APEC Workshop on Enhancing Net-Zero Carbon Emission Goals through Circular Agriculture: Best Practices and Innovations

Summary Report

APEC Agricultural Technical Cooperation Working Group

August 2026

Asia-Pacific
Economic Cooperation

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I. Introduction

The “APEC Workshop on Enhancing Net-Zero Carbon Emission Goals through Circular Agriculture: Best Practices and Innovations (ATCWG_201_2024)” was successfully hosted by the Ministry of Agriculture (MOA), Chinese Taipei, at the InterContinental Kaohsiung from September 23 to 25, 2025, under the framework of the Agricultural Technical Cooperation Working Group (ATCWG). The project aimed to enhance the capacity of APEC economies—particularly developing economies—to adopt, share, and apply circular agriculture practices that reduce carbon emissions and recycle surplus resources through innovative technologies. It also recognizes the broader challenges facing global agriculture, including extreme weather and natural disasters, population growth, and intensifying resource competition.

The workshop emphasized the core framework of circular agriculture—reduce, reuse, recycle, and remove—which supports the transformation of agricultural by-products into value-added resources while stimulating innovation. The initiative directly contributes to key APEC priorities, including the APEC Bangkok Goals, Peru 2024 Priorities, and the APEC Food Security Roadmap Towards 2030. The host economy emphasized three guiding principles: Linkage, Innovation, and Prosperity, to strengthen partnerships and create sustainable opportunities.

The workshop included an APEC-wide pre-workshop survey, two days of technical sessions, and a one-day field visit to local circular agriculture facilities. Experts, policymakers, and industry representatives from 14 APEC member economies participated, demonstrating strong regional engagement and support. The pre-workshop survey provided a valuable foundation for discussions during the three-day event.

II. Workshop Summary

The workshop attracted broad participation from across the APEC region, with 125 participants (excluding speakers/experts) from 14 member economies attending the event. The composition of participants reflected strong engagement from both the public and private sectors, including government officials, researchers, industry representatives, and international experts. In terms of gender distribution, 68 participants were female (approximately 54%) and 57 were male (46%), exceeding the project’s gender target and demonstrating a relatively balanced and inclusive participation profile.

A total of 20 speakers and experts were invited to deliver keynote speeches, technical presentations, and panel contributions. While female participation among speakers remained comparatively lower at 20%, the diversity of expertise provided a comprehensive perspective across policy, technology, and business dimensions of circular agriculture.

The three-day program was structured to facilitate both knowledge exchange and practical learning. The first day featured discussions on emerging technologies,

innovation pathways, and economy-level policy developments related to circular agriculture. The second day focused on applied solutions, including decarbonization strategies in livestock systems, carbon credit mechanisms, and business models that support the commercialization of circular practices. The program concluded with a field-based learning component, allowing participants to observe real-world applications and operational models in southern Chinese Taipei.

Across the sessions, participating economies shared a wide range of experiences, from economy-level policy frameworks to farm-level technologies and private-sector innovations. The diversity of contributions highlighted the different stages of development among economies, while also revealing common areas of interest, including resource recycling, emission reduction technologies, and the integration of circular approaches into agricultural value chains.

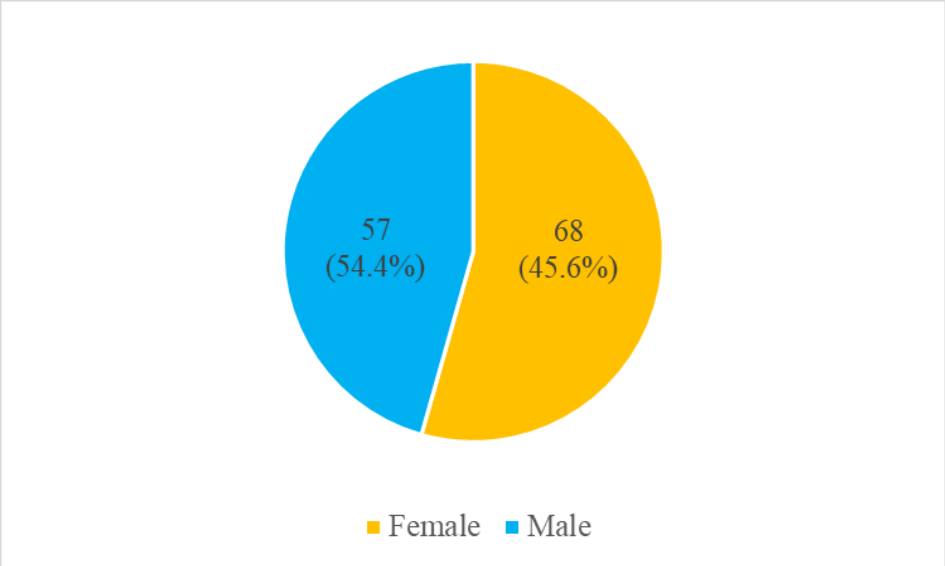


Figure 1. Participants' percentages by gender

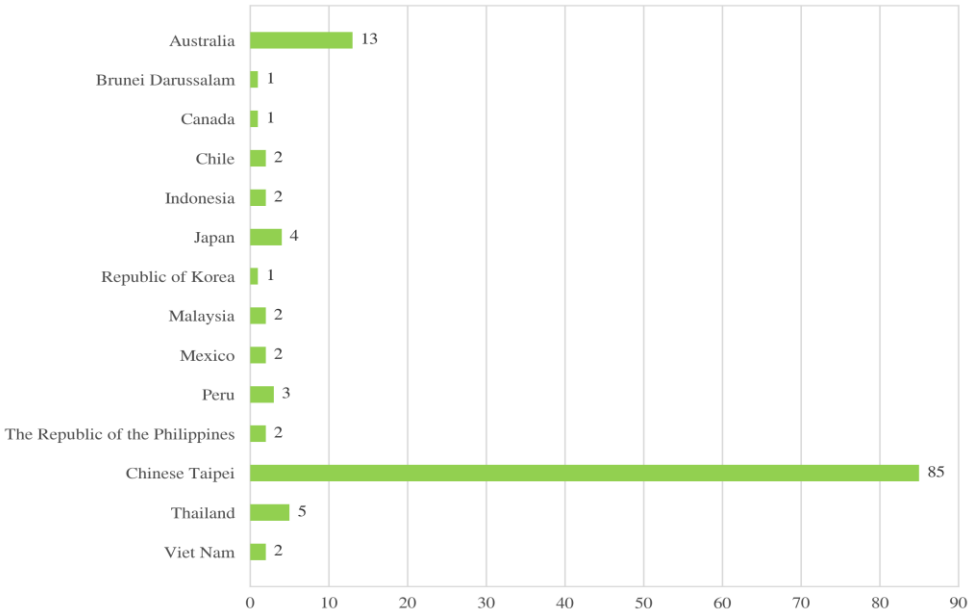


Figure 2. Number of participants by APEC economies

1. Keynote Speech (Day 1)

On the Way to Zero Agricultural Waste in Chinese Taipei – Case of Pineapple and Oyster

Dr Lao-Dar Juang, Director General, Department of Resources Sustainability, Ministry of Agriculture (MOA), Chinese Taipei

Dr Juang introduced Chinese Taipei's comprehensive efforts to transition toward a zero-waste agricultural system. He noted that in 2023, Chinese Taipei generated approximately 4.81 million tons of biological agricultural residual resources, primarily from the livestock and crop sectors, reflecting both the scale of resource availability and the urgency of improving waste management systems. He emphasized that circular agriculture is positioned as a key pillar in achieving agricultural greenhouse gas reduction targets, alongside measures such as low-carbon practices, efficiency improvements, and carbon sink enhancement.

The presentation highlighted two representative case studies demonstrating how agricultural residues can be transformed into high-value products. In the case of pineapple production, which generates approximately 700 thousand metric tons of stem and leaf residues annually, Dr Juang explained that traditional practices such as field incorporation result in slow decomposition and additional carbon emissions. To address these challenges, the government has promoted technological solutions including mechanized harvesting, fiber extraction technologies, and supply chain integration. As a result, pineapple leaves can now be processed into textile fibers, mixed yarns, and vegan leather products, while residual materials can be further utilized for eco-friendly tableware and other applications, forming a complete circular value chain.

In the case of oyster shells, with annual generation volumes of approximately 100–160 thousand tons, particularly in offshore islands such as Penghu, Dr Juang illustrated how waste shells can be repurposed through advanced material technologies. Applications include alkali-activated construction materials, water-activated heat packs, and 3D-printed coral reef structures for marine ecosystem restoration. These innovations demonstrate how circular agriculture can extend beyond land-based systems to support broader environmental objectives.

To support the scaling of such initiatives, Dr Juang introduced the government's plan to establish Specialized Regional Circulation Centers, which aim to integrate resource mapping, preprocessing facilities, logistics systems, and cross-sector collaboration. These centers will focus on different resource streams—such as natural fibers, shellfish by-products, and agricultural plastics—and promote the production of value-added outputs including energy, feed, fertilizer, and industrial materials. He emphasized that achieving a zero-waste agricultural system requires strong public–private partnerships, coordinated supply chains, and the development of quality standards and industrial applications, enabling circular agriculture to become both environmentally sustainable and economically viable.

2. Session 1: Trends, Prospects, and Innovations in Circular Agriculture

Environmental Inhibitors in Agri-food Systems

Mr Raj Rajasekar, Senior Programme Manager, Ministry for Primary Industries, New Zealand

Mr Rajasekar presented New Zealand's approach to reducing agricultural greenhouse gas emissions, which account for approximately 53 percent of the economy's total emissions, making agriculture a central focus of its climate policy. He highlighted the development of inhibitor technologies as a key innovation pathway to mitigate emissions while maintaining agricultural productivity. These technologies are broadly categorized into two types. The first includes soil-based chemical inhibitors, which reduce nitrogen losses from pasture systems by limiting nitrification and associated emissions such as nitrous oxide. The second involves animal-based inhibitors, including boluses, feed additives, and emerging vaccine technologies designed to reduce methane emissions generated during livestock digestion.

Mr Rajasekar emphasized that these solutions are being developed as part of a long-term strategy to support low-emission agricultural systems without compromising farm profitability. To accelerate progress, New Zealand has committed approximately NZD 400 million for the period 2024–2029 to support research, development, and commercialization of these technologies. He noted that beyond technological advancement, regulatory alignment and international cooperation are critical for scaling adoption. In particular, he highlighted the importance of platforms such as Codex Alimentarius in establishing science-based standards to ensure the safe and efficient deployment of these innovations across economies. This approach reflects the need to balance environmental objectives with food production and trade considerations.

