Workshop on Reducing Food Loss and Waste through Packaging Innovations and Progress Review of FLW in the APEC Region

APEC Agricultural Technical Cooperation Working Group

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Table of Contents

I. Introduction

Food loss and waste (FLW) occurs throughout the food supply chain especially in storage and packaging (FAO 2019). Food waste in the consumption stage has also been increasing (UNEP 2024), and it's partly caused by malpractices in upstream stages, including storage and packaging (HLPE 2014). Packaging has a huge potential to prevent FLW and can strengthen food safety and food security by extending shelf life and allowing food to be transported across longer distribution channels as underscored in FAO's 2023 State of Food Security and Nutrition in the World. Poor packaging can contribute up to 20% of food waste; therefore, adjustment in packaging is recognized as one of the top three solutions to combat FLW by ReFED (2016). Moreover, statements no. 6 and 11 of the 9th APEC Food Security Ministerial Meeting last year emphasized packaging among the areas that need support to bolster food security. Hence, this workshop aims to improve the capacity of APEC economies to share and develop knowledge and skills to reduce FLW, particularly but not exclusively, in the packaging stage of the food supply chain. This could include case studies of the best practices from industry showcasing where and how packaging innovations and supply chain improvements led to food waste reductions.

Apart from this, in line with the Implementation Plan for APEC Food Security Roadmap Towards 2030 17(e), we also aim to review APEC's progress to gather information on each economy's individual and collective actions on FLW reduction along the food supply chain. The preliminary results of this review will be presented and discussed in the workshop.

This workshop covers topics on how innovative and actionable solutions will lead to reducing food loss and waste, and review progress on data measurement, collaboration, and policy actions, which are the key levers for achieving the most meaningful results on FLW reduction in APEC. Outcomes of this workshop were delivered to the ATCWG and PPFS during the APEC 2025 Food Security Week in Korea.

II. Workshop Summary

The workshop was held in Taichung City in Chinese Taipei on 5–6 June 2025, with 152 representatives from 16 APEC member economies in attendance.

Among the participants, 77 were female (51%) and 75 were male (49%). The first day's workshop comprised four sessions: Session 1: Global outlook and policy review on reducing FLW; Session 2: Packaging innovations & applications on FLW reduction; Session 3: APEC midterm review on FLW reduction; and Session 4: Member economy report: Progress review on FLW reduction. On the second day, the workshop comprised two sessions and the field study. The session 5 discusses date labeling and on-pack consumer education, and the session 6 is the panel discussion on packaging and mid-term review on FLW reduction. After that, the participants visited the Packaging Institution at Sustainable Materials Library (SML), which showcases sustainable materials in seven categories. Designers and product developers can explore materials and prototypes, while suppliers connect with market demands; and also visited the Food Packaging Warehouse at Cheng Mei Cultural Park (CMCP), which is a humanities museum dedicated to preserving the values of everyday life, integrating traditional and modern cultures, revitalizing local exhibitions, and promoting tourism and leisure. Through these visits, participants were able to gain a first-hand understanding of sustainable materials of packaging, as well as the humanities culture and plant ecology in Chinese Taipei.

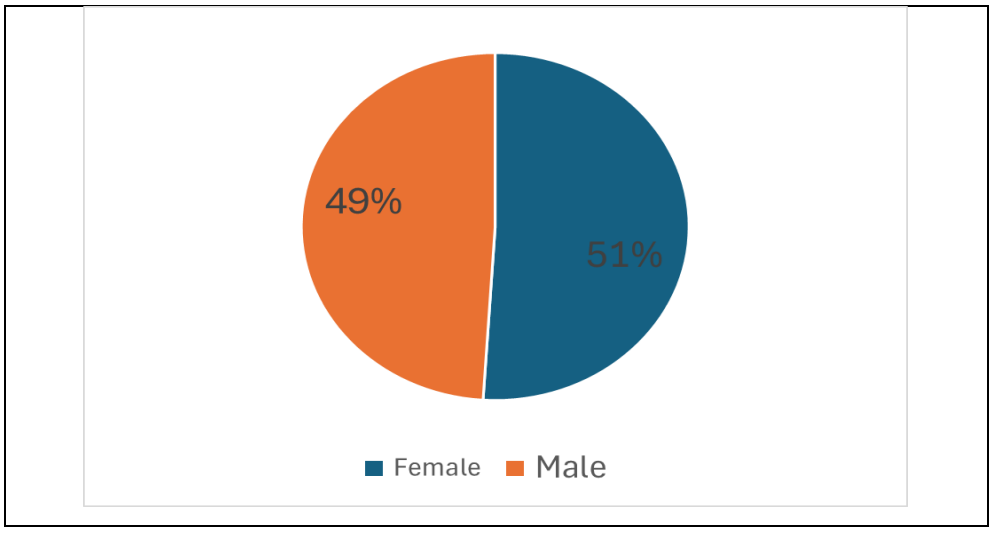

Figure 1. Participants' percentages in genders

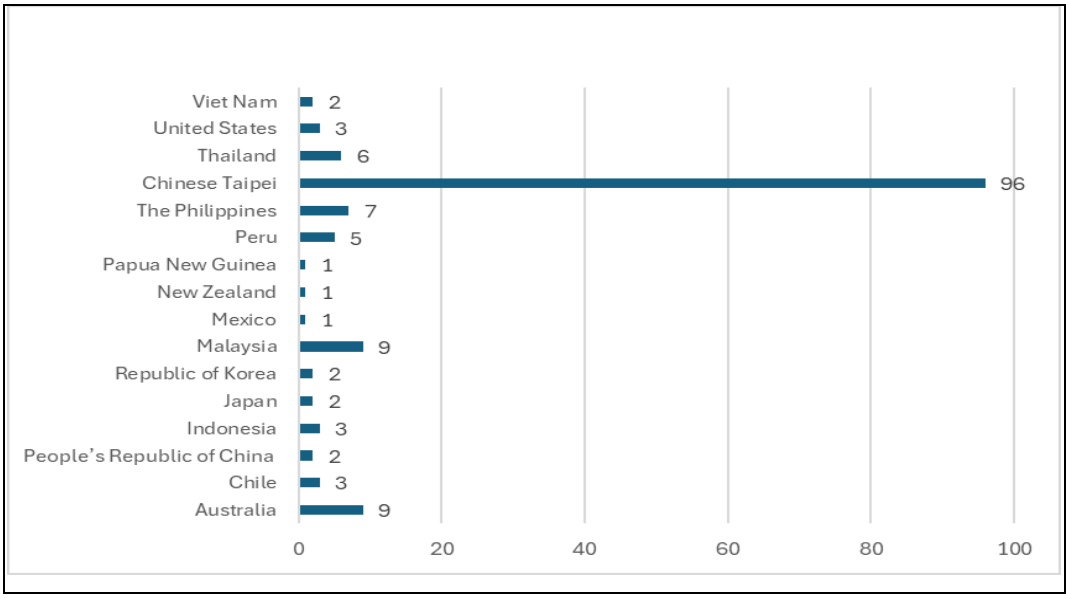

Figure 2. Number of participants by APEC economies

1. Session 1: Global outlook and policy review on reducing FLW

Global FLW prevention and reduction: A hopeful outlook
Maximo Torero, FAO

In his presentation on *Global FLW Prevention and Reduction: A Hopeful Outlook*, Dr Torero discussed recent developments and data in food loss and waste (FLW) reduction worldwide. He began by reviewing the FAO's updated definitions of food loss and food waste, noting that the organization is shifting from independently calculating food loss to relying more on data reported by individual economies. Regional patterns show varying trends: food loss in Sub-Saharan Africa slightly decreased but remains the highest globally, while Latin America and the Caribbean experienced the sharpest increase of 2.8 percentage points between 2016 and 2021. In contrast, Central and Southern Asia achieved the largest decrease. Globally, food waste currently stands at 19%, with one-sixth attributable to households discarding food.

