Recommendations Report

Development and Application of Ex Post Regulatory Impact Assessment (RIA) Indicators for the Fisheries Management of Jack Mackerel and Jumbo Flying Squid in APEC Economies

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APEC Ocean and Fisheries Working Group

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report documents the results of the project “Developing and Applying Ex-Post Regulatory Impact Assessment (RIA) Indicators for Fisheries Management of Jack Mackerel and Jumbo Flying Squid,” implemented under the APEC Ocean and Fisheries Working Group (OFWG). The main objective of the project was to strengthen the capacities of APEC economies to design, validate, and apply ex post Regulatory Impact Assessment (RIA) indicators in the management of transboundary fisheries, using jack mackerel (*Trachurus murphyi*) and jumbo flying squid (*Dosidicus gigas*) in the South Pacific as case studies.

The project was motivated by the growing need to assess not only the design of fisheries regulations but also their actual performance once implemented, in contexts characterized by high biological variability, multiple jurisdictions, international fleets, and heterogeneous regulatory frameworks. In this regard, ex post RIA emerges as a key tool to enhance regulatory quality, promote transparency, and strengthen results-based governance.

Methodologically, the project combined documentary review, primary data collection through surveys and interviews with authorities and experts from APEC economies, and the organization of an in-person international workshop held in Lima, Peru, in November 2025. The regional diagnostic identified significant gaps in the application of ex post RIA, particularly in terms of data availability, integration of multidimensional indicators, institutional capacities, and systematic evaluation of regulatory outcomes.

The international workshop constituted a core component of the project, enabling collective validation of the diagnostic findings, exchange of regulatory and scientific experiences, and technical discussions on the design of indicators applicable to transboundary fisheries. Sessions addressed jack mackerel and jumbo flying squid separately, incorporating recent evidence on population structure, genomics, satellite telemetry, stock assessment, fleet monitoring, and socioeconomic dimensions. Pre- and post-test results administered to participants demonstrated a significant strengthening of capacities regarding the concept and practical application of ex post RIA.

The comparative analysis of both resources illustrated two contrasting fisheries management trajectories. Jack mackerel represents a case in which the progressive adoption of management measures, scientific support, and regional coordination have contributed to stock recovery, providing a favorable scenario for evaluating regulatory effectiveness through ex post RIA. In contrast, jumbo flying squid highlights the challenges associated with a highly dynamic fishery, characterized by high environmental variability, limited historical information, and regulatory frameworks currently undergoing updates. This context reinforces the role of ex post RIA as a diagnostic and regulatory improvement tool.

The report also presents a detailed analysis of the regulatory frameworks governing jack mackerel and jumbo flying squid in Chile and Peru, highlighting recent advances, particularly the 2025 update of the Regulatory Management Plan (ROP) for jumbo flying squid in Peru and the implementation of participatory management plans for jack mackerel

in Chile.
This analysis demonstrates that regulatory effectiveness depends not only on the existence of norms, but also on the capacity to monitor, evaluate, and adjust those norms based on verifiable evidence.

One of the project's main outputs is the proposal of a structured set of ex post RIA indicators, organized into five dimensions: biological, environmental, economic, social, and governance. These indicators were designed under the principles of relevance, feasibility, and adaptability, enabling their application in economies with varying levels of institutional capacity and data availability. Practical recommendations are also provided for their phased implementation, prioritizing "core" indicators and promoting the use of proxy indicators in contexts with limited information.

Overall, the project demonstrates that ex post RIA constitutes a viable and necessary tool to strengthen fisheries management in APEC economies, particularly in highly complex transboundary fisheries. By integrating scientific evidence, regulatory analysis, and stakeholder participation, the proposed approach contributes to improving decision-making, promoting the sustainability of shared resources, and advancing toward more transparent, coherent, and fisheries governance.

II. INTRODUCTION

Marine fisheries constitute a strategic activity for Asia-Pacific economies, contributing significantly to food security, employment generation, international trade, and the economic development of coastal communities. In the APEC region, a substantial share of fishery production comes from highly productive and widely distributed resources, whose exploitation involves multiple fleets, diverse regulatory frameworks, and a variety of economic and social interests. In this context, ensuring the sustainability of fisheries is not only an environmental challenge, but also an institutional and economic one, requiring robust governance systems grounded in scientific evidence and effective public policy evaluation mechanisms.

Modern fisheries management relies on a set of regulatory measures aimed at ensuring the conservation of aquatic resources and the responsible use of marine ecosystems, while promoting economic efficiency and social equity. These measures include, among others, catch limits, fishing effort regulations, closed seasons, access controls, monitoring systems, and compliance schemes. However, the mere implementation of regulations does not guarantee the achievement of their objectives. For this reason, Ex Post Regulatory Impact Assessment (Ex Post RIA) has become a fundamental tool for analyzing whether adopted regulations achieve their intended outcomes, identifying unintended effects, measuring costs and benefits, and generating information to improve the design and implementation of future regulations. The use of appropriate and comparable indicators is central to ensuring that this process is effective, transparent, and useful for decision-making.

The jumbo flying squid (*Dosidicus gigas*) represents one of the most dynamic and economically important fisheries in the South Pacific. It is a highly migratory species, characterized by short life cycles, marked interannual variability, and strong influence from oceanographic and climatic conditions. Its exploitation involves both industrial and artisanal fleets and takes place within the exclusive economic zones of various APEC economies, as well as in areas beyond each jurisdiction. These characteristics create significant management challenges, particularly with regard to regional coordination, control of fishing effort, regulatory compliance, and assessment of the economic and social impacts of adopted measures. In this context, the availability of indicators that enable systematic evaluation of the performance of regulations applied to the jumbo flying squid fishery is essential to strengthen its sustainability and governance.

Similarly, jack mackerel (*Trachurus murphyi*) is one of the most important pelagic resources in the South Pacific, both in terms of catch volume and its relevance for supplying domestic and international markets. Like jumbo flying squid, jack mackerel exhibits a transboundary distribution spanning multiple jurisdictions and areas beyond each jurisdiction, requiring coordinated management approaches among economies. Over recent decades, this fishery has been subject to various management regimes and international agreements aimed at stock conservation and regulation of fishing effort. However, assessing the extent to which these regulations have effectively contributed to stock recovery and

long-term sustainability requires the application of ex post evaluations supported by clear, consistent, and data-based indicators. Enhancing the capacity of APEC economies to design and implement these indicators is essential for improving jack mackerel management and advancing more effective, transparent, and results oriented fisheries governance.

2.1. GENERAL OBJECTIVE

The objective of the project was to strengthen regulatory capacities in fisheries management across APEC economies through the development, validation, and application of comparable indicators for Ex Post Regulatory Impact Assessment (RIA) of regulations concerning jack mackerel and jumbo flying squid, with the aim of promoting good practices, improving decision-making, and contributing to the conservation and sustainable use of these resources.

2.2. SPECIFIC OBJECTIVES

1. SO1 — Status and Gap Diagnosis: Identify the current status, capacities, and gaps in the implementation of ex post RIA indicators in fisheries regulations concerning jack mackerel and jumbo flying squid across APEC economies.

2. SO2 — Design and Application of a Technical Instrument: Design, validate, and apply a technical survey and interview protocol to collect standardized, comparable, and actionable information on indicators, data sources, and monitoring practices.

3. SO3 — Exchange and Validation through Workshop: Organize and facilitate an international workshop in Lima to present and validate the results of the data collection process, promote the exchange of experiences among economies, and co-develop operational criteria for the proposed indicators.

4 SO4 — Systematization and Recommendations: Prepare a Technical Recommendations Report integrating findings, comparative analysis, indicator technical sheets, and operational proposals for regulatory improvement and ex post monitoring in fisheries.

III. METHODOLOGY

The consultancy was carried out in two stages. During the first phase, a mixed-methods study was conducted, involving the collection of quantitative and qualitative data related to the fisheries management of jumbo flying squid (*D. gigas*) and jack mackerel (*T. murphyi*) in APEC economies. To this end, various primary and secondary data collection instruments were used. The process included the development of a digital questionnaire, which was distributed to official representatives of APEC economies within the OFWG. Additionally, information was gathered through virtual interviews with key stakeholders in the value chains of jumbo flying squid and jack mackerel. Secondary sources included the mapping of fisheries policies in each economy, international fisheries regulatory guidelines, and academic and scientific literature on the management of these two species.

The second stage of the project involved the design and implementation of a two-day in-person workshop on the project's thematic focus, held in Lima, Peru. The workshop included representatives from six APEC economies: Chile; People's Republic of China; Indonesia; Peru; Thailand; Viet Nam.

3.1. PRIMARY SOURCES OF INFORMATION

Initially, a digital questionnaire was designed consisting of 43 questions structured into three independent sections: (1) General Information, (2) Jumbo Flying Squid Management, and (3) Jack Mackerel Management. Responses to the first section were mandatory for all members, while the remaining sections were optional depending on whether economies reported having specific regulations for managing these fisheries resources.

The digital questionnaire was conceived as an exploratory tool aimed at identifying economies within the region that had specific regulatory frameworks for the fisheries management of these species. The questionnaire received 17 responses from members representing 9 APEC economies: Chile; Chinese Taipei; People's Republic of China; Indonesia; New Zealand; Papua New Guinea; Peru; Thailand; Viet Nam.

The questionnaire was developed using the KoboToolbox platform and disseminated to the 21 APEC economies through the official communication channels of the Ocean and Fisheries Working Group (OFWG) Secretariat, as well as through direct communications from the consulting team. Subsequently, semi-structured virtual interviews were conducted with fisheries sector professionals in those APEC economies that demonstrated active management of jumbo flying squid and jack mackerel during the initial questionnaire response phase.

3.2. SECONDARY SOURCES OF INFORMATION

The information obtained from the questionnaire and interviews guided the secondary data search, for which a systematic review of the most relevant literature on the subject was conducted. Scientific articles, fisheries regulations, consultancy reports, and other types of literature were reviewed in order to structure the analytical framework, identify the state of the art in the management of these fisheries, map public policies at the global, regional, and local levels, and identify challenges and potential solutions for the sector.
Given that not all 21 APEC economies harvest these resources, priority was given to those that

do: Australia; Chile; People's Republic of China; Mexico; New Zealand; Peru; Chinese Taipei. Additionally, information was included from non-APEC economies managing these resources, such as Ecuador.

The inclusion criteria were:

1. Documents related to the status or management of jumbo flying squid and/or jack mackerel.
2. Documents published in English or Spanish.
3. Documents containing information from APEC economies or Ecuador.

Keywords included: fisheries, jumbo flying squid, jack mackerel, "jibia", "pota", giant squid, regulation, fisheries regulation, public policy, regulatory impact assessment, RIA, ex post. Different combinations of keywords were used in line with the research objectives, intentionally employing the operators "AND" and "OR" to broaden the search.

3.3. IN-PERSON WORKSHOP

The in-person workshop was held on 13-14 November 2025, in Lima, Peru. The objective of the workshop was to strengthen the capacities of participating economies for the design, validation, and application of ex post Regulatory Impact Assessment (RIA) indicators in transboundary fisheries. The technical focus of the event centered on two resources of major biological, economic, and geopolitical importance in the South Pacific: jack mackerel and jumbo flying squid. Both resources exhibit extensive migratory patterns, complex population dynamics, interactions among fleets from multiple jurisdictions, and significant activity on the high seas, making the use of advanced scientific tools and comparable regulatory systems across economies essential.

The first day of the workshop (see Annex 1 – Event Agenda) was entirely dedicated to jack mackerel fisheries management. The workshop opened with welcome remarks delivered by Dr. Harry Aranibar Zambrano, who serves as Project Overseer (PO) on behalf of the Ministry of Production. Subsequently, Víctor Muñoz Tuesta, Peru's Alternate Senior Official to APEC from the Ministry of Foreign Affairs, highlighted the collaboration among APEC economies that made the event possible.

Technical presentations on the first day included: the presentation of the regional diagnostic results; the regulatory frameworks applied by China to its distant-water fishing fleets; and monitoring systems integrating satellite analysis, inspections, and electronic control tools. These discussions illustrated how biological and operational evidence can be translated into useful regulatory indicators for ex post performance evaluation, considering parameters such as fishing pressure, regulatory compliance, and conservation measure effectiveness.

The second day of the event focused on jumbo flying squid, also known as giant squid or "jibia" (in Chile), from scientific, operational, and socioeconomic perspectives. Sessions included presentations of satellite tagging research, providing detailed information on vertical and horizontal movement patterns, environmental variability associated with migrations, and connectivity among fishing areas, key aspects for designing dynamic regulatory measures.

Additionally, a project on spatial analysis derived from satellite data on fishing activity was presented, aimed at identifying interactions between international fleets and coastal communities, underscoring the importance of integrating socioeconomic dimensions into regulatory indicators. Presentations also included methodological contributions to improve stock assessments in data-limited fisheries, emphasizing the role of advanced statistical models and proxy parameters in designing RIA indicators applicable in heterogeneous contexts.

Overall, the workshop systematically integrated the latest scientific evidence, including the use of genomic technologies to identify population units, fundamental for improving stock assessment precision and defining biological reference points for management. The use of tagging and satellite tracking technologies was also discussed, providing high-resolution information on migratory routes, operational depths, and spatiotemporal movements of jumbo flying squid and jack mackerel, key elements for designing adaptive regulatory measures.

Complementarily, monitoring, control, and surveillance experiences applied to distant-water fishing fleets were reviewed, particularly those of Chile and China, whose advances in traceability, scientific observation, and operational control constitute critical inputs for the development of verifiable regulatory indicators.

Throughout both days, the presentation and collective validation of the regional diagnostic results enabled technical alignment among participating economies, ensuring that the proposed indicators respond to real governance needs and can be implemented across varying levels of institutional capacity. Final discussions consolidated an operational framework integrating scientific evidence, advanced technologies, and regulatory guidelines, laying the foundation for results-based fisheries management and continuous regulatory improvement.

In sum, the workshop provided a clear synthesis of the project's purpose and scope, its methodological structure, and its main contributions, strengthening cooperation among APEC economies and providing a solid platform for the harmonization of ex post RIA indicators in the sustainable management of jack mackerel and jumbo flying squid in the South Pacific.

Table 1. Technical summary of the organized workshop.