A Low-Carbon Model for Durian Production in Thailand

Dr Eakpol Phuvanartnarubal, Agricultural Research Officer, Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand

Dr Eakpol Phuvanartnarubal presented Thailand's approach to developing a low-carbon production model for durian, one of the economy's most important agricultural export products and a key contributor to rural income. Recognizing the growing importance of sustainability in global agri-food markets, the model aims to reduce greenhouse gas emissions while maintaining product quality and market competitiveness. Central to this approach is the "Smart-Grow Durians: Less Carbon, More Flavor" framework, which integrates precision agriculture techniques into conventional farming practices.

A key component of the model is precision nutrient management, where fertilizers are applied based on soil analysis and crop requirements, rather than conventional blanket application methods. This targeted approach helps reduce excess nitrogen use and minimizes emissions of nitrous oxide, a potent greenhouse gas. In

addition, the model incorporates zero-waste management practices, including composting durian shells and converting pruning residues into biochar. These practices not only reduce waste but also contribute to improved soil health and increased soil carbon sequestration, enhancing long-term agricultural sustainability.

Dr Eakpol emphasized that the model demonstrates how climate-friendly agricultural practices can be aligned with economic objectives, as improved production efficiency and sustainability attributes can strengthen the market positioning of Thai durians. He also noted that scaling up such models will require continued support in areas such as farmer training, technology adoption, and policy incentives, highlighting the importance of integrating low-carbon practices into broader agricultural development strategies.

BECCS-Driven Bioenergy: Renewable Solutions from Piggery Wastewater
Dr Jung-Jeng Su, Professor, National Taiwan University, Chinese Taipei

Dr Su presented over a decade of research on transforming piggery wastewater into renewable energy through Bioenergy with Carbon Capture and Storage (BECCS) technologies. Given the significant environmental challenges associated with livestock wastewater, his work demonstrates how waste streams can be converted into valuable energy resources while reducing greenhouse gas emissions. A key innovation highlighted was the development of biogas purification systems, including bio-desulfurization technologies capable of achieving nearly 100% hydrogen sulfide (H_2S) removal, thereby improving gas quality and reducing environmental pollutants.

In addition, Dr Su introduced CO_2 adsorption modules that upgrade raw biogas into high-purity biomethane, with methane concentrations exceeding 98%, making it suitable for energy applications. Another notable advancement is the use of Sediment Microbial Fuel Cells (SMFCs), which enable simultaneous wastewater treatment and micro-electricity generation, demonstrating the potential for integrated resource recovery systems.

These technologies illustrate how livestock wastewater can be repositioned as a renewable energy source within circular agriculture systems. Dr Su emphasized that such integrated approaches not only reduce environmental burdens but also contribute to energy self-sufficiency and carbon mitigation, highlighting the importance of scaling up these innovations through policy support and infrastructure development.

Innovative Models in Applying Circular Economy to Coffee and Cocoa in Viet Nam
Dr Lai Van Manh, Head, Department of Economic Resources and Environment, Institute of Strategy and Policy on Agriculture and Environment, Viet Nam

Dr Manh presented Viet Nam's efforts to apply circular economy principles in the coffee and cocoa sectors, two important export-oriented agricultural industries. He noted that coffee production generates approximately 1.83 kg CO_2 e per kilogram of

green coffee beans, underscoring the need for emission reduction strategies along the value chain. To address this, circular practices have been introduced to convert agricultural by-products into useful resources, such as utilizing coffee grounds and residues as biomass and processing coffee pulp into organic fertilizers.

In the cocoa sector, Dr Manh highlighted the use of cocoa husks to produce biochar, which not only improves soil fertility but also enhances carbon sequestration. The process also generates heat energy that can be reused in post-harvest processing, significantly improving efficiency. For example, the application of circular technologies has reduced cocoa drying time from 15 days to 7 days, demonstrating both environmental and economic benefits.

Dr Manh emphasized that Viet Nam's experience shows that successful implementation of circular agriculture requires the integration of technology, policy frameworks, and financial mechanisms. He noted that scaling up these models will depend on strengthening institutional support, improving access to finance, and enhancing capacity building for farmers and small enterprises, ensuring that circular economy practices can be widely adopted and sustained.

3. Session 2: Net-Zero Decarbonization through Circular Agriculture

Best Practice Sharing on Circular Agriculture Strategies for Livestock Net Zero
Dr Jeng-Bin Lin, Researcher & Chief, Taiwan Livestock Research Institute (TLRI), MOA, Chinese Taipei

Dr Lin presented Chinese Taipei's approach to reducing livestock-related greenhouse gas emissions based on life cycle assessment principles. He noted that livestock is a major emission source, with cattle and swine accounting for approximately 60.0% and 34.7% of total livestock emissions, respectively. To address this, Chinese Taipei has promoted circular agriculture strategies centered on the "Recycle, Reduce, and Revalue" framework, aiming to improve resource efficiency while lowering environmental impacts.

Key measures include the recycling of livestock wastewater, with approximately one-seventh reused for farmland irrigation, reducing water consumption and nutrient loss. In addition, livestock by-products such as offal and bones are increasingly utilized for high-value applications, including peptide powders, gelatin-based materials, and other functional products, thereby enhancing economic returns while minimizing waste.

Dr Lin also highlighted the achievements of a demonstration dairy farm operated by TLRI, which has successfully integrated circular practices into production systems and achieved an annual reduction of approximately 1,003 tons of CO_2 e. He emphasized that scaling up such models requires the integration of technological innovation, farm-level management improvements, and supportive policy frameworks

to ensure both environmental sustainability and economic viability in the livestock sector.

Implementation of the Circular Economy Roadmap in Peru
Mrs Gabriela Corina Quiroz Mosquera, Director, Ministry of Agrarian Development and Irrigation, Peru

Mrs Quiroz Mosquera introduced Peru's Circular Economy Roadmap for agriculture, which aims to enhance resource efficiency, strengthen food security, and reduce environmental pressures such as deforestation. The roadmap provides a strategic framework for integrating circular economy principles into agricultural production systems, with a strong emphasis on sustainability and resilience.

She outlined Peru's key targets, including increasing the adoption of circular economy practices among 10% of agricultural producers by 2030 and ensuring that 2% of Peru's GDP is generated from eco-efficient economic activities. To achieve these goals, the roadmap promotes the diversification of agricultural by-products into value-added outputs such as biochar, biofuels, and bio-inputs, thereby reducing waste and creating new economic opportunities.

Mrs Quiroz Mosquera emphasized the importance of public–private partnerships and technological innovation in supporting implementation. She also highlighted the need for capacity building, financial support mechanisms, and policy coordination to facilitate adoption, particularly among smallholders. The Peruvian experience demonstrates how economy-wide strategies can guide the transition toward circular agriculture while aligning environmental sustainability with economic development objectives.

Oyster Shell Valorization and Whole-Fish Utilization
Dr Yen-Wei Chang, Associate Researcher, Fisheries Research Institute, MOA, Chinese Taipei

Dr Chang presented circular economy applications in the fisheries sector, focusing on the valorization of oyster shells and the full utilization of fish resources. In Penghu, approximately 600–700 tons of discarded shells annually into three grades of powder (5–20, 10–60, >60 mesh), driving the local circular economy, creating both environmental and disposal challenges. Through circular approaches, these shells are repurposed into a range of value-added products, including eco-friendly construction materials, cat litter, cosmetics, and 3D-printed artificial coral reefs that support marine ecosystem restoration.

In addition, Dr Chang introduced whole-fish utilization technologies that maximize the use of fish processing by-products. Instead of discarding parts such as fish heads, frames, and viscera, these materials are processed into products such as sausages, calcium-rich supplements, and collagen-based cosmetics, thereby reducing waste and increasing economic value.

These practices demonstrate how circular economy principles can be effectively applied in the fisheries sector to improve resource efficiency, reduce environmental

impacts, and create new market opportunities. Dr Chang emphasized that further development will require stronger integration of technology, market development, and policy support to scale up these innovations.

Policy and Practice on Reducing Food Loss and Waste in Japan
Mr Manabu Suzuki, Director, Food Loss & Waste and Recycling Management Office, MAFF, Japan

Mr Suzuki presented Japan's policy framework and practical measures for reducing food loss and waste (FLW), highlighting the economy's significant progress in this area. He noted that Japan achieved its original 2030 FLW reduction target eight years ahead of schedule, demonstrating the effectiveness of its comprehensive policy approach. Building on this success, Japan has now set a more ambitious target of achieving a 60% reduction in business-related food waste.

Key policies supporting these achievements include the Food Loss and Waste Reduction Act and the Food Recycling Act, which establish regulatory frameworks and promote resource recycling across the food supply chain. In addition, Japan has implemented a range of practical initiatives, such as the "Temaedori" campaign, which encourages consumers to purchase products with earlier expiration dates, and the use of AI-based demand forecasting systems to optimize inventory management and reduce surplus food.

Mr Suzuki emphasized that the success of Japan's approach lies in the integration of policy, technology, and behavioral change. He noted that continued progress will depend on strengthening collaboration among government, industry, and consumers, as well as expanding innovative solutions that address FLW at multiple stages of the supply chain.

4. Session 3: Economies' Policies, Strategies, and APEC Survey Findings

A. Selected Economy Brief Remarks

Australia
Ms Kelly Porter, Department of Agriculture, Fisheries and Forestry, Australia

Ms Kelly Porter from the Department of Agriculture, Fisheries and Forestry presented Australia's strategies and programs concerning the circular economy. She explained that Australia has released its first Circular Economy Framework, which aims to significantly increase economy-wide circularity by 2035 as a key step toward achieving the 2050 net-zero goal. The framework focuses on transforming four major sectors—industry, the built environment, resources, and particularly food and agriculture. Ms Porter highlighted that the Commonwealth Scientific and Industrial Research Organisation (CSIRO) estimates that circular economy measures could help reduce economy-wide emissions by 14% by 2035.