Dr Torero underscored that reducing FLW is critical for easing global food insecurity and hunger, as well as for mitigating greenhouse gas emissions. He emphasized the circular economy as the pathway forward, prioritizing three key actions: first, prevent and reduce FLW; second, recover, reuse, and redistribute; and third, transform by-products into valuable resources. To illustrate effective strategies, he cited examples such as mobile applications, bulk packaging, hermetic grain storage, renewable energy use, optimized water management, composting, and collective learning initiatives.

He noted the growing demand for cooling technologies, calling for a comprehensive, system-based approach that also addresses the reduction of F-gases. On packaging solutions, he recommended shifting to lighter and more flexible

materials to reduce resource consumption and enhance transport efficiency, alongside adopting smart packaging technologies such as active and intelligent systems. As of August 2024, 90 economies have incorporated FLW reduction strategies into their Food Systems Transformation Pathways submitted to the FAO.

Dr Torero concluded with several recommendations: prioritize the collection of high-quality data to inform policies and incentivize scale-up of sustainable FLW reduction practices; promote collaboration across the food chain through partnerships, networks, integrated approaches, and awareness campaigns; continuously monitor technological innovations that reduce FLW from farm to fork; and invest in human resource capacity development to support implementation efforts globally.

How can private-public-partnerships drive reductions in FLW: From targets, measure, to actions

Dana Gunders, ReFED, United States

In her presentation titled *How Can Public-Private Partnerships Drive Reductions in FLW: From Targets, Measure, to Actions*, Dana Gunders outlined how strategic collaborations between public and private sectors can accelerate progress toward food loss and waste (FLW) reduction. After introducing ReFED and providing an overview of the U.S. food waste landscape, she discussed two major public-private partnership (PPP) initiatives led by the organization: the Pacific Coast Food Waste Commitment (PCFWC) and the U.S. Food Waste Pact, the latter being an economy-wide expansion of the PCFWC model.

Gunders shared that over half of the grocery stores in the United States are now engaged in these initiatives, and that Hilton Hotels recently became the first hotel chain to join. The PCFWC has spent five years gathering data and coordinating action among government agencies and private companies, while the U.S. Food Waste Pact operates primarily with business collaborators and the World Wildlife Fund (WWF). Both initiatives apply a clear framework built around three steps: target, measure, and act. According to their findings, participating PCFWC retailers have reduced unsold food rates by 30% since 2019. Although these rates fell sharply during the COVID-19 pandemic, only a slight rebound occurred afterward.

She explained that the observed decline in food donations is actually a positive outcome, as it reflects less waste generated at the source, even as the overall volume of food donations rose. To strengthen impact, ReFED recently introduced two additional working groups that complement existing food recovery efforts: staff training and engagement, and whole-chain solutions. The first helps companies uncover bottom-up innovations from employees that might otherwise go unnoticed at the management level. The second connects stakeholders across the same supply chain—such as producers, distributors, and retailers of a specific product like strawberries—to develop tailored solutions for reducing FLW within that product's lifecycle.

2. Session 2: Packaging innovations & applications on FLW reduction

The reduction of grains loss and the control of mycotoxins by package innovation

Fuguo Xing, Chinese Academy of Agricultural Sciences, China

Dr Xing provided an overview of China's food security landscape, emphasizing its unique position as both the world's largest food producer and consumer. He highlighted that China sustains 20% of the global population using only 9% of the world's arable land. One example of this efficiency is China's hybrid rice, capable of producing up to 18 tons per hectare. He then outlined several practices adopted across the Chinese food supply chain that contribute to reducing food loss and waste (FLW).

A major challenge addressed in his presentation was the presence of mycotoxins, toxic compounds produced by fungi that infect crops and contribute to significant food losses from pre-harvest to storage. Beyond their economic impact, mycotoxins pose serious health risks and have also constrained Chinese food exports. To address this, his team developed predictive models designed to work in tandem with a whole-cell biosensor array, which can deliver real-time data to inform early prevention and control strategies against mycotoxin contamination in maize and peanuts.

In addition to these advances, he showcased several related innovations: a bacterial strain engineered to inhibit fungal infection in pears, maize, and peanuts; a green anti-mildew packaging material that can monitor biochemical or microbial changes inside grain packaging, effectively functioning as a grain safety tracker; a packaging and stacking design tailored for small-scale storage that reduces pest and mildew incidence by 90%; and a non-destructive testing technology utilizing laser scanning and spectral imaging to detect fungal infections in maize and peanuts.

FLW reduction strategies in Japan and the role of packaging

Manabu Suzuki, Ministry of Agriculture, Forestry and Fisheries, Japan

Japan enacted the Food Recycling Act in 2000, setting a target to reduce FLW by half by the year 2030. As Japan achieved this objective in 2022, a new target was established for businesses to achieve a 60% reduction in FLW, using 2000 as the baseline.

The presentation described a range of initiatives implemented along the supply chain, including extension of best-before dates, upcycling, revision of expired food management and return policies, restaurant campaigns to prevent food waste, promotion of the *temaedori* consumer shopping practice, the no food loss campaign, AI-based demand forecasting, the *Mottainai* Awards, and guidelines for food donation.

Packaging innovations showcased included the *Hakuri* bottle, featuring an internal valve to maintain freshness, and modified atmosphere packaging designed to reduce spoilage. It was noted that the Circular Partners for Food initiative is scheduled to launch in 2025.

Innovative eco-friendly packaging technology to reduce FLW
Chan Suk Yoon, EverChemTech, Republic of Korea

In his presentation on *Innovative Eco-Friendly Packaging Technology to Reduce FLW*, Mr Yoon discussed how packaging innovations can play a critical role in minimizing FLW by regulating key environmental factors around food, including gases (O_2, CO_2, ethylene), moisture, temperature, and pathogens.

He categorized packaging technologies into five types: (a) active packaging, which removes or controls oxygen, moisture, and bacteria inside the package; (b) intelligent packaging, which uses visual or tactile indicators to help consumers assess product freshness without opening the package; (c) small-portion packaging; (d) high-barrier packaging; and (e) resealable packaging. The first two types—active and intelligent—are collectively referred to as smart packaging.

Mr. Yoon noted that the rise of single-person households has driven increased demand for convenience foods and smaller packaging. However, he also highlighted the trade-offs associated with high-barrier packaging, including challenges with recyclability, safety, and cost. As an eco-friendly alternative, his team developed a protein-based barrier coating using milk protein derived from cheese production by-products, aligning with recycling mandates and sustainability goals.