Item	Details
Event Name	"Workshop on Developing and Applying Ex-Post Regulatory Impact Assessment (RIA) Indicators for Fisheries Management of Jack Mackerel and Jumbo Flying Squid across APEC Economies"
Project Code	OFWG 02 2024A
Date	13–14 November 2025
Modality	In-person

Venue	Hotel Los Delfines (Oppian Room), Lima, Peru
Organizer	Ministry of Production of Peru (PRODUCE)
Host Economy	Peru — Project Overseer: Dr. Harry Aranibar Zambrano
Co-sponsoring Economies	**People's Republic of China; Indonesia; The Russian Federation; Chinese Taipei; Thailand; Viet Nam**
Funding Source	APEC Support Fund (ASF) – Subfund: ASF Innovative Development, Economic Reform and Growth (IERG)

3.4. SUMMARY OF THE SESSIONS

During the plenary and technical sessions, various aspects related to the fisheries management of jack mackerel and jumbo flying squid (giant squid) were addressed, including topics directly linked to the development of indicators for evaluating fisheries management regulations, as well as other indirectly related components. For detailed content of each session, please refer to Annexes 2 and 3. In summary, the main findings presented and discussions generated during the workshop focused on the following:

Stock assessment and measurement of management outcomes:
The integration of population models with biological, genomic, and environmental data enables the generation of indicators on abundance, fishing mortality, recruitment, and management effectiveness. These constitute core metrics for ex post RIA, as they directly reflect the effectiveness of regulations and their contribution to resource sustainability.

Need to further elucidate the population and genetic structure of jack mackerel stocks:
Scientific evidence regarding the population structure of jack mackerel, whether it constitutes a single homogeneous stock or multiple populations, is not unanimous. Some data support the hypothesis that jack mackerel forms a single, highly homogeneous population in the South Pacific, while other evidence suggests the existence of metapopulations along the South Pacific coasts (Chile and Peru) and island areas in Oceania, including New Zealand. It is proposed to promote the use of genetic markers and genomic analyses in each APEC economy managing this resource to determine the most plausible hypothesis. Based on these findings, biological management units could be defined, critical subpopulations identified, and regional quota allocated.

Satellite-based spatial monitoring of jumbo flying squid is key to understanding its population dynamics:
Satellite tagging and telemetry of *D. gigas* provide information on migratory routes, vertical distribution, aggregation patterns, and responses to environmental factors. These data allow for the design of indicators related to resource availability, fishing effort, and overexploitation risk, which can be incorporated into regulatory impact assessments. Chile's experience in this area could be replicated by Mexico; Peru, or Ecuador to more clearly delimit the dispersal range of jumbo flying squid within their respective jurisdictions and to promote joint management of the population in the Southeast Pacific (Chile; Peru, and Ecuador) through the South Pacific Regional Fisheries Management Organisation (SPRFMO).

Promotion of regulatory compliance among distant-water fishing fleets and joint fisheries management:
The integration of experiences from distant-water fleets and the regulatory frameworks of different economies (Chile; China, and Peru), together with satellite monitoring systems and electronic control mechanisms, strengthens the development of compliance, effort-control, and catch-monitoring indicators. These elements are essential for ex post regulatory impact evaluation and for improving the governance of shared stocks.

Socioecological interactions and sustainability:
Both industrial and coastal fleets within the APEC region exhibit governance, transparency, and participation gaps that can be quantified. Such indicators are crucial for assessing the impact of fisheries regulations and policies on communities and ecosystems.

The technical sessions were delivered by Peruvian and international experts. The following table presents a summary of each session.

Table 2. Summary of the Topics and Discussions of Each Workshop Session.

Session	Description
Plenary — Day 1 – Dr. Mariano Gutiérrez (PE) – Metapopulation Structure of Jack Mackerel in the South Pacific	Presented evidence supporting a metapopulation structure (rather than a single stock) and analyzed its implications for regional management, quota allocation, and stock assessment.
Plenary 2 — Day 1 – Dr. Li Weiwen (PRC) – China's High Seas Fisheries Management Practices in the Southeast Pacific	Presented the regulatory, monitoring, and compliance framework applied by China to its distant-water fleets; highlighted tools, tracking systems, and enforcement mechanisms.
Technical Session — Day 1 – Dr. Cristian Canales (CHL) – Genetic and Genomic Contributions to Jack Mackerel Management	Explained how genomic tools can detect population structure, identify population boundaries, and improve harvest strategies and scientific stock assessments.

Technical Session — Day 2 – MSc. Karen Belmar (CHL) – Monitoring and Satellite Tagging of Jumbo Flying Squid in Chile	Presented Chile's scientific monitoring system and initial satellite tagging results, revealing migratory routes, depth-use patterns, and environmental drivers influencing squid movements.
Technical Session — Day 2 – MSc. Isabella Prado (UK/PE) – Space Technology for Studying Interactions Between Coastal and Distant-Water Fleets and Fish Stocks	Presented a doctoral research project using satellite data and spatial analysis to explore interactions between industrial and artisanal fleets and fish stocks, highlighting governance, transparency, and sustainability gaps.
Plenary — Day 2 – Dr. Ruben Roa-Ureta (ESP) – Gaps and Opportunities in Jumbo Flying Squid Stock Assessment in the South Pacific	Provided an overview of current statistical models, identified information gaps, and proposed methodological improvements for assessing a highly variable, short-lived species.
Technical Session — Days 1 and 2– Mg. Antonino Moreno (PE) – Regulatory Framework for Jack Mackerel and Jumbo Flying Squid in Peru	Reviewed Peru's legal and regulatory instruments for managing jack mackerel and jumbo flying squid, as well as compliance mechanisms and institutional roles, highlighting challenges and opportunities for ex post regulatory evaluation.

Moreover, the performance analysis of the workshop is presented in Annex 4, as well as the pre-workshop baseline survey in Annex 5 and the post-workshop satisfaction survey in Annex 6, both instruments used to assess the success of the event.

IV. RESULTS

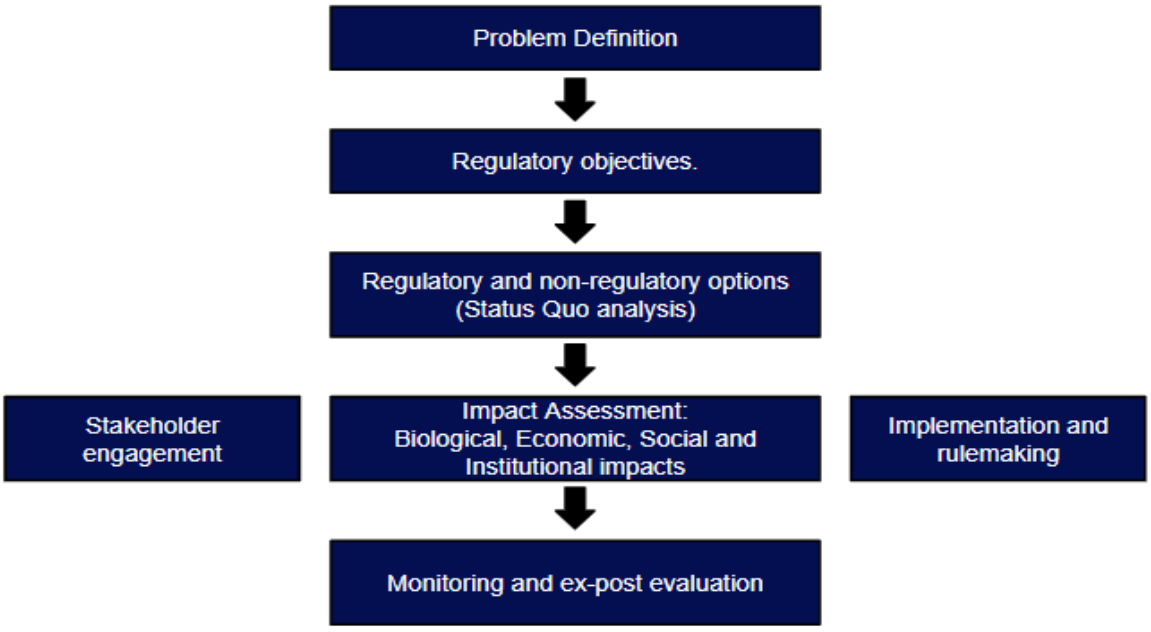
4.1. EX POST REGULATORY IMPACT ASSESSMENT (RIA) AND FISHERIES MANAGEMENT

Regulatory Impact Assessment (RIA) is a public policy tool aimed at improving the quality of regulatory decisions through objective, systematic, and consistent analysis of the impacts derived from government action, from economic, social, environmental, and institutional perspectives (Carvalho et al., 2017). RIA frameworks consider analysis at different stages of the implementation of a regulation, rule, or specific legislation: ex ante, ex tempore, or ex post. In particular, ex post RIA focuses on evaluating public policies once they have already been implemented.

The origin of RIA dates back to the United States experience in the late 1970s, with significant expansion during the 1980s and subsequent diffusion among OECD economies. Currently, RIA is promoted as one of the main instruments within the "better regulation" agenda; however, its effective application remains uneven across economies and sectors, especially outside the OECD context and at subnational or sectoral levels (OECD, 2020).

From a conceptual standpoint, RIA does not constitute a decision in itself, but rather a decision-support instrument whose value lies in structuring the regulatory process, making policy objectives explicit, identifying alternatives, analyzing costs and benefits, incorporating stakeholder participation, and establishing follow-up and evaluation mechanisms. Various frameworks proposed in the literature converge on a basic sequence that includes: problem definition, objective setting, identification of regulatory options, impact assessment, stakeholder consultation, and ex post review of outcomes (see Fig. 1). RIA should not be understood as a single linear process but rather as an iterative or spiral process.

Figure 1. Conceptual framework of the regulatory impact assessment (RIA) process.



Furthermore, RIA can assist decision-makers (whether ex ante or ex post) by:

(i) reducing uncertainty in public decision-making;
(ii) limiting the influence of service providers or regulated actors;
(iii) making policy trade-offs explicit; and
(iv) systematically organizing dispersed information.

In this way, the approach links governance structures and regulatory content to strengthen the overall regulatory system. Methodologically, RIA allows for a flexible combination of quantitative and qualitative approaches, including cost-benefit analysis, risk analysis, multicriteria models, and participatory methods. The literature emphasizes, however, that the selection of methods depends on factors such as data availability, institutional capacity, financial resources, and the complexity of the regulatory problem. In this sense, RIA can be adapted to different contexts through graduated approaches or "light RIA" models, without losing its central function of enhancing rationality and transparency in regulatory processes.

In the fisheries sector, ex post RIA is particularly relevant, as it allows for assessing whether implemented regulations have effectively achieved their objectives, identifying unintended effects, and generating evidence for continuous improvement of the regulatory framework. The absence of systematic ex post evaluations has been identified as one of the main weaknesses of RIA systems in practice, reinforcing the need to develop clear, verifiable, and comparable indicators for application in fisheries such as jack mackerel and jumbo flying squid.

4.1.1 Definition of Fisheries Management

Fisheries management encompasses the set of policies, instruments, and institutional arrangements used to conserve aquatic resources and sustain the economic and social benefits derived from fishing activities. Across APEC economies, these instruments are applied in highly diverse contexts: from large-scale industrial fisheries to small-scale coastal fisheries; from relatively well-assessed stocks to data-limited fisheries; and from purely local jurisdictions to transboundary scenarios involving high seas activities. Consequently, there is no single management model. Economies typically combine tools such as Total Allowable Catches (TACs) and quotas, effort controls, use rights systems, integrated management plans, electronic monitoring, and co-management schemes.

In general terms, several recurrent (often combined) models can be identified:

(i) rights-based systems (e.g., ITQs/catch shares),
(ii) harvest strategy approaches with explicit reference points and objectives,
(iii) co-management schemes and territorial use rights (e.g., TURFs), and (iv)integrated management plans that articulate science, compliance, and operational measures by fishery.

For example, New Zealand operates a comprehensive Quota Management System (QMS) as a central sustainability and access control instrument. The United States applies catch shares in selected fisheries to allocate portions of the TAC to individuals, communities, or cooperatives, thereby reducing the "race to fish."

Australia employs a Harvest Strategy Policy framework to set extraction levels in a precautionary and evidence-based manner, with explicit objectives and reference points. Canada uses Integrated Fisheries Management Plans (IFMPs) to guide conservation and

sustainable use, integrating scientific knowledge, Indigenous knowledge, and industry data. Japan, following recent reforms, has strengthened TAC-based management and is advancing toward Individual Quotas (IQs) as a core management instrument in TAC fisheries.

4.1.2 Fisheries Management Models and Their Evaluation Through Ex-post RIA

Ex post RIA enables assessment of whether a management model (or a specific regulation within that model) delivered on its promises and at what cost, by comparing observed outcomes against a baseline and explicit objectives. In fisheries, this translates into a set of evaluable dimensions:

Biological effectiveness:
Changes in biomass, fishing mortality, recruitment, catch per unit effort (CPUE), probability of overfishing, and progress toward biological reference points.

Compliance and control:
Traceability systems, VMS/EM coverage, reporting quality, violations, and enforcement capacity.

Economic efficiency:
Reduction of the "race to fish," operational costs, supply stability, resource rents, value added, and value chain performance.

Distributional and social impacts:
Employment, food security, impacts on artisanal versus industrial fisheries, territorial equity, and conflict dynamics.

Administrative costs and governance:
Regulatory burden, implementation costs, inter-institutional coordination, legitimacy, and stakeholder acceptance.

Adaptability:
Capacity of the system to respond to environmental variability, market shocks, or shifts in stock distribution.

Within this framework, ex post RIA can compare different management models (e.g., rights-based versus effort-based systems; harvest strategies versus integrated plans; co-management versus centralized management) or assess incremental improvements within the same model (e.g., introducing electronic monitoring, adjusting harvest rules, strengthening consultation and participation mechanisms).

The following table presents selected fisheries management models identified in APEC economies and outlines which aspects of each are suitable for evaluation through ex post RIA.

Table 3. Experiences of fisheries management models in APEC economies and their evaluation through ex post RIA.

