Improving Small-Scale Aquaculture Food Safety through the Collection and Use of Data

Project Summary Report

APEC Sub-Committee on Standards and Conformance

June 2026

Asia-Pacific Economic Cooperation

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Economic Cooperation

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APEC Project: SCSC 208 2024A

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APEC#226-CT-04.6

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EXECUTIVE SUMMARY

Small-scale aquaculture (SSA) plays a vital role in food security, income generation, and the livelihoods of coastal communities across APEC economies. Despite its importance, SSA producers face persistent challenges related to food safety, sanitary management, and the proper use of antimicrobials—largely due to limited availability of reliable data and inconsistent record keeping. These gaps hinder productivity, reduce market access, and elevate food safety risks.

This project aimed to improve food safety in SSA by strengthening the capacity of small-scale producers to systematically collect, record, and analyse sanitary management and antimicrobial use data. Through the development of a standardized Record Forms Set and delivery of a three-day capacity-building workshop, the project aimed to help SSA producers adopt better practices, enhance the quality and safety of their products, and reduce losses caused by non-compliance with food safety requirements.

The project directly supports APEC's Putrajaya Vision 2040 by contributing to strong, sustainable, and inclusive growth, with particular benefits for developing economies where SSA is a key source of food and income. Women, who are heavily represented in SSA activities, particularly in onshore and post-harvest roles, are a key topic during the workshop.

The 3-day workshop delivered through this project covered:

1. Present and discuss baseline information on current data collection practices in SSA, including survey results and experiences from multiple APEC economies.
2. Highlight the importance of data collection in aquaculture production management from government and private-sector perspectives, reinforcing its role in decision-making and food safety.
3. Examine APEC regional experiences and challenges in SSA data collection, from the participant economies.
4. Strengthen understanding of food safety risks, including antimicrobial use and sanitary/husbandry parameters that need to be captured through effective record keeping.
5. Promote gender awareness in aquaculture, recognizing women's roles in SSA and integrating gender considerations into capacity-building efforts.
6. Equip participants with tools and strategies for practical outreach and farmer engagement to ensure adoption of improved record-keeping practices.
7. Facilitate collaborative development of data record prototypes through group work, interactive introductions, and peer-review sessions.
8. Analyse, refine, and validate the proposed Data Record Set, ensuring it is fit for SSA producers across APEC economies.

9. Foster hands-on learning through a field visit to a small aquaculture farm, allowing participants to connect workshop concepts with real-world practices.

PROJECT OVERVIEW AND OBJECTIVES

Small-scale aquaculture (SSA) is essential to food security, income generation, and rural livelihoods across APEC economies. However, SSA producers face persistent challenges in food safety due to inconsistent, incomplete, or inaccurate data collection relating to sanitary management and antimicrobial use. These gaps limit farmers' ability to analyse risks, improve productivity, meet food safety standards, and access domestic and international markets.

This project seeks to strengthen SSA food safety by developing a standardized set of record-keeping forms, accompanied by user guidance, and by delivering a capacity-building workshop for APEC economies. By teaching small-scale farmers how to collect and analyse data reliably, the project will promote safer production practices, reduce losses due to non-compliance, and elevate the competitiveness and sustainability of SSA products in the region.

The primary objective of the project is to improve food safety in small-scale aquaculture by strengthening producers' capacity to collect, record, and analyse sanitary management and antimicrobial use data. This will enable farmers to make informed decisions that enhance product quality, improve market access, reduce losses from unmet food safety requirements, and contribute to APEC's goals for secure, sustainable, and inclusive growth.

PRE-WORKSHOP SURVEY

The survey was responded by 9 APEC economies; Australia; Chile; People´s Republic of China; Indonesia; Republic of Korea; Malaysia; Peru; The Philippines and Thailand. From the responses, the data collected was:

1. Production Profile and Small-Scale Aquaculture Definition

The production is primarily focused on seaweed (33.33%, 4 responses) and tilapia (25%, 3 responses), predominantly utilizing land-based pond systems (66.67%, 8 responses).

The definition of small-scale aquaculture (SSA) varies across the region; the most common criterion is a lower annual turnover or balance sheet of less than USD10,000 (25%, 3 responses), followed by limits on harvested volume (less than 50 tonnes per year) and surface area (less than 1,000 m^2).

The primary purpose of these activities is split between domestic/internal consumption (50%, 6 responses) and supplying small or local communities and household food security (50%, 6 responses).

2. Sanitary Management Register and use of data

Regarding sanitary management, 75% of economies (9 responses) report data on diseases or parasites, while 58.33% (7 responses) track mortality rates.

This information is used primarily for regulatory decision-making (83.33%, 10 responses) and the design and implementation of public policies (66.67%, 8 responses).

Although 75% of agencies use internal digital databases for storage, the collection of sanitary and environmental data remains largely sporadic (58.33% in both categories).

The most critical challenges facing the sector, evaluated by weighted averages of relevance, include a lack of human or financial resources (2.42) and difficulty in obtaining accurate and reliable data (2.50).

This is exacerbated by a persistent technological gap: 41.67% (5 responses) of farmers still rely on traditional manual methods using paper, even though smartphone usage (33.33%, 4 responses) for data registration now exceeds the use of computers or tablets (16.67%, 2 responses).

Despite these gaps, 75% of jurisdictions (9 responses) state that current food safety regulations clearly and directly address record-keeping for SSA farmers, providing a solid legal foundation to implement recommendations for mobile digitalization and regional data standardization aimed at strengthening sector competitiveness

3. Women’s Role

The role of women in the value chain is vital, as they are involved in 91.67% (11 responses) of both processing and selling/marketing activities. Specifically, processing and commercialization are identified as their primary responsibilities in 75% of cases.

However, institutional support is limited; only 44.44% of economies (4 responses) confirm having specific technical training programs for women, and 25% explicitly report a lack of financial support mechanisms for them.

Key Highlights and conclusion from the Survey:

- The information came mainly from public agencies that work directly with Aquaculture, followed by academia/researchers, and small group of ‘other’ institutions.
- Primary aquaculture systems are Ponds (63.64%)
- The primary SSA activities were household consumption/food supply of local communities
- Types of records used in SSA are from internal databases, in physical records and in geographic information system (GIS).
- Main challenges are the lack of human or financial resources, difficulties in obtaining reliable and accurate data, and lack of standardization in data collection.
- The current regulation address record keeping for SSA (72.73%).
- The traditional methods (i.e., paper) are the most common technology used to register data (45.45%)
- Women are involved in processing food, selling and marketing, administrative work.

Data Collection is Evolving: Most economies are collecting health and environmental data, primarily through mandatory reporting and agency inspections. However, this is often done sporadically, and traditional paper-based methods are still the most common.

Significant Challenges Remain: The primary obstacles to effective data collection and use are a lack of financial and human resources, compounded by the difficulty of obtaining accurate and reliable data from producers.

Data's Key Role: Collected data is predominantly used for regulatory decision-making, which is essential for ensuring food safety standards in small-scale aquaculture.

Women Drive the Business: Women are integral to the small-scale aquaculture sector, with high involvement in processing, selling, and marketing. Their contributions are vital to the industry's success, highlighting a need for more targeted support programs.

WORKSHOP SUMMARY

WORKSHOP OVERVIEW

The three-day workshop, held from 2–4 September 2025 in Puerto Varas, Chile, set out the stage for a collaborative exploration of data-driven improvements in small-scale aquaculture (SSA). Throughout Day 1, participants reviewed the pre-workshop survey results and examined the importance of data collection for production management from both government and private-sector perspectives, and also its experience working with small farmers was shared. The agenda then expands to regional data challenges, followed by a session highlighting women's roles and gender dynamics in aquaculture. Day 2 opened with a focus on sustainable food production and food security, exploring how improved data records can support these goals, followed by presentations on antimicrobial use and key sanitary parameters for record keeping. Participant APEC economies then presented their "state of the art" experiences, outlining data gaps, resources, and challenges with the opportunity after each presentation to discuss each economy particular situation discovering similitudes that can be used in future collaborative work. Practical tools for farmer engagement were discussed before participants engaged in group work to develop proposed data record formats. Day 3 centered on refining and analysing the Data Record Set, with groups presenting their final proposals, after which the workshop concluded with a field visit to a local small-scale aquaculture farm, where participants saw first-hand how SSA works in Chile and were able to discuss among themselves.

AGENDA

The agenda were elaborated as a structured program aimed at strengthening knowledge, building capacity, and collaboratively shaping tools for data collection in small-scale aquaculture, with dedicated sessions to women role in SSA and the opportunity from each one of the participant economies to share their state of art in Small Scale Aquaculture data collection and use.