Additional developments include transparent packaging that enables freshness inspection, non-stick surface modification technology that prevents residue inside containers, and examples of global applications where innovative packaging successfully extended product shelf life and reduced FLW. He concluded by encouraging APEC economies to strengthen collaborative policies and joint research efforts to accelerate the deployment of sustainable packaging solutions across the region.

Applications of innovative packaging to reduce FLW from farm to household in Chinese Taipei
Hoong-Yuan Ho, Plastics Industry Development Center, Chinese Taipei

In her presentation on *Applications of Innovative Packaging to Reduce FLW from Farm to Household in Chinese Taipei*, Ms Ho outlined how packaging can mitigate food loss and waste (FLW) by controlling key environmental factors around food, including oxygen, carbon dioxide, ethylene, moisture, temperature, and pathogens. She summarized global packaging trends relevant to FLW reduction—Modified Atmosphere Packaging, active packaging, smart packaging, compostable and edible formats, recyclable mono-materials, and upcycled materials—and reviewed advantages and disadvantages associated with bio-based, mono-material, and biodegradable solutions. She reported that durable, breathable waterproof bags for fruit bagging can cut losses by nearly half and introduced the Fresher Green Bag, which combines ethylene adsorption with temperature and humidity control to extend freshness by about 1.5 times and has been patented in Japan and the United States. Additional applications included pressure-regulating packaging for microwaveable

convenience foods to avoid immediate opening at point of sale, transparent packaging to aid rapid freshness checks, non-stick surface modifications that enable complete dispensing of contents, and antibacterial packaging tailored for aquatic products vulnerable to microbial spoilage. She also noted the market shift driven by the rise of single-person households, which is increasing demand for convenience foods and small-portion packs, and highlighted trade-offs with high-barrier packaging in terms of recyclability, safety, and affordability. As an eco-friendly alternative, she described a protein-based barrier coating derived from dairy by-products that aligns with mandatory recycling policies. She concluded by encouraging APEC economies to expand policy coordination and joint research to accelerate deployment of sustainable packaging solutions across the supply chain.

Recent advances innovation to extend shelf life for horticultural products packaging and waste reduction in Thailand
Chusak Chuenprayoth, Thai Chamber of Commerce, Thailand

In his presentation, Mr Chuenprayoth highlighted several key advances. He described Active PAK, a technology developed by the National Science and Technology Development Agency (NSTDA), which uses a unique transparent, anti-fog plastic that allows consumers to easily view the produce inside. By creating a balanced modified atmosphere, Active PAK preserves the freshness, nutritional value, and flavor of fruits and vegetables for two to five times longer than conventional bags, which often require perforation and can cause wilting. This packaging extends the shelf life of fresh vegetables by an additional 7–14 days and reduces vegetable loss by approximately 7–8%.

Another advancement, OptiBreath, controls the exchange of oxygen and carbon dioxide in packaging to minimize microbial growth and keep products fresh and nutritious. This solution can maintain vegetable quality for an extra 3–5 days and fruit for 7–11 days, helping suppliers manage storage costs and reach distant markets by allowing for longer transit durations. Mr Chuenprayoth also noted a successful collaboration between Charoen Pokphand Foods, PTT Global Chemical, and various packaging manufacturers to develop 100% recycled PET plastic egg trays for fresh and processed eggs.

Additionally, he introduced a biodegradable bioplastic tray sealing film—Odor Lock—produced from a specialized plastic that prevents the leakage of strong food odors, such as those from durian or salted fish. This film is compatible with heat sealing, resists condensation in cold storage, and effectively preserves the original flavor of food products.

3. Session 3: APEC midterm review on FLW reduction

APEC mid-term progress review: Preliminary results
Kenneth Dy, Academia Sinica, Chinese Taipei

There will be a separate full report on the progress review per economy. Here only a summary is presented. Data in the review indicates that average FLW in APEC grew by 9.6% from 2015 to 2022 (1.32% annually), with the greatest increases attributed to Indonesia; Mexico; and Peru. Conversely, Russia and Chinese Taipei achieved reductions, primarily at the consumption stage or through improved handling of specific commodities. Most FLW growth occurred downstream in the supply chain, notably in processing, distribution, and final consumption, with vegetables and cereals being the most affected commodity groups. Comparing economies remains challenging given variations in size, structure, and data quality, and in some cases broader indicators like organic or municipal waste are used as proxies for FLW metrics.

Policy responses highlighted in the documents include a mix of legislative and non-legislative interventions: food donation and tax incentive laws, specific FLW reduction roadmaps, public awareness campaigns, private sector engagement (such as partnerships with food banks), and circular economy initiatives like composting, animal feed recycling, or waste-to-energy conversion. The progress review stresses the importance of mid-term and long-term strategies, cross-sector collaboration, and continuous knowledge sharing through platforms such as APEC-FLOWS. It also identifies persistent challenges, such as establishing harmonized definitions and indicators and bridging capacity gaps especially for data collection and midstream logistics.

Looking ahead, participants recommended prioritizing support for economies in implementing tailored FLW policies, enhancing investment in measurement and innovation, and expanding engagement among governments, businesses, academia, and civil society. Continued focus on actionable plans, measurable outcomes, and mutual learning—anchored in shared regional objectives—are seen as pivotal for achieving meaningful reductions in food loss and waste by 2030.

Remarks on OECD (2025), "Beyond food loss and waste reduction targets: Translating reduction ambitions into policy outcomes"
Tony S-H Hsu, Taiwan Association of Input-Output Studies, Chinese Taipei

Dr Hsu of the Taiwan Association of Input-Output Studies presented remarks on the 2025 OECD report, "Beyond Food Loss and Waste Reduction Targets: Translating Reduction Ambitions into Policy Outcomes," which offers an extensive review of global food loss and waste (FLW) policy environments. The OECD conducted a survey of 42 economies, including input from the European Commission, in 2023. Eleven of the surveyed economies are in the APEC region: Australia; Canada; Chile; China; Indonesia; Japan; Korea; Mexico; New Zealand; Peru; and the United States, with Australia and Japan among the three best-practice case studies selected (the third being France).

Dr Hsu summarized the report's findings on FLW knowledge, policy ambition, domestic commitment, implementation, and effectiveness, emphasizing that while many economies set ambitious reduction targets, consistent definitions, metrics, and effective cross-government coordination remain major challenges. He reiterated the overarching goals outlined in the APEC Food Security Roadmap Towards 2020, the 2030 update, and the 2024 Trujillo Principles for Preventing and Reducing Food Loss and Waste, noting these frameworks' focus on strengthening institutions, fostering public-private partnerships, promoting innovation, and expanding capacity building throughout the region.

He concluded by pointing out that while the OECD report is comprehensive, it did not cite the many APEC projects on FLW reduction undertaken since 2013, which have been central to capacity building, measurement, and best practice sharing for member economies.