APEC Economy	Fisheries Management Model	Key Features	Aspects Evaluable through Ex Post RIA
Australia	Harvest Strategy Policy Framework	Science-based harvest control rules with explicit biological reference points; precautionary approach	Progress toward target/reference points; adaptability to stock variability; transparency in decision rules; stakeholder confidence and legitimacy
Canada	Integrated Fisheries Management Plans (IFMP)	Comprehensive fishery-specific plans integrating science, Indigenous knowledge, and industry data	Policy coherence; effectiveness of stakeholder participation; conservation outcomes; implementation and coordination costs
Indonesia	Effort controls and licensing schemes	Licensing systems, gear restrictions, seasonal closures; emerging harvest strategies	Compliance levels; biological recovery trends; enforcement capacity; administrative burden and coordination challenges
Japan	TAC-based management with expansion of Individual Quotas (IQ)	Strengthened TAC system with gradual adoption of IQs in selected fisheries	Changes in catch control and compliance; economic performance of fleets; transition costs; equity impacts among fishing communities
New Zealand	Quota Management System (QMS) – rights-based (ITQs)	Individual transferable quotas allocated as shares of Total Allowable Catch (TAC); strong monitoring and compliance framework	Biological effectiveness (stock rebuilding, biomass trends); economic efficiency (rent generation, fleet rationalization); distributional impacts (concentration of quota ownership); compliance costs and monitoring performance
Peru	Rights-based management (ITQ) for anchoveta; effort controls in other fisheries	Individual Vessel Quotas (IVQs) in industrial fisheries; seasonal closures and effort limits in artisanal fisheries	Stock status improvements; reduction in overcapacity; socioeconomic impacts on small-scale fishers; enforcement capacity and monitoring effectiveness

United States	Catch Shares Programs	Allocation of TAC shares to individuals, cooperatives, or communities; reduction of “race to fish”	Reduction in overcapacity; safety improvements; income stability; impacts on small-scale fleets; administrative and transaction costs

4.1.3. Indicators for RIA in Fisheries

Ex post Regulatory Impact Assessment in the fisheries sector requires the use of indicators that allow for the objective and verifiable measurement of the actual effects of implemented regulations. Given the multidimensional nature of fisheries management, these indicators must capture not only biological outcomes, but also economic, social, institutional, and environmental impacts. In this regard, a structure of indicators organized into three main analytical blocks is proposed, enabling an integrated evaluation of regulatory performance. Biological, ecological, and environmental indicators constitute the core of the evaluation of fisheries regulations, as they determine whether implemented management measures have effectively contributed to the conservation and sustainability of resources. These indicators reflect changes in biomass, population structure, and stock dynamics, as well as the influence of environmental factors that may affect the availability and distribution of the resource. Within an ex post RIA framework, this set of indicators is essential to distinguish between effects attributable to regulation and variations associated with oceanographic or climatic variability.

Table 4. Biological, ecological, and environmental indicators for ex-post RIA in fisheries.

Indicator	What It Measures	Information Source	Relevance for Ex-Post RIA
Stock biomass status	Total or spawning biomass relative to biological reference points	Stock assessments, acoustic surveys, population models	Allows evaluation of the biological effectiveness of regulations
Fishing mortality (F)	Intensity of extraction by the fishing activity	Stock assessment models, catch and effort data	Indicates whether fishing pressure is within sustainable levels
Size and age structure	Proportion of juveniles and adults in catches and samples	Biological sampling programs	Evaluates gear selectivity and effects of technical measures
Recruitment	Entry of new individuals into the exploitable population	Stock assessment time series	Reflects medium- and long-term sustainability
Spatial distribution of the resource	Changes in horizontal and vertical distribution of the stock	Satellite data, electronic tagging	Allows evaluation of regulatory effects under environmental variability

Key environmental indicators	Relevant oceanographic conditions (temperature, oxygen, productivity)	Satellite sensors and oceanographic stations	Provides context for biological changes not attributable to regulation

Economic Indicators

Economic indicators make it possible to analyze the effects of fisheries regulations on productive efficiency, profitability, and the economic stability of the sector. In an ex post RIA, these indicators are essential to assess whether management measures have reduced inefficiencies, mitigated the race to fish, and generated sustainable economic benefits, as well as to identify unforeseen regulatory costs that may affect the viability of the activity.

Table 5. Economic indicators for ex-post RIA in fisheries.

Indicator	What It Measures	Information Source	Relevance for Ex-Post RIA
Fleet profitability	Relationship between revenue and operational costs	Financial statements, economic surveys	Evaluates economic impacts of regulations
Regulatory compliance cost	Expenses associated with following regulations	Operator surveys, administrative records	Measures regulatory burden
Effort productivity (CPUE)	Catch per unit of effort	Catch and effort records	Reflects operational efficiency
Value added along the supply chain	Changes in prices, processing, and market access	Trade statistics	Evaluates impacts beyond extraction
Income stability	Year-to-year variability of income	Socioeconomic surveys	Indicates economic resilience

Social and institutional indicators

Social and institutional indicators make it possible to capture the effects of fisheries regulations on communities, employment, governance, and regulatory compliance. In the context of an ex post RIA, these indicators are essential to assess the legitimacy of the measures adopted, their acceptance by the stakeholders involved, and their contribution to the social sustainability of fisheries.

Table 6. Social and institutional indicators for ex-post RIA in fisheries.

Indicator	What It Measures	Information Source	Relevance for Ex-Post RIA
Fisheries employment	Number of direct and indirect jobs	Labor statistics	Evaluates social impacts
Stakeholder participation	Level of involvement in decision-making	Consultation records	Reflects legitimacy and governance
Regulatory compliance	Degree of adherence to regulations	Inspection/enforcement records	Measures institutional effectiveness
Local food security	Availability of fishery products	Consumption surveys	Evaluates indirect impacts
Socio-environmental conflicts	Number and intensity of conflicts	Administrative reports	Identifies unintended effects

4.2. OVERVIEW OF THE JACK MACKEREL (*Trachurus murphyi*) FISHERY IN THE APEC REGION

Jack mackerel, also known as Chilean jack mackerel (*T. murphyi*), constitutes one of the most important transboundary pelagic fisheries in the South Pacific, both in terms of its historical catch volume and its strategic role in food security, international trade, and the socioeconomic stability of economies in the region. It is a highly migratory species with a wide longitudinal distribution, whose population dynamics connect the Exclusive Economic Zones (EEZs) of several economies with extensive areas of the high seas, making its management a central challenge for regional fisheries governance.

Stock distribution and economies involved

The South Pacific jack mackerel stock is distributed primarily within the EEZs of Chile and Peru, as well as in extensive high seas areas of the South Pacific, where it undertakes migratory movements associated with oceanographic conditions, trophic availability, and reproductive processes. To a lesser extent, the resource is also found in areas under the jurisdiction of Ecuador. The transboundary nature of the resource led to the creation of the South Pacific Regional Fisheries Management Organisation (SPRFMO), the body responsible for establishing conservation and management measures for jack mackerel on the high seas and coordinating actions among participating economies.

Economies exploiting the resource and recent catch levels

The exploitation of jack mackerel involves both coastal islands and distant-water fishing fleets. Among the main actors are Chile; Ecuador; People's Republic of China; Peru; Republic of Korea; The Russian Federation, in addition to other participants with smaller quotas. In recent years, total jack mackerel catches in the South Pacific have remained approximately within a range of 600,000 to 900,000 metric tons annually, with interannual variations associated with regulatory decisions, resource availability, and environmental conditions. Chile and China have historically accounted for the largest share of catches, followed by Peru and Russia, although the relative distribution among economies varies according to quota allocation schemes defined by the South Pacific Regional Fisheries Management Organisation and local management policies.

Recent stock evolution and current status

South Pacific jack mackerel experienced a period of severe overexploitation between the late 1990s and the mid-2000s, when catches consistently exceeded biologically sustainable levels, leading to a marked reduction in spawning biomass. This situation raised international concern and highlighted the limitations of existing management systems in a high seas fishing context involving multiple actors.

Since the implementation of stricter management measures, including global quotas, economy-specific limits, effort controls, and strengthened monitoring, control, and surveillance systems, the stock has shown signs of gradual recovery, although it remains highly sensitive to environmental variability and recruitment fluctuations. Currently, jack mackerel is considered a resource in recovery, but one that requires a precautionary approach and continuous assessment to prevent setbacks.

Current management challenges for Jack Mackerel

Among the main challenges facing the jack mackerel fishery are the complexity of transboundary governance, the need to ensure effective compliance with high seas regulations, the spatial variability of the resource associated with environmental change, and economic pressures to increase quotas in response to signs of stock recovery. These factors underscore the importance of having evaluation tools that allow for the objective measurement of the performance of implemented regulations.

Box *1*. Case study: Success story in the recovery of the jack mackerel

The recent history of jack mackerel overexploitation, followed by the adoption of coordinated regulatory measures at the regional level and particularly in Chile, provides an ideal scenario to assess the extent to which these regulations have achieved their biological, economic, and social objectives.

From a biological perspective, the jack mackerel fishery case allows for the analysis of regulatory effectiveness in terms of stock recovery, control of fishing mortality, and recruitment stability. From an economic standpoint, the fishery illustrates the costs and benefits associated with the implementation of quotas, effort restrictions, and monitoring systems, both for industrial fleets and for those responsible for enforcement. In the social and institutional sphere, the jack mackerel fishery highlights the challenges of international coordination, transparency, and compliance in high seas fishing contexts.

Chile has played a central role in efforts to rebuild the South Pacific jack mackerel stock, implementing a set of regulatory, institutional, and scientific measures that have been key to reversing the overexploitation scenario observed at the beginning of the 21st century. Given that Chile historically accounted for a significant proportion of total catches of the resource, the economy faced early on the need to reform its fisheries management system and strengthen its participation in regional governance mechanisms. The following table presents a summary of the measures adopted by Chile that enabled the successful recovery of this fishery resource.

Table 7. Regulatory measures adopted by Chile for the recovery of the Jack Mackerel (*T. murphyi*) stock and their Results.

Type of Measure	Implementation Period	Implementation Method	Observed Results	Relevance
Quota reduction and effort control	2008–2012 (continuous adjustments thereafter)	Progressive reduction of annual catch quotas aligned with scientific recommendations and establishment of strict limits on fishing effort	Significant decrease in fishing mortality and prevention of stock collapse	Allows evaluation of the effectiveness of catch limits in biological recovery
Access management and fishing rights	2012–2014	Implementation of licensing and fishing rights regimes with clear and stable allocations	Reduction of incentives for overcapacity and greater predictability in the system	Evaluates economic impacts and regulatory efficiency

Scientific strengthening and stock assessment	2010–present	Increased investment in acoustic surveys, biological sampling, and population models	Improved estimates of biomass, recruitment, and biological reference points	Supports biological indicators and strengthens the evidence base
Participation in regional governance (SPRFMO)	2012–present	Promotion of global quotas, allocations per economy, and common high-seas rules	Greater regional coherence and reduced displacement of effort	Evaluates regulatory coherence and international coordination
Monitoring, control, and surveillance (MCS)	2010–present	Mandatory use of VMS, scientific observers, and traceability systems	Improved compliance, data quality, and reduction of illegal fishing	Allows measurement of compliance and operational effectiveness of regulations

4.2.1. Fisheries Management of Jack Mackerel in Peru

The jack mackerel (*T. murphyi*) fishery in Peru is regulated under a legal framework that combines long-term structural provisions with specific management measures applied on an annual or seasonal basis. The central objective of this framework is to ensure the rational exploitation of the resource, in accordance with the principle of biological sustainability, the protection of marine ecosystems, and the generation of economic and social benefits.

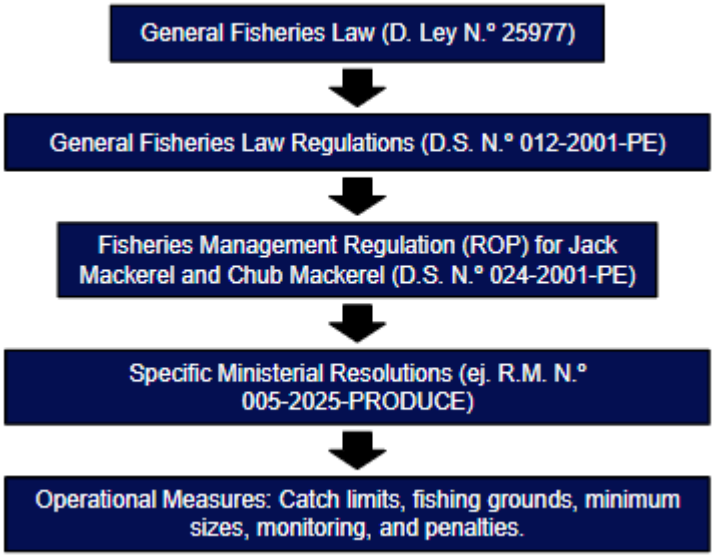
The main regulatory instrument is the Regulation for the Management of Jack Mackerel and Mackerel Fisheries (Reglamento de Ordenamiento Pesquero de Jurel y Caballa), approved by Supreme Decree No. 024-2001-PE, which establishes the objectives, scope of application, access regimes, conservation measures, control systems, and sanctions applicable to extractive activities. This regulation is complemented by ministerial resolutions that set catch limits and specific operational conditions for particular periods, such as Ministerial Resolution No. 005-2025-PRODUCE.

Table 8. Main Regulatory Provisions Applicable to the Jack Mackerel Fishery in Peru.

Regulation	Key Articles	What It Regulates	Main Objective	Main Objective
D.S. N.º024-2001-PE	Arts. 1, 2, 4, 6,8 y 9	Objectives of management, access to the fishery, fishing gears, zones, minimum sizes, control and sanctions	Purse-seine fleets, midwater trawl, and factory trawl; natural and legal persons	Rational exploitation and sustainability of jack mackerel (jurel) and chub mackerel (caballa)

R.M. N.º 005-2025-PRODUCE	Arts. 1, 2 y 3	Catch limits, distribution by periods and hold capacity, operational conditions	Artisanal purse-seine vessels with a valid permit	Align fishing effort with scientific recommendations from IMARPE

Figure 2. Summary scheme of the regulatory mark for Jack mackarel in Peru.



4.2.2. Fisheries Management of Jack Mackerel in Chile

In Chile, the management of the jack mackerel fishery is based on regulatory instruments that include management plans approved by the Undersecretariat for Fisheries and Aquaculture (SUBPESCA). The document reviewed corresponds to the administrative resolution approving the “Management Plan for the Jack Mackerel Fishery in Regions XV–X,” constituting a formal milestone within the fisheries governance cycle, as it validates a technical and participatory process conducted by the Management Committee and reviewed by the Fisheries Scientific Technical Committee.

Legal basis and administrative background

The resolution is grounded in the general legal framework governing fisheries in Chile, including the General Fisheries and Aquaculture Law (Law No. 18,892 and its amendments), as well as applicable administrative regulations (Law No. 19,880 on administrative procedures). It also cites the regulation concerning the designation and functioning of Management Committees (Exempt Decree No. 95 of 2013) and technical/administrative background documents issued during 2017.