Period	**Day 1- September 2, 2025** **Moderator: Constanza Vergara E.**
09:00 -09:30	**Accreditation**
09:30 - 09:45	Opening words. *Mr. Alex Chaparro – SUBREI & Rolando Ibarra Monterey Bay Aquarium*
09:45 - 10:15	Housekeeping announcement and participants' introduction
10:15 - 11:00	Survey results presentation and discussion. *Mr. Rolando Ibarra – Monterey Bay Aquarium*
11:00 - 11:30	**Coffee Break**

11:30 - 12:00	Importance of data collection in production management decisions taken: Government perspective. *Francisco Vásquez – SERNAPESCA - Chile*
12:30 - 13:00	Experiences of Indonesia in data collection in small farmers. *Mr. Mochamad Aji Purbayu - Marine and Fisheries Quality Assurance Agency (MFQAA), Indonesia.*
13:00 - 14:00	**Lunch Break**
14:00 - 14:30	Importance of data collection in the production management decision taken: Private perspective. *Dr. Daniel Jiménez – Aquabench - Chile*
14:30 - 15:00	Data collection diagnostic and challenges in tracking data in SSA Asia. *Dr. Sophie St-Hillary - City University of Hong Kong, Hong Kong, China*
15:00 - 16:00	Women's role and gender dynamics in aquaculture *Dr. Daniela Farías & Dr. Birgitte Paulsen – Monterey Bay Aquarium*
16:00 - 16:30	Discussion and Q&A - Interactive session. (Constanza Vergara, Rolando Ibarra and Daniela Farías)
16:30	**Ending session coffee**

Period	**Day 2 - September 3, 2025** **Moderator: Rolando Ibarra & Daniela Farías**
09:30 – 9.45	Welcome words day 2
09:45 – 10:15	Sustainable food production and food security in the SSA. How may the record of data help? *Dr. Michael Tlusty - University Massachusetts Boston, USA*
10:15 - 10:45	Antimicrobial use in Aquaculture, data records from the food safety perspective. *Dr. Javiera Cornejo – Center for Antimicrobial Stewardship in Aquaculture, University of Chile.*
10:45 - 11:15	**Coffee Break**
11.15 – 11:45	Aquaculture Sanitary and husbandry parameters of consideration for record keeping. *Dr. Rolando Ibarra – Monterey Bay Aquarium*
11:45 - 12:30	Economies State of Art, resources, data, challenges in Small Scale Aquaculture experiences – Chile - Ms. Carla Anguita, SERNAPESCA Indonesia – Mr. Adi Krisianto, Ms.Aya Sofa Novia – BSN Malaysia – Ms. Nor Fatmahwati Binti Yakup, Dept. of Fisheries. México - Mr. Francisco Martínez, CONAPESCA Q&A
12:30 - 13:30	**Lunch Break**
13:30 – 14:30	Economies State of Art, resources, data, challenges in Small Scale Aquaculture experiences – (~15min presentation each) Perú – Mr. Arturo Aivar, SANIPES The Philippines – Ms. Sonia Somga, Ms. Elymi Ar J Tuñacao, DA-BFAR. Thailand – Ms. Kaninkporn Kessuwan, Ms. Ketpaitoon Kaewpaitoon, Dept. of Fisheries. Q&A

14:30 – 15:00	Practical transfer tools and farmer engagement. *Mr. Ben Amick – Founder, Marketedge Global, USA*
15:00 – 15:30	**Coffee Break**
15:30 – 15:45	Data Record Essentials: Interactive introduction Moderators: Ms. Constanza Vergara, Mr. Rolando Ibarra and Ms. Daniela Farías.
15:45 – 16:30	Data Records proposals by workshop participants - Group work. Moderators: Ms. Constanza Vergara, Mr. Rolando Ibarra and Ms. Daniela Farías.
16:30 - 17:00	Presentation and Analysis of the Data Records proposals by workshop participants - Group work. Moderators: Constanza Vergara, Rolando Ibarra and Daniela Farías.
17:00 -17:15	**Ending session**

Period	**Day 3 - September 4th** **Moderator: Ms. Constanza Vergara/ Mr. Rolando Ibarra**
09:00 - 9:15	Welcome words day 3
09:15 - 10:00	Final Analysis and revision of Data Record Set and presentation of records - Group work results presentation.
10:00 - 10:30	**Coffee Break**
11:00 - 17:30	Visit to an *in-land* Small Aquaculture Farm in Puerto Varas (*Distance 40 min by bus from Puerto Varas city, transport included wear comfortable clothes*). Discussion session and take away conclusions. Workshop survey evaluation by participants.
17:30	**Arrival at Puerto Varas – End activities**

SUMMARY OF PRESENTATIONS

"Importance of data collection in production management decisions taken: Government perspective"

Speaker: Mr. Francisco Vásquez – Fisheries and Aquaculture Service (SERNAPESCA), Chile.

The presentation outlined, how data collection has become a fundamental instrument for guiding public decision-making in Chile's aquaculture sector, emphasizing its role in strengthening sustainable production management from a governmental perspective. It described SERNAPESCA's mission to safeguard fisheries and aquatic resources through comprehensive sanitary control and regulatory oversight, underscoring how data-driven policies have shaped sectoral behaviour, particularly following critical events such as the 2008 ISA virus outbreak. The speaker explained that this approach rests on a solid regulatory framework, continuous monitoring across the entire aquaculture value chain, and the integration of productive, sanitary, and traceability information through advanced analytical platforms. Regular reporting and public access to key sanitary data were highlighted as essential tools to ensure transparency, regulatory compliance, and informed decision-making. The presenter concluded by noting the tangible results achieved enhanced food safety, reduced sanitary risks, improved market access, and more responsible antimicrobial use, and by stressing the central lesson that effective and sustainable aquaculture governance depends on robust, standardized data systems, capacity building for data interpretation, and strong, transparent public–private collaboration.

"Improving Aquaculture Food Safety Through Data Collection in Indonesia"

Speaker: Mr. Mochamad Aji Purbayu – Marine and Fisheries Quality Assurance Agency (MFQAA), Indonesia.

The presentation provided a comprehensive overview of how systematic data collection and analysis are being leveraged to strengthen food safety governance within Indonesia's aquaculture sector, with particular relevance to small-scale producers. It highlighted the economic importance of key aquaculture commodities—including shrimp, tilapia, crab, seaweed, and lobster—which together underpin Indonesia's strong position in global markets and contribute significantly to Indonesia's trade competitiveness. Indonesia was presented as one of the world's leading aquaculture producers, with notable global market shares, operating within a sector largely characterized by small, household-level production units. Against this backdrop, the presentation examined the principal food safety challenges facing the sector, including chemical residues, heavy metals, natural toxins, and microbiological hazards, and emphasized the critical importance of compliance with international standards to secure export market access.

The narrative further outlined Indonesia's quality assurance framework, under which the Marine and Fisheries Quality Assurance Agency (MFQAA) functions as the competent authority, supported by an extensive laboratory network and specialized personnel. Central to this framework is the implementation of a National Residue Monitoring Program, which enables systematic sampling, testing, and follow-up actions across hatchery and grow-out operations. The presentation detailed how comprehensive monitoring covers water, fish, and shrimp throughout the production chain, targeting both prohibited substances and regulated inputs, with laboratory results integrated into the economy's information and residue control management systems to ensure traceability and informed decision-making. It was noted that this data-driven approach has enabled sustained compliance levels exceeding 97 percent over more than a decade, with no recent cases of non-compliance reported. In conclusion, the presentation underscored that robust data collection, and monitoring systems have delivered tangible strategic outcomes, including strengthened food safety compliance, enhanced export acceptance, improved product competitiveness, effective traceability, and stronger foundations for research, technical decision-making, and long-term economic growth.

"Importance of data collection in the production management decision taken: Private perspective."

Speaker: Dr. Daniel Jiménez – Aquabench – Chile

The presentation delivered a structured and forward-looking narrative on the growing importance of data-driven decision-making in modern aquaculture and food production systems. The speaker underscored the exponential growth of global data, noting that the vast majority of the world's data has been generated only in recent years, and emphasized that competitiveness today depends less on physical assets than on the capacity to collect, interpret, and translate data into operational decisions. In this context, data transparency and real-time insights were identified as key drivers shaping customer expectations, operational efficiency, and market dynamics. The presentation cautioned that failure to harness data can lead to inefficiencies, weak decision-making, and loss of competitiveness, and introduced a value-chain framework for transforming raw data into actionable insights through data cleaning, structured analysis, insight generation, and continuous feedback loops. Four complementary analytical approaches; descriptive; diagnostic; predictive, and prescriptive analytics, were presented as essential tools that must be applied in an integrated manner to support effective action.