She further noted that the government is providing strong financial support, including ASD 15 billion through the National Reconstruction Fund to strengthen agriculture, fisheries, and forestry value chains, and an additional ASD 37 million through the Food Waste for Healthy Soils Fund to convert organic waste into soil-improving inputs. Ms Porter also shared successful examples, including Bardee, a private insect farming company in Melbourne that transforms food waste into high-value insect protein and organic fertilizers, with black soldier fly larvae capable of growing 3,000 times their size within seven days with only waste food and added water. Another case involved a public–private partnership at the University of Sydney, where campus food waste is converted into agricultural products that are redistributed to peri-urban farmers, creating a tangible circular system. She concluded that Australia views trade in green goods and services as essential for sustainable agricultural development but cautioned that prescriptive compliance requirements may hinder broader economic and environmental objectives.

Chile
Mr Jaime Giacomozzi, Ministry of Agriculture, Chile

Chile's Climate Law mandates a Net-Zero Target by 2050, and agriculture must develop its mitigation plan.

Representing Chile, Mr Jaime Giacomozzi explained how the agriculture sector is integrated with the economy's climate policy. He described Chile's legally binding 2050 net-zero target, established through the Climate Law, which requires major emitting sectors—including agriculture—to develop sectoral Mitigation Plans. In that context, it is recognized that circular economy solutions can deliver cost-effective benefits for climate mitigation goals. Chile has also launched key policy to address these issues, such as the Roadmap for a Circular Chile by 2040, which includes four pillars and 28 initiatives to accelerate the transition toward a circular economy by maintaining material use, eliminating waste, and regenerating natural systems.

Mr Giacomozzi highlighted additional economy-wide strategies such as the 2020–2040 Organic Waste Strategy, which targets the valorization of 30% of organic waste by 2030 and 66% by 2040; the development of a Food Loss and Waste (FLW) Road Map in the agricultural sector and a FLW National Strategy which promotes food donations through tax guidelines. While the Nationally Determined Contributions (NDCs) reference FLW reduction, the targets remain qualitative. Soil health is supported through the SIRSD-S Program for soil improvement, which incentivizes soil rehabilitation and nutrient cycling, promoting the use of circular economy solutions for soil management.

He noted that scaling effective practices such as anaerobic digestion and composting remains a challenge, especially for small farms and cooperatives. These solutions require substantial investment and operational support, and agricultural mitigation options remain limited compared with other sectors. Despite the challenges, Chile is addressing these issues through several policy instruments and incentives,

especially by focusing on delivering climate targets and finding synergies with circular economy solutions.

Japan
Mr Daisuke Takahashi, MAFF, Japan

Japan's MIDORI Strategy targets zero CO_2 emissions from fossil fuels in the AF&F sectors and a 50% reduction in chemical pesticides by 2050.

Mr Daisuke Takahashi of the Ministry of Agriculture, Forestry and Fisheries (MAFF) presented Japan's agricultural policies and international cooperation strategies for achieving net-zero. He explained that Japan's revised Basic Act on Food, Agriculture and Rural Areas now identifies "Food systems in harmony with the environment" as a guiding principle. Under the 2050 MIDORI Strategy, Japan aims to achieve zero CO_2 emissions from fossil fuel combustion in agriculture, forestry, and fisheries; reduce chemical pesticide risk-weighted use by 50%; cut chemical fertilizer use by 30%; and expand organic agriculture to one million hectares, roughly 25% of all farmland.

Mr Takahashi highlighted Japan's supply-chain-wide approach, which involves producers, distributors, consumers, and private companies. He also outlined Japan's leadership in international cooperation, noting regional similarities across the Asian monsoon zone — such as hot, humid climates, paddy systems, and smallholder farming—which provide a basis for mutual learning. Japan initiated the ASEAN–Japan MIDORI Cooperation, approved in October 2023, followed by the Global MIDORI Initiative, launched in December 2024 to expand collaboration beyond Asia. He emphasized that Japan does not advocate a "one-size-fits-all" solution but instead promotes tailored cooperation based on accumulated experience. The most recent initiative, MIDORI ∞ INFINITY, launched in April 2025, aims to globally scale Japan's innovative agricultural technologies in support of net-zero and food security goals.

Malaysia
Dr Nurul Ain binti Abu Bakar, MARDI, Malaysia

Representing Malaysia, Dr Nurul explained that the economy's agricultural policies are shaped by the dual objectives of ensuring food security and adapting to climate change. Although agriculture contributes a relatively modest share of Malaysia's total greenhouse gas emissions—around 2 to 2.2 percent—Malaysia remains committed to reducing emissions in line with its economy-wide net-zero target for 2050. She noted that both the 12th Malaysia Plan and the National Agrofood Policy 2021–2030 have incorporated circular agriculture principles, reflecting the economy's intention to improve resource efficiency while maintaining agricultural productivity.

Dr Nurul illustrated Malaysia's approach through a case study from the rice sector. She explained that circular and low-emission rice production is being promoted through improved water management techniques such as Alternate Wetting and Drying (AWD)

and other sustainable irrigation practices that reduce methane emissions from paddy cultivation. Malaysia is also encouraging the conversion of rice straw into value-added products rather than open-field disposal, with some private companies already transforming rice straw into biopackaging materials. These practices demonstrate how crop residues can be better utilized to reduce waste while creating economic opportunities.

At the same time, she emphasized that broader implementation still requires stronger capacity building, technology transfer, and knowledge exchange, particularly in areas such as affordable biogas systems and practical low-carbon technologies for farmers. She also highlighted the need for more consistent market standards and wider recognition of carbon labels to support demand for sustainable products. Her presentation suggested that while Malaysia has begun integrating circular agriculture into domestic policy, further progress will depend on linking innovation, market development, and international cooperation.

Mexico

Dr Nuria Aide López Hernández, INIFAP, Mexico

Mexico emphasized expanding Voluntary Agricultural Carbon Markets and strengthening international cooperation.

Dr Nuria Aide López Hernández (Norea) from INIFAP presented Mexico's strategies for a sustainable and progressive agricultural economy. She noted that Mexico's policy foundation includes major government programs such as the Sembrando Vida Plan. Mexico is also advancing Voluntary Agricultural Carbon Markets, formally recognized by the federal government, which play an increasingly important role in Latin America and globally.

Mexico collaborates with international organizations such as CIMMYT to promote sustainable agricultural systems under the MASAGRO program, and engages with private partners such as Heineken Mexico, which is achieving 15–20% water savings in barley production. Regulations have tightened significantly, with the 2025 ban on 35 high-risk pesticides to protect human health and the environment.

Key challenges include uneven adoption of technologies across diverse farmer groups, limited capacity to measure sequestered carbon, and vulnerability of programs dependent on political continuity. She concluded that although Mexico has built a solid policy base, achieving its 2033 and 2050 agricultural goals will require stronger action and expanded international cooperation.

Peru

Mrs Gabriela Corina Quiroz Mosquera, Ministry of Agrarian Development and Irrigation, Peru

Mrs Gabriela Corina Quiroz Mosquera shared Peru's ongoing efforts to implement circular economy principles in the agricultural sector, building on its previously introduced Circular Economy Roadmap. She emphasized that Peru views the management and protection of forests as a critical component of climate action, given

their role as major carbon sinks. In this context, the government is promoting agroforestry and silvopastoral systems as practical approaches that can both improve farmers' incomes and reduce pressure on forest resources. These systems are seen as important for linking productive agriculture with conservation objectives.

She also highlighted the government's promotion of a circular economy model in agriculture that focuses on the reuse of agricultural residues and waste products for new purposes. Examples include the production of compost, fertilizers, and biodigesters, which can help reduce waste while creating new resource streams for farming systems. In addition, Peru is seeking to attract both domestic and foreign investment to support circular economy technologies and related infrastructure. Mrs Quiroz Mosquera referred to broader economic development efforts, including large-scale logistics and port projects, as part of Peru's strategy to improve connectivity, generate employment, and create new business opportunities that may also benefit circular agriculture development.

Her remarks indicated that Peru's circular agriculture agenda is closely linked to wider development priorities, including forest protection, sustainable production, and investment attraction. The presentation also reflected a strong interest in using circular economy strategies not only to improve environmental performance, but also to strengthen economic resilience and rural development. Overall, Peru's approach highlighted the importance of integrating circular agriculture with land use, investment planning, and territorial development strategies.

Chinese Taipei
Mr Yi-Wei Ciou, MOA, Chinese Taipei

Mr Yi-Wei Ciou presented Chinese Taipei's strategy for building a zero-waste agricultural industry through a gradual and systematic policy approach. He explained that Chinese Taipei first focuses on collecting and analyzing agricultural residue data, promoting source separation, and improving waste reduction at the point of generation. From there, the government advances recycling technologies and pilot projects, with the longer-term objective of transforming agricultural residues into usable resources within a circular agricultural system. He noted that Chinese Taipei generated more than 10 million tons of agricultural residual resources in 2021, demonstrating both the scale of the challenge and the opportunity for resource recovery.

A central component of the strategy is the development of Regional Resource Processing Centers, supported by organized collection systems. These centers are designed to meet criteria related to public benefit, economic feasibility, and accessibility, and are intended to support practical residue management solutions in different regions. Key priority areas include livestock manure recycling, agricultural plastic collection and washing, biomass pellet production, and other forms of residue processing. Mr Ciou emphasized that this region-based approach is intended to create a scalable and coordinated circular resource management system rather than isolated pilot efforts.

He also stressed the importance of combining technology, policy, and cooperation to overcome technical and logistical barriers. According to his remarks, Chinese Taipei aims not only to reduce waste, but also to promote higher-value applications of agricultural residues and encourage innovation through demonstration projects and field-level testing. His presentation highlighted that zero-waste agriculture requires not only technical solutions, but also institutional design and coordinated implementation mechanisms that can connect residue generation, collection, treatment, and market use.

Thailand
Ms Vatisha Pani, Department of Agriculture, Thailand

Ms Vatisha Pani presented Thailand's policy and strategic framework for circular agriculture, explaining that it is closely aligned with the economy's Bio-Circular-Green (BCG) Economy Model. Under this framework, circular agriculture is promoted as a way to improve the efficient use of agricultural resources, reduce waste, and support long-term sustainability. She highlighted the "76 Provinces, 76 Models" program as a flagship initiative led by the Department of Agriculture to encourage localized and practical sustainable farming approaches. These include the use of biofertilizers, biopesticides, and on-farm resource circulation systems tailored to local agricultural conditions.