Among the technical inputs referenced are Technical Memorandum (R.PESQ.) No. 229-2017 (December 15, 2017); the opinion of the Fisheries Scientific Technical Committee through Technical Report No. 01-2017; and internal communications from SUBPESCA associated with

the Jack Mackerel Management Committee for Regions XV–X (including the submission of the corrected final document). The resolution also provides for the forwarding of the administrative act to enforcement and maritime authorities (SERNAPESCA and DIRECTEMAR), as well as to zonal directorates and regional authorities.

Key regulatory aspects (scope and delimitation)

The administrative act primarily regulates the procedure for approving the Management Plan and its formal adoption. In the recitals, reference is made to Article 8 of the General Fisheries and Aquaculture Law, indicating that for fisheries with closed access and those declared under recovery or incipient development regimes, SUBPESCA must establish a management plan that includes minimum components and the procedure for its approval. Within this framework, the role of the Management Committee (participatory formulation) and the Fisheries Scientific Technical Committee (technical opinion) is recognized as essential.

It is important to clarify that the reviewed document does not include the full text of the Management Plan itself, but rather the resolution approving it "in the form and under the terms set forth" in Technical Memorandum R.PESQ. No. 229-2017. Therefore, to describe specific measures (e.g., catch rules, reference points, technical measures), the complete annex/management plan is required.

4.3. OVERVIEW OF THE JUMBO FLYING SQUID (*Dosidicus gigas*) FISHERY IN THE APEC REGION

The jumbo flying squid, also known as giant squid or "*jibia"*, is one of the most dynamic and complex fisheries in the South Pacific, characterized by high catch volumes, marked spatial-temporal variability, and a strong influence of environmental and oceanographic factors. Unlike other pelagic fisheries, jumbo flying squid has a short life cycle, high ecological plasticity, and broad migratory patterns, which complicates the application of traditional management schemes based on static quotas and conventional stock assessments. These characteristics have made jumbo flying squid a strategic resource, but also a persistent challenge for regional fisheries governance.

Stock distribution and economies where It occurs

The distribution of *D. gigas* spans a wide strip of the Eastern Pacific, including the Exclusive Economic Zones (EEZs) of Chile; Mexico; Peru and Ecuador, as well as extensive adjacent high seas areas. The species undertakes daily vertical movements and large-scale horizontal migrations associated with thermal gradients, oxygen availability, and primary productivity.

This broad transboundary distribution, combined with the absence of clearly defined population boundaries, has historically complicated the identification of biological management units and the adoption of coordinated regulatory measures among economies.

Economies exploiting the resource and recent catch levels

The exploitation of jumbo flying squid involves both coastal artisanal fleets and industrial and distant-water fleets. Peru is by far the main producing economy, historically accounting for more than 50% of global catches, followed by Chile; China, and, to a lesser extent, other Pacific economies.

In recent years, total jumbo flying squid catches in the South Pacific have shown high variability, fluctuating approximately between 700,000 and more than 1 million metric tons annually, with abrupt changes associated with environmental variability (for example, El Niño events), stock displacement, and variations in fishing effort, particularly on the high seas.

Recent resource status and management trends

Unlike jack mackerel, jumbo flying squid has not followed a clear trajectory of collapse and recovery, but rather a pattern of high interannual variability, which has at times been misinterpreted as structural resilience of the resource. This characteristic is largely explained by the species' short life cycle (one year), which implies a high renewal rate. This perception has contributed to the adoption of predominantly reactive management schemes, with limited capacity to anticipate changes in stock abundance or distribution.

Although some biological indicators suggest that *D. gigas* may withstand relatively high levels of exploitation due to its rapid renewal rate, the absence of comprehensive stock assessments and clearly defined effort control rules has generated uncertainty regarding the cumulative impact of fishing, particularly in contexts of increasing high seas fishing effort.

Current challenges for Jumbo Flying Squid management

Among the main challenges facing the jumbo flying squid fishery are limited regional coordination in resource management, weaknesses in monitoring and control mechanisms on the high seas, insufficient integration of socioeconomic information into regulatory design, and the difficulty of applying precautionary approaches in a context of high environmental variability. These factors have limited the ability of economies to systematically evaluate the effectiveness of implemented measures and to adjust their regulatory frameworks in a timely manner.

Box 2. Case Study: Limitations of Fisheries Management in the Jumbo Flying Squid Fishery

The jumbo flying squid fishery constitutes an illustrative case study of the current limitations of fisheries management and the application of ex post RIA in highly variable and transboundary resources. Unlike jack mackerel, where the adoption of coordinated regulatory measures has contributed to stock recovery, jumbo flying squid reflects a scenario in which the absence of robust regional regulatory frameworks has hindered the evaluation of the performance of implemented policies.

From a regulatory perspective, many of the measures applied to jumbo flying squid have focused on partial effort controls or on individual, non-harmonized regulations adopted by each economy. This has led to the displacement of fishing effort toward less regulated areas and has limited the overall effectiveness of policies. The lack of standardized indicators to measure compliance, socioeconomic impact, and biological performance has prevented the conduct of comparable ex post evaluations across economies.

From a scientific standpoint, reliance on indirect indicators and the scarcity of comprehensive stock assessments have reduced the ability to link observed changes in the fishery to specific regulatory decisions. Likewise, the limited incorporation of social dimensions, such as impacts on coastal communities, employment, and food security, has constrained a comprehensive understanding of the effects of existing regulations.

4.3.1. Fisheries Management of Jumbo Flying Squid in Peru

The jumbo flying squid or "*pota"* fishery in Peru is governed by a Fisheries Management Regulation (Reglamento de Ordenamiento Pesquero, ROP) that was recently updated (2025) in order to adapt resource management to its high biological, economic, and social importance, as well as to its status as a highly dynamic and transboundary fishery. The current regulatory framework seeks to strengthen the sustainability approach, improve control and traceability of fishing activities, and align each economy's management with the commitments assumed by Peru within the framework of the South Pacific Regional Fisheries Management Organisation (SPRFMO).

The central instrument is Supreme Decree No. 003-2025-PRODUCE, which approves the Fisheries Management Regulation for the Jumbo Flying Squid (*Calamar Gigante o Pota*) resource and repeals the previous regulation approved by Supreme Decree No. 014-2011-PRODUCE. This update represents a significant milestone, as it incorporates clearer provisions on scientific research, access to the fishery, traceability, high seas control, participatory mechanisms, and performance evaluation of the management regime.

Key aspects of the fisheries management regulation for Jumbo Flying Squid

The ROP for jumbo flying squid establishes as its main objectives ensuring the rational and sustainable exploitation of the resource, promoting the orderly development of fishing activities, protecting the marine ecosystem, and guaranteeing economic and social benefits, particularly for the artisanal fleet. The regulation defines its scope of application for extractive, processing, and marketing activities, including operations in jurisdictional waters and on the high seas.

Likewise, the regulation reinforces the role of IMARPE as the entity responsible for scientific research and technical support for decision-making, establishes access conditions through fishing permits, regulates authorized gear and methods, incorporates traceability and onboard conservation obligations, and defines supervision, enforcement, and sanctioning schemes. A novel element is the explicit incorporation of provisions on monitoring, evaluation, and performance indicators of the fisheries management regime.

Table 9. Main Regulatory Provisions of the Jumbo Flying Squid Fisheries Management Framework in Peru.

Regulation	Key articles	What does it regulate?	Scope of application	Update Highlights
D.S. N.º003-2025-PRODUCE	Arts. 1–3; 6–9;10–16; 17–23	Objectives, scientific research, access, fishing gear, traceability, catch limits, monitoring and sanctions.	Artisanal and industrial fleet, processing plants, operations in maritime domain and high seas.	It updates the management approach, incorporates monitoring and evaluation, and strengthens traceability and control.

Figure 3. Diagram of the Updated Regulatory Framework for the Jumbo Flying Squid Fishery in Peru.

V. DISCUSSION AND CONCLUSIONS

This report synthesizes the main results, lessons learned, and contributions of the project aimed at the development, validation, and application of ex post RIA indicators for the fisheries management of jack mackerel and jumbo flying squid in the South Pacific. Throughout this report, it has been demonstrated that the application of the ex post RIA approach in transboundary fisheries is not only relevant, but necessary, in a context characterized by high biological variability, multiple stakeholders, heterogeneous regulatory regimes, and increasing demands for transparency and accountability.

One of the project's main contributions has been positioning ex post RIA not as a theoretical or exclusively normative exercise, but as an operational tool to strengthen results-based fisheries governance. In this regard, the report progressively articulates the conceptual foundations of RIA, the comparative experiences of fisheries management models in APEC economies, the regulatory analysis of local and regional frameworks, and the empirical evidence generated through the regional diagnosis and the international workshop. This integration makes it possible to understand ex post RIA as a cross-cutting process that connects science, regulation, and the real-world performance of public policies.

The analysis of the conceptual RIA framework made it possible to identify that one of the main challenges in its practical application is the gap between regulatory design and the systematic evaluation of results. Although many APEC economies have advanced in adopting sophisticated fisheries management instruments, such as individual transferable quotas, management plans, harvest control rules, or co-management schemes, the ex post evaluation of their effectiveness remains limited, fragmented, or nonexistent. In this context, the project provides a structured framework to operationalize ex post RIA through verifiable, comparable indicators adaptable to different levels of institutional capacity.

The review of fisheries management models adopted by various APEC economies revealed that there is no single optimal approach, but rather combinations of instruments that respond to specific bioeconomic and institutional contexts. Nevertheless, common elements critical to the success of any management model were identified: clarity of objectives, strong scientific support, effective monitoring and enforcement mechanisms, stakeholder participation, and the capacity to adapt to environmental and socioeconomic changes. These elements also constitute key dimensions for ex post regulatory impact evaluation, reinforcing the idea that RIA should be explicitly integrated into the fisheries management cycle.

Within this framework, the selection of jack mackerel and jumbo flying squid as case studies proved particularly strategic. Both resources share characteristics of high mobility, transboundary distribution, and exploitation by multiple fleets, yet they differ substantially in terms of management trajectory and regulatory outcomes. Jack mackerel represents a case in which the progressive adoption of coordinated regional management measures, strengthened scientific support, and improved monitoring systems have contributed to a gradual stock recovery. In contrast, jumbo flying squid reflects a scenario of high variability, a historical absence of robust regional frameworks, and persistent difficulties in evaluating the performance of existing regulations.

The contrast between both cases made it possible to concretely illustrate how ex post RIA can be used both to consolidate successful experiences and to identify structural weaknesses in management. In the case of jack mackerel, ex post evaluation can focus on determining the extent to which adopted regulations have effectively reduced fishing mortality, stabilized recruitment, improved compliance, and generated sustainable economic benefits. In the case of jumbo flying squid, ex post RIA plays a diagnostic and corrective role, aimed at identifying regulatory gaps, unintended effects, and institutional limitations that have hindered more coherent and predictable resource management.

The regulatory analysis conducted for Chile and Peru reinforces this comparative perspective. In both economies, significant progress is observed in the formalization of fisheries management frameworks, whether through specific regulations or management plans approved under participatory schemes. However, it is also evident that the mere existence of regulations does not guarantee their effectiveness. The explicit incorporation of provisions on monitoring, evaluation, and indicator, such as those included in the updated jumbo flying squid regulation in Peru, represents an important step toward institutionalizing ex post RIA, but its impact will depend on the real capacity for implementation, monitoring, and regulatory feedback.

A central contribution of the project has been the proposal of a structured set of indicators for ex post RIA, organized into biological, ecological, and environmental; economic; and social and institutional blocks. This structure acknowledges the multidimensional nature of fisheries management and avoids an evaluation limited exclusively to biological variables. By integrating indicators of biomass, population structure, and environmental conditions with economic metrics of profitability and efficiency, and social indicators of employment, participation, and compliance, the proposed approach enables a more comprehensive and realistic assessment of regulatory performance.

Likewise, the participatory process developed through the regional diagnosis and the international workshop allowed these approaches to be validated through the practical experience of APEC economies. Technical and plenary discussions revealed a growing consensus on the need to move toward more comparable, adaptive, and results-oriented indicators, as well as on the importance of strengthening institutional capacities for their implementation. The exchange of experiences regarding satellite monitoring, genomics, stock assessment, and distant-water fleet control highlighted the potential of emerging technologies to improve the quality of ex post RIA, provided they are integrated into clear and transparent regulatory frameworks.

Overall, the project's results confirm that ex post RIA constitutes a key tool to improve the quality of fisheries regulation in APEC economies, particularly in highly complex transboundary fisheries. Its systematic application makes it possible not only to assess whether regulations work, but also to understand why they work, or why they fail, thus generating evidence for the continuous improvement of public policies. However, the report also makes clear that the effectiveness of ex post RIA depends on enabling factors such as data availability, interinstitutional coordination, stakeholder participation, and political commitment to transparency and accountability.

As a general conclusion, this project provides a conceptual, methodological, and operational foundation for advancing toward more results-based fisheries management, in which ex post RIA ceases to be a marginal practice and becomes an integral component of the regulatory cycle. Jack mackerel and jumbo flying squid illustrate, from contrasting perspectives, both the potential and the challenges of this approach. Capitalizing on these lessons will enable APEC economies to strengthen their fisheries governance systems, improve the sustainability of shared resources, and respond more effectively to future fisheries management challenges in the South Pacific.

To maximize the impact of future activities, it is recommended to institutionalize a monitoring mechanism within APEC or within the government of each APEC economy to track the adoption and implementation of Regulatory Impact Assessment (RIA) indicators for fisheries resources, including those discussed during the workshop. This will ensure that the knowledge acquired is translated into concrete and measurable actions within each participating economy.

From a methodological perspective, workshop participants noted that practical formats are more effective than lecture-based presentations for applied learning. Therefore, it is recommended to prioritize interactive sessions that include data analysis exercises, indicator design, and public policy simulations, allowing participants to directly transfer lessons learned to their professional contexts.

Finally, to improve the visibility and application of the gender approach, it is suggested to incorporate specific panels or sessions analyzing the differentiated impact of regulations on men and women in fisheries, as well as tools to assess gender equity within RIA indicators. This integration will strengthen both the technical relevance and inclusiveness of future workshops.

VI. RECOMMENDATIONS FOR INDICATOR DESIGN

Both the initial information gathering and the discussions held during the workshop helped consolidate the exchange of scientific, regulatory, and operational knowledge on the management of jack mackerel and jumbo flying squid, strengthening technical capacities for the implementation of ex post Regulatory Impact Assessment (RIA) indicators in APEC economies. Participants acquired methodological tools, an understanding of advanced technologies such as genomics and satellite tagging, as well as knowledge derived from the experiences of other economies, which will contribute to improving the planning, monitoring, and evaluation of fisheries policies.