The presentation further addressed practical aspects of data collection in aquaculture, highlighting accuracy, completeness, relevance, and timeliness as core principles, and noting how modern technologies such as sensors, mobile platforms, and cloud-based systems now enable automated, real-time monitoring and data integration. A salmon farming case study illustrated how data collection throughout the production cycle, from hatchery to seawater grow-out, supports key performance objectives, including biomass management, feeding optimization, health and mortality control, traceability, and mitigation of environmental risks such as low oxygen events and harmful algal blooms. Complementing this, an analysis of internal shrimp farm data over a 90-day period demonstrated how feed inputs, water quality, microbial indicators, growth, mortality, and pond-level environmental differences can be correlated using advanced statistical techniques to reveal inconsistencies in management practices. The presentation concluded that data-driven transformation is increasingly feasible and necessary, given ongoing advances in sensors, automation, and artificial intelligence, and stressed the need for robust data infrastructure, common performance indicators, strong data governance, and greater transparency. These elements were presented as essential to improving productivity, enhancing disease and environmental management, strengthening animal welfare, and supporting sustainable profitability and market access.

"Data collection diagnostic and challenges in tracking data in Small Scale Aquaculture in Asia."

Speaker: Dr. Sophie St-Hilaire - City University of Hong Kong, Hong Kong, China

The presentation underscored the tangible benefits of systematic data collection and_use, emphasizing that data-driven decision-making enhances productivity, efficiency, and overall business performance. It highlighted that data only generates value when it is properly collected, analysed, interpreted, and translated into timely actions, allowing stakeholders to assess its practical usefulness and continuously improve outcomes.

At the same time, the speaker identified persistent gaps faced by small-scale farm holders in adopting data collection practices. These challenges include limited access to appropriate technologies, reliance on manual methods, and insufficient skills, all of which point to the need for targeted technology transfer and capacity building. Small producers also operate with constrained cash flow, staffing, equipment, and digital infrastructure, making sustained data collection difficult. Moreover, data collection requirements are often driven by government mandates aimed at protecting public resources, health, and international trade, while farmers themselves may perceive limited direct benefits.

To address these gaps, the presentation offered practical recommendations for data gathering in small-scale aquaculture systems. It stressed the value of mobile phone applications over complex computer-based tools, the importance of keeping data requirements simple and proportional to available staff, and the need to use local languages to ensure accessibility. Providing regular feedback to farmers was identified as critical to demonstrating the usefulness of the data and encouraging continued engagement. The recommendations also included auditing mechanisms to ensure compliance, as well as pilot programs with initial costs covered, as a means to build trust and secure early buy-in from small producers.

“Women's role and gender dynamics in aquaculture”

Speakers: Dr. Daniela Farías & Dr. Birgitte Paulsen – Monterey Bay Aquarium

The presentation offered a structured and evidence-based narrative on the role of gender in small-scale aquaculture.

It underscored that although women make substantial contributions to aquaculture production, accounting for a significant share of the aquaculture workforce and nearly half of the global fisheries value chain, their roles remain largely invisible due to the persistent absence of sex-disaggregated data. This data gap was identified as a principal factor leading to the systematic underestimation of women’s economic, technical, and managerial contributions.

Drawing on the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), the presentation framed gender inequality as an intersectional challenge, where gender interacts with other dimensions such as ethnicity, age, migration status, culture, and religion, thereby exacerbating vulnerability and marginalization. Findings from a systematic review of the literature highlighted clear gendered patterns across the aquaculture value chain, with women concentrated in supporting and post-harvest roles while men dominate farm ownership, management, and access to training and technology. Structural barriers, including unequal access to land, capital, credit, training, and decision-making power, as well as restrictive social norms and domestic responsibilities, were identified as key constraints to women’s empowerment.

At the same time, the presentation demonstrated that intentional inclusion of women in aquaculture development generates measurable benefits, including improved food security and nutrition, increased household income, stronger technology adoption, and enhanced economic autonomy, as evidenced by case studies from Asia. The presentation concluded that while gender-disaggregated data is essential, it must be complemented by more nuanced information on roles, remuneration, access to resources, and working conditions, and that gender-responsive policies, research, and capacity-building strategies are critical to strengthening the sustainability, resilience, and inclusive growth of small-scale aquaculture in the APEC region.

“Sustainable food production and food security in the SSA. How may the record of data help?”

Dr. Michael Tlusty - University Massachusetts Boston, USA

The presentation highlighted the central role of data in strengthening the sustainability, productivity, and long-term resilience of small-scale aquaculture, with particular emphasis on its contribution to food security, environmental performance, and the economic viability of small producers. Drawing on earlier analytical work, it underscored animal health as the foundation of sustainable aquaculture, noting that poor health outcomes, often driven by inadequate environmental conditions, disease pressure, and weak biosecurity, lead to increased medical treatments, environmental degradation, and declining system performance, with negative consequences for communities and ecosystems alike. The speaker framed data as a neutral but powerful tool that, when properly collected and analysed, supports informed decision-making, problem solving, innovation, and strategic planning, while also enabling monitoring, evaluation, and predictive analysis. Both positive indicators and data revealing deficiencies were presented as equally valuable, as they expose areas requiring improvement and guide corrective action. The presentation further identified key environmental, production, socioeconomic, and management indicators essential for assessing sustainability and emphasized that producer behaviour, attitudes, and knowledge strongly influence outcomes, with data helping to distinguish environmental constraints from management shortcomings. Finally, the narrative illustrated how sustained training, combined with continuous data tracking over time, produces incremental yet meaningful improvements, concluding that data-driven systems, reinforced by capacity building and behaviour change, constitute the most effective pathway for achieving sustainable, resilient, and inclusive outcomes in small-scale aquaculture.

“Antimicrobial use in Aquaculture, data records from the food safety perspective.”

Speaker: Dr. Javiera Cornejo – Center for Antimicrobial Stewardship in Aquaculture, University of Chile.

The presentation examined the increasingly important role of data records in aquaculture food safety, with a particular focus on the monitoring of antimicrobial use and veterinary drug residues as key elements for protecting public health, supporting sustainable trade, and strengthening confidence in regional supply chains across APEC economies. It highlighted that antimicrobials in aquaculture are permitted solely for therapeutic and metaphylactic purposes, warning that inappropriate use can lead to residue accumulation in seafood products and contribute to the global challenge of antimicrobial resistance.

The presentation detailed a comprehensive monitoring system based on pre-harvest sampling, routine analysis at processing plants, and testing in ISO 17025-accredited laboratories, combined with harmonized maximum residue limits and a digital veterinary prescription platform that enables real-time monitoring, traceability, and regulatory oversight.

Data from international alert systems further illustrated that chemical hazards, particularly veterinary drug residues, account for the majority of food safety notifications in aquaculture products, reinforcing the need for harmonized surveillance and risk communication. At the same time, the presentation acknowledged persistent global challenges, including limited availability of comparable data on antimicrobial use and resistance, fragmented surveillance systems, and inconsistent record-keeping, which constrain effective risk assessment and policy design. Looking forward, the presenter emphasized a transition toward risk-based, data-driven monitoring approaches, enhanced analytical methods, stronger international data platforms, and preventive strategies that reduce reliance on antimicrobials. The presentation concluded that robust, harmonized, and digitalized food safety systems, supported by regional cooperation, capacity building, and regulatory convergence, are essential for safeguarding public health, maintaining market access, and ensuring the long-term sustainability and competitiveness of aquaculture supply chains in the APEC region.

"Aquaculture Sanitary and Husbandry Parameters of consideration for Record keeping"

Speaker: Dr. Rolando Ibarra – Monterey Bay Aquarium

The presentation outlined record-keeping as a core professional practice for sustainable aquaculture management, emphasizing its role in improving efficiency, profitability, regulatory compliance, and fish health and welfare.

It explained how systematic records allow farmers to track productive, sanitary, environmental, and operational trends over time, enabling early detection of problems and more timely corrective actions.

The presentation described a comprehensive set of data to be recorded, including productive indicators such as stock numbers, biomass, mortality, and cycle performance; environmental parameters such as temperature, oxygen, ammonia, pH, and bloom events; and husbandry and sanitary practices covering feeding, diagnostics, treatments, vaccinations, and animal movements.

Additional information, ranging from laboratory results and stock origin to behavioral observations and predator interactions, was presented as valuable for interpreting performance and risk. The presentation compared record-keeping methods, noting the simplicity of logbooks, the analytical flexibility of spreadsheets, and the growing advantages of mobile applications and specialized software despite their cost and training requirements.

In conclusion, record-keeping was framed not as an administrative burden but as a strategic tool that shifts aquaculture from reactive to proactive management, supports integration of environmental, productive, and sanitary data, enables industry-wide improvements such as antibiotic reduction, and ultimately strengthens biological optimization, regulatory compliance, and long-term economic sustainability.

Economies State of Art, resources, data challenges in Small Scale Aquaculture experiences

(Chile; Indonesia; Malaysia; Mexico; Peru; The Philippines; Thailand)

During the workshop, participating economies were asked to prepare a presentation which contained a brief overview of the Small-Scale Aquaculture (SSA) at their economy as introduction, followed by a description of what type of data is collected and the women participation in SSA and answer 2 questions: What are the main challenges your economy faces regarding collecting, managing or using sanitary and environmental data from SSA? and how do you believe better data collection and records can help to improve your SSA sector?.