4. Session 4: Member economy report: Progress review on FLW reduction

Australia

Since 2019, Australia set the target of reducing FLW which aligned with the UN Sustainable Development Goal 12.3. Australia uses the food waste hierarchy strategy to reduce FLW, including education campaigns, upcycle, animal feeds, anaerobic digestion, and waste disposal. The strategy adopts 4 priority areas, including policy support, business improvements, market development, and behavioral change. In 2020, Australia established End Food Waste Australia with funding from the federal government. This is a voluntary agreement that brings together the largest food businesses to commit to targeting food waste throughout their supply chains, with packed signatories receiving support from End Food Waste Australia in the form of tools, resources and technical assistance. Since 2021, signatories to the pack have donated a total of 245,000,000 meals to food rescue organizations and reduced the food waste by 13%. Australia also develops the sector action plans, which identify food waste hotspots and priority actions for specific sectors. Furthermore, Australia organizes the activities through End Food Waste Cooperative Research Centre, which is a precursor to the End Food Waste Australia and focuses on collaborative and industry LED research solutions to reduce food waste across the supply chain and to transform unavoidable waste into saleable products. Australia government also cooperates with non-profit organizations to rescue food from landfill back into the consumption chain. For example, since 2004, the organization called Ozharvest has delivered almost 300 million meals and rescues 300 tonnes of surplus food and donors to 1500 charities.

Indonesia

The definition of FLW in Indonesia aligns with the FAO. The FLW in Indonesia between 2000 to 2019 was approximately 115-184 kg per capita, which released 1702.9 million tons of CO_2 emission, equivalent to 4-5% of Indonesia's GDP. The loss could feed approximately 61-125 million people. The Ministry of National Development Planning formulates FLW management policies and strategies economy-wide, as well as collaborating with the Danish government to support FLW management. The Ministry of Agriculture supports infrastructure (harvesting and postharvest equipments, including cold storage, PHO, and processing units) and collaborates with the private sector and relevant stakeholders. The National Food Agency (NFA) emphasizes efforts to prevent food waste throughout the supply chain, from production to consumption. Overall, it improves consumer behaviors towards food and stabilizes food prices and supplies.

Japan

According to the Waste Management Act, the Ministry of Agriculture, Ministry of Environment, Consumer Affairs Agency, and the local government, Japan has already achieved the reducing FLW target (SDG 12.3); therefore, revised its target to 60% and moving forward to encourage the industries, as well as consumers to reduce FLW further. In Japan, approximately 85% of the food losses and wastes are used as animal feeds with only 15% as compost through cooperation with industries, food companies, and farmers to recycle food.

Peru

Peru initiates the *Trujillo Principles for Preventing and Reducing Food Loss and Waste in the Asia-Pacific Region* in 2024, which supports APEC economies in designing and implementing effective policies to reduce and prevent food loss and waste under a circularity approach to strengthen food systems. In domestic practices, Peru establishes the framework for implementing actions to prevent and reduce FLW throughout the food chain with different mechanism for recovering surplus food from markets and delivering it to vulnerable populations. Peru also promotes the donation of food in emergency situations due to natural disasters. Furthermore, Peru has organized many relevant activities, such as the Workshop on Preventing and Reducing FLW, Good Practices in Preventing and Reducing FLW Award, and Multisectoral Commission on Food Security and Nutrition Meeting.

The Philippines

The Philippines measures the FLW on mango (17.75%-28.65%), onion (29.01%-31.49%), calamansi (14.76%), banana (14.93%-13.71%), broccoli (18.08%), carrots (44.45%), cauliflower (19.50%), white potato (21.82%), cabbage (16.75%), rice (approximately 16%) and corn (6.43%-7.18%). The Philippines has implemented the research-for-development (R4D) initiative, extending and commercializing under the Food Security Thematic Programs, including the Rice Competitiveness Enhancement Fund Program, the Coconut Farmers Industry Development Program, the upcoming Corn Competitiveness Enhancement Fund (CCEF), and the Livestock Feed Supplement Program using sugarcane by-product and salt. The data of the food waste of retail markets and consumers is still scarce, and therefore should be handled by the appropriate agencies of the government (i.e. FNRI, PSA, DOH, etc.) to map out the complete picture of FLW of the Philippines. The Philippines will continue to participate in APEC and international initiatives or programs on reducing FLW, as well as adopting corporate social responsibility (CSR) models like Food Rescue Program.

Chinese Taipei

In 2019, Chinese Taipei's Council for Sustainable Development announced the SDG target 12.3 for the economy to reduce food loss in the production and supply chain

and reduce food waste in consumption. Among other goals, Chinese Taipei aims to achieve the following targets to reduce FLW on vegetables and fruits to 8.8% in 2030. According to the statistics from the Ministry of Agriculture, the loss of vegetables dropped from 281,000 tonnes in 2020 to 278,000 tonnes in 2021; and the loss of fruits dropped from 313,000 tonnes in 2020 to 302,000 tonnes in 2021. Furthermore, according to the statistics from the Ministry of Environment, the total of leftovers in 2023 was 478,000 tonnes, compared to 609,000 tonnes in 2015, decreased131,000 tonnes. For the actions and activities on reducing FLW, Chinese Taipei announced Food and Agricultural Education (FAE) Act since 2022, and Guidelines for the Safe and Hygienic Donation of Food, Food Safety and Sanitation Management Act since 2023. The Ministry of Agriculture strengthens the strategies of reducing disaster losses, reducing distribution losses, cold chain facilities, post-harvest processing, and circular economy sites. The Ministry of Health and Welfare also supports food sector in deploying First-In, First-Out (FIFO) method for stock management, and supports food banks to develop food donation networks. Furthermore, the government also invests heavily in cold chain logistics, smart cold chain fresh food logistics center, biomass energy center, and organic fertilizers. The Ministry of Agriculture, Ministry of Health and Welfare, and the local governments also organize activities on reducing FLW, such as the APEC workshop on reducing FLW, foodbank experience conference, cherishing food festival, and sustainable food forum.

Thailand

Thailand has established an economy-wide food losses baseline in 2023, which included 13 agricultural products from five groups of the communities, such as bean, banana, mango, catfish, palm oil, chicken, shrimp, etc. While the food losses baseline in Thailand is 3.79%, it aims to reduce to 3% in 2027, and reduce 4% from 2028 to 2030. Thailand aims to reduce 5% of food losses through hosting technology workshops for farmers, and change the production of banana, mango, and palm oil. The food waste in 2022 was approximately 38% and Thailand aims to reduce to 28% in 2030. Furthermore, according to the National Food Board, the private sector will collaborate with the government to reduce food losses and waste through sub-committee and technical working meetings. Participants from the whole food supply chain can better understand how to achieve the FLW reduction targets. The private sector also can exchange their viewpoints. through the meetings.

Viet Nam

The definition of FLW in Viet Nam aligns with the FAO. According to the survey of Viet Nam Institute of Agricultural Engineering and Postharvest Technology (VIAEP), the post-harvest loss of agricultural products generally ranges from 20%-25%; specifically, rice loses approximately 13.7%-15.0%, corn around 15%-18%, fruits and vegetables about 30%, and seafood about 30%. Major challenges in Viet Nam's agricultural production, such as small-scale farms, limited infrastructure investment, and an unskilled workforce have led to significant FLW in Viet Nam. In response, the

Prime Minister of Viet Nam has issued a number of decisions for reducing FLW, including the policy to reduce post-harvest losses for agricultural and aquatic products in 2010, the policy to reduce losses in agriculture in 2013, and the "National Action Plan for Transforming the Food System to be Transparent, Responsible and Sustainable in Viet Nam by 2030" in 2023. The Ministry of Agriculture and Environment also has taken actions, including approval of the Project to Increase the Added Value of Agricultural, Forestry and Aquatic Products in Processing and Reduce Post-harvest Losses" in 2014, as well the Project on Establishment of Food Innovation HUB (FIH) in 2023.