Ms Vatisha noted that Thailand has committed to achieving net-zero greenhouse gas emissions by 2065, and that agriculture accounts for around 20 percent of economy-wide emissions. She emphasized that circular agriculture is therefore an important part of Thailand's climate and agricultural policy agenda. In addition to government action, she pointed to the role of private companies, non-governmental organizations, and local stakeholders in driving innovation, adoption, and scaling. Business-led initiatives are promoting technologies such as biogas systems, biofertilizers, and sustainable packaging, while NGO-supported models are encouraging organic and zero-waste farming practices in rural communities.

Her presentation underscored that circular agriculture in Thailand is not viewed solely as an environmental agenda, but also as a means of supporting farmers and strengthening sustainable food systems. She concluded by expressing Thailand's strong interest in international cooperation, particularly in areas that can help expand innovation, generate benefits for farmers, and support climate goals. The Thai experience demonstrated how economy-wide strategy, local implementation models, and multi-stakeholder participation can work together to advance circular agriculture.

Viet Nam
Mrs Nguyen Cam Thuy, Partnership for Sustainable Agriculture in Viet Nam

Viet Nam requires 100% of urban and 70% of rural organic waste to be recycled by 2030 and provides green loans of up to 70% of project cost.

Mrs Nguyen Cam Thuy presented an overview of Viet Nam's progress in circular agriculture. Policy development began in the early 2000s and has evolved toward

stronger extended producer responsibility (EPR) requirements, obligating manufacturers and importers to take responsibility for recovering and disposing of used products.

Under Decision No. 687/2022/QD-TTg, Viet Nam aims to recycle 100% of urban organic waste and 70% of rural organic waste by 2030. Circular agriculture contributes to Viet Nam's economy-wide commitment to reduce greenhouse gas emissions intensity per GDP unit by at least 15% by 2030. Decision No. 540/QD-TTg specifies that by 2030, 20% of agricultural science and technology missions must support circular agriculture.

Popular circular models include biogas systems converting waste and wastewater into energy and integrated crop–livestock–aquaculture systems that maximize nutrient cycling. Mrs Nguyen emphasized that technology, policy, and financing mechanisms must advance together. Viet Nam is testing blended finance, fintech/agtech tools for improving farmers' credit profiles, and models for validating financing solutions tailored to smallholders.

B. APEC Survey Report

Dr Ivy Yi-Chieh Chen, Senior Research Fellow, Agricultural Technology Research Institute, Chinese Taipei

Dr Ivy Yi-Chieh Chen from the Agricultural Technology Research Institute (ATRI) presented the results of the APEC Pre-Workshop Survey on circular agriculture practices and challenges. The survey received 10 valid responses from eight economies, all of which reported having implemented circular agriculture policies, with half of the respondents reported more than five years of experience.

Funding shortages emerged as the most significant challenge, and although circular agriculture contributes to net-zero efforts, seven respondents estimated its contribution at below 50%, viewing it primarily as a supportive strategy. While eight economies have economy-wide net-zero targets, only five have explicitly included agriculture in their net-zero roadmaps.

Private-sector participation remains limited, with most economies reporting only moderate or low engagement, and government financial support for private sector activities typically below 50%. The highest priorities for future APEC support were technology transfer (score 4.38) and capacity building (score 4.25). Respondents also noted that globally, the AFOLU sector receives around 4 percent of climate finance, making resource access a major constraint.

The full report is available in Annex 3.

5. Keynote Speech (Day 2)

Current Status and Technical Strategies for Low-Carbon Livestock Development in China

Dr Hongmin Dong, Professor, Institute of Environment and Sustainable Development in Agriculture (IEDA), CAAS, China

Dr Hongmin Dong presented an overview of China's livestock sector and its strategies for advancing low-carbon development within one of the world's largest agricultural systems. She noted that China accounts for approximately half of the world's pig population, one-third of global poultry production, and one-fifth of sheep production, highlighting the significant role of the livestock sector in both food security and greenhouse gas emissions. Against this backdrop, reducing emissions from livestock production is a critical component of China's broader climate mitigation efforts.

Dr Dong outlined three key technical pathways for reducing emissions in the livestock sector. First, improving productivity and feed efficiency can lower emissions intensity by producing more output with fewer inputs. Second, the adoption of low-protein diets can significantly reduce nitrogen excretion, with studies showing reductions of around 10 percent, thereby decreasing associated emissions such as ammonia and nitrous oxide. Third, enhancing manure management and utilization plays a central role in circular agriculture, with livestock waste increasingly treated and reused as organic fertilizer or processed for energy recovery.

In addition to technological measures, Dr Dong emphasized the importance of developing standardized greenhouse gas accounting systems. China has established domestic standards such as GB/T 44903-2024 to support consistent emissions measurement and reporting. She also noted that mitigation projects in the livestock sector are being registered under international carbon mechanisms, including the Verified Carbon Standard (VCS) and the Gold Standard, enabling participation in carbon markets and supporting financial incentives for emission reduction.

Overall, the presentation highlighted that achieving low-carbon livestock development requires an integrated approach combining technological innovation, standardized measurement systems, and market-based mechanisms, enabling large-scale agricultural systems to transition toward more sustainable and climate-resilient production models.

6. Session 4: Business Models and Market Prospects for Carbon Reduction

Recent Policy Development for Supply Chain Collaborations and Carbon Credit Schemes – The Case of Japan's MIDORI
Mr Daisuke Takahashi, Deputy Director, MIDORI Strategy Division, MAFF, Japan

Mr Takahashi presented Japan's policy developments in promoting low-carbon agriculture through market-based mechanisms and supply chain collaboration under the MIDORI Strategy. He highlighted the role of the J-Credit Scheme, which incentivizes farmers and companies to adopt climate-friendly agricultural practices by generating tradable carbon credits. One key example is the implementation of Alternate Wetting and Drying (AWD) in rice cultivation, which can reduce methane emissions by approximately 30 percent compared to conventional continuous flooding practices.

Mr Takahashi emphasized that Japan's approach integrates emission reduction with economic incentives, allowing farmers to benefit financially while contributing to economy-wide climate targets. In addition, Mr Takahashi introduced Japan's collaboration with the Asian Development Bank (ADB) to launch the first agricultural project under the Joint Crediting Mechanism (JCM) in Asia. This initiative aims to promote cross-border carbon reduction projects and facilitate technology transfer across economies.

Mr Takahashi noted that strengthening supply chain collaboration—linking producers, companies, and financial institutions—is essential for scaling up carbon credit schemes. Overall, Japan's experience demonstrates how policy frameworks, market mechanisms, and international cooperation can be combined to accelerate the transition toward low-carbon agricultural systems.

Toward Net-Zero: Waste Circularity in Livestock Farming

Dr Chi-Ling Chen, Researcher, Taiwan Agricultural Research Institute, MOA, Chinese Taipei

Dr Chen presented research on integrating circular agriculture technologies into livestock systems to achieve net-zero emission outcomes. Using life-cycle assessment (LCA) methods, she demonstrated that combining multiple technologies—including biogas systems, solar photovoltaic (PV) generation, and the application of biogas slurry to farmland—can significantly reduce emissions. In one integrated model, the system achieved a net reduction of approximately -269 tCO_2e per year, illustrating the potential for livestock operations to become net carbon sinks under optimized conditions.

A key technical focus of her presentation was the management of biogas slurry. Dr Chen emphasized that traditional spraying methods can lead to nitrogen loss and environmental pollution, whereas slurry injection techniques allow nutrients to be applied directly into the soil, improving nutrient efficiency and reducing emissions.

Her research highlights that achieving net-zero livestock systems requires the integration of multiple technologies across energy, waste management, and crop production. She noted that scaling up such models will depend on improving technology adoption at the farm level, strengthening infrastructure, and providing policy support to encourage wider implementation.

Circular Agriculture in Egg Production – Shih An Farm

Mr Duncan Fang, Manager, Shih An Farm Co., Ltd., Chinese Taipei

Mr Fang presented the circular agriculture practices implemented by Shih An Farm, a leading egg production company in Chinese Taipei. He explained how the company has adopted a closed-loop production system that fully recycles livestock waste and integrates renewable energy technologies. Through the combined use of manure management systems, wastewater treatment, and biogas energy generation, the farm has significantly improved resource efficiency and reduced environmental impacts.

Between 2019 and 2023, Shih An Farm achieved a 46 percent reduction in its carbon footprint, lowering emissions to approximately 0.179 kg CO_2 e per kilogram of eggs. This was accomplished through continuous investment in circular systems and renewable energy, as well as improvements in operational efficiency.

Mr Fang emphasized that achieving such outcomes requires long-term commitment, technological investment, and strong management practices. He also highlighted that circular agriculture can enhance both environmental sustainability and economic competitiveness, demonstrating that well-designed business models can successfully integrate carbon reduction with commercial performance.

CPF Circular Agriculture Practices
Mr Adit Krisanawong, Director, Charoen Pokphand Food PLC., Thailand

Mr Krisanawong presented the circular agriculture practices of Charoen Pokphand Foods (CPF), one of the largest agribusiness companies in the region. He introduced CPF's "Feed–Farm–Food" integrated model, which aims to maximize resource efficiency and minimize waste across the entire production chain. Under this model, by-products from one stage of production are systematically reused as inputs in another, forming a closed-loop system.

Examples include the conversion of feathers into animal feed, the processing of livestock manure into biogas and organic soil enhancers such as MEGA168, and the transformation of eggshell waste into bio-cement materials used to improve soil quality and address issues such as soil salinity. These practices demonstrate how industrial-scale operations can apply circular economy principles to reduce waste while creating additional value streams.

Mr Krisanawong emphasized that large-scale private enterprises play a critical role in scaling circular agriculture solutions. He noted that integrating innovation, operational efficiency, and sustainability objectives can enable companies to reduce emissions while maintaining competitiveness in global markets.

Opportunities for Sustainable Technologies in the EU Market
Dr Eric Schmitt, Principal, Sinefield BV, Belgium

Dr Schmitt provided insights into market opportunities for sustainable agricultural technologies in the European Union, emphasizing that the EU is increasingly prioritizing sustainability in both policy and market demand. He noted that producers seeking to enter the EU market must align with stringent environmental standards and demonstrate clear sustainability performance.