As a result of the group discussions, ex post RIA indicators were identified and organized into three dimensions: biological, economic, and social. The following table summarizes the indicators proposed by the groups:

Table 10. Summary of the indicators proposed by participants during the Day 2 working group sessions of the workshop.

Dimension	Indicators Group 1	Indicators Group 2
Biological	Biomass, catch per unit effort (CPUE), reproductive status, fishing mortality, and spawning biomass.	Stock assessment, total allowable catch (TAC), catch per unit effort (CPUE), maximum sustainable yield (MSY), recruitment, SD/SDmsy, F/Fmsy and genetic indicators.
Economical	Cost-effectiveness, average salary, market price, fishing days, financial tools.	Product price, employment, exports, cost variability.
Social	Employment, working conditions, well-being, formalization, gender equality.	

This table reflects a comprehensive approach to evaluating fisheries policies, combining resource sustainability, economic efficiency, and social well-being. In the biological dimension, metrics of abundance and productivity are prioritized, enabling regulatory adjustments through adaptive management. The economic dimension incorporates indicators of profitability and fishery stability, while the social dimension considers employment, working conditions, and gender equity, highlighting the importance of the social impacts of regulation. The systematization of these indicators provides a solid technical framework for ex post evaluation, enabling the generation of comparable evidence, policy adjustments, and the strengthening of fisheries governance at both regional and local levels. Their application will directly contribute to the sustainability and transparency of jack mackerel and jumbo flying squid fisheries in the South Pacific.

The design of indicators for ex post Regulatory Impact Assessment (RIA ex post) in fisheries must respond to the need to objectively, transparently, and comparably evaluate the performance of implemented regulations. Based on the results of the regional diagnosis, the technical discussions of the workshop, and the analysis of the jack mackerel and jumbo flying

squid case studies, a set of recommendations has been identified to structure indicator systems that are technically robust and operationally feasible for APEC economies.

The proposed indicators must comply with basic principles of relevance, verifiability, temporal consistency, and adaptability to contexts with limited information. It is also essential that they be explicitly integrated into the regulatory cycle, allowing not only the measurement of results but also feedback for the design and adjustment of fisheries policies.

6.1. Biological Indicators

Biological indicators constitute the core of regulatory impact evaluation, as they determine whether management measures have effectively contributed to the conservation and sustainability of fisheries resources.

Recommended indicators

- Stock biomass status (total biomass and/or spawning biomass relative to reference points).
- Fishing mortality (F) in relation to biologically sustainable levels.
- Size and age structure in catches (proportion of juveniles and adults)
- Recruitment and interannual variability in the entry of new individuals.
- Catch per unit of effort (CPUE) as an indirect indicator of abundance.
- Compliance with minimum size limits and gear selectivity.

Recommendations for implementation

- Prioritize indicators already used in stock assessments or routine monitoring.
- Use proxy indicators when information is limited, especially in highly variable fisheries
- Ensure consistent time series to evaluate trends rather than isolated values
- Explicitly link these indicators to regulatory objectives defined in management plans.

6.2. Environmental and Ecological Indicators

Environmental indicators provide context for observed changes in stocks and help distinguish effects attributable to regulation from those associated with oceanographic variability or climate change.

Recommended indicators

- Sea surface temperature and thermal anomalies in fishing areas.
- Dissolved oxygen concentration and presence of oxygen minimum zones.
- Primary productivity (chlorophyll-a) in key areas.
- Changes in the spatial and vertical distribution of the resource.
- Frequency and intensity of extreme oceanographic events (e.g., El Niño).

Recommendations for implementation

- Integrate information from satellite sensors and existing observation systems.
- Select a limited set of key environmental variables relevant to each fishery.

- Incorporate these indicators as explanatory variables when interpreting biological results.
- Avoid overloading the system with environmental indicators that do not provide relevant decision-making value.

6.3. Economic Indicators

Economic indicators allow evaluation of whether regulations have generated sustainable economic benefits and improved the efficiency of the fisheries sector.

Recommended indicators

- Average fleet profitability (revenues vs. operating costs).
- Productivity of fishing effort.
- Income stability over time.
- Regulatory compliance costs for operators.
- Value added generated along the value chain.

Recommendations for implementation

- Use aggregated economic information when individual data are unavailable.
- Incorporate periodic, low-cost, high-coverage economic surveys.
- Assess economic indicators alongside biological indicators to avoid perverse incentives.
- Analyze the distributive effects of regulations across different fleet segments.

6.4. Social Indicators

Social indicators enable evaluation of regulatory impacts on fishing communities, employment, and the legitimacy of implemented policies.

Recommended indicators

- Level of direct and indirect employment associated with the fishery.
- Stakeholder participation in decision-making processes.
- Perceived legitimacy and acceptance of regulations.
- Food security and local access to fishery products.
- Incidence of social conflicts associated with fishing activity.

Recommendations for implementation

- Integrate simple and qualitative social indicators where quantification is limited.
- Use consultation mechanisms and surveys as sources of social information.
- Incorporate the social dimension from the RIA design stage, not only in final evaluation.
- Pay special attention to impacts on artisanal fisheries and coastal communities.

6.5. Governance and Compliance Indicators

Governance indicators assess institutional capacity to implement, monitor, and enforce

fisheries regulations.

Recommended indicators

- Level of regulatory compliance (infractions, sanctions).
- Coverage of monitoring systems (VMS, observers, electronic monitoring).
- Quality and timeliness of catch and effort reporting.
- Interinstitutional coordination in management and enforcement.
- Transparency and access to regulatory information.

Recommendations for implementation

- Prioritize indicators directly linked to existing institutional functions.
- Integrate governance indicators with monitoring and enforcement systems.
- Establish clear responsibilities for data collection and reporting.
- Use the results of these indicators to adjust procedures and strengthen institutional capacity.

Overall, the proposed indicators constitute a flexible and scalable framework for the application of ex post RIA in fisheries, adaptable to different levels of information availability and institutional capacity. Their progressive implementation will enable APEC economies to more systematically evaluate the performance of their fisheries regulations, improve transparency, and strengthen evidence-based decision-making.

VII. ANNEXES

ANNEX 1: Workshop Agenda

DAY 1 — JACK MACKEREL (*Trachurus murphyi*)

Schedule (time slots)	Activity (brief)
08:30 – 09:00	Participant registration
09:00 – 09:05	**Opening and Workshop Introduction**: "Welcome Remarks by the Project Overseer," Dr. Harry Aranibar Zambrano, Ministry of Production (PRODUCE).
9:05-9:15	**Welcome remarks**: "Perspectives on Peru's Participation in the Asia-Pacific Economic Cooperation (APEC) Forum", Minister Víctor Muñoz Tuesta, Alternate Senior Official of Peru to APEC, Ministry of Foreign Affairs.
09:15 - 09:25	Administration of opening surveys for the workshop, by Equilibrium.
09:25 – 9:55	**Technical presentation**: *Results of the regional survey (synthesizing practices and gaps on ex-post indicators)* *Msc. Victor Alexander Cueva Quiroz, Equilibrium. Mr. Bruno Cevallos Gil, Equilibrium*
09:55 – 10:00	*Q&A session*
10:00 – 10:15	*Coffee break*
10:15 – 11:00	**Plenary 1***:* Implications of the existence of a metapopulation structure for jack mackerel in the South Pacific *Dr. Mariano Gutiérrez Torero, Director of the Scientific Research Projects in Instituto Humboldt de Investigación Marina y Acuícola (IHMA)*
11:00 – 11:15	*Q&A session*
11:15 – 12:00	**Plenary 2**: China's management practices about fisheries in the high seas of the Southeast Pacific Ocean *Dr. Li Weiwen, Third Institute of Oceanography, Ministry of Natural Resources, China*
12:00 – 12:15	Q&A session
12:15 – 13:30	Free time for lunch (Not covered by the workshop)
13:30 – 14:30	**Technical presentations**: Chile's Experience in Jack Mackerel Fisheries *Mr. Luciano Alejandro Espinoza Henriquez, Fisheries Analyst, Undersecretary of Fisheries and Aquaculture, Chile* From science to policy: lessons from jack mackerel management in Peru *Mr. Antonino Edmundo Moreno Macedo. Specialist in Monitoring and Evaluation of International Commitments, Ministry of Production (PRODUCE), Peru*
14:30 – 14:45	Coffee break
14:45 – 15:45	**Technical presentations**: Genetic and Genomic Insights into Jack Mackerel (*T. murphyi*) for Fisheries Management *Dr. Cristian Braulio Canales Aguirre, Professor and Researcher, Center for Research and Development of Coastal Resources and Environments, i-Mar, Universidad de Los Lagos, Chile*
15:45 – 16:45	**Round table**: Development of tools and best practices for ex-post regulatory impact assessments in APEC fisheries with focus on jack mackerel
16:45 – 17:00	Day's synthesis and takeaways for working groups.
17:00 – 17:15	Official photo shoot

DAY 2 — JUMBO FLYING SQUID (*Dosidicus gigas*)

Schedule (time slots)	Activity (brief)
08:30 – 09:00	Participant registration
09:00 – 09:15	Day 1 recap and Day 2 objectives
09:15 – 10:00	**Plenary 3**: Status of the Management of Jumbo Flying Squid in the South Pacific *MSc. Renato Gozzer Wuest, Innovations for Ocean Science Foundation (virtual)*
10:00 – 10:15	*Q&A session*
10:15 – 10:30	*Coffee break*
10:30 – 11:15	**Plenary 4**: Monitoring of the jumbo squid fishery in Chile *MSc. Karen Belmar Salinas, Fisheries Research Division, Fisheries Department, Fisheries Development Institute (IFOP), Valparaíso, Chile* **Project presentation**: "Bridging the divide between distant water fleets and coastal communities in the biggest unregulated fishery in the world". *MSc Isabella Prado. PhD candidate. School of Geography and Sustainable Development, University of St. Andrews.*
11:15 – 11:30	Q&A session
11:30 – 12:15	**Plenary 5**: Current status of jumbo flying squid fisheries in the South Pacific: Gaps and opportunities ahead *Dr. Ruben Roa Ureta, External consultant in statistical methods applied to fisheries, Spain (virtual)*
12:15 – 12:30	Q&A session
12:30 – 13:45	Free time for lunch (Not covered by the workshop)
13:45 – 14:45	**Technical presentations**: Satellite tagging of jumbo squid in Chile: preliminary results in two sectors *MSc. Karen Belmar Salinas, Fisheries Research Division, Fisheries Department, Fisheries Development Institute (IFOP), Valparaíso, Chile*
14:45 – 15:05	Coffee break
15:00 – 16:00	**Technical presentation**: Jumbo Flying Squid Fisheries Management in Peru *Mr. Antonino Edmundo Moreno Macedo. Especialista en Seguimiento y Evaluación de Compromisos Internacionales, Ministerio de la Producción (PRODUCE), Peru*
16:00 – 16:30	**Round table**: Development of tools and best practices for ex-post regulatory impact assessments in APEC fisheries with focus on jumbo flying squid
16:30 – 16:45	Administration of post-workshop surveys, next steps, and closing
16:45 – 17:00	Official photo shoot

Note: The plenary sessions were conducted by speakers contracted by the project. The technical presentations were delivered by invited specialists from the participating economies. Both in the working groups and the roundtable, joint participation of contracted and invited speakers was encouraged, fostering a balanced exchange of perspectives and experiences.

ANNEX 2: Expanded Summary of Day 1 Presentations

The first day of the workshop was dedicated to fisheries management and the development of indicators for the management of jack mackerel. Below is a summary of each of the sessions conducted, as listed in the agenda (see Annex 1).

Presentation of the Survey Report
Presented by consultants Mr. Alexander Cueva Quiroz and Mr. Bruno Cevallos Gil from Equilibrium Consulting.

The report was prepared based on surveys and technical interviews, obtaining 16 valid responses from 8 APEC economies in East Asia, Southeast Asia, Oceania, and South America. The sample mainly included fisheries authorities, complemented by scientific institutions and non-governmental organizations, providing a balanced view of capacities, practices, and gaps in the implementation of ex post RIA. The results indicate that significant exploitation of jack mackerel and jumbo flying squid is concentrated in Chile and Peru, with operations primarily in sovereign waters. Although participation was predominantly male, female representation was recorded in governments and research institutions. This review introduced advances regarding the metapopulation structure of jack mackerel in the South Pacific, a key input for quota allocation, population model design, and coordination among regional fisheries management organizations.

Implications of the Existence of a Metapopulation Structure for Chilean Jack Mackerel in the South Pacific
Presented by Dr. Mariano Gutiérrez Torero, Scientific Director of the Humboldt Institute for Marine and Aquaculture Research (IHMA).

Dr. Mariano presented scientific evidence suggesting that jack mackerel in the South Pacific does not constitute a single homogeneous population, but rather a metapopulation, meaning a set of subpopulations connected by occasional exchanges of individuals. The presentation reviewed decadal changes in abundance, spatial distribution of fisheries, and possible population structures. Based on biological, fisheries, structural, and distribution data, including differences in age composition, migration patterns, and spawning areas, it was argued that the most likely scenario for jack mackerel is a metapopulation, in contrast to the single-stock hypothesis still used in fisheries management. In Dr. Mariano's view, this should be updated by the South Pacific Regional Fisheries Management Organisation (SPRFMO).

The plenary discussion addressed the implications of adopting the metapopulation approach for regional management, proposing differentiated management by subpopulations, consideration of jurisdictional waters within the SPRFMO framework, and strengthening connectivity studies (such as satellite tagging). Finally, the current status of the resource based on recent assessments was presented, showing healthy spawning biomass under one- or two-stock models, particularly the Chilean biomass, and concluding that sufficient grounds exist for SPRFMO to formally incorporate this metapopulation structure into its decision-making process.

China's High Seas Fisheries Management Practices in the Southeast Pacific
Presented by Dr. Li Weiwen, Third Institute of Oceanography, Ministry of Natural Resources, China.

During this session, Dr. Li explained how China applies and complies with management measures adopted by SPRFMO for the two main fisheries in the eastern South Pacific: jumbo flying squid and jack mackerel. He first described the role and structure of SPRFMO, noting that the jumbo flying squid fishery is regulated through limits on vessel numbers and gross tonnage, strict monitoring requirements (Vessel Monitoring System (VMS), observers, electronic reporting), and data collection and verification obligations. China also implements internal mechanisms such as voluntary high seas moratoria to promote sustainability. Regarding jack mackerel, the presentation summarized economy-level catch limits, quota transfer procedures, reporting requirements (monthly and biweekly when 70% of the limit is reached), mandatory VMS use, and a minimum 10% observer coverage for the industrial fleet.