5. Session 5: Date labeling and on-pack consumer education

Date Labels in the United States

Trevor Findley, Harvard Law School's FLPC, United States

Mr Findley delivered remarks on the state of date labeling policy in the United States. He noted that there are currently no federally standardized definitions or regulations for date labels on food packaging. Instead, more than 40 states impose their own requirements, none of which are completely aligned with one another. According to FLPC's research, public confusion regarding the meaning of date labels increased from 2016 to 2025, with particularly adverse impacts on vulnerable populations who devote a larger share of their income to food.

He suggested that federal intervention could become likely if the confusion continues to worsen. He offered several recommendations: introducing standardized labels that differentiate between food safety and quality, expanding public education and awareness campaigns, and explicitly permitting the sale or donation of food past its quality date. Some progress has been made, including the CBA-FMI Voluntary Product Code Dating Initiative (2017) and calls for standard date labeling from the Consumer Goods Forum (CGF) Board of Directors and Champions 12.3.

He also highlighted California Assembly Bill 660 (enacted in 2024), which establishes a requirement for companies to use either a quality date or a safety date, prohibits the use of the 'sell by' label, and explicitly allows the sale or donation of food that is past its quality date or carries an incorrect date label.

Date Labels, Education and Innovation: Engaging Consumer Through Packaging

Miranda Mirosa, University of Otago, New Zealand

Dr Mirosa presented insights from emerging research on consumer behavior, household food waste, and the role of packaging as both a cause and a solution to food waste. She emphasized the need for clearer, standardized, and simplified date labeling, recommending industry-wide adoption and explicit instructions on packaging to distinguish between quality and safety dates. Beyond date labels, Dr Mirosa advocated for packaging that provides consumers with practical food storage guidance,

usage suggestions, and motivational messages, leveraging the package itself as a holistic communication tool. She discussed challenges in engaging consumers—such as misconceptions about packaging's protective role, communication gaps, higher costs, and issues of trust and transparency—and recommended a multi-pronged approach combining innovative packaging design, clear communication, consumer education, and collaboration across the supply chain. Specific roles were outlined for consumers, retailers, designers, and policymakers in supporting such efforts. She also highlighted successful New Zealand initiatives, including the Kai Commitment programme, 'eat-me-first' stickers, and attention-grabbing campaigns to encourage waste reduction.

Thailand date labeling regulations: PPP in practice
Nopawan Charlongpuntarat, Charoen Pokphand Foods (CPF) Public Company Limited, Thailand

Ms Charlongpuntarat detailed recent regulatory and public-private partnership (PPP) developments related to date labeling in Thailand. She highlighted the Notification of the Ministry of Public Health (No. 450) B.E. 2567 (2024), which governs labeling requirements for prepackaged foods, including definitions for 'Expiration Date' and 'Best Before' or 'Best Before End' to enhance consumer clarity. Thailand's Food and Drug Administration (FDA) is advancing sustainability by promoting digital food labels—particularly for water bottles—and supporting the shift to a circular economy in the food sector. She explained that the government regularly consults with industry leaders on regulatory matters and assists with compliance when new rules are implemented. As an example of PPP in practice, she cited Charoen Pokphand Foods (CPF), a major international food company, which is committed to sustainable packaging through the use of renewable materials, initiatives to increase recycled content while maintaining food safety and quality, and transition from single-use to reusable packaging systems.

Date labeling, consumer education and food waste reduction
Murray Davis, MLA, Australia

Mr Davis provided an overview of Australia's role in global red meat production and export, noting the economy produces 3% of the world's beef and 7% of sheep meat, but accounts for 15% and 42% of global beef and sheep meat exports, respectively. He described how consumer perspectives on sustainability in the food sector have shifted, with food waste reduction now viewed as a core component. Survey data indicate that 43% of global consumers consider overconsumption and food waste a very important sustainability issue, and 37% believe the red meat industry should prioritize action in this area.

He outlined a range of initiatives MLA has implemented to reduce FLW across the supply chain: mapping food loss and waste and conducting targeted interventions; developing a shelf-life calculator tool to predict the shelf life of vacuum-packed beef and lamb exports and retail-ready products, supporting both waste reduction and trade negotiations; validating novel sustainable packaging formats; and investigating opportunities to maximize carcass utilization. MLA collaborates with the End Food Waste CRC to

research consumer behavior, remains up-to-date with global legislative changes in food packaging, and oversees the Meat Standards Australia program to ensure eating quality standards from paddock to plate. Additionally, MLA supports initiatives for meat recovery and food relief in partnership with End Food Waste Australia.

6. Session 6: Panel discussion on packaging and mid-term review on FLW reduction

This session discussed the challenges and opportunities to reduce FLW by packaging innovations, as well as the suggestions on mid-term progress review. The speakers of this session included Mr Chusak Chuenprayoth, Mr Murray Davis, Dr Trevor Findley, Dr Tony S-H Hsu, Dr Miranda Mirosa and Dr Binghuei Barry Yang.

While the challenges and opportunities to reduce FLW by Packaging innovations, the crucial role of Public-Private Partnership (PPP) was emphasized by multiple speakers as key to translating policy into effective implementation. Furthermore, effective government policy and feasible regulations are vital. Existing regulations should be reviewed for their contribution to FLW reduction and promoted. Moreover, Mr Chuenprayoth shared Thailand's experience, noting that large companies are committed to sustainability, but SMEs need assistance with knowledge access. Policy should consider domestic and industry interests, with PPP ensuring effective execution. Mr Davis also shared the example of Australia's Cooperative Research Centre (CRC), and suggested the international frameworks like APEC can help governments to set targets and drive action. Dr Findley stressed the need for policymakers to ensure information for consumers is clear and consistent, avoiding confusion between innovations (e.g., smart labels) and existing regulations (e.g., date labels). He suggested exploring unified date labeling standards across regions.

Another point, most speakers and delegates agreed the consumer education was widely acknowledged as extremely important. Dr Findley emphasized the importance of understanding date labels between "Best Before" (quality) and "Expiry Date" (safety). Beyond the labels, consumers should be encouraged to use their senses (sight, smell, taste) to judge food edibility. Dr Mirosa suggested the education should start early to raise awareness among younger generations, as well as promoting campaigns.

In addition, the role of industries in packaging practices and innovation is also important, most of the speakers and delegates agreed that technology, science, innovation, and digitalization were recognized as important tools for reducing FLW. Mr Davis also highlighted Australia's meat industry practices, such as Meat Standards Australia (MSA) and shelf-life prediction tools, to manage quality and reduce waste. Dr Mirosa suggested that sharing successful case studies and conducting Return on Investment (ROI) studies can encourage businesses to adopt FLW reduction measures. Mr Findley mentioned to consider food waste deterrent policies, such as bans or fees on organic waste entering landfills.