He encouraged APEC economies to engage more actively with the EU by establishing local partnerships or market presence, which can help navigate regulatory requirements and better understand market expectations. Dr Schmitt also highlighted the importance of aligning innovation strategies with the EU's research and funding programs, particularly the upcoming Horizon Europe framework (2028–2034), which is expected to expand opportunities for international collaboration.

He emphasized that while sustainability requirements may present challenges, they also create opportunities for producers who can meet high standards and offer innovative solutions. His remarks underscored that accessing advanced markets such as the EU requires not only technological capability, but also strategic positioning, regulatory alignment, and long-term investment in sustainability.

7. Panel Discussion

During the panel discussion session, participants from various APEC economies engaged in an in-depth exchange of perspectives on the policy, financial, and technological challenges associated with promoting circular agriculture as part of the transition toward net-zero carbon emissions. A common view among participants was that financing gaps remain one of the most significant barriers to scaling up circular agriculture initiatives. Compared with other sectors, agriculture often faces difficulties in accessing climate finance. As a result, stronger collaboration between multilateral development banks and private capital was highlighted as essential to mobilizing sufficient investment for climate-related agricultural projects.

Participants also emphasized the importance of policy continuity in enabling long-term investment in net-zero initiatives. In democratic systems, changes in government leadership may lead to shifts in policy priorities, which can interrupt long-term climate and sustainability programs. Such uncertainty may discourage private-sector engagement and investment in circular agriculture projects that require stable regulatory environments and extended implementation periods.

Another issue raised during the discussion concerned the practical challenges associated with carbon footprint labeling. Industry representatives noted that when production capacity is not fully utilized, the calculated carbon footprint per unit of product may appear artificially high, potentially misleading consumers. As a result, companies may hesitate to display carbon footprint labels on their products even if they have obtained formal certification. Participants therefore suggested that the development of more consistent international standards and clearer consumer communication would help improve the effectiveness of carbon labeling systems.

From a regional cooperation perspective, participants agreed that APEC can continue to play a catalytic role in promoting circular agriculture and net-zero transitions. Suggested areas for cooperation include technology transfer, capacity building, policy dialogue, and matchmaking for pilot and demonstration projects. Strengthening collaboration among member economies can facilitate the exchange of best practices and accelerate the deployment of innovative solutions.

A European participant also introduced recent developments under the Horizon Programme, the European Union’s research and innovation funding framework. The programme is currently undergoing reforms aimed at making funding mechanisms larger in scale, faster in operation, and simpler in administrative procedures. APEC economies were encouraged to explore opportunities for collaboration with European institutions under Horizon to expand international cooperation in circular agriculture and net-zero technologies.

Moderator: Dr Hu-Sheng Lu (Chinese Taipei)

Dr Lu served as the moderator of the panel discussion. The session focused on topics including public–private partnership models, carbon reduction measurement methodologies, and market-based mechanisms such as carbon trading, incentive schemes, and certification systems. As the final session of the two-day workshop, the panel discussion was designed to provide participants with two hours of open dialogue and exchange.

Dr Lu emphasized that in democratic societies, policy continuity is essential for establishing strong public–private partnerships. Without stable policies, private investors may hesitate to engage in long-term sustainability initiatives. Drawing from his own experience in academic research, he also highlighted the significant challenges associated with technology transfer. Despite holding several patents, many of his innovations had not been successfully commercialized. This experience underscores the importance of engaging potential users early in the research and development process so that technological innovation can better align with market demand.

With regard to carbon footprint labeling, Dr Lu described an effective labeling system as being similar to "a beautiful rose—attractive but costly." He suggested that the success of such systems may depend on a relatively short "half-life" of about five years, meaning that their effectiveness must be evaluated and updated regularly to remain relevant.

Mr Chi-Heng Wu (Nice Garden, Chinese Taipei)

Mr Wu spoke from the perspective of the private sector, representing the company Nice Garden. He emphasized that commercial viability is fundamental to the success of the circular economy. In the current economic system, sustainable practices can only be widely adopted if they generate tangible economic value.

Mr Wu described the company's vertically integrated business model of hog industry, under which partner farmers are required to follow standardized feed and farming practices. In return, the company purchases livestock from participating farmers at higher prices, thereby creating incentives for farmers to adopt sustainable production methods.

He also presented a case study of a biogas power generation facility, which transformed a heavily polluted pig farm that had been in operation for more than 35 years. The project was made possible through collaboration between private investment, government subsidies under the former Council of Agriculture's "Biogas-to-Energy Program," and technical support from Feng Chia University. This example illustrates how public–private partnerships can facilitate the successful implementation of circular agriculture initiatives.

However, Mr Wu noted that many farms in Chinese Taipei are small to medium in scale, which limits the volume of available agricultural waste and constrains the potential output of bioenergy systems. He also discussed his company's experience with carbon footprint certification. Although the company obtained ISO 14067 certification in 2017 and established a Product Category Rule (PCR) for its pork products, it chose

not to display carbon footprint labels on product packaging. This decision was based on concerns that consumers may not fully understand carbon footprint information, and that low production capacity during the early stages of factory operations could lead to misleading carbon emission figures.

Mr Wu highlighted that by improving production efficiency and increasing sales volume, the company has successfully reduced the carbon footprint of its products by approximately 50 percent. He emphasized that governments should provide stable and long-term policy frameworks rather than short-term subsidies, noting that mandatory targets such as the European Union's 2030 climate goals can encourage industries to prepare for future regulatory changes. He also pointed out that in some cases regulatory fragmentation—such as different government agencies managing food waste and agricultural waste separately—may limit the ability of companies to combine feedstocks and maximize biogas production.

Dr Jing-Xiang Chen (Chinese Taipei)

Dr Chen introduced the work of the "Mao Mao Sun" team, which has developed an innovative product that converts discarded tea stems into compostable drinking straws. Each year, more than 30,000 tons of tea stems are discarded as waste. The team has transformed this agricultural by-product into biodegradable straws made from tea fiber.

The product is currently the only straw in the world certified with the German DIN CERTCO home-compostable certification, enabling what Dr Chen described as "zero-barrier circularity." Unlike many biodegradable plastics that require industrial composting facilities, the straws can naturally decompose by more than 90 percent within 360 days under home composting conditions and do not generate microplastics.

Dr Chen estimated that each ton of product can reduce approximately 3.7 tons of CO_2 equivalent emissions, giving the product tangible carbon credit value. From an academic perspective, he also observed that university researchers in Chinese Taipei can generally be divided into two groups: those who focus primarily on publishing SCI-indexed academic research, and those who prioritize applied research and collaboration with industry. Dr Chen identified himself as belonging to the latter group, emphasizing the importance of translating research results into practical applications.

Dr Lao-Da Juang (Ministry of Agriculture, Chinese Taipei)

Dr Juang highlighted that regulatory frameworks represent one of the most important roles of the government and must evolve alongside industrial development. He noted that the government of Chinese Taipei is currently revising relevant legislation, including the Agricultural Waste Management Act and farmland management regulations, to allow circular agriculture facilities such as biogas plants to be established on agricultural land.

Chinese Taipei has also developed its own domestic carbon credit system, with five methodologies currently available for the agricultural sector. These include methodologies related to afforestation, alternate wetting and drying (AWD) irrigation

in rice cultivation, forest and bamboo management, mangrove and seagrass restoration, and agricultural energy transformation.

To further encourage public–private collaboration, the Ministry of Agriculture has established an ESG Store platform, which serves as a matchmaking mechanism connecting private enterprises with agricultural ESG initiatives. In response to concerns raised by industry regarding carbon footprint labels and PCR systems, Dr Juang noted that the government is working with the Ministry of Environment to review PCR standards and will continue promoting low-carbon labeling while strengthening consumer education.

International Perspectives

Representatives from several APEC economies also shared their perspectives on the role of government, private sector engagement, and international collaboration.

Dr Eric Schmitt (Belgium) noted that although European policies are not perfect, the European Commission has been effective in providing clear policy direction and coordinated implementation. He suggested that private-sector stakeholders seeking regulatory adjustments should present more specific and practical proposals that address safety requirements. He also emphasized the importance of university technology transfer offices in helping researchers understand real market needs. Dr Schmitt observed that while carbon accounting methods are gradually becoming standardized—largely driven by multinational corporations—carbon labeling remains challenging to standardize internationally because labels also function as brands influenced by cultural and societal contexts.

Dr Nuria Aide López Hernández (Mexico) highlighted the importance of public–private partnerships, particularly in political systems where frequent changes in government can interrupt policy continuity. Collaboration with private-sector partners can help ensure stable funding sources and maintain long-term project continuity. She also shared examples of field experiments conducted by Mexico's domestic research institutions on farmers' land, allowing farmers to directly benefit from technological innovation.

Ms Kelly Porter (Australia) explained that the Australian government has adopted a "ground up" approach regarding circular agriculture innovations, providing general policy direction and research funding through R&D associations while avoiding direct intervention in industry activities. She emphasized that innovation must ultimately be commercially viable in order to be sustainable.

Mr Daisuke Takahashi (Japan) introduced Japan's MIDORI policy, which emphasizes collaboration among private-sector actors. Rather than relying primarily on subsidies, the government focuses on creating platforms that connect businesses and establish market conditions in which sustainable practices can generate profit. He also described the MIDORI ∞ INFINITY international cooperation initiative, which has expanded from Southeast Asia to Africa and Latin America and will showcase results at COP30.

Mrs Nguyen Thu Hang (Viet Nam) emphasized that governments must listen carefully to the challenges faced by private companies in implementing circular

economy initiatives. One major barrier is the lack of standardized certification systems. She also noted that insufficient financing remains one of the largest obstacles for businesses seeking to implement carbon reduction measures. Viet Nam is currently developing a green taxonomy and green finance mechanisms to address these challenges.

Mr Jaime Giacomozzi (Chile) explained that Chile faces limited domestic funding for climate mitigation initiatives and must therefore rely on international financing mechanisms such as the Green Climate Fund. Clear regulatory frameworks are essential for strengthening private-sector competitiveness while also supporting smallholder farmers who often lack technical expertise and knowledge.

Dr Eakpol Phuvanartnarubal (Thailand) described how the Thai government promotes private-sector participation by providing research information and facilitating collaboration. One example includes cooperation between government agencies, companies, and smallholder farmers to deploy solar-powered water pumps and IoT sensors, helping improve the productivity and quality of crops such as durian.