The summary of each one of the economies presentations can be found at Appendix 4 and the main findings of all economies together is presented below.

a) Collection and Use of Data

Across economies, small-scale aquaculture plays a critical role in food security, rural livelihoods, and local economies, often dominating the number of aquaculture operators even where production volumes vary. Data collection systems typically involve multiple public institutions, sometimes supported by academia, NGOs, certification bodies, and the private sector.

Common features include:

- Farm registration systems as a foundation for monitoring, food safety, and traceability.
- Mandatory or semi-mandatory reporting of key production events such as stocking, harvesting, mortality, movement of organisms, and sanitary conditions.
- Use of digital platforms for registration, certification, surveillance, and permit management, though paper-based reporting remains common in SSA.

Sanitary and environmental data sets are primarily used for:

- Disease surveillance and residue monitoring
- Regulatory compliance and export requirements
- Policy formulation, planning, and risk management

Overall, data collection is increasingly recognized as essential, but implementation remains uneven, particularly for small-scale and remote producers.

b) Main Challenges in Collecting, Managing, or Using SSA Data

Despite progress, economies consistently report structural and operational challenges, including:

- Incomplete identification and registration of small-scale producers, leading to gaps in coverage.
- Low awareness, skills, and incentives among farmers to keep accurate sanitary and environmental records.
- Heavy reliance on paper-based systems, with limited adoption of digital tools.
- Fragmented and non-integrated databases across institutions, limiting interoperability and effective use of data.
- Resource constraints, including limited manpower, funding, monitoring equipment, laboratory capacity, and digital connectivity, especially in rural or coastal areas.
- Difficulties in data verification, accuracy, and reliability, which weaken traceability and evidence-based decision-making.

As a conclusion, all these challenges collectively hinder efficient regulation, targeted support programs, and risk-based sanitary management.

c) Women's Participation in Small-Scale Aquaculture

Women are consistently recognized as essential contributors across the SSA value chain, though their roles are often under-documented. Across economies, women are actively involved in:

- On-farm activities (feeding, husbandry, maintenance, monitoring)
- Post-harvest handling, processing, and value-added activities
- Marketing, retailing, and small-scale commercialization
- Administrative tasks, record-keeping, and community-based management

On the presentations it was visible that many economies have introduced gender-focused programs aimed at; Capacity building and technical training, Entrepreneurship, financial literacy, and micro-enterprise development and Improving women's access to formal registration, certification, and public support.

Registration and improved data systems are viewed as key enablers for making women's contributions visible, increasing their access to training, institutional support, and decision-making opportunities, and reinforcing inclusive sector development.

d) How Better Data Collection and Records Can Improve SSA

There is strong consensus, among all presentations, that improved data collection and record-keeping would deliver significant, multi-dimensional benefits, including:

- Stronger sanitary and environmental control, enabling early disease detection, reduced biosecurity risks, and better compliance with health standards.
- Improved traceability and food safety, supporting domestic consumer confidence and export market access.
- More effective farm management, including better feed use, health monitoring, and productivity assessment.
- Evidence-based public policy, allowing authorities to design targeted support programs, allocate resources more efficiently, and adapt regulations based on emerging risks.
- Formalization of small-scale producers, improving access to government assistance, certification schemes, training, and finance.
- Enhanced sustainability and resilience of the aquaculture sector through better governance, planning, and long-term monitoring.

In several economies, the integration and digitization of datasets—linking farmer-level records with institutional, geographic, and surveillance data—are viewed as a strategic priority for advancing SSA development.

e) Overall Conclusions

Participating economies share common challenges and opportunities in SSA data systems. Strengthening inclusive, integrated, and practical data collection frameworks, with particular attention to small-scale operators and women, emerges as a central pathway to improving food safety, sustainability, livelihoods, and trade readiness across the APEC region.

"Practical Transfer Tools and Farmer engagement."

Speaker: Mr. Ben Amick – Founder, Marketedge Global, USA

This presentation outlined practical approaches, business models, and digital tools that enable effective data transfer and engagement with smallholder farmers. Its core message was that data systems succeed or fail depending on the incentives embedded in their design, requiring careful consideration of who pays, who owns, who uses, and who benefits from the data.

According to the presenter, the success of data solutions depends on correctly aligning incentives for all participants.
Key questions determining adoption include:

- Who pays? (farmers, buyers, governments, donors)
- Who owns the data? (farmer, platform, shared, or public)
- Who uses the data? (producers, buyers, regulators, financiers, insurers)
- Who benefits? (affecting adoption energy, data quality, system longevity)

<u>Four Data-Driven Business Models for Farmer Engagement</u> <u>were presented</u>:

1. <u>Model 1: Farmer-Pays / Value to Producer</u>

- Revenue is generated through subscriptions or bundled services.
- Farmers retain data rights; platforms host.
- Value is derived from immediate ROI such as higher yields, reduced waste, and faster payments.
- Engagement requires low-literacy, offline-tolerant workflows and de-risked early trials.

2. <u>Model 2: Buyer/Corporate-Pays (B2B SaaS)</u>

- Buyers pay for enterprise licenses and verification fees.
- Data ownership is often centralized with buyers or platforms.
- Used for traceability, certification, and regulatory compliance (e.g., EUDR).
- Farmers participate in terms of premiums and contract stability.

3. <u>Model 3: Government/Donor-Pays (Public Good)</u>

- Public budgets fund platforms supporting disease surveillance, food safety, antimicrobial monitoring, and climate reporting.
- Value emerges from economy oversight and trade facilitation.
- Farmer engagement improves when linked to subsidies or services.

4. <u>Model 4: Marketplace / Two-Sided Platforms</u>

- Revenue arises from transaction fees, fintech margins, and logistical services.
- Data supports price discovery, working capital, and lower costs.
- Data entry becomes the “ticket” to finance, markets, and payments.

The comparison of the four data-driven business models demonstrates that no single approach is universally applicable; rather, effectiveness depends on the policy objectives, market structure, and capacity of farmers within each economy. The farmer-pays model offers the strongest alignment with producer incentives and data ownership, but its scalability is constrained by affordability, literacy levels, and the need to clearly demonstrate short-term return on investment. This model is most viable where producers are commercially oriented and where early adoption risks can be mitigated.

The buyer- or corporate-pays model has emerged as a powerful driver of adoption where traceability, certification, and regulatory compliance are required by downstream markets. While this approach reduces the financial burden on farmers and can deliver stability through contracts or price premiums, it often concentrates data ownership outside the farm level, raising concerns related to transparency, trust, and long-term farmer empowerment.

The government- or donor-funded model plays a critical role in supporting data systems that deliver public goods, including disease surveillance, food safety assurance, antimicrobial stewardship, and climate reporting. Farmer participation under this model is significantly enhanced when data provision is linked to tangible benefits such as access to subsidies, technical services, or simplified compliance processes. However, sustainability depends on continued public funding and institutional coordination.

The marketplace or two-sided platform model presents the strongest commercial scalability, as data collection is directly tied to access to markets, finance, and payments. In this context, data entry becomes an enabling mechanism rather than a compliance obligation, creating strong incentives for farmer participation. Nonetheless, this model requires robust digital infrastructure and safeguards to ensure fair data use and equitable value sharing.

Overall, the analysis indicates that hybrid models, combining public funding, private sector demand, and direct farmer value creation, are most likely to achieve sustained participation, high-quality data, and long-term impact. Aligning incentives, clarifying data rights, lowering entry barriers, and ensuring that farmers perceive clear and immediate benefits are essential conditions for success across all models.

<u>Digital Tools and Case Examples:</u>

Several available options were presented.

The review of digital tools and case examples illustrates the diverse pathways through which data-driven solutions can enhance farmer engagement, data quality, and value creation across agricultural and aquaculture systems. Publicly and donor-funded platforms such as Dimagi–CommCare demonstrate strong effectiveness in supporting extension services, surveys, and monitoring at scale, particularly where affordability and inclusiveness are priorities. Their wide adoption underscores the importance of subsidized access and user-friendly, low-complexity design in strengthening data completeness and operational efficiency.

Buyer-funded solutions highlight the role of private-sector demand in accelerating adoption, especially where traceability, certification, and regulatory compliance are required. Linking farmer participation to contracts and price premiums has proven to be a strong incentive, though long-term success depends on maintaining trust and ensuring that value is shared equitably along the value chain.

Hybrid models, demonstrate the potential of combining public funding, grants, and commercial services to reduce barriers for farmers while delivering high-value outcomes such as transactional transparency, dispute reduction, and digital identity creation. These approaches are particularly effective in environments where trust and accountability are critical constraints.