Nevertheless, the suggestions on mid-term progress review, Dr Hsu emphasized the APEC has played a leading role in reducing FLW, with initiatives predating the UN SDGs, starting around 2010. The capacity building and sharing best practices through workshops

and training should continue. He also suggested APEC to share its successful models and experiences with other international organizations (e.g., OECD, UN). Finally, all speakers and delegates agreed to continue strengthening PPP and involve more private sector representatives in APEC activities, as well as integrating FLW reduction into greenhouse gas (GHG) emission reduction strategies in the future.

7. Field Trip

Workshop participants visited the Packaging Institution at Sustainable Materials Library (SML) and the Food Packaging Warehouse at Cheng Mei Cultural Park (CMCP).

The Sustainable Materials Library (SML), established by the Plastics Industry Development Center in 2020, is located in Taichung. It showcases sustainable materials in seven categories. Designers and product developers can explore materials and prototypes, while suppliers connect with market demands. The online platform, funded by the Ministry of Economic Affairs, offers a global database and manufacturer matchmaking service.

The Cheng Mei Cultural Park (CMCP) is a humanities museum dedicated to preserving the values of everyday life, integrating old and new cultures, revitalizing local exhibitions, and promoting tourism and leisure. The Park boasts rich plant ecology, elegant garden landscapes, and restored traditional historical buildings.

The CMCP upholds the ancestral spirit of "helping others to achieve beauty" and aims to build multilateral connections for mutual benefit among businesses, local communities, and society, realizing five major missions: "continuing tradition," "inheriting culture," "benefiting the community," "promoting Yongjing," and "bringing happiness to Chinese Taipei." With the goal of winning the UNESCO Asia-Pacific Awards for Cultural Heritage Conservation, the Park focuses on preserving tangible cultural assets while committed to passing on intangible cultural heritage. Aligning with the United Nations Sustainable Development Goals, CMCP pursues mental and physical well-being, cultural sustainability, and ecological continuity, creating values of mutual benefit, prosperity, and sharing, thereby becoming a unique global cultural attraction.

8. Workshop summary and key take-aways

Food loss and waste (FLW) accounts for up to one-third of global food production, with the majority occurring in developing economies due to inadequate storage, poor packaging, and weak cold chain systems. These inefficiencies lead to reduced food availability, lower incomes for farmers, and increased environmental impact. Targeted interventions in storage, packaging, labeling, and education can drastically improve food system resilience.

This workshop aims to exchange information on packaging innovations that reduce FLW across storage and distribution stages. Evidence indicates that active/intelligent packaging, modified atmosphere packaging, edible coatings, and

digital traceability can extend shelf life, improve food safety, quality, and decrease discard rates. Time-temperature indicators, AI-based demand forecasting and dynamic shelf-life labels demonstrate measurable waste reductions in case studies, while hermetic packaging substantially curbs postharvest losses of grains in developing regions. Policy momentum in the FAO platforms complements technological advances with targets and guidance.

Preventing and reducing FLW during the storage and packaging stage requires a mix of good management, innovative technologies, infrastructure improvement, and consumer awareness to optimize monitoring, traceability, and efficiency of the food supply chain. Date labeling and consumer education are crucial complementary solutions for reducing FLW, especially at the storage, packaging, retail, and household stages. Clearer date labeling and enabling rules for smart or dynamic labels can unlock waste reductions. whereas overly restrictive rules may slow technology adoption. For maximum impact, combining low-cost solutions with modern technologies is most effective. In developing regions, the storage and packaging stages are often the weakest points of the food supply chain. Thus, solutions should focus on low-cost technologies, infrastructure development, and capacity building.

Some participants of the workshop raised a number of challenges, such as inadequate storage, lack of reliable, energy-efficient refrigeration, weak packaging systems, or non-sustainable materials leading to spoilage, confusing date labeling, limited data, and coordination. Even with good packaging and storage, household-level waste remains high due to poor storage habits, overbuying, or misunderstanding food labels.

To address these challenges, various strategies were proposed during the workshop, including strengthening infrastructure and innovation in storage and packaging, and promoting behavioral and regulatory change through education and labeling reform. By embracing advanced packaging technologies, the food industry can also significantly reduce spoilage and waste, contributing to a more sustainable food system. Together, these measures can enhance food security, protect the environment, and improve livelihoods. Figure 3 summarizes how these strategies connect across the food supply chain.

As we move forward, the integration of sustainable practices in packaging, combined with continued innovation, will pave the way for a future where food waste is minimized, and resources are utilized more efficiently. In the future, APEC member economies may consider the following collaborative efforts:

1. Sharing policies and innovative solutions among member economies;
2. Promote joint R&D and pilot demonstration projects; and
3. Develop food packaging principles/guidelines.

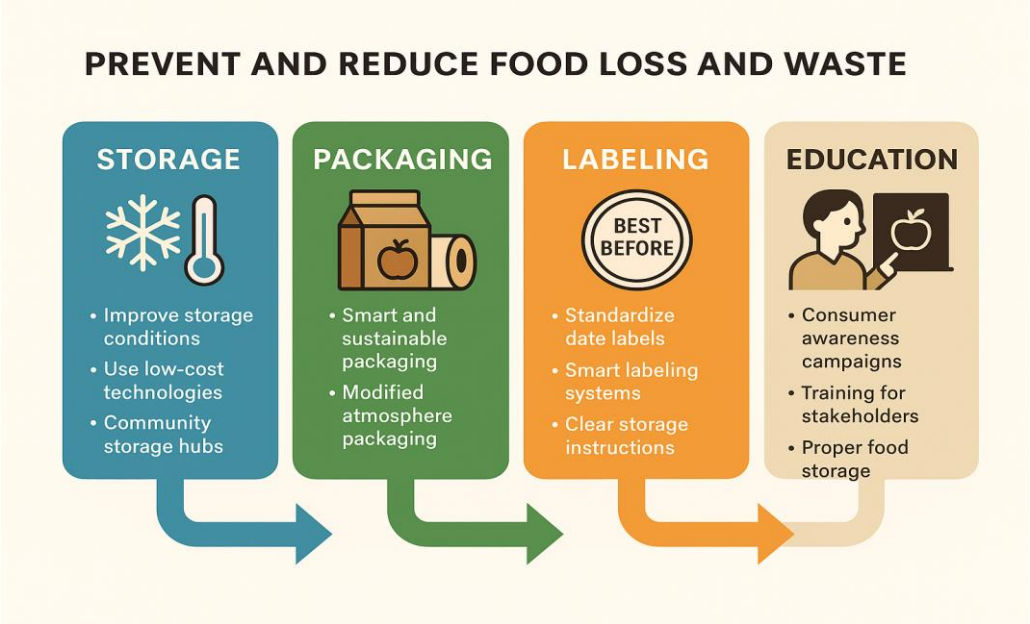

Figure 3. Proposed strategies to prevent and reduce FLW during storage and packaging stages across the food supply chain

III.Summary of Post-workshop Survey

After the workshop, we distributed the "APEC Project Evaluation Survey" to participants and received 68 responses from 13 economies. Table 1 shows the breakdown of the respondents according to economy. Most of the respondents are from Asia (88%), followed by South America (4.4%), Oceania (4.4%), and North America (3.2%).