Key Challenges Identified

Beyond the financing gap—particularly the fact that around 4 percent of global climate finance flows to the AFOLU sector (Agriculture, Forestry and Other Land Use)—participants identified several additional challenges associated with implementing circular agriculture and net-zero strategies.

A. Farmer Incentives and Commercial Motivation

Encouraging farmers and private enterprises to voluntarily adopt carbon reduction practices remains difficult due to the lack of clear market signals and financial incentives. Businesses emphasized that within a market-based economic system, sustainability initiatives must generate economic returns in order to be sustained. Farmers are more willing to invest in costly sustainable infrastructure only when their products can be sold at higher market prices or when guaranteed purchase agreements are provided.

Private-sector experience suggests that maximizing production efficiency can be one of the most effective ways to reduce carbon emissions, rather than relying solely on technological solutions or subsidies.

B. Implementation Barriers

Several structural barriers also hinder the implementation of circular agriculture practices.

First, the small scale of many farms, particularly in economies such as Chinese Taipei, limits the volume of agricultural waste available for bioenergy production, reducing the commercial viability of facilities such as biogas plants.

Second, many farmers lack the technical knowledge required to adopt new low-carbon technologies. For example, biogas production requires specialized technical expertise that farmers typically do not possess.

Third, technology transfer from universities to industry remains challenging. Academic research outcomes do not always align with market demand, and the absence of intermediary institutions that provide ongoing technical support can hinder the commercialization of innovations.

Finally, regulatory complexity can also pose barriers. In some cases, different government agencies regulate different types of waste streams—such as food waste and agricultural waste—preventing companies from combining feedstocks to optimize biogas production. Some governments are therefore beginning to revise relevant regulations in order to remove restrictions on circular agriculture infrastructure.

8. Field Trip (Day 3)

On Day 3, participants visited several demonstration sites in the Kaohsiung–Pingtung (Gaoping) region to gain first-hand insights into the practical implementation of circular agriculture and its role in advancing sustainable food systems and net-zero transitions in Chinese Taipei.

The visit began at the **Kaohsiung District Agricultural Research and Extension Station**, where participants observed how long-standing public research institutions contribute to the development and dissemination of environmentally friendly agricultural practices. Innovations such as pineapple fiber extraction and the application of biochar technologies illustrated how agricultural residues can be effectively transformed into value-added materials, highlighting the importance of bridging scientific research with field-level adoption.

At **TCI Co., Ltd.**, participants were introduced to a "bio-mining" model that applies advanced biotechnology to convert agricultural by-products—such as fruit residues and plant materials—into high-value functional ingredients. This case demonstrated that circular agriculture can extend beyond waste management to become a driver of new business models and economic value creation, particularly when supported by strong research and development capabilities.

The visit to the **Agricultural Technology Park Administration Center** further emphasized the role of integrated policy support and industrial ecosystems in fostering agricultural biotechnology industries, showing how clustering mechanisms and government facilitation can accelerate innovation and commercialization.

In addition, a presentation was delivered by **Taiwan Sugar Corporation (TSC)** on the Dong Hai Feng Agricultural Circulation Park, providing participants with an overview of its development and operational model. As the world's first BSI-certified green circular pig farm, the park applies anaerobic digestion technology to convert livestock waste into biogas and organic fertilizers, forming a closed-loop system that integrates renewable energy production and resource recycling. The presentation highlighted how traditional livestock operations can be transformed into environmentally sustainable and community-friendly systems through circular economy approaches, while also addressing concerns related to environmental impacts.

The field trip also included a visit to the **Indigenous Peoples Cultural Development Center**, which provided participants with a broader perspective on the

social and cultural dimensions of sustainability. The Center highlighted the importance of integrating Indigenous knowledge, cultural heritage, and community participation into sustainable rural development strategies.

Overall, the field trip offered several important insights for APEC economies. First, it demonstrated that successful circular agriculture requires a systems-based approach, integrating upstream production, waste management, value-added processing, and downstream market development. Second, it highlighted the critical role of public–private collaboration, where research institutions, government agencies, and private enterprises each contribute distinct but complementary functions in innovation, scaling, and implementation. Third, the cases illustrated that economic viability is essential for the long-term adoption of circular practices; solutions that create tangible market value are more likely to be sustained and replicated. Fourth, the examples underscored the importance of policy coherence and enabling environments, including regulatory flexibility, infrastructure support, and institutional coordination, in facilitating circular agriculture development. Finally, the field trip reinforced that while many circular agriculture solutions are already technically feasible, the key challenge for the region lies in scaling up these practices, particularly in the context of smallholder-dominated agricultural systems and fragmented supply chains. These observations provide valuable reference points for APEC member economies seeking to translate circular agriculture concepts into practical, scalable, and inclusive solutions that contribute to climate mitigation and sustainable development goals.

9. Workshop Summary and Key Takeaways

The “APEC Workshop on Enhancing Net-Zero Carbon Emission Goals through Circular Agriculture: Best Practices and Innovations (ATCWG_201_2024A)” brought together 125 participants from 14 APEC member economies, together with invited experts from two additional APEC economies and Belgium to exchange experiences and explore practical pathways for integrating circular agriculture into climate mitigation strategies. Through keynote speeches, thematic sessions, a panel discussion, field visits, and a pre-workshop survey of APEC member economies, the workshop provided a comprehensive overview of policy developments, technological innovations, and implementation challenges related to circular agriculture across the region.

One of the key achievements of the project was the documentation of 21 best practice cases, significantly exceeding the initial project target of collecting 10 cases. These cases illustrate the diversity of circular agriculture applications across the APEC region and demonstrate how circular solutions can contribute to both environmental sustainability and economic value creation. Notable examples include Shih An Farm’s waste-to-energy system, which achieved a 46 percent reduction in greenhouse gas emissions, and the development of certified home-compostable tea-fiber straws in Chinese Taipei, which convert discarded tea stems into biodegradable materials while avoiding microplastic pollution. Additional innovative applications were also

highlighted, such as the use of 3D-printed oyster shells to support coral reef restoration, demonstrating how circular resource use can contribute to broader ecosystem protection.

The workshop discussions also highlighted the increasing transition of circular agriculture from conceptual innovation toward practical implementation. Many economies have already introduced policy frameworks and pilot initiatives aimed at improving resource efficiency, reducing agricultural waste, and promoting bioenergy production. According to the pre-workshop survey, all responding economies reported the existence of circular agriculture policies or programs, with many having more than five years of implementation experience. Key policy tools include economy-wide strategies, regulatory frameworks, research and demonstration projects, and public–private partnerships.

Despite this progress, participants also identified several structural challenges that continue to limit the large-scale adoption of circular agriculture practices.

First, financial constraints remain one of the most significant barriers. Globally, only around 4.3 percent of climate finance flows to the AFOLU sector (Agriculture, Forestry and Other Land Use). Limited access to climate finance restricts the ability of farmers, small and medium-sized enterprises (SMEs), and local governments to invest in circular technologies such as biogas systems, biomass recycling, and waste-to-energy infrastructure.

Second, standardization gaps in carbon accounting and life-cycle assessment (LCA) methodologies pose challenges for measuring and verifying emission reductions. Inconsistent methodologies across economies may hinder the development of comparable carbon footprint data and reduce the effectiveness of carbon labeling systems and market-based mechanisms.

Third, structural characteristics of the agricultural sector—particularly small farm sizes in many economies—can limit the economic viability of certain circular technologies. For example, small-scale farms may not generate sufficient biomass or organic waste to support large-scale bioenergy production systems. This highlights the need for cooperative models, resource aggregation mechanisms, or regional processing facilities to enable economies of scale.

In addition to these structural challenges, the workshop discussions underscored the importance of stable policy frameworks and effective public–private collaboration. Private-sector representatives emphasized that circular agriculture solutions must be economically viable in order to achieve long-term adoption. Governments therefore play a critical role not only in providing funding support, but also in creating enabling regulatory environments, facilitating market incentives, and strengthening coordination across sectors.

Based on the discussions and survey findings, several key recommendations for future APEC cooperation emerged.

First, strengthening technology transfer and knowledge exchange will be essential for accelerating the adoption of circular agriculture practices across member economies. Sharing successful case studies, technical standards, and research results can help economies replicate proven solutions and avoid common implementation challenges.

Second, promoting green finance and innovative investment mechanisms will be critical to scaling up circular agriculture initiatives. Greater collaboration with multilateral development banks, climate funds, and private investors could help mobilize resources for circular agriculture projects and reduce financial risks for farmers and enterprises.

Third, enhancing regional collaboration mechanisms within APEC can support more coordinated development of circular agriculture systems. One potential approach discussed during the workshop is the establishment of regional resource processing centers or cooperative platforms, which could aggregate agricultural residues and organic waste from multiple farms, thereby improving the economic feasibility of bioenergy production and resource recycling.

Finally, the workshop highlighted the important role of APEC as a platform for policy dialogue, capacity building, and regional cooperation. By facilitating knowledge exchange, supporting collaborative pilot projects, and strengthening institutional networks, APEC can help member economies advance circular agriculture while contributing to broader goals of sustainable agri-food systems and net-zero carbon transitions.

Overall, the workshop demonstrated strong interest and commitment among APEC economies to further explore circular agriculture as a practical pathway toward climate mitigation and sustainable agricultural development. Continued collaboration through the ATCWG framework will be important for translating these discussions into concrete actions and long-term regional cooperation.

III. Summary of Post-Workshop Survey

After the workshop, an APEC Project Evaluation Survey was distributed to participants, and a total of 90 valid responses were received. The survey followed the standard APEC format for seminars, symposiums, and workshops, and assessed participants' level of agreement on key aspects, including whether the objectives of the training were clearly defined, whether the project achieved its intended objectives, the relevance of agenda items and topics covered, the organization of content, the performance of trainers/experts, the usefulness of materials distributed, the sufficiency of time allotted, as well as gender considerations and knowledge gains. Participation in the survey was voluntary and anonymous.

Respondents represented a diverse range of APEC member economies, including Chile; Indonesia; Japan; Malaysia; Mexico; Peru; Chinese Taipei; Thailand; Viet Nam, as well as private sector participants from Belgium. Approximately 70 percent of respondents were from government agencies, while the remainder were from research institutions and private sector organizations.

Overall, participants expressed a high level of agreement across most evaluation dimensions. More than 85 percent of respondents selected "Strongly Agree" for key statements, including that the objectives of the training were clearly defined, the project achieved its intended objectives, the agenda items and topics covered were relevant, and that the trainers/experts were well prepared and knowledgeable about

the topic. Respondents also indicated strong agreement that the content was well organized and easy to follow and that the materials distributed were useful, suggesting that the workshop was effectively designed and implemented.