Finally, farmer-pays weather forecasting service illustrates that producers are willing to directly invest in data services when benefits are immediate, tangible, and clearly linked to productivity gains. The demonstrated yield improvements reinforce the importance of clear value propositions and simple delivery mechanisms, even in low-resource settings.

Taken together, these examples confirm that successful digital data tools are those that align incentives, minimize entry barriers, and clearly demonstrate value to farmers while meeting the needs of buyers, governments, and regulators. The evidence supports the conclusion that scalable and sustainable data systems in small-scale agriculture and aquaculture are most likely to emerge through blended approaches that combine public support, private-sector participation, and farmer-centered design.

Data Records: Designing a proposal

Speaker: Constanza Vergara – Undersecretariat of International Economics Relations, Chile

The session convened participants to design practical, field-ready record-keeping proposals for small-scale aquaculture (SSA). The overarching aim was to align data recording with regulatory needs and producer value, ensuring that sanitary, food safety, and productive information can be captured consistently and used to inform decisions at farm and authority levels.
The objective of the work was for participants to design one or more record-keeping proposals that comprehensively address three dimensions: sanitary parameters, food safety parameters, and productive parameters. This

focus ensured that the resulting tools would support compliance while remaining actionable for producers to guide daily operations and continuous improvement.

To accomplish this, attendees were organized into three working groups, each facilitated by the expert's speakers and aligned with different participating economies. Group 1 included Chile and Peru; Group 2 comprised Indonesia;Malaysia; and the Philippines; and Group 3 included Thailand and Viet Nam, each group was supported by the expert speakers. This configuration was intended to promote peer exchange across varied production realities while maintaining manageable group sizes for hands-on design work.

Each group was given a concise set of instructions to structure the activity and keep outputs comparable. First, teams were asked to select a species representative of their local context and to briefly describe its production cycle. This grounded the record-keeping proposal in a concrete biological and operational timeline spawning or sourcing seed, nursery or acclimation, grow-out stages, and harvest, so that the placement of data capture points would be realistic. Second, groups were instructed to identify the key parameters that simultaneously support compliance (e.g., meeting sanitary and food safety requirements) and generate management value (i.e., information that producers can use to make better operational decisions, reduce risk, or improve efficiency). Third, the teams were to create either a unified "one-size-fits-all" record set or a small set of tailored records covering the three dimensions (sanitary, food safety, productive) for the selected species and production system.

The records proposals should be directly usable by farms and easily reviewed by competent authorities with the emphasis on clarity, minimal data burden, and traceability.

In summary, the working-group exercise objective was to move from high-level concepts delivered by the speakers through their lectures, to concrete record-design proposals. By anchoring the work in real production cycles and prioritizing a small set of high-leverage parameters across sanitary, food safety, and productive domains.

The results and record proposals by each group are shown in Appendix 1.

Workshop Conclusions

The workshop reaffirmed the fundamental importance of data collection as a cornerstone of effective aquaculture production management across APEC economies, from both government and private-sector perspectives. Participants agreed that reliable data is essential for informed decision-making, food safety assurance, and long-term sustainability.

At the same time, the discussions highlighted a significant data gap within the region, with practices varying widely, from limited or non-existent record-keeping to advanced, authority-led monitoring systems, underscoring the need for greater convergence and capacity building.

The workshop concluded that robust and consistent data recording delivers clear benefits at the farm and policy levels. Improved data quality supports better feed efficiency, strengthens fish health management, and enables earlier detection and prevention of disease outbreaks.

From a governance perspective, accurate records contribute to fairer allocation of public support, including grants and subsidies, while fostering a transition toward evidence-based, data-driven regulatory frameworks.

Participants emphasized that data recording tools must be tailored to biological and operational realities. A uniform approach is not appropriate given the diversity of aquaculture species and production systems across the region. Instead, species-specific data frameworks, reflecting the distinct life cycles and management requirements of finfish, crustaceans, seaweed, and other products, are required to ensure that information collected is relevant and actionable.

Finally, the workshop stressed that successful adoption depends on simplicity and accessibility. Data systems must be easy to use, clearly explained, and available in local languages to encourage producer participation. Promoting practical, context-appropriate data records was identified as a key enabler for strengthening farming systems, improving productivity, and advancing sustainable aquaculture development across APEC economies.

Appendix 1- Results from Workshop group work session.

Table 1. Record data form proposed by group 1, designed for Shrimp farming species.

Parameters / Location	Size/ No of PLs	Date	Age (days)	Sanitary									Food safety				Productive								Note
				Water quality					Motality (No)			Lab results	Treatment				Feed			suplement		Average weight	ADG	FCR	
				time	pH	DO	S ‰	temp	Nor	Abn	Symt		Name	method	Dosag	withdraw	Lot	Size	Quantity	Name	Quantity				
pond 1	PL15 1500000																								
pond 2	…																								
pond ...	…																								

Table 2. Record data form proposed by group 2, designed for seaweed farming species.

Category	Parameter	Sub-Parameter	Frequency	Record Value
Sanitary	Location selection	Distance from pollution sources	Seasonal	
Sanitary	Location selection	Tidal flow/current	Seasonal	
Sanitary	Location selection	Accessibility (roads, landing)	Seasonal	
Sanitary	Biosecurity management	Fencing	Monthly	
Sanitary	Biosecurity management	Predator control	Monthly	
Sanitary	Biosecurity management	Visitor log	Monthly	
Sanitary	Biosecurity management	Disinfection / footbath facilities	Monthly	
Sanitary	Disease surveillance	Clinical signs & lab test results	Monthly / as needed	
Food Safety	Antibiotics use	Record of antibiotics used	As needed	
Food Safety	Antibiotics use	Withdrawal periods observed	As needed	
Food Safety	Contaminants	Heavy metals (Hg, Pb, Cd)	Quarterly	
Food Safety	Contaminants	Pesticide residues	Quarterly	
Food Safety	Contaminants	Microplastics	Quarterly	
Food Safety	Contaminants	Microbiological counts	Quarterly	
Food Safety	Good Handling Practices	Personal hygiene practices	Daily	
Food Safety	Good Handling Practices	Protective clothing availability	Daily	

Food Safety	Good Handling Practices	Equipment cleaning / sanitation	Weekly	
Production	Biomass	Standing crop weight (kg/area, wet basis)	Weekly / Monthly	
Production	Quality assurance	Moisture % in harvested product	Weekly	
Production	Qualified seeds	Seed certification documents	One-time per batch	
Production	Mortality	Dead stock removed (kg/area)	Weekly / Monthly	
Production	Buying prices	Price per kg (farm gate)	Per transaction	
Production	Feed Conversion Ratio (FCR)	Feed input vs biomass gain ratio	Weekly	
Production	Growth rate	Weight gain per day (%)	Weekly / Monthly	
Production	Harvest yield	Harvested biomass per cycle	Per harvest	
Production	Economic records	Cost of feed	Monthly	
Production	Economic records	Labour costs	Monthly	
Production	Economic records	Revenue & profit margin	Quarterly	

Table 3. Record data form proposed by group 3, designed for farming species *Rainbow trout*. Data collection table and reporting table.

Data collection table

Tank	N° of fish	Tank volume	Origen	Week number					
				No. Fish	Average weight	Mortality	Other outputs	Feed provided amount	Suggested feed amount
Tank 1	123456	123456	Farm name						0
Tank 2	123456	123456	Farm name						0
Tank 3	123456	123456	Farm name						0
Tank ...	123456	123456	Farm name						0

Reporting table

Week	Mortality	Average Mortality	Average Weight (kg)	Feed Intake (kg)	Feed Cost (USD)
1	10	54869.33	0.01	564.89	$282
2	10	54869.33	0.01	649.62	$325

Appendix 2 – Record form set and User guideline

I. RECORD FORM AND DATA ENTRY MANUAL FOR SEAWEED FARM OPERATIONS

RECORD FORM EXCEL TEMPLATE: Record forms Templates

Manual: Small-Scale Seaweed Aquaculture Monitoring

1. Overview

This manual explains how to fill out the three main sections of your data records template 1) Production Events, 2) High-Frequency Monitoring, and 3) Periodic Management.

**Units can vary according to species and production systems*.

2. Section 1: Production Event

This sheet records the physical setup of your farm units (e.g., longlines, nets, or rafts). Fill this out every time you install or remove a production unit.

- **Site & Farm Unit ID:** Use a unique name or number for each location and rope (e.g., *Site_A, Line_01*).
- **Dimensions (number): *Length/Width/Depth:** Record in meters.
- **Quantity (number):** The number of units installed (e.g., number of seedlings per rope or number of ropes).
- **Installation/Removal Date:** Use standard format (e.g., MM-DD-YYYY)

3. Section 2: High-Frequency Monitoring

This sheet will track the health of your crop and the water conditions.

A. Environmental Indicators

- **Temperature (°C):** Measure at the depth desired (e.g., superficial 0m/ deep 10 m).
- **Salinity (PSU):** salinity at different depths (e.g., superficial 0m/ deep 10 m).