Future management perspectives focused on improving cooperation between coastal and high seas economies, strengthening data accuracy through training and electronic monitoring, and advancing more robust scientific assessments, including models and simulations adapted to environmental variability and climate change. It was also suggested that developing aquaculture of related species such as *Trachurus japonicus*, *Scomber japonicu*s, and *Decapterus maruadsi* could reduce pressure on wild fisheries, highlighting China's aquaculture experiences aimed at decreasing dependence on extractive catches.

Experience of the Chilean Economy in Jack Mackerel Fisheries Management (APEC)
Presented by Mr. Luciano Espinoza, Fisheries Management Division, Undersecretariat for Fisheries and Aquaculture (SUBPESCA), Chile.

Luciano presented how Chile has managed the jack mackerel fishery following the crisis of the late 1990s, when the resource collapsed due to overfishing, lack of regional coordination, and environmental variability. Starting in 2000, Chile implemented a precautionary approach based on scientific evidence, strengthened its institutions (SUBPESCA, SERNAPESCA, and IFOP), and consolidated participatory mechanisms through scientific and management committees. Coordination with SPRFMO was emphasized as crucial, including conservation measures, joint acoustic surveys, and an annual management cycle integrating scientific advice at both local and regional levels. These efforts enabled sustained stock recovery, with historically high spawning biomass and fishing mortality below target levels.

Chile also applies ex post evaluations (RIA) integrating biological, economic, social, and institutional dimensions to measure regulatory effectiveness, along with increasing incorporation of advanced tools such as Management Strategy Evaluation (MSE) at both regional and local levels. Key lessons highlighted include data transparency, scientific legitimacy, and stakeholder participation. Remaining challenges include integrating climate change into fisheries management, strengthening socioeconomic analysis, and advancing toward ecosystem-based management. The final message underscored that adaptive, evidence-based management has been central to jack mackerel recovery and will continue guiding regional cooperation in the South Pacific.

From Science to Policy: Lessons from Jack Mackerel Management in Peru
Presented by Mr. Antonino Edmundo Moreno Macedo, Specialist in Monitoring and Evaluation of International Commitments, Ministry of Production (PRODUCE), Peru.

Antonino described how jack mackerel, a key resource for nutrition and food security in Peru, is managed through a legal framework prioritizing its use for direct human consumption and supported by continuous scientific assessments conducted by IMARPE. These assessments inform regulatory decisions such as annual quotas, fishing seasons, minimum sizes, and juvenile tolerance limits. Recent measures for 2025 differentiate between artisanal and industrial fleets, aiming to ensure sustainability, protect coastal communities, and align Peruvian management with guidelines and models also applied within SPRFMO.

Genetic and Genomic Information on Jack Mackerel (*T. murphyi*) for Fisheries Management
Presented by Dr. Cristian Canales Aguirre, Researcher at the i~mar Center, Universidad de Los Lagos, Chile.

This plenary session presented genetic and genomic tools that have transformed understanding of the biological and population aspects of jack mackerel, including their application in fisheries management in the South Pacific. Dr. Canales reviewed methodologies ranging from allozyme and microsatellite studies to thousands of SNPs generated through high-throughput sequencing technologies, consistently demonstrating that jack mackerel constitutes a single, large, well-connected population without significant genetic differentiation across its distribution. However, recent advances revealed important nuances, including identification of adaptive markers linked to environmental variables, detection of a ZW sex-determination system, and development of a complete reference genome, opening new opportunities for improved monitoring, traceability, and assessment of population resilience.

From an applied perspective, the work proposes integrating genomic indicators into ex post (RIA) evaluations of the fishery, such as connectivity, genetic diversity, and environmentally sensitive adaptive markers, strengthening authorities' capacity to anticipate management effects and verify biological stability. A panel of 300 neutral, adaptive, and sex-linked SNPs was also developed as a low-cost tool for large-scale routine monitoring. The plenary discussion concluded that regional cooperation, methodological standardization, and gradual incorporation of genomics into public policy are key to sustainable jack mackerel management within the SPRFMO framework.

ANNEX 3: Expanded Summary of Day 2 Presentations

The second day of the workshop was dedicated to fisheries management and indicator development for the evaluation of the jumbo flying squid resource. A summary of each session, as listed in the agenda (see Annex 1), is presented below.

Status of Jumbo Flying Squid management in the South Pacific
Presented by Mr. Renato Gozzer Wuest, Director of the Latin America Program at Innovations for Ocean Action.

Mr. Renato Gozzer analyzed the management status of jumbo flying squid (*D. gigas*) in the South Pacific, highlighting its biological and economic importance for Chile; Peru; Ecuador and the international fleet. The species was described as short-lived, fast-growing, and widely distributed, with global production showing a sharp decline in 2024. Available genetic studies suggest the existence of a large metapopulation without significant spatial differentiation, though further research using modern genomic tools is needed. Governance challenges include managing both high seas areas under SPRFMO and coastal jurisdictions, with significant differences in capacity, fleet size, and exploitation levels between China and coastal economies.

The central role of jumbo flying squid in food security and income for hundreds of thousands of artisanal fishers was emphasized, yet management remains insufficient. SPRFMO faces critical challenges: absence of catch limits, data scarcity, uncertainty about stock status, and lack of effective coordination and precautionary mechanisms. Coastal economies have made partial progress, such as Peru in registration and monitoring, Chile in reactivating committees, Ecuador in recognizing the resource's importance, but still need to strengthen effort control, research, and conservation measures. The session concluded with a call to apply available scientific knowledge and accelerate implementation of precautionary and cooperative management to ensure sustainability in the South Pacific.

Monitoring of Jumbo Flying Squid in Chile
Presented by Ms. Karen Belmar Salinas, Semi-senior Researcher, Institute for Fisheries Development (IFOP), Chile.

The scientific monitoring program for jumbo flying squid in Chile, developed by IFOP since 2014 in Coquimbo, Valparaíso, Maule, and Biobío, was presented. The project uses scientific observers and dockside sampling under standardized protocols to collect information on effort (industrial and artisanal logbooks), catches, size structure, and biological parameters (including maturity stages). Data show high interannual variability: Chilean landings peaked at 181,269 tons in 2016, reached an artisanal minimum of 14,684 tons in 2019, and rebounded to 139,094 tons in 2024. Artisanal CPUE shows higher availability during the first half of each year and a marked minimum in 2019, while industrial CPUE remains low (<2 t/hour trawled) and highly variable.

Biological results indicate regional differences in size structure within the artisanal fleet, with predominance of the large morphotype in Biobío and greater size diversity in Coquimbo and

Valparaíso. The industrial fleet shows a narrower mantle length range (approx. 65–85 cm). In 2025, most industrial females were in advanced maturity stages (EDMII–EDMIII). However, critical gaps remain, including lack of information on spawning areas, scarcity of mature females observed in Chilean waters, and limited understanding of the local life cycle, strongly influenced by ENSO variability. The conclusions emphasized the need for stronger sectoral and institutional collaboration to improve spatial and biological resolution of monitoring.

Bridging the gap between distant-water fleets and coastal communities in the world's largest unregulated fishery
Presented by Ms. Isabela Prado, PhD Candidate, School of Geography and Sustainable Development, University of St. Andrews, United Kingdom.

Isabela presented her doctoral project related to jumbo flying squid management. The project evaluates inadequate fishing practices in the fishery by combining detection of irregular fishing using machine learning, AIS/VMS data, and satellite sensors (VIIRS, SAR), along with socioeconomic analysis quantifying the impact of declining availability and increased distant-water fleet activity on the income and economic security of thousands of fishers. The ultimate objective is to develop tools capable of mapping IUU fishing in real time.

Current status of Jumbo Flying Squid fishing in the South Pacific: challenges and future opportunities
Presented by Dr. Ruben Roa Ureta, External Consultant in Statistical Methods Applied to Fisheries, Spain.

Dr. Roa summarized the current status of the jumbo flying squid fishery, highlighting recent genetic evidence indicating a single biological population from Ecuador to Chile, supporting the need for regional stock assessment. He also described collaborative efforts with Dr. Rodrigo Wiff, advising the CALAMASUR association, to build a first regional fisheries database using transparency requests and SPRFMO data, including catches, effort, and size data from Chile; Peru and Asian fleets. Multi-annual/multi-fleet depletion models and a surplus production model revealed concerning signals: sustained biomass decline since 2016, a strong collapse in 2024 (<1 million tons), and greater instability during El Niño years. Although exploitation remains below biologically sustainable levels, simultaneous catch declines in Peru and China in 2024 suggest increasing risk.

The presentation argued that SPRFMO should prioritize scientific stock assessment, mandate integration of coastal and high seas fleet data, and move toward a coordinated global catch limit. The jack mackerel experience was cited as evidence that regional cooperation can recover collapsed resources, and that jumbo flying squid presents a unique window of opportunity to act before irreversible overexploitation.

Satellite tagging of Jumbo Flying Squid in Chile: preliminary results in two areas
Presented by Ms. Karen Belmar Salinas, IFOP, Chile.

Preliminary satellite telemetry results from four tagged *D. gigas* individuals in Coquimbo and Biobío showed consistent diel vertical migration: daytime immersion into deeper hypoxic

layers and nighttime ascent to warmer surface waters. Regional differences were observed, with Coquimbo individuals remaining shallower during the day and Biobío individuals performing deeper nocturnal dives. This ecological plasticity allows exploitation of a wide vertical range under variable oceanographic conditions. Although costly, such studies provide essential data for fisheries management, and interinstitutional collaboration could mitigate financial constraints.

Management of Jumbo Flying Squid in Peru
Presented by Mr. Antonino Edmundo Moreno Macedo, PRODUCE, Peru.

The final presentation summarized Peru's approach to managing its second most important fishery, averaging 438,000 tons annually over the past five years and sustained exclusively by the artisanal fleet. The regulatory framework, based on the General Fisheries Law, the Fisheries Management Regulation, and CMM 18-2025, includes permanent scientific research (IMARPE), exclusive use for direct human consumption, annual MTALC setting, mandatory use of handlines/hooks, reproductive closures, hold-size quotas, and mandatory landings at authorized ports with traceability formats. These measures aim to balance food security, biological sustainability, and formalization of Peru's main employment-generating fishery.

ANNEX 4: Analysis of Workshop Indicators

Participants and speakers

The event had 45 attendees (see Annex 1). One objective was to have at least 30 participants (excluding consultants and speakers), which was achieved with 31 qualifying attendees.

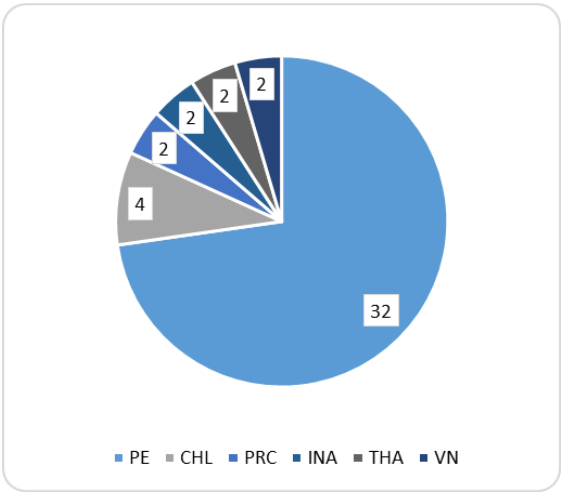
All 21 APEC economies were formally invited through official OFWG Secretariat channels and direct contacts from the consulting team and Peru's Ministry of Production. Up to five general invitations and four personalized invitations were sent.

Six APEC economies (28.5%) were represented: Chile; China; Indonesia; Peru; Thailand, and Viet Nam, plus one invited expert from a non-APEC European economy (Spain). The lower-than-expected participation (initial target: 11 economies) was attributed to logistical challenges of the in-person format, financial constraints, and the highly specific focus on jack mackerel and jumbo flying squid fisheries, which are not exploited by all APEC economies. APEC funding was available for only 11 economies. Future projects should consider more conservative participation targets based on thematic scope.

Participation by economy

The workshop brought together 44 participants from member and non-member economies. Peru, as host, had 32 participants. Other APEC economies were represented as follows: Chile (4); China (PRC) (2); Indonesia (2); Thailand (2); and Viet Nam (2). Spain participated with one invited expert virtually. Of the total participants, 40 attended in person (89%) and five virtually (11%) via Zoom.

Figure 4. Distribution of participants by economy.



Disaggregated participation by gender

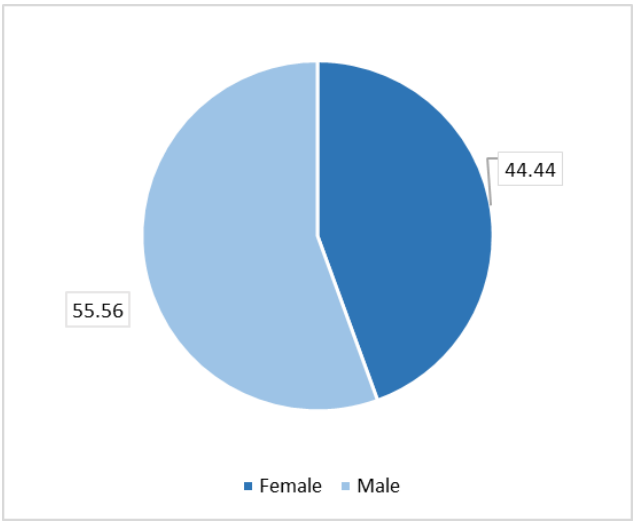
In terms of gender-disaggregated participation, the total group comprised 44 individuals, of whom 24 were men and 20 were women. This reflects a relatively balanced distribution, with a slight predominance of male participants.

By economy, Chile had 4 participants, evenly distributed between men and women. Spain and Indonesia were represented exclusively by male participants, with 1 and 2 men respectively. Peru, which accounted for the largest share of participants (31 individuals), showed a highly balanced distribution: 16 men and 15 women. China; Thailand; and Viet Nam each had 2 participants, maintaining in all cases an equal proportion of one man and one woman per economy.

Regarding speakers, a total of eight were identified, of whom 25% were women. Although female representation among speakers was lower than that of men, their participation ensured diversity of perspectives and voices during the event. This indicator highlights progress made, while also pointing to opportunities to further strengthen balanced representation in future editions.