Table 1 Respondents by Member Economy

Member Economy	Number	Member Economy	Number
Australia	2	Peru	2
Chile	1	The Philippines	6
Indonesia	4	Chinese Taipei	36
Japan	1	Thailand	5
Malaysia	6	United States	1
Mexico	1	Viet Nam	2
New Zealand	1		

Furthermore, most of the respondents participated on-site (50 of 68 respondents, 74%), whereas most of the respondents from South America participated online (2 of 3 respondents, 67%). Table 2 shows the breakdown by continent and participation mode.

Table 2 Respondents by continent and participation mode

	Physical	Online	Total
Asia	45	15	**60**
South America	1	2	**3**
North America	1	1	**2**
Oceania	3	0	**3**
Total	**50**	**18**	**68**

Figure 4 shows the sessions which were deemed most helpful by the participants. Most of the respondents recognized that Session 2: Packaging innovations & applications on FLW reduction (59 respondents, 87%), Session 1: Global outlook and policy review on reducing FLW (54 respondents, 79%), and Session 5: Date labeling and on-pack consumer education (54 respondents, 79%) were the most helpful among all sessions. The least helpful according to the post-workshop survey was Session 4: Member economy report: Progress review on FLW reduction; only 56 respondents thought it was the most helpful (69%).

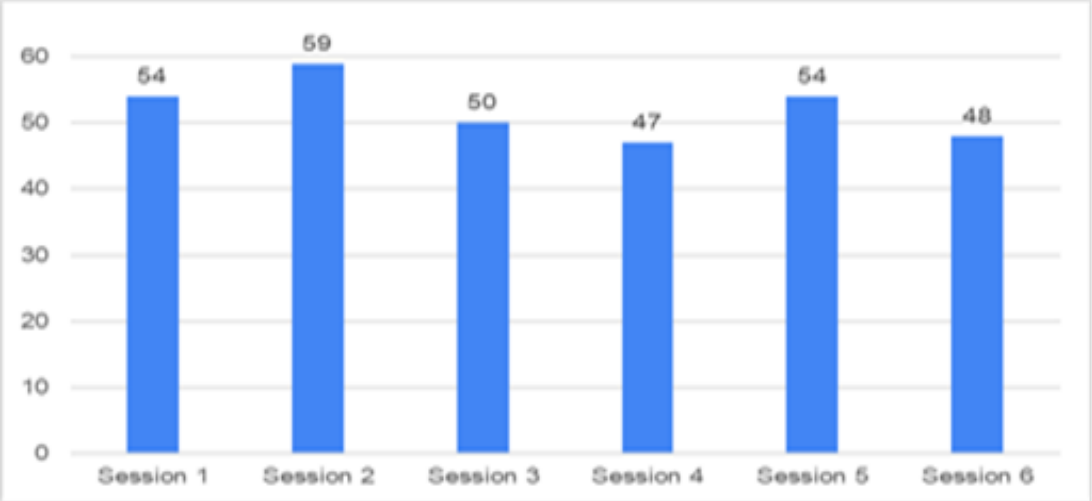

Figure 4 The sessionthat were most helpful

When asked whether this workshop met the expectations, about 50% of the participants strongly agreed (Figure 5). Furthermore, about 98% of the respondents agreed (42% strongly agree) that their knowledge and skills about food loss and waste improved (Figure 6).

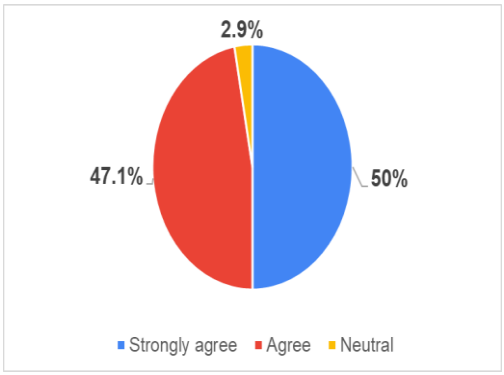

Figure 5 Expectations met

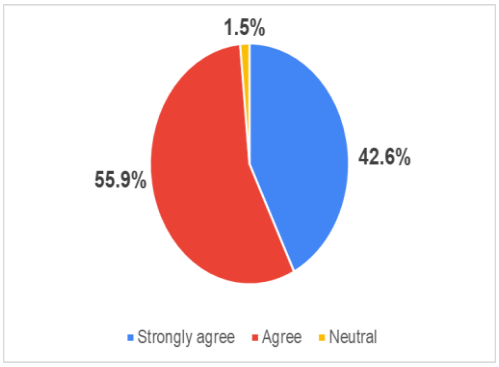

Figure 6 Knowledge of FLW improved

Moreover, we asked respondents to score the different dimensions about this workshop from 1 to 5 (with 1 being the lowest). The different dimensions include physical venue, food, time allotment, materials distributed, and overall organization of the workshop. Figure 7 below shows the average scores for each dimension, the highest scores were overall organization of the workshop (4.66), materials distributed (4.64), and physical venue (4.64). The lowest average score was time allotment (4.49).[1] In the detailed comments of the post-workshop survey, most respondents agree that the workshop was well-organized and that speakers were excellent. However, a respondent hopes the workshop can be organized in different time zones.

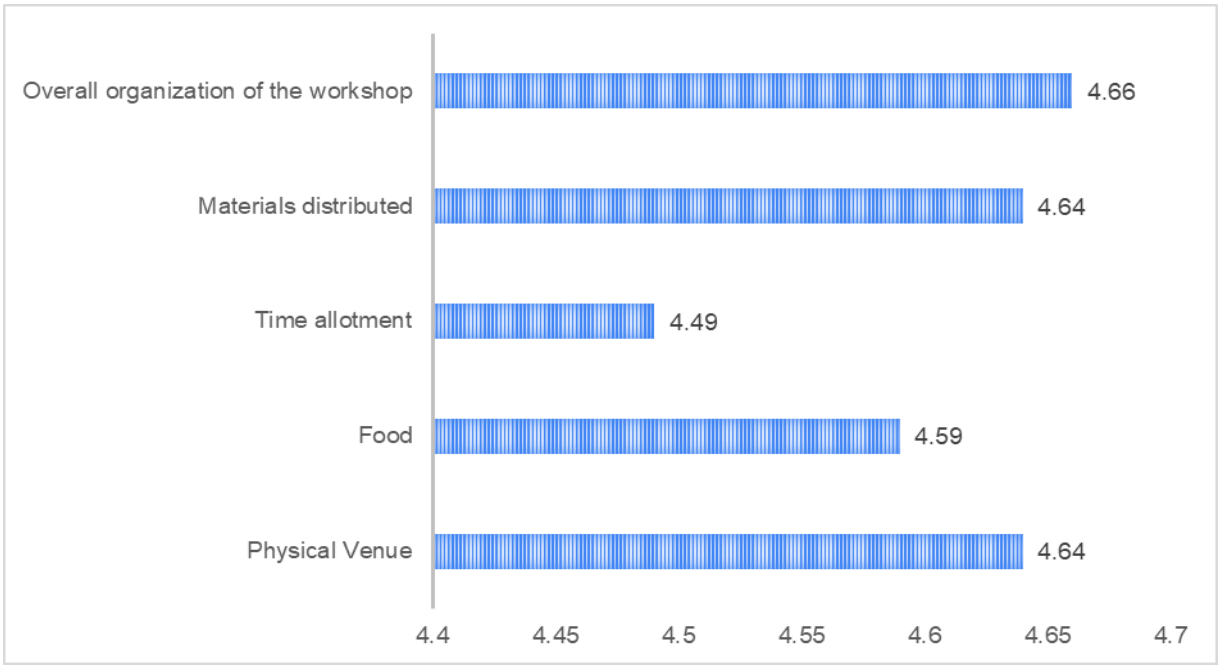

Figure 7 Average scores for each dimension of this workshop

Finally, this survey also asked the respondents what topics about food loss and waste they would be willing to know more about in subsequent APEC workshops. As Table 3 shows, most respondents are interested in best practices and FLW data system.

