencies.

Many respondents also expressed their intention to review and draft regulations, particularly those related to digital data collection, monitoring, and reporting mechanisms. This indicates an emerging movement toward policy harmonization and regulatory strengthening as an outcome of the workshop.

Several participants reported intentions to develop new tools and procedures to improve data accuracy, establish processing protocols, and reduce reporting errors. Others noted plans to upgrade existing DSS systems or integrate additional modules, such as digital dashboards and electronic logbooks, to enhance transparency and trust among fishers and regulators. Notably, participants from Sernapesca, Chile, mentioned expanding electronic logbooks and integrating risk-based monitoring and traceability modules, while participants from Brunei Darussalam noted plans to develop a domestic fisheries database by 2027.

Another prominent theme was capacity building and knowledge sharing. Many participants stated they would organize trainings, workshops, or internal briefings to transfer knowledge about DSS applications and digital data use to their colleagues. These efforts are expected to multiply the impact of the workshop within their institutions and across economies.

In addition, several respondents emphasized strengthening collaboration—both within their own institutions and across APEC economies. Plans include initiating new cooperation on DSS development, enhancing inter-institutional communication, and forming partnerships to advance electronic data systems. Such initiatives are expected to contribute to regional integration and shared learning in fisheries data management.

Collectively, these responses highlight a strong momentum among participants to translate workshop learning into actionable initiatives, ranging from policy formulation and regulatory reform to technical upgrades and human resource development. This follow-up commitment ensures that the benefits of the workshop extend beyond individual learning outcomes, contributing directly to APEC's broader goals of sustainable fisheries management, digital innovation, and regional cooperation.

g. Follow-up Actions and Future Directions

In response to the question *"What needs to be done next by APEC? Are there plans to link the project's outcomes to subsequent collective actions by fora or individual actions by economies?"*, participants provided a wide range of suggestions emphasizing the importance of sustainability, technical capacity building, and cross-economy collaboration.

Overall, participants expressed a strong desire for APEC to continue its collective work on integrating Decision Support Systems (DSS) and digital data applications into fisheries management. The feedback highlights the need for follow-up actions that ensure the workshop's outcomes translate into long-term regional impacts.

The table below summarizes the main themes identified from participant responses:

Main responses	Description	Illustrative Responses
Follow-up Workshops and Trainings	Participants strongly recommended organizing additional capacity-building activities to deepen technical understanding and implementation of DSS in fisheries management.	▫ Make another workshop on implementing digital data for DSS. ▫ Follow-up training on DSS. More training on implementing DSS in fisheries management.
Integration into APEC Fora	Several participants suggested that the project's outcomes be institutionalized through OFWG or other relevant APEC mechanisms to ensure long-term policy continuity.	▫ Integrate DSS issue into OFWG's work ▫ A follow-up project on mainstreaming DSS application in APEC economies.
Data-Sharing and Database Development	Many responses emphasized the importance of establishing shared databases and standardized data frameworks among APEC economies.	▫ Make a database for economies, especially fish base data. ▫ APEC should promote data-sharing and data analytics for fisheries.
Collaboration and Peer Exchange	Participants encouraged continuous dialogue and peer-to-peer exchanges across economies to strengthen cooperation and practical learning.	▫ Begin small group exchanges across economies. ▫ Get in touch more frequently among economies.
Technical Innovation and Expansion	Some proposed applying DSS tools to additional fisheries sectors and developing new analytical technologies to support sustainable resource management.	▫ Implement new tools to generate the best data. ▫ Expand the project to other economies and demersal fisheries.
Stakeholder Education and Awareness	A few participants highlighted the need for education and behavioral change initiatives, particularly targeting fishers' technological literacy.	▫ Stakeholder education and behavioral shaping techniques because many fishermen cannot use PCs.

The findings suggest strong momentum for a follow-up collective action under OFWG, focusing on:

- Continuous capacity building through regional workshops and online technical sessions.
- Integration of DSS-related activities into APEC's strategic plans.
- Development of shared data platforms and inter-economy learning hubs.
- Mainstreaming DSS application in both small pelagic and demersal fisheries management.

Collectively, these recommendations reflect the workshop's success in stimulating actionable commitments and paving the way for continued regional cooperation toward digitally enabled, sustainable fisheries management in the APEC region.