Overall, the gender distribution reflects a clear effort to promote inclusion and diversity, particularly in economies with a higher number of participants, such as Chile and Peru, where female representation closely approaches that of men.

Figure 5. Distribution of participants by gender



Profile of the audience

The list of participants included government delegates, representatives from academia and research institutes, as well as members of the private sector. This diversity of institutional backgrounds enriched the discussions by incorporating regulatory, scientific, and industry perspectives into the workshop.

Table 12. Institutions represented by workshop participants

Economy	Institutions / Organizations Present
Chile	Universidad de Los Lagos, Instituto de Fomento Pesquero, Subsecretaría de Pesca, Instituto Humboldt de Investigación Marina y Acuícola (IHMA)
People's Republic of China	Third Institute of Oceanography, Ministry of Natural Resources of China, Chinese Marine Data and Information Service, Ministry of Natural Resources of China
Indonesia	Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries (MMAF), Indonesian Research and Innovation Agency (BRIN)
Peru	Ministry of Production of Peru (PRODUCE), Equilibrium BDC, Universidad Científica del Sur (UCSUR), Universidad de Ingeniería y Tecnología (UTEC), Fondo Nacional de Desarrollo Pesquero (FONDEPES), Instituto del Mar del Perú (IMARPE), Universidad Nacional Agraria La Molina (UNALM), Cámara Peruana del Calamar (CAPECAL)
Thailand	Marine Fisheries Research and Development Division, Thailand's Department of Fisheries (DOF)
Viet Nam	Viet Nam Association of Seafood Exporters and Producers (VASEP), Viet Nam Tuna Association

Pre- and Post-Workshop questionnaires

As part of the methodological design aimed at measuring the workshop's impact, a Pre-Event Survey (Pre-Test) was administered at the beginning of the first day (09:15 a.m., November 13). The survey consisted of four multiple-choice questions designed to assess participants' level of knowledge on the event's core topics. Its purpose was to establish a quantitative baseline regarding participants' technical knowledge prior to any training intervention.

To ensure the comparative validity of the analysis, the same four questions from the Pre-Test were re-administered in the Post-Event Survey. This allowed for a direct comparison of results and an assessment of the magnitude of changes attributable to the workshop.

Baseline survey results

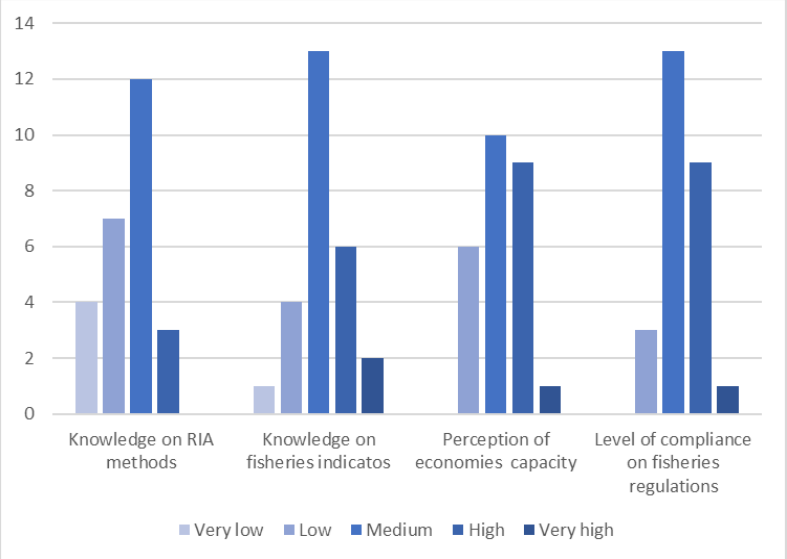
The analysis of the pre-event survey, completed by 24 participants, established a clear baseline for the implementation of the project. The data revealed an audience profile composed primarily of technical specialists with solid knowledge of biological and operational aspects of the resources (Question 2, predominantly medium to high levels), but with a significant gap in the application of ex-post Regulatory Impact Assessment (RIA) methodologies (Question 1, predominantly low to medium levels).

This asymmetry between biological knowledge (high) and methodological-regulatory knowledge (low) validated the workshop's structure. It confirmed that the focus should not be on teaching basic biology of *T. murphyi* or *D. gigas*, but rather on strengthening analytical tools to evaluate policies applied to these resources.

Additionally, the institutional diagnosis (Question 3) revealed marked heterogeneity among participating economies. While some representatives reported high technical capacity and strong data availability, a considerable segment acknowledged structural limitations (low and medium levels) within their institutions.

Finally, perceptions regarding compliance with current regulations (Question 4) were generally at a medium level. This finding justified the project's relevance and urgency: participating economies recognize that existing regulatory frameworks are not fully effective and require objective tools, such as the proposed RIA indicators, to measure and improve their performance in managing transboundary fisheries.

Figure 6. Baseline survey results



Note: These baseline values are compared with the results obtained in the post-event survey (section c.i), which was administered using the same questions to ensure consistent measurement.

Post-Workshop survey

The Post-Event Survey not only incorporated the four original questions included in the Pre-Workshop assessment, but also added a set of multiple-choice and open-ended questions designed to capture both quantitative and qualitative information. These questions addressed perceived learning outcomes, recommendations for improving future training processes, and participants' perspectives regarding the practical application of the topics covered.

The survey followed the format defined by Asia-Pacific Economic Cooperation (APEC) in the form titled *"Appendix I APEC Project Evaluation Survey: Seminar, Symposium, Workshop."* See Annex 3.

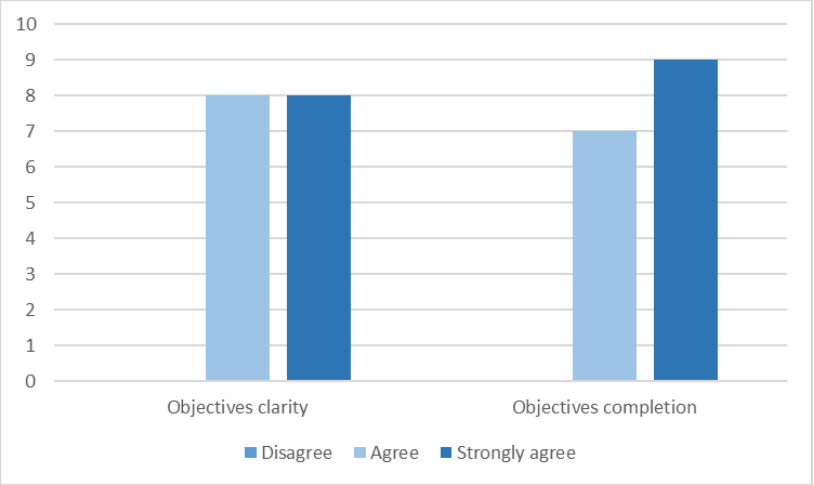
Workshop objectives

This section evaluates whether the initial communication, including the welcoming remarks delivered by the Project Overseer, Dr. Harry Aranibar Zambrano, and Minister Víctor Muñoz Tuesta, successfully conveyed the central purpose of the event: to strengthen capacities for the design of ex-post RIA indicators in transboundary fisheries.

One hundred percent (100%) of participants selected either "Agree" or "Strongly agree." This confirms that the project framework was successfully communicated from the outset. Participants clearly understood that the objective extended beyond biological considerations to include regulatory harmonization grounded in scientific evidence (genetic and satellite-based) for the management of *T. murphyi* and *D. gigas*. The clear identification of the target resources avoided ambiguity regarding the scope of the workshop.

Moreover, the unanimity of positive responses indicates that the two-day structure (Day 1: Jack mackerel/Diagnostic; Day 2: Jumbo flying squid/Technology) was effective. Participants validated that the event successfully synthesized complex scientific evidence and translated it into practical inputs for fisheries governance, thereby fulfilling the capacity-building objective presented to APEC.

Figure 7. Participants' perception of the clarity and achievement of the workshop objectives



Relevance of the agenda and organization of content

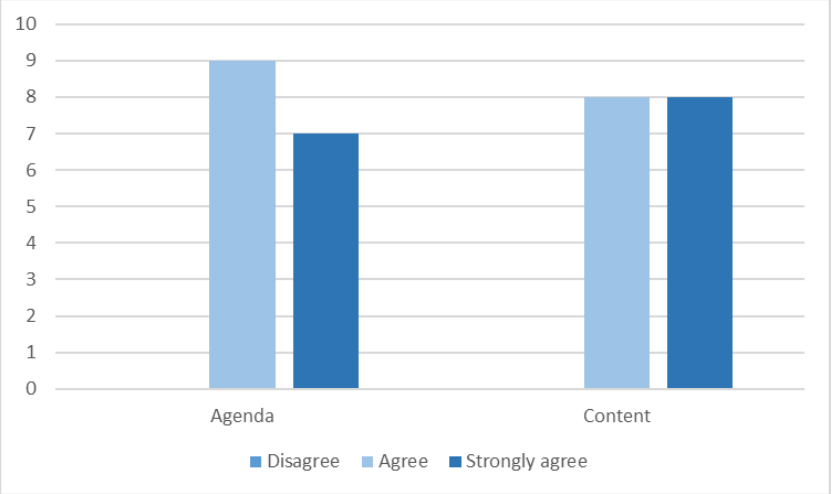
The high ratings reflect that the agenda addressed urgent issues in the South Pacific. The inclusion of cutting-edge technologies, such as genomics and telemetry, together with

discussions on governance challenges (including international fleets), was considered highly relevant given the transboundary nature and geopolitical importance of the resources analyzed.

The majority of participants selected “Strongly agree.” This suggests that the decision to structure the analyses by species, first jack mackerel, followed by jumbo flying squid, and by levels of information (biological first, then operational/MCS) facilitated the assimilation of dense technical content. The step-by-step progression enabled participants to build knowledge in a structured and coherent manner.

Overall, the results indicate that both the thematic focus and the sequencing of presentations were aligned with participants’ expectations and professional needs, reinforcing the practical value of the workshop for fisheries governance in the region.

Figure 8. Perception of the relevance of the agenda and content organization.

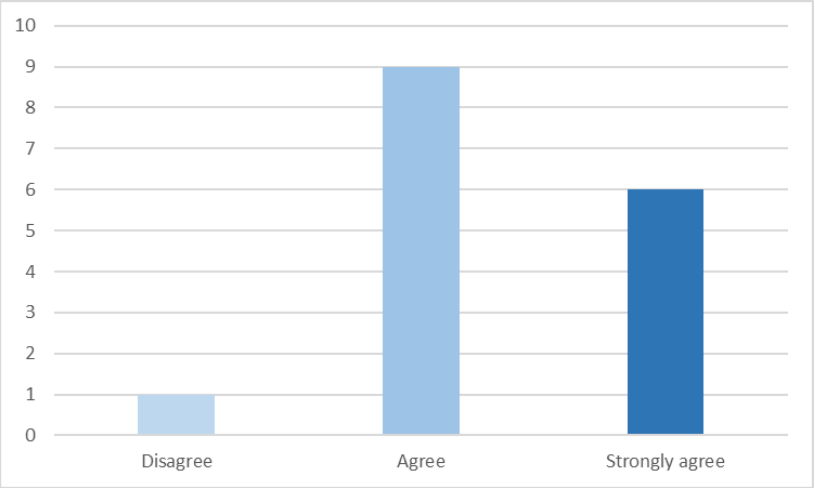


Gender considerations

Although the majority of responses were positive, the presence of one “Disagree” rating constitutes an important warning signal. While socioeconomic indicators were addressed during the workshop, it is possible that the specific analysis of gender gaps, whether in the value chains of jumbo flying squid and jack mackerel, or in fisheries decision-making processes, was not sufficiently explicit for all participants.

This finding suggests that, in future editions, the gender dimension could be integrated more systematically and visibly, for example through dedicated sessions, targeted case studies, or disaggregated data analysis. Strengthening the explicit incorporation of gender perspectives would further align the workshop with inclusive capacity-building principles and international best practices.

Figure 9. Perception of the inclusion of the gender approach



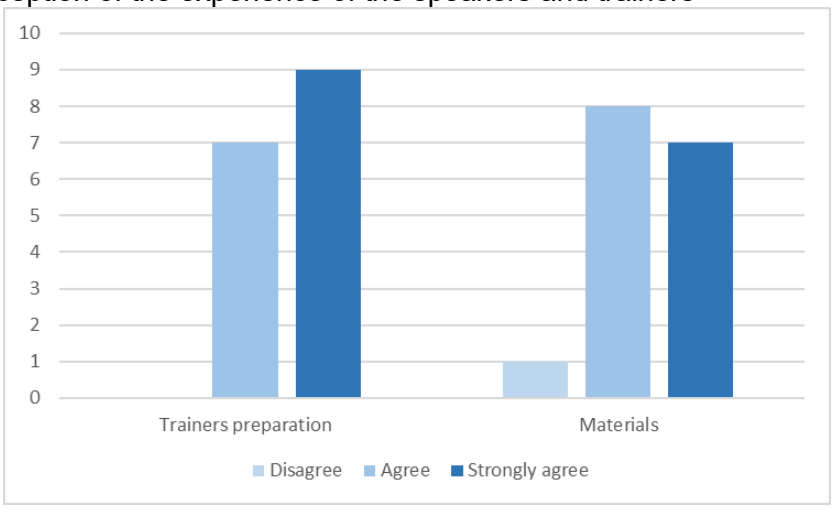
Experience of the speakers and usefulness of the materials

The experience of the trainers and speakers was the highest-rated category (almost entirely "Strongly agree"). Participants recognized the high level of specialization of the experts, validating the quality of the information presented on complex migratory dynamics and electronic monitoring systems. The technical authority of the speakers was a central pillar of the event's success.

At the same time, although the overall reception was positive, one participant expressed disagreement. Given the highly technical and visual nature of the content, such as satellite maps and genomic graphs, this response may indicate the need to improve the resolution or accessibility of printed and digital materials. It may also suggest the value of providing more accessible executive summaries of the research presented, particularly for participants whose expertise lies more in policy or administration than in advanced technical analysis.

Overall, the results confirm strong confidence in the expertise of the speakers, while also identifying a practical opportunity to enhance the usability and clarity of supporting materials in future editions.