The only aspect receiving relatively lower ratings was the time allotted for the training, where approximately 28 percent of respondents selected “Agree” rather than “Strongly Agree”, indicating that the schedule was somewhat tight. In particular, several respondents noted that the field visit involving inter-regional travel could benefit from additional time or an extended program duration.

Regarding project relevance, most respondents rated the workshop as “very” or “mostly” relevant to their work and their economy(4.62). Several participants highlighted that the project provided useful inputs for developing domestic policies and strategies related to circular agriculture and net-zero transitions.

In terms of knowledge and skills, respondents reported clear improvements after participating in the event. Many indicated that their level of knowledge and skills increased from “medium” or “high” prior to the workshop to “high” or “very high” afterward. Participants specifically noted enhanced understanding in areas such as life cycle assessment (LCA), environmental inhibitors, biochar technologies, biomass applications, agricultural by-product valorization, public–private partnerships, financing mechanisms, and international cooperation frameworks.

When asked how they would apply the project’s content and knowledge gained, respondents indicated that they plan to use the outcomes in their workplace through activities such as developing new policy initiatives, strengthening inter-agency coordination, organizing training programs, developing work plans or strategies, and initiating pilot or demonstration projects. These responses indicate that the project has contributed to capacity building across participating economies.

Regarding future actions, respondents suggested that APEC should continue to strengthen regional collaboration platforms, including better sharing of presentation materials, participant contact information, and centralized access to knowledge resources. They also emphasized the importance of improving access to financing and technical support, particularly for developing economies implementing circular agriculture projects.

In terms of project improvement, some respondents suggested incorporating more interactive formats, such as breakout discussions and case-based workshops, to enhance engagement. Others recommended improving agenda design to reduce overlap between presentations and ensure clearer thematic focus.

Overall, the survey results indicate that participants were highly satisfied with the workshop and that the project successfully achieved its intended objectives. The feedback also highlights strong demand for continued APEC cooperation in circular agriculture, particularly in areas such as technology exchange, policy development, and capacity building.

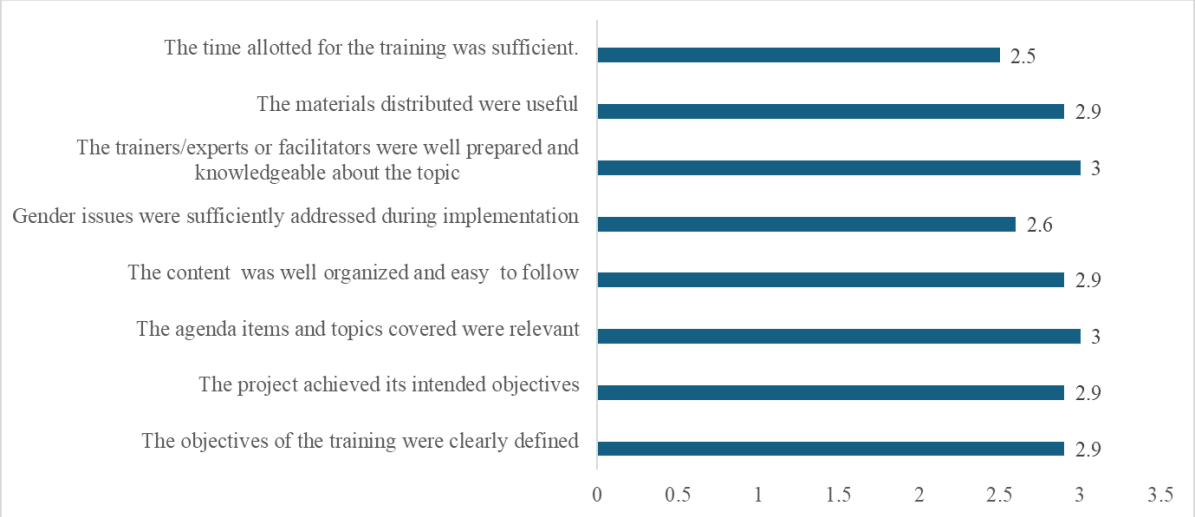


Figure 3. Average scores for each dimension of this workshop

IV. Annexes

1. Agenda

Day 0: September 22, 2025 (Monday), Participants arrival	
Day 1: September 23, 2025 (Tuesday)	
08:30 – 09:00	**Arrival and Check-in**
09:00 – 09:30	**Opening Session - Welcome and Opening Remarks** ***Group Photo***
09:30 –10:00	**Keynote Speech: 20 + 10 min** **On the Way to Zero Agricultural Waste in Chinese Taipei - Case of Pineapple and Oyster** **Speakers: Dr Lao-Dar Juang**, Director General, Department of Resources Sustainability, Ministry of Agriculture (MOA), Chinese Taipei **Chair: Dr Huu-Sheng Lur,** Professor Emeritus, College of Bioresources and Agriculture, National Taiwan University, Chinese Taipei
10:00 – 10:20	**Coffee/Tea Break**
10:20 –12:00	**Session 1 - Trends, Prospects, and Innovations in Circular Agriculture** *Focus on new technologies and approaches (e.g., green energy, bio-based materials, smart/precision agriculture)* - 4 speakers, each 20 min + 5 min Q&A **Speakers:** 1. Environmental Inhibitors in Agri-food Systems - **Mr Raj Rajasekar, Senior Programme Manager, New Zealand Ministry for Primary Industries, New Zealand** 2. A Low-Carbon Model for Durian Production in Thailand - **Dr Eakpol Phuvanartnarubal,** Agricultural Research Officer, Crops for the Future and Greenhouse Gas Management in Agricultural Sector Research and Development Division, Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand 3. BECCS-Driven Bioenergy: Renewable Solutions from Piggery Wastewater Using Reduce, Reuse, Recycle Strategies - **Dr Jung-Jeng Su,** Professor, National Taiwan University, Chinese Taipei 4. Innovative Models in Applying Circular Economy to Coffee, Cocoa Production and Processing in Viet Nam – Experiences and Lessons Learnt - **Dr Lai Van Manh**, Head, Department of Economic Resources and Environment, Institute of Strategy and Policy on Agriculture and Environment, Viet Nam **Chair: Dr Huu-Sheng Lur,** Professor Emeritus, College of Bioresources and

	Agriculture, National Taiwan University, Chinese Taipei
12:00 – 13:00	**Lunch Break**
13:00 – 14:40	**Session 2 - Net-Zero Decarbonization through Circular Agriculture in Agriculture, Forestry, Fisheries, and Livestock – Life Cycle–Based Best Practices** *Focus on experts from the agriculture, forestry, fisheries, and livestock sectors who have successfully deployed circular agriculture strategies to achieve net-zero carbon objectives, particularly by using life cycle–based frameworks.* - 4 speakers, each 20 min + 5 min Q&A 1. Best Practice Sharing on How Chinese Taipei's Livestock Industry can Achieve Net Zero Carbon Reduction Goals through the Use of Circular Agriculture Strategies Based on the Life Cycle Concept - **Dr Jeng-Bin Lin,** Researcher & Chief, Taiwan Livestock Research Institute, MOA, Chinese Taipei 2. Implementation of the Circular Economy Roadmap in Peru's Agricultural and Irrigation Sector - **Mrs Gabriela Quiroz**, Director, Ministry of Agrarian Development and Irrigation, Peru 3. Oyster Shell Valorization and Whole-Fish Utilization: Applications and Practices from Chinese Taipei - **Dr Yen-Wei Chang,** Associate Researcher, Fisheries Research Institute, MOA, Chinese Taipei 4. Policy and Practice on Reducing Food Loss and Waste and Food Waste Recycling - **Mr Manabu Suzuki**, Director, Food Loss & Waste and Recycling Management Office, Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan **Chair: Dr Chi-Ling Chen**, Researcher, Taiwan Agricultural Research Institute, MOA, Chinese Taipei
14:40 – 15:00	Coffee/Tea Break
15:00 – 16:50	**Session 3 - Economies' Policies, Strategies, and APEC-wide Survey Findings** *Focus on official representatives share policies, regulations, and programs on circular agriculture; Presentation of preliminary survey results* **Speakers:** 1. Brief remarks from each interested economy + Q&A **- Australia; Chile; Japan; Malaysia; Mexico; Peru; Chinese Taipei; Thailand; Viet Nam** 2. APEC survey report

	- **Dr Ivy Yi-Chieh Chen**, Senior Research Fellow, Agricultural Technology Research Institute, Chinese Taipei **Chair: Dr Su-San Chang,** Lead Shepherd, ATCWG, APEC
16:50 – 17:00	**Closing Remarks- Day 1 Wrap-up**
Day 2: September 24, 2025 (Wednesday)	
09:00 – 09:10	***Arrival and Check-in***
09:10 –09:40	**Keynote Speech:** **Current Status and Technical Strategies for Green and Low-Carbon Development in China's Livestock Industry** **Speakers: Dr DONG Hongmin,** Professor, Institute of Environment and Sustainable development in Agriculture (IEDA), Chinese Academy of Agricultural Sciences (CAAS), China **Chair: Dr Jeng-Fang Huang,** Director General, Taiwan Livestock Research Institute, MOA, Chinese Taipei
09:40 – 10:00	**Coffee/Tea Break**
10:00 –12:00	**Session 4 - Business Models and Market Prospects for Carbon Reduction through Circular Agriculture** *Focus on commercializing circular agriculture solutions, exploring cost–benefit analysis, market feasibility, and financing mechanisms that enable widespread adoption. Topics may include supply chain collaborations, investor and policy support, and success stories from startups, SMEs, and large-scale enterprises* - 5 speakers, each 20 min + 5 min Q&A 1. Recent Policy Development for Supply Chain Collaborations and Carbon Credit Scheme for Sustainable Food Systems – The Case of Japan's MIDORI – - **Mr Daisuke Takahashi**, Deputy Director, Climate Change Negotiations at the Global Environment Office, MIDORI Strategy for Sustainable Food Systems Division, MAFF, Japan 2. Toward Net-Zero: Waste Circularity and Carbon Reduction in Livestock Farming - **Dr Chi-Ling Chen,** Researcher, Taiwan Agricultural Research Institute, MOA, Chinese Taipei 3. Egg Industry Circular Agriculture and Carbon Reduction Case Sharing – Shih An Farm - **Mr Duncan Fang**, Manager, Shih An Farm Co., Ltd, Chinese Taipei 4. CPF Circular Agriculture Practices - **Mr Adit Krisanawong**, Director, Livestock Feed Business & Top Executive of Public Private Relations, Charoen Pokphand Food PLC.,