- **Nutrients (NO_3, PO_4, NH_4):** Concentration of Nitrate, Phosphate, and Ammonium in the water (e.g., mg/L).

B. Biological Indicators

- **Biomass per meter (kg/m):** depending on your farming system, collect a determined number of individual or 1-meter section of rope/substrate to obtain seaweed weight.
- **Growth Rate (%):** The percentage increase in size since the last measurement.
- **Health Status:** Use determined words such as "bleached", “epiphytes present” or "good condition/healthy".
- **Epiphyte Load:** Define a percentage of coverage by unwanted organisms growing thallus (e.g., 50% of coverage).

4. Section 3: Production

This section focused on the production of the system/farm.

Event time: indicate when an event occurs, such as seeding, harvesting or treatment applied.

Input/Treatment: detail in case a treatment was applied, for instance, epiphyte removal.

Biomass production: the amount of biomass was seeding/harvested in kilos per square meter, linear meter, hectares, etc. Use the unit according to your farm system/production unit.

5. Glossary of Indicators

Biofouling: Organisms like barnacles on your ropes. High fouling adds weight and can sink buoys.

Thallus: The body of seaweed (equivalent to a plant's leaf/stem).

II. RECORD FORM AND DATA ENTRY MANUAL FOR SHRIMP FARM OPERATIONS
RECORD FORM EXCEL TEMPLATE: Record forms Templates

Manual: Small-Scale Shrimp Aquaculture Monitoring
Goal: To standardize data collection, reduce mortality, and optimize the Feed Conversion Ratio (FCR) for better profitability.

1. Daily Setup & Identification

Before recording measurements, ensure the basic "Day zero" data is correct.

- **Date:** The current calendar day.
- **N Stocking PL:** The total number of post-larvae (shrimp seeds) released into the pond at the start.
- **Farming Days (DOC):** Days of Culture. Day 1 is the day of stocking.

2. Water Quality Monitoring

Water quality is the life support system of your shrimp. Measurements should ideally be taken at **dawn (6:00 AM – 7:30 AM)** when Oxygen is at its lowest.

Parameter definitions & critical ranges

Parameter	Definition	Ideal Range	Action out of range
pH	Level of acidity/alkalinity.	**7.5 – 8.5**	If < 7.0, add agricultural lime.
DO (Oxygen)	Dissolved Oxygen in water.	**> 4.0 mg/L**	If < 3.0, turn on all aerators immediately.
S ‰ (Salinity)	Salt concentration.	**15 – 25 ‰**	Monitor based on local species requirements.
Transparency	Clarity measured by Secchi Disk.	**30 – 45 cm**	< 25 cm (Algae bloom), > 60 cm (Clear water/No food).
Ammonia	Toxic waste from shrimp/feed.	**< 0.1 mg/L**	If > 0.2, reduce feed and exchange water.
Alkalinity	Water's pH buffering capacity.	**100 – 150 mg/L**	Crucial for shell hardening after molting.
Temp	Water temperature.	**26 – 32 °C**	< 22°C or > 34°C will stop shrimp from eating.

3. Health & Biosecurity

This section tracks shrimp health conditions and mortality.

- **Mortality (Number):** Count dead shrimp found in feed trays or pond edges.
- **Symptoms (Symt):** Note any abnormalities. *Example Codes:* **(N)** Normal, **(SS)** Soft Shell, **(EG)** Empty Gut, **(WS)** White Spots.
- **Microbial Management:** Record any probiotics (e.g., *Bacillus*) added to improve water or soil health.

- **Food Safety (Withdrawal):** If any legal chemical treatment is used, you **must** record the "Withdrawal Period." This is the number of days you must wait before harvesting to ensure no chemicals remain in the meat.

4. Feeding & Productivity

Feeding represents ~60% of your costs. Recording this accurately is vital.

- **Feed Qty (kg):** Total kilos of feed given that day.
- **Average Weight (g):** Once a week, weigh a sample of 100 shrimp and divide by 100.
- **Biomass:** The estimated total weight of shrimp is currently in the pond.

5. Key Performance Calculations

The spreadsheet will use these formulas to tell you if the farm is performing well:

Average Daily Gain (ADG)

Indicates how many grams the shrimp grow every day.

$$ADG = \frac{\text{Current weight (g)} - \text{Previous weight (g)}}{\text{Days between samples}}$$

*Target: **0.15g – 0.30g / day***

Feed Conversion Ratio (FCR)

The most important efficiency metric. It shows how many kilos of feed were used to produce 1 kg of shrimp meat.

$$FCR: \frac{\text{Total feed consumed (kg)}}{\text{Biomass gained (Kg)}}$$

*Target: **1.2 – 1.6.** If FCR is > 2.0, you are losing money on feed.*

III. RECORD FORM AND DATA ENTRY MANUAL FOR FINFISH FARM OPERATIONS
RECORD FORM EXCEL TEMPLATE: Record forms Templates

Manual: Small-Scale Finfish Aquaculture Monitoring

1. Introduction

This manual provides the necessary guidelines for small-scale trout producers to collect, calculate, and interpret farm data. Proper monitoring is essential for optimizing growth (SGR) and feeding efficiency (FCR).

2. Key Parameters and Definitions

2.1 Stocking and Inventory

- Initial Stocking: The total number of fish at the beginning of the cycle.
- Number of Fish: The current count of living fish.
- Average Weight (g): The average size of the fish is determined through sampling.
- Biomass (kg): Total weight of fish in the tank.

Biomass: $\frac{\text{Number of Fish} \times \text{Average Weight}}{1000}$

- Density (kg/m³): The load of fish per unit of volume.

Density: $\frac{\text{Biomass}}{\text{Tank Volume}}$

Critical Range: Maintain below 30-35 kg/m³ for trout.

2.2 Performance Metrics

- FCR (Feed Conversion Ratio): Measures feed efficiency.

FCR: $\frac{\text{Total Feed (kg)}}{\text{Biomass Gain (kg)}}$

Target: 1.1 to 1.3

- SGR (Specific Growth Rate): Percentage of weight gain per day.

SGR: $\frac{\ln(\text{Final Weight}) - \ln(\text{Initial Weight})}{\text{Days}} \times 100$

Target: 0.8% - 1.2% for fattening stage.

- SFR (Specific Feeding Rate): Percentage of biomass given as feed daily.

$$SFR: \frac{\text{Daily Feed}}{\text{Biomass}} \times 100$$

2.3 Water Quality

- Oxygen Saturation (%): Must be above 85% for optimal growth. Below 70% is an emergency.
- Temperature (°C): Trout prefer 12°C - 16°C. High temperatures (>18°C) are dangerous.
- pH: Target range is 6.5 to 8.5.

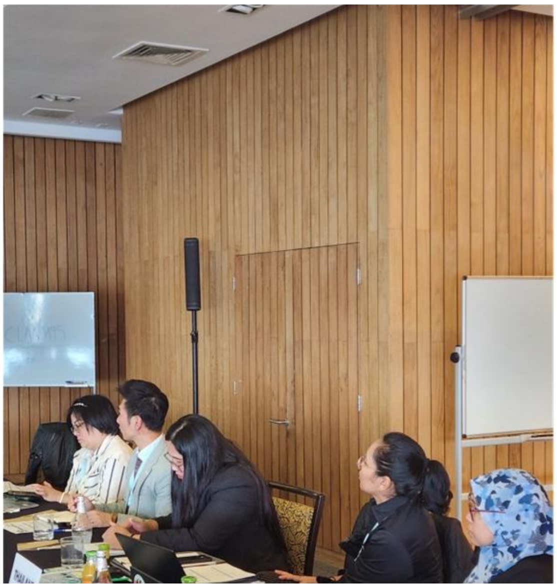
3. Data Entry Routine

- Daily: Record Temperature, Oxygen, Mortality, and Feed.
- Weekly: Sample fish for weight updates and calculate FCR/SGR.
- Monthly: Review feed costs and harvest projections.

4. Withdrawal Period and Safety

- Withdrawal (Days): The mandatory time between a treatment (e.g., antibiotics) and harvest to ensure food safety.

Appendix 3 – Workshop photos




CHILE


A
B
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Appendix 4 – Workshop´s Participant Economies State of Art in SSA.