[1] The slight difference in length on Figure 4 is due to rounding off to the second decimal place.

Table 3 Topics about FLW respondents want to learn more about

No	Response
1	Sharing good practice and lessons learned for reduction of FLW
2	Role of institutions and partnerships in the state of FLW and its management
3	More visibility from the fishery sector
4	FLW data systems, governance mechanisms for targeted action, institutionalization
5	Promoting Circular Economy Principles for Food Waste (e.g. up-cycling)
6	Post-Harvest Handling & Cold Chain Innovations - Cost-effective technologies to minimize post-harvest losses in developing member economies. - Improving cold chain logistics for perishable fruits and vegetables in rural and cross-border settings.
7	Efforts by consumer groups or NGOs, if any, that are working towards FLW reduction from the consumption side.
8	Creating awareness of the importance of reducing food loss among stakeholders in the food chain.
9	FLW Innovations and their implementations
10	Discussion on experiences of use of regulation and compliance activities to support FLW action

Overall, most respondents are satisfied with the implementation of this project. This project marks the importance of food packaging to reduce FLW as well as reviews the midterm results on FLW reduction. It's also sharing best practices on packaging innovations, and date labeling and on-pack consumer education to FLW reduction.

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V. Annexes

1. Agenda

Day 1: 5 June 2025 (Thursday)	
08:30 – 09:00	Arrival and Registration
09:00 – 09:30	**Welcome and Opening Remarks** 1. **Wen-Jane TU,** Deputy Minister, Ministry of Agriculture 2. **Su-San CHANG,** Lead Shepherd, ATCWG, APEC 3. **Teddy PAVON,** Program Director, APEC Secretariat 4. **Yung-Sheng Tsai,** Deputy Director of Agriculture Bureau, Taichung City *Group Photo*
09:30 –10:10	**Session 1– <u>Global outlook and policy review on reducing FLW</u>** 1. Global FLW prevention and reduction: A hopeful outlook - **Maximo Torero,** FAO 2. How can private-public-partnerships drive reductions in FLW: From targets, measure, to actions - **Dana Gunders,** ReFED, United States **Chair: Su-San Chang**, Lead Shepherd, ATCWG, APEC
10:10 – 10:20	Coffee/Tea Break
10:20 – 12:20	**Session 2– <u>Packaging innovations & applications on FLW reduction</u>** - *explore different types of storage/packaging innovations, their benefits, and how they can be effectively implemented to minimize FLW.* 1. The reduction of grains loss and the control of mycotoxins by package innovation - **Fuguo Xing,** Chinese Academy of Agricultural Sciences, China 2. FLW reduction strategies in Japan and the role of packaging - **Manabu Suzuki,** Ministry of Agriculture, Forestry and Fisheries, Japan 3. Innovative eco-friendly packaging technology to reduce FLW - **Chan Suk Yoon,** EverChemTech, Korea 4. Applications of innovative packaging to reduce FLW from farm to household in Chinese Taipei - **Hoong-Yuan Ho**, Plastics Industry Development Center, Chinese Taipei 5. Recent advances innovation to extend shelf life for horticultural products packaging and waste reduction in Thailand. - **Chusak Chuenprayoth**, Thai Chamber of Commerce, Thailand **Chair: Chii-Cherng Liao,** Food Industry Research and Development Institute
12:20 – 13:50	Lunch Break
13:50 – 14:40	**Session 3– <u>APEC midterm review on FLW reduction</u>** 1. APEC mid-term progress review: Preliminary results - **Kenneth B. Dy**, Academia Sinica, Chinese Taipei

	2. Remarks on OECD (2025), "Beyond food loss and waste reduction targets: Translating reduction ambitions into policy outcomes" **- Tony S-H Hsu**, Taiwan Association of Input-Output Studies **Chair: Tony S-H Hsu**, Taiwan Association of Input-Output Studies
14:40 – 15:00	Coffee/Tea Break
15:00 – 17:00	**Session 4 – <u>Member economy report: Progress review on FLW reduction</u>** *1. Member economy delegates are welcome to speak for 15-20 min each on the actions, policies, progress, and challenges to accelerate progress in FLW reduction;* *2. Updates and revisions on the initial draft of the midterm progress review prepared by Chinese Taipei are very much welcome.* **Chair: Rose Dong-Chong Hsiou**, Project Overseer, Ministry of Agriculture
17:00 – 17:10	**Wrap-up** **Ching-Cheng Chang**, Academia Sinica
Day 2: 6 June 2025 (Friday)	
08:30 – 09:00	Arrival and Check-in
09:00 –10:30	**Session 5 – <u>Date labeling and on-pack consumer education</u>** *- to explore actionable solutions for using packaging as a tool to prevent and reduce food loss and waste in retail and in consumer households* 1.Date labeling legislation and food waste policy in the US **- Trevor Findley,** Harvard Food Law and Policy Clinic, United States 2.Food waste legislation on date labeling and consumer education in New Zealand **- Miranda Mirosa,** University of Otega, New Zealand 3. Thailand date labeling regulations: PPP in practice. **- Nopawon Charlongpuntarat,** Charoen Pokphand Foods (CPF) Public Company Limited, Thailand 4. Date labeling, consumer education and food waste reduction as an integral part of sustainability **- Murray Davis,** Meat & Livestock Australia, Australia **Chair: Binghuei Barry Yang,** Food Industry Research and Development Institute
10:30 – 10:50	Coffee/Tea Break
10:50 – 11:50	**Session 6– <u>Panel discussion on packaging and mid-term review on FLW reduction</u>** *1. Packaging innovations: Challenges and opportunities to reduce FLW* *2. Comment/Suggestions on mid-term progress review* Panelists: **Chusak Chuenprayoth, Murray Davis, Trevor Findley, Tony S-H Hsu, Miranda Mirosa, Binghuei Barry Yang** **Moderator: Su-San Chang**, ATCWG, APEC

11:50 – 12:10	**Closing Session** **1.** Wrap up on next step from workshop participants - **Ching-Cheng CHANG**, Academia Sinica **2.** Closing remarks - **Rose Dong-Chong Hsiou**, Project Overseer, Ministry of Agriculture
12:10 – 14:00	Lunch Break
14:00	**Field Study**

2. Photo

Figure 6. Workshop Group Photo

Figure 7. Session 1 Presentations

Figure 8. FLW Exhibition Photos

Figure 9. Field Study photos at Packaging Institution at Sustainable Materials Library (SML) and the Food Packaging Warehouse at Cheng Mei Cultural Park (CMCP)