Figure 10. Perception of the experience of the speakers and trainers

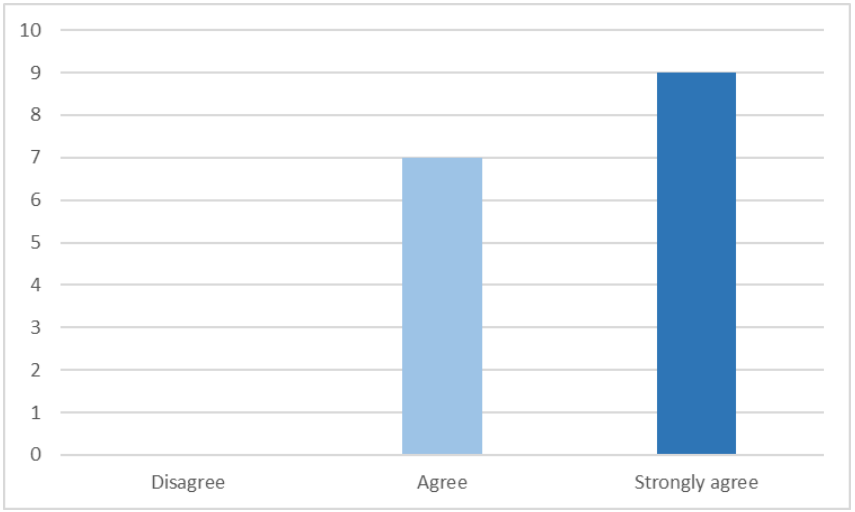


Duration of the presentations

Participants considered the allocated time to be appropriate. Despite the density of the program, time management allowed for adequate coverage of both theoretical components, such as statistical models, and practical discussions on interinstitutional cooperation, without excessive time pressure.

This balance suggests that the structure of the sessions successfully accommodated technical depth while preserving space for dialogue and reflection, which is essential in capacity-building initiatives involving regulatory and scientific integration.

Figure 11. Perception of the duration of the workshop presentations

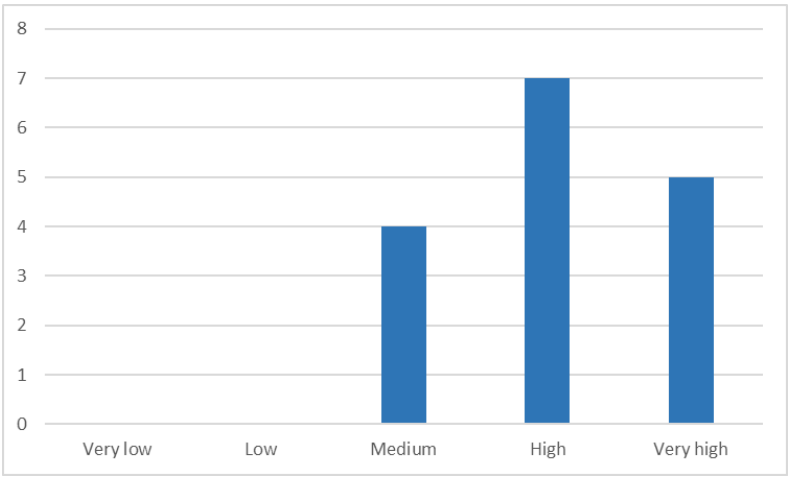


Relevance of the project

Participants' responses indicate a broadly positive perception regarding the project's impact and the strengthening of technical capacities derived from the workshop.

The results suggest that attendees recognize the added value of the initiative in enhancing analytical tools, promoting evidence-based regulatory approaches, and fostering regional dialogue on the management of transboundary fisheries resources. The project is therefore perceived not only as an academic exercise, but as a practical contribution to improving institutional performance and policy design within participating economies.

Figure 12. Perception of the relevance of the project for participating economies



In relation to the project's results and achievements, participants highlighted the extensive transfer of knowledge applicable to marine resource management, particularly regarding methodologies, indicators, and management approaches for jack mackerel and jumbo flying squid. The workshop strengthened understanding of the importance of Regional Fisheries Management Organizations (RFMOs) in the administration of shared resources and fostered the creation of an international network of specialists, considered a strategic outcome for future cooperation and the dissemination of best practices.

The relevance of the project was widely acknowledged, especially among economies directly managing jack mackerel and jumbo flying squid. Participants valued the opportunity to learn about regulatory, methodological, and institutional approaches implemented in economies such as Chile; China; and Peru. Several attendees noted that the project enabled them to identify potential indicators and "verify their feasibility of implementation" within their own local contexts, while also increasing awareness of the importance of fisheries management methodologies based on Regulatory Impact Assessment (RIA) indicators. The exchange of biological and regulatory information was also emphasized as a key contribution toward advancing the sustainable use of both species and promoting continuous improvement in their management.

Regarding newly acquired knowledge and skills, participants underscored the usefulness of sessions dedicated to advanced technologies, particularly satellite tagging, genetics, and genomics, which were regarded as high-value tools for understanding population structure, movement patterns, and resource dynamics. A deeper understanding of the state and progress of research in other economies, especially in the South Pacific, was also highly appreciated, enabling a more comprehensive and comparative analysis of shared challenges.

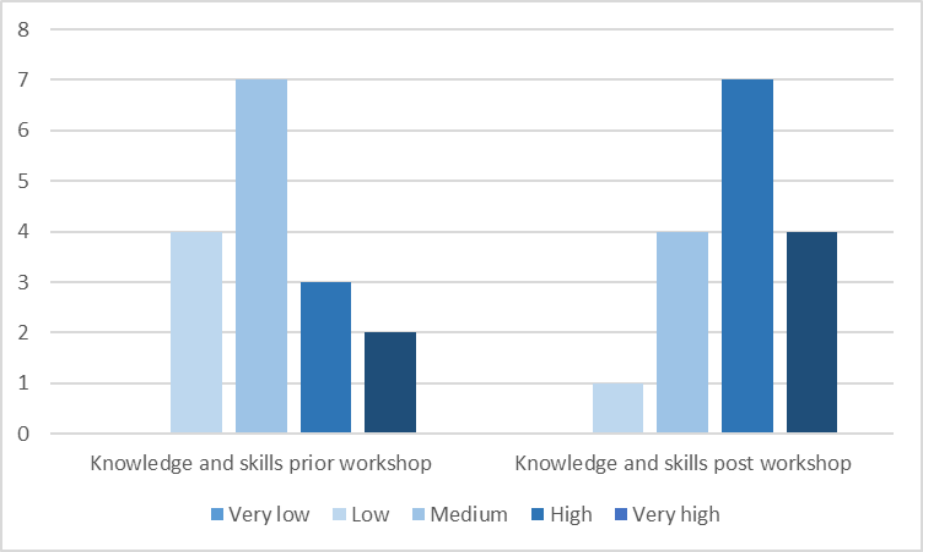
Participants further emphasized their improved understanding of the Regulatory Impact Assessment (RIA) methodology as applied to fisheries, recognizing its relevance for strengthening evidence-based decision-making and governance. The exchange of experiences among economies was especially valued, with several attendees acknowledging that the event helped them identify gaps or limitations in their own institutional indicator systems, as well as possible pathways for future development.

Finally, responses reflect that the workshop fostered cross-cutting competencies such as technical communication, comparative analytical skills, and the identification of innovative approaches presented by international experts. Overall, testimonies indicate that the project not only strengthened scientific and regulatory understanding of jack mackerel and jumbo flying squid, but also consolidated a shared knowledge base and practical toolkit that will facilitate the application of RIA indicators across participating economies.

Evaluation of learning and application of knowledge

Participants' responses demonstrate a clear intention to translate acquired knowledge into practical actions and institutional improvements. In general terms, the workshop generated applicable inputs for public management, scientific research, academic training, and operational planning.

Figure 13. Participants' level of knowledge and skills before and after the workshop.



An initial set of responses focuses on the planning and design of management instruments, where several participants indicated that they will use what they learned to develop work plans, strengthen data collection, and create new procedures or tools related to fisheries management and the use of indicators. This intention reflects a deeper understanding of existing gaps and a motivation to improve ex-post monitoring and evaluation systems, particularly for jack mackerel and jumbo squid.

Another group of responses highlights the application of knowledge to develop or improve regulations, management plans, and fisheries policy resolutions. Participants indicated that they will discuss the findings with policy-makers in their institutions, proposing measures that are more appropriate and aligned with regional governance trends. The use of information to overcome market barriers was also mentioned, suggesting that the workshop strengthened understanding of how regulatory coherence and compliance impact sector competitiveness and sustainability.

In the academic sphere, some participants noted that they will integrate workshop content into natural resource management courses at both undergraduate and graduate levels. This suggests that the project will have a multiplier effect through the training of future professionals, extending the impact beyond the workshop itself.

Additionally, several participants indicated that they will use the information to promote applied research, including new case studies, monitoring initiatives, and comparative analyses of practices across different economies. They emphasized the intention to “replicate good practices,” demonstrating explicit recognition of regional cooperation and the usefulness of technical exchange for adapting solutions to the context of each economy.

These qualitative questions enrich the interpretation of the results by providing a deeper view of the workshop experience, the sense of ownership, and the usefulness from the participants’ perspective. Based on the explanations and comments provided by participants in the post-event survey (P1, P2, P3, P5, P6, P7, P8), five key emerging themes were identified:

Table 13. Emerging themes extracted from the textual responses of the post-workshop questionnaire.

#	Emerging Themes (Textual Summary)	Associated Questions
1	**Shared resource management and fisheries approach:** The main relevance and achievement of the event lies in its direct application to the management of shared fish stocks (jack mackerel and jumbo squid), validating the project’s pertinence for the marine economy	Q1, Q2
2	**Development of work plans and internal strategies:** Practical application will focus on the immediate implementation of work plans, development of strategies, and organization of internal training to replicate the knowledge gained.	Q6

3	**Need for more practical tools and applied focus:** There is a demand for additional time for practical exercises and for the provision of applied tools that allow theoretical concepts to be translated into the realities of each economy.	Q8
4	**Need for further practical tools and applied focus:** There is a strong request for more time dedicated to practical exercises and for tools that facilitate the translation of theoretical concepts into actionable measures in the different economies.	Q2, Q3, Q5
5	**Recommendation for follow-up and APEC collective actions:** Participants request that APEC consider a follow-up phase or the creation of a coordination mechanism connecting project results with collective actions or support for regional implementation of indicators.	Q7

Finally, the responses reflect an interest in implementing internal training and outreach activities aimed at other stakeholders in the sector, which will allow participants to share the workshop's lessons with colleagues, related institutions, and interested parties, thereby strengthening the project's operational impact.

In general terms, participants anticipate applying what they learned through actions encompassing strategic planning, regulatory improvement, applied research, specialized teaching, and institutional training, confirming that the workshop provided tools for direct use to enhance fisheries management and the processes associated with Regulatory Impact Assessment (RIA) indicators in their economies.

ANNEX 5: Pre-Workshop Baseline Survey

APEC Project Pre- Evaluation Survey:
WORKSHOP ON DEVELOPING AND APPLYING EX-POST REGULATORY IMPACT ASSESSMENT (RIA) INDICATORS FOR FISHERIES MANAGEMENT OF JACK MACKEREL AND JUMBO FLYING SQUID ACROSS APEC ECONOMIES
(OFWG 202 2024A)

APEC Project Name/Number: _____

Date:_____

Instructions: Please indicate your level of agreement with the statements listed in the table below.

1. What is your level of knowledge regarding the ex-post regulatory impact assessment (RIA) methodology as applied to fisheries?

5	4	3	2	1
very high	high	medium	low	very low

2. What is your level of knowledge regarding biological, economic, and social indicators, as well as monitoring and data collection systems applicable to jack mackerel and jumbo flying squid?

5	4	3	2	1
very high	high	medium	low	very low

3. In your economy, are there sufficient technical capacities, accessible data, and inter-institutional cooperation to design and apply ex-post indicators in fisheries?

5	4	3	2	1
very high	high	medium	low	very low

4. What level of compliance do you perceive in your economy with regard to fisheries regulations applied to jack mackerel and jumbo flying squid?

5	4	3	2	1
very high	high	medium	low	very low

ANNEX 6: Post-Workshop Satisfaction Survey

APEC Project Post Evaluation Survey:
WORKSHOP ON DEVELOPING AND APPLYING EX-POST REGULATORY IMPACT ASSESSMENT (RIA) INDICATORS FOR FISHERIES MANAGEMENT OF JACK MACKEREL AND JUMBO FLYING SQUID ACROSS APEC ECONOMIES (OFWG 202 2024A)

APEC Project Name/Number: _____

Date:_____

Instructions: Please indicate your level of agreement with the statements listed in the table below.

	Strongly Agree	Agree	Disagree	COMMENTS (Continue on back if necessary)
The objectives of the training were clearly defined				
The project achieved its intended objectives				
The agenda items and topics covered were relevant				
The content was well organized and easy to follow				
Gender issues were sufficiently addressed during implementation				
The trainers/experts or facilitators were well prepared and knowledgeable about the topic				
The materials distributed were useful				
The time allotted for the training was sufficient.				

1. How relevant was this project to you and your economy?

5	4	3	2	1

very high	high	medium	low	very low

*Explain:*_____

2. In your view, what were the project's results/achievements?
*Explain:*_____

3. What new skills and knowledge did you gain from this event?

*Explain:*_____

4. Rate your level of knowledge of and skills in the topic prior to participating in the event:

5	**4**	**3**	**2**	**1**
very high	high	medium	low	very low

5. Rate your level of knowledge of and skills in the topic after participating in the event:

5	**4**	**3**	**2**	**1**
very high	high	medium	low	very low

*Explain:*_____

6. How will you apply the project's content and knowledge gained at your workplace? Please provide examples (e.g. develop new policy initiatives, organise training, develop work plans/strategies, draft regulations, develop new procedures/tools etc.).

*Explain:*_____

7. 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?

*Explain:*_____

8. How could this project have been improved? Please provide comments on how to improve the project, if relevant.

*Explain:*_____

9. What is your level of knowledge regarding the ex-post regulatory impact assessment (RIA) methodology as applied to fisheries?

5	4	3	2	1
very high	high	medium	low	very low

10. What is your level of knowledge regarding biological, economic, and social indicators, as well as monitoring and data collection systems applicable to jack mackerel and jumbo flying squid?

5	4	3	2	1
very high	high	medium	low	very low

11. In your economy, are there sufficient technical capacities, accessible data, and inter-institutional cooperation to design and apply ex-post indicators in fisheries?

5	4	3	2	1
very high	high	medium	low	very low

12. What level of compliance do you perceive in your economy with regard to fisheries regulations applied to jack mackerel and jumbo flying squid?

5	4	3	2	1
very high	high	medium	low	very low

Participant information (identifying information is optional):

Name: _____

Organisation/Economy: _____

Email: _____

Gender: M / F

Thank you. Your evaluation is important in helping us assess this project, improve project quality and plan next steps.