Chile – Ms. Carla Anguita, SERNAPESCA

a) **Collection and Use of Data**

Small Scale Aquaculture Regulation Framework in Chile:

D.S. N° 45-2022 Approves the Small-Scale Aquaculture Regulation

Key elements of the regulation include:

- Creating a registry of SSA producers
- Establishing a list of authorized species
- Defining areas where aquaculture can occur
- Implementing sanitary and environmental provisions
    - Mandatory reporting requirements for SSA include Stocking – per event, Harvest – per event, Fish mortality – monthly, Stock – monthly, other outflows – per event.
    - Reports must be submitted through CCA-CCO / SIFA systems by the 12th of the following month.
    - In cases of mass mortalities, producers must immediately notify SERNAPESCA.
    - Instructing SERNAPESCA to develop a Good Aquaculture Practices Manual focused on reinforcing sanitary and environmental compliance obligations for SSA.

b) **What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?**

Main challenges identified are:

- Identifying producers (completing the registry)
- Communicating regulations and assisting producers in reporting
- Improving data collection systems and digital tools

c) **Women Participation in SSA**

Gender inclusion is recognized as an important component of Chile's SSA framework, and the inclusion of women is a formal priority in SSA Development

For this, the Fisheries and Aquaculture Service (SERNAPESCA) acknowledge women as a significant and growing part of the SSA sector. This reflects broader commitments to support rural and coastal women who often work in:

- Shellfish harvesting
- Seaweed gathering and farming
- Processing and value-added activities

- Small-scale aquaculture husbandry

Women in Chile are actively engaged in hands-on aquaculture activities:

- Farm operations (feeding, husbandry, cleaning, maintenance)
- Post-harvest tasks (sorting, grading, handling)
- Processing and small-scale commercialization
- Community-based management of aquaculture areas

This positioning emphasizes that women are not peripheral workers but active contributors within the value chain.
Role of Women within the New Regulatory Framework (D.S. N° 45-2022) will permit to be direct beneficiaries of clearer procedures, better safety guidelines, and stronger institutional support, because new SSA regulation (D.S. N° 45-2022) requires registration of small-scale producers.

d) How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?

Benefits of improved data:

I. Strengthening and expanding productive and commercial capacities.
II. Supporting evidence-based decisions for public policies.
III. Enhancing health standards and overall sustainability within SSA.

Indonesia - Mr. Adi Krisianto, Ms.Aya Sofa Novia – BSN

a) Collection and Use of Data

Overview of Indonesia's aquaculture sector:
Main Species:

- Shrimp (vannamei, tiger), tilapia, carp, catfish, milkfish, gourami, seaweed (*Eucheuma*, *Gracillaria*), pearl oysters, and grouper.

Types of Production Systems:

- Ponds & paddy fields (carp, tilapia, catfish, gourami, milkfish)
- Open-water cages (carp, tilapia, catfish)
- Brackish-water ponds (shrimp, milkfish)
- Mariculture/longlines (grouper, seaweed, seabass)

Economic Role:

- Aquaculture contributes >50% of fish production
- Sector engages 2.2+ million households (~40% of the fisheries workforce)
- 90% of fish is consumed domestically; per-capita consumption 56 kg/year
- Shrimp accounts for >50% of export value; seaweed grows rapidly in volume/value

Institutions involved:

- DGA (Directorate General of Aquaculture) – implementation
- MFQAA – competent authority
- BPS (Statistics Agency) – compiles Indonesia aquaculture statistics
- BSN – develops SNI standards for GAP, HACCP, feed, hatcheries
- KAN – accredits certification bodies
- NGOs and private sector – support sustainability, traceability, and maintain farm-level records (e.g., Rare, SFP, LINI, MDPI)

Indonesia´s Data Systems & Standards:

- “One Data” platform by KKP
- BPS aquaculture surveys
- CBIB certification records (farm-level logs of feed, water quality, chemical use, harvest)
- SNI standards (CBIB, CPIB, CPPIB)
- Accredited certification bodies (e.g., Balai Besar units Jepara, Sukabumi, Takalar)

Statistics for small-scale aquaculture households (2019–2023):

- Marine culture: ~1.28–1.59 million households
- Brackish water: ~211,090–239,147
- Freshwater: ~957,662–1,201,559 households

b) **What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?**
Key SSA data-related challenges:
- Awareness of the importance of data recording
- Low awareness among small farmers; weak skills in maintaining sanitary & environmental logbooks.
- Fragmented and unintegrated data systems
- Farmers, local offices, certification bodies, and research institutions collect data independently, no unified economy system.
- Resource and infrastructure constraints
- Limited affordable monitoring tools (e.g water quality indicators), disease surveillance, digital connectivity, especially in rural areas.

c) **Women Participation in SSA**
Women play meaningful roles across aquaculture subsectors.
Share of Women in Aquaculture Workforce (BPS 2023):
- Freshwater aquaculture: 16.8%

- Hatcheries: 13.5%
- Brackish water aquaculture: 9.5%

Main Activities:

- Post-harvest handling (cleaning, drying, simple processing)
- Local marketing and retail distribution
- Feeding, pond care, logbook maintenance (CBIB)
- Seaweed and ornamental fish farming

Programs Supporting Women:

- Gender Mainstreaming Program (PUG) by KKP
- Kelompok Wanita Tani Ikan (Women Fish Farmer Groups) for capacity building & microfinance
- NGO initiatives (WWF, Rare, LINI) in community-based sustainable aquaculture

d) How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?

Improved data collection will:

- Strengthening compliance with SNI GAP record-keeping
- Standardized logbooks improve feed, water quality, and chemical input documentation.
- Integrate and digitize aquaculture data systems
- Linking farmer-level, local, NGO, and certification-body data facilitates decision-making and traceability.
- Support capacity building and accessibility
- Training and affordable tools for farmers, especially women, improve participation in digital reporting and supply chain integration.

Benefits of improved data systems include:

- Enhanced food safety compliance
- Greater export acceptance
- Better trade facilitation
- Higher product competitiveness
- Improved traceability and rapid corrective action
- Stronger technical decision-making
- Support for research and development
- Positive economic impact

Malaysia – Ms. Nor Fatmahwati Binti Yakup, Dept. of Fisheries.

a) **Collection and Use of Data**

Key information on SSA production:

- Aquaculture production value: MYR300,000 per year
- Main species farmed: seaweed and catfish

Production systems:

- Seaweed: longline raft in open sea
- Catfish: tanks or ponds

SSA production is mostly for domestic/internal consumption rather than export.

The *eKanMAS* digital system supports aquaculture data management and regulatory processes, including:

- Farm registration
- Sampling program
- Import/export applications (live shrimp)
- Health certificate applications
- Certification program applications
- Private laboratory verification

This system plays a key role in monitoring, traceability, and sanitary compliance.

b) **What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?**

Malaysia identifies three major SSA data challenges:

- Lack of cooperation/participation from farmers:
- Limited human or financial resources for data collection
- Difficulty obtaining accurate and reliable data

These gaps hinder Malaysia´s monitoring and regulatory efficiency.

c) **Women Participation in SSA**

Women contribute to SSA mainly through:

- Administrative tasks
- Selling and marketing aquaculture products
- Product processing

This highlights women's role in economic and value-added segments of the SSA chain. For this reason, Malaysia also implements programs to empower women in SSA with the aim to build women's capacity and participation in aquaculture-related income generation:

- Technical training programs (e.g., product processing courses)

    - Financial training courses to support entrepreneurship and micro-enterprise management

d) **How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?**

Improved data collection is expected to:

- Improve operational efficiency
- Better feed management
- Improved fish health monitoring
- Early disease detection
- Enhance distribution of government assistance (grants, subsidies)
- Enable data-driven decisions for both farmers and government
- Better farm management
- More informed policy and planning

México – Mr. Francisco Martínez, CONAPESCA

a) **Collection and Use of Data**

- CONAPESCA collects data and publishes annual databooks, but the SSA database is non-continuous, covering only general variables such as total production, species, and location, with a focus on production volume rather than productivity or efficiency.
- SENASICA, Mexico´s agri-food health authority, maintains the most extensive aquaculture database, including sanitary and health information for inland and marine aquaculture. Its mandate is to protect agricultural, livestock, aquaculture, and fishing resources from pests and diseases.

  Regulatory requirements include:
    - Notice of stocking,
    - Notice of harvesting,
    - Documentation of seed origin,
    - Notice of organism movement,
    - Traceability throughout production cycles.

b) **What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?**

  - Farmers must be continually encouraged, through outreach and extension, to keep records consistently.

- Most farmers still rely on paper-based systems, and adoption of digital tools is very limited. Paper often needs to be transferred manually into electronic formats.
- Extension work starts with collecting and analyzing data, including input/output variables and financial information.
- Some commercial mobile apps exist, but their use remains uncommon.
- There is very limited information on the value chain, especially last-mile markets.
- Partial insights come from academic and NGO studies, which complement but do not replace systematic economy´s databases.

c) **Women Participation in SSA**

Three major programs are emphasized:

- Program for Self-Managed Aquaculture Technical Support
- Strategy for the Empowerment of Women in Aquaculture
- Strategy for Indigenous and Afro-Mexican Aquaculture Development

These initiatives promote inclusion, technical development, and systematic information collection in SSA.

d) **How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?**
No information on this aspect was presented.

Perú – Mr. Arturo Aivar, SANIPES

a) **Collection and Use of Data**

Peru's aquaculture sector is dominated by small-scale producers and continues to grow in volume and diversity. By 2024, total aquaculture production surpassed 108,000 MT, of which 59% was maritime and 41% continental. The main cultivated species are:

- Scallop: 43,000 MT
- Trout: 38,726 MT
- Shrimp: 20,425 MT
- Tilapia: 2,447 MT
- Other species: 3,540 MT

Peru recognizes three producer categories:

- AREL: Small-scale aquaculture (<3.5 gross tons), focused on subsistence and local/regional markets.
- AMYPE: Micro and small aquaculture (3.5–150 gross tons).
- AMYGE: Medium and large aquaculture (>150 gross tons).

These categories, especially AREL and AMYPE,mainly operate in corrals, floating cages, and ponds.
Of all aquaculture licenses and permits in the economy:

- 73% correspond to AREL,
- 27% to AMYPE + AMYGE.

This highlights the dominance and social relevance of small-scale aquaculture

SANIPES, the aquaculture and fisheries health competent authority, collects and uses data from authorized operators to guide regulatory and sanitary management.

It compiles information through 3 major programs, including:

- Official Control Program for Bivalve Mollusks
- Veterinary Drug Residue Control Program
- Monitoring of prohibited substances and pesticides in aquaculture

These datasets support continuous improvements in:

- Health surveillance
- Sanitary risk control
- Regulatory adaptation
- Evidence-based management decisions

b) **<u>What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?</u>**

Peru faces significant barriers to establishing a unified, reliable data system for small-scale aquaculture:

- Need to collect information from multiple public institutions
- Need to process and integrate heterogeneous datasets.
- Need to analyze information to detect trends and inform decision-making.
- Need to train small producers in proper record-keeping and data use.

c) **<u>Women Participation in SSA</u>**

Women play an essential role in AREL and AMYPE, particularly in:

- Farming
- Marketing
- Primary processing

SANIPES has made consistent efforts to strengthen women's involvement through training, with the percentage of women trained by public programs has rise from 31.6% in 2023 to 33% in 2025.

d) **How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?**

Improved data and record-keeping will generate direct and indirect benefits, which are:

- Strengthening health surveillance and sanitary control
- Enhancing adaptation of health regulations as new risks or trends emerge
- Supporting capacity building through better understanding of production dynamics.
- Formalization of small-scale producers across the aquaculture sector
- Increased participation of women by integrating them into formal training and data-driven programs.
- Strengthening the aquaculture production chain, improving governance and long-term sustainability.

The Philippines - Ms. Sonia Somga, Ms. Elymi Ar J Tuñacao, DA-BFAR.

a) **Collection and Use of Data**

The Philippines is an archipelagic economy where aquaculture is a major contributor to fisheries production. Key SSA characteristics include:

- Seaweeds: 1.63M MT in 2023 (68% of aquaculture output)
- Milkfish (Bangus): dominant in brackish water ponds and marine cages
- Tilapia: major species in freshwater ponds and cages
- Shrimp (P. vannamei): rapidly expanding (+32.3% in 2024)

Production systems include brackish water ponds, freshwater ponds/cages, and marine cages/pens. SSA is crucial for domestic food security and supports 2.3 million fisherfolk, of which 11.4% are in aquaculture.

Key Stakeholders:

- o BFAR: farm registration, monitoring, and food safety
- o PSA: The Philippines´s aquaculture production surveys
- o LGUs: assist and validate farm-level data
- o International partners: UN-FAO, NACA, SEAFDEC, NGOs
- o Private sector: fish farmers and farm operators

Main Data Systems:

- o FishR: fisherfolk registry
- o NRCP Farm Registration: mandatory for residue monitoring and export compliance
- o PSA Fisheries Surveys: quarterly data on species and environment

These systems support traceability, planning, and food safety compliance.

<u>Latest Production Data:</u>

2023: 2.38M MT (56% of total fisheries),
2024: 2.22M MT, a 6.8% decline
2025 (Q1–Q2): early signs of recovery
Uses of SSA Data:

- Policy formulation and program design
- Monitoring livelihoods and socio-economic indicators
- Ensuring food safety and trade compliance

b) What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?

Many SSA farms remain unregistered, creating:

- Gaps in production statistics
- Weak traceability and incomplete biosecurity risk data
- Challenges in harmonizing databases
- Difficulty designing targeted capacity-building and support programs

SSA operators often lack skills or systems for documenting:

- Production practices
- Antimicrobial use
- Environmental parameters

This leads to weak traceability, higher AMR risks, and inability to correlate production with socio-economic and food safety outcomes.

In data verification and integration gaps, main problems include:

- Difficulty validating reported production data due to limited manpower
- Non-harmonized databases: FishR, NRCP, PSA
- Difficulty consolidating datasets for policy, planning, trade compliance

c) Women Participation in SSA

Of 2.29 million registered fisherfolk, 30% are women.
Women are heavily involved in:

- Fish processing
- Fish vending
- Pre-fishing activities (equipment preparation, net mending, etc.)

d) How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?

1. Build Farmer Capacity in Record-Keeping

- Training SSA farmers on documenting production, feeding, health, antimicrobial use, and environmental practices.
- Improving traceability and food safety compliance through better records.

2. Pilot implementation of AqFGIS

The Aquaculture in Fisheries Geospatial Information System (AqFGIS) aims to:

- Provide systematic aquaculture inventory and profiling.
- Support planning and decision-making.
- Integrate FishR, NRCP, and PSA data.
- Expand digital tools for registration, reporting, and residue monitoring
- The pilot currently covers 13 regions, 31 provinces, 306 municipalities, with wide rollout planned.

Thailand – Ms. Kaninkporn Kessuwan, Ms. Ketpaitoon Kaewpaitoon, Dept. of Fisheries.

a) Collection and Use of Data

Thailand is a leading aquaculture producer in Southeast Asia, supported by extensive coastlines and inland waters.

Two main sectors: coastal aquaculture and inland aquaculture.

Key farmed species include shrimp, fish, mollusks, and other aquatic organisms for domestic use and export.

Total aquaculture production reached 1,001,220 tons in 2023.

Thailand´s aquaculture volumes and their economic relevance:

Freshwater (45.94%, 459,980 tons):

- Tilapia: 266,480 tons
- Walking catfish: 91,001 tons
- Giant freshwater prawn: 41,919 tons
- Others: 60,580 tons

Coastal (54.06%, 541,240 tons):

- Marine shrimp: 392,544 tons
- Marine fish: 55,734 tons
- Marine shellfish: 89,426 tons
- Sea crabs: 3,536 tons

- Total value: USD 2.885 billion, representing 55% of all fisheries production.
- Slight 7% decrease from 2022.
- Inland aquaculture value: USD 837.5 million.
- Coastal aquaculture value: USD 2.051 billion.

Data collection involves multiple institutions:

- Department of Fisheries (DoF)
- Universities
- Private sector: hatcheries, processing plants, farm supply stores

- Other organizations

These actors contribute to farm registration, production surveys, standards, and environmental/health monitoring.

The DoF manages:

- Farm registration for coastal and inland species (e.g., shrimp, marine finfish, mollusks, prawns, finfish)
- Standards: GAP, Thai Agricultural Standards (TAS), BAP, ASC
- Production data: questionnaires and Aquatic Animal Purchasing Document (APD)

Surveillance programs:

- Aquatic disease (WOAH-aligned)
- Water quality monitoring
- Residue monitoring (RMP/AMR)

Small Scale Aquaculture (SSA) does not have a universal definition in Thailand. Instead, it is characterized by:

- Low to moderate production levels
- Limited technology use
- Low capital investment
- Strong reliance on family/household labor
- Classification varies depending on species (high-value, economically important species), scale, farming area (no fixed limit; ~10 rai (~1.6 ha) may be considered SSA), and production methods.

b) **What are the main challenges your economy faces regarding collecting, managing, or using sanitary and environmental data from small-scale aquaculture (SSA)?**
Major challenges include:
    - Limited Data Collection Practices: No standardized protocols for data recording/reporting
    - Low Incentives for Farmers: Minimal perceived benefit from providing data
    - High Operational Costs: Staff training, equipment, digital tools, laboratory testing, and system development.

c) **Women Participation in SSA**
Women play diverse roles across aquaculture operations:
    - Hatchery Stage: Water quality monitoring, disease diagnosis, administrative tasks

- Farm Level: Preparing feed and supplements, selling products at local markets, managing finances
- Processing Plants: Processing labor, administrative roles
- Other Roles: Additional support functions as needed

d) **How do you believe better data collection and records can help to improve your small-scale aquaculture (SSA)?**
Thailand identified several benefits of better data collection:
   - Improved Management & Decision-Making
   - Enhanced Traceability & Market Access
   - Better Disease & Environmental Management
   - Greater Access to Finance
   - Stronger Collaboration & Policy Support