	Thailand 5. Opportunities for Sustainable Chinese Taipei's Technology in the EU Market - **Dr Eric Schmitt,** Principal, Sinefield BV, Belgium **Chair: Dr Jeng-Fang Huang,** Director General, Taiwan Livestock Research Institute, MOA, Chinese Taipei
12:00 – 13:30	**Lunch Break**
13:30 – 15:30	**Panel Discussion - Potential discussion points:** *1. Collaboration models between enterprises and government* *2. Measuring carbon reduction and leveraging market mechanisms (carbon trading, incentives, certifications)* *3. Policy recommendations and future trends* **-** Panelists: cross-sector experts (government, research institutes, industry, NGOs) - Open Q&A and discussion **(TBC)** - **Dr Lao-Dar Juang,** Director General, Department of Resources Sustainability, MOA, Chinese Taipei - **Mr Chi-Heng Wu,** Chief Executive Officer, Nice Garden Industrial Co., Ltd., Chinese Taipei - **Dr Jin-Siang Chen**, Principal Advisor, Mo Mo Sun Int Co.,Ltd., Chinese Taipei - **Dr Eric Schmitt,** Principal, Sinefield BV, Belgium **Chair: Dr Huu-Sheng Lur,** Professor Emeritus, College of Bioresources and Agriculture, National Taiwan University, Chinese Taipei
15:30 – 16:00	***Closing Session*** **1.** Wrap up and Discussion on next step from workshop participants **2.** Closing remarks
Day 3: September 25, 2025 (Thursday)- On-site Visit & Field Trip	
	Recommended Schedule (Example) **08:30: Departure from hotel/venue** **09:40–10:40: Arrival at the 1st circular agriculture demonstration site** - Kaohsiung District Agricultural Research and Extension Station, Ministry of Agriculture **11:00–12:00: Visit the 2nd site** - TCI Co., Ltd **12:20–13:20: Lunch** - Agricultural Technology Park Administration Center, MOA **13:20–13:50: Presentation** - Taiwan Sugar Corp. Dong Hai Feng Agricultural Circulation Park **14:00–14:30: Visit the 3rd site** - Agricultural Technology Park Ornamental Aquatic Animal Exhibition

	Center **14:50–16:30: Visit the 4th site** - Indigenous Peoples Cultural Development Center **16:30~** Return to the hotel
Day 4: September 26, 2025 (Friday)- Participants departure	

2. Photo

Chair's speaking

Economies' reporting

Speaker's Reporting

Workshop Group Photo

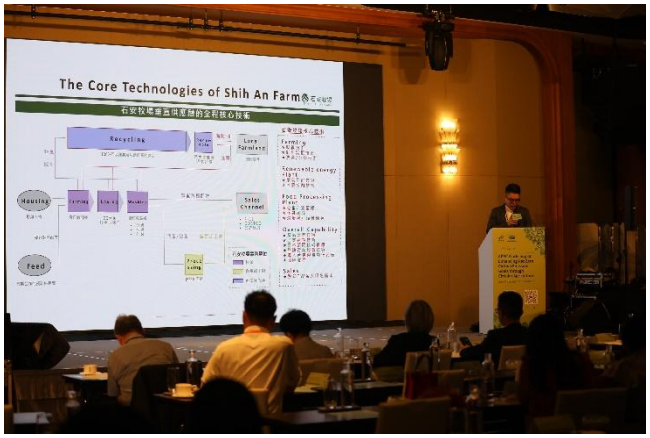
Figure 4. Workshop Photos of Day1

Panel Discussion

Coffee Break Conversations

Speaker’s Reporting

Panel Discussion



Speaker’s Reporting

Figure 5. Workshop Photos of Day2

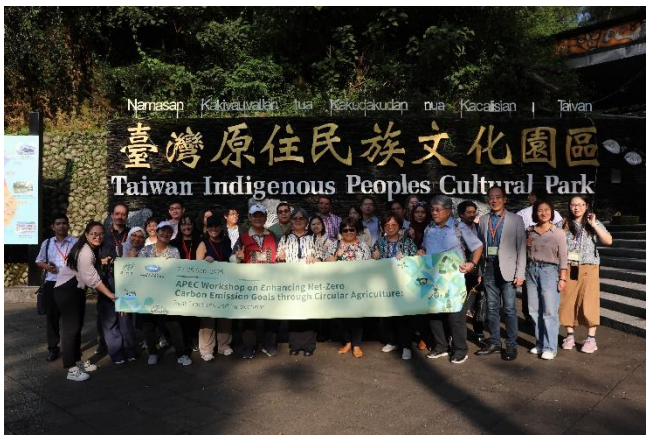
Kaohsiung District Agricultural Research and Extension Station, Ministry of Agriculture

TCI Co., Ltd

Agricultural Technology Park Administration Center, MOA

Taiwan Sugar Corp. Dong Hai Feng Agricultural Circulation Park

Agricultural Technology Park Ornamental Aquatic Animal Exhibition Center



Indigenous Peoples Cultural Development Center

Figure 6. Field Trip Photos of Day3

3. APEC Survey Report

Survey Analysis Report on Circular Agriculture and Net-Zero Carbon Transition among APEC Economies

Dr Ivy Yi-Chieh Chen, Senior Research Fellow, Agricultural Technology Research Institute, Chinese Taipei

A. Purpose of the Survey

To better understand the progress made by APEC member economies in promoting circular agriculture and advancing toward net-zero carbon emissions prior to the workshop, the project team designed a pre-workshop survey as an important preparatory output of the project. The survey aimed to collect information on existing policies, measures, and practical cases related to circular agriculture across member economies. It also included specific questions on the linkage between circular agriculture and net-zero goals, the level of private-sector engagement, needs for international cooperation, and expectations for the workshop.

Through systematic feedback collection and analysis, the survey results were compiled into statistical charts and case summaries for presentation in Session 3 of the workshop and were incorporated into the final project report as an important reference for promoting circular agriculture and carbon reduction strategies across the APEC region.

The main objectives of the survey were as follows:

a. **To map the current status of circular agriculture development across APEC economies**, including the extent of policy adoption, implementation strategies, program content, and progress made, in order to provide a comprehensive regional picture of circular agriculture development.

b. **To understand the linkage between circular agriculture and economy-wide net-zero emission goals** by examining how economies position circular agriculture within their greenhouse gas mitigation strategies and broader economy-wide climate policy frameworks.

c. **To gather information on policy tools and best practices**, including policy measures, cross-sectoral collaboration needs, implementation challenges, and representative cases, so as to inform workshop agenda design and support future APEC cooperation.

The survey was conducted between **July and September 2025**, and a total of **10 valid responses from 8 economies** were received.

B. Survey Structure

The survey questionnaire was designed in response to the practical policy needs surrounding circular agriculture and net-zero carbon transition and was structured into five parts:

Part A. Current Status of Circular Agriculture Policy Implementation

This section asked economies whether relevant policies, measures, or programs had been introduced and collected information on implementation period, annual budget, and major approaches adopted, such as composting, bioenergy, and agricultural waste reuse.

Part B. Linkages between Circular Agriculture and Net-Zero Goals

This section examined whether economies had established economy-wide or agricultural sector net-zero targets, the role of circular agriculture in achieving emission reduction pathways, and the greenhouse gas accounting and monitoring methods used, such as life-cycle assessment, carbon inventories, and MRV systems.

Part C. Private-Sector Participation and Best Practices

This section explored the degree of participation by private enterprises and non-governmental actors and invited economies to provide representative examples, including information on technological innovation, funding sources, economic returns, and carbon reduction outcomes.

Part D. Needs and Expectations for International Cooperation

This section sought to understand economies' needs in areas such as technology transfer, capacity building, financial support, policy exchange, and market cooperation, and to assess the role that APEC could play in supporting future collaboration.

Part E. Expectations for the Workshop

This section invited economies to identify the topics they hoped the workshop would address, including technological innovation, best practices, policy frameworks, financial mechanisms, scaling-up challenges, and methods for verifying decarbonization outcomes, and to indicate whether they were willing to make presentations during the workshop.

C. Core Design Features of the Survey

The survey was designed not only as a tool for collecting policies and case examples, but also with a strong emphasis on **comparability** and **forward-looking analysis**.

For example, in the section on the implementation status of circular agriculture, respondents were asked not only whether a given measure had been introduced, but also to assess the level of development of different types of circular agriculture practices on a scale ranging from "not implemented" to "highly mature." This approach enabled the construction of cross-economy comparative data.

Similarly, in the section on policy tools, respondents were asked to evaluate and rank the importance of different instruments, including economy-wide action plans, dedicated subsidy programs, regulatory frameworks, R&D pilot projects, education and training, and public–private partnerships. This allowed for further analysis of differences in policy tool use and policy emphasis among economies.

In addition, the section on implementation barriers was designed with multiple-choice questions accompanied by impact scoring. These questions covered a wide

range of potential challenges, including technological bottlenecks, insufficient funding, lack of infrastructure, and weak market incentives, thereby providing a more complete picture of the difficulties encountered by member economies in promoting circular agriculture.

D. Survey Results and Policy Implications

The survey was distributed in **July 2025** via email and an online form (Google Form) to all **21 APEC member economies**, with a submission deadline of **31 August 2025**. The responses were compiled into statistical charts, and the best practice examples and policy needs shared by participating economies were further synthesized. The survey findings were also presented during **Session 3 of the workshop on 23 September 2025** as the "APEC Member Economies Survey Report."

The key findings are summarized below.

Part A: Current Status of Circular Agriculture Policy Implementation

A1. Overall Policy Adoption

According to the survey results, **all 10 respondents** confirmed that their economies had already introduced policies, measures, or programs related to circular agriculture. This suggests that circular agriculture is widely recognized as a relevant policy issue and has emerged as an area of active interest and implementation across responding economies.

A2. Duration of Implementation and Level of Maturity

Most responding economies reported a relatively mature implementation history. A total of **five responses** indicated that circular agriculture had been promoted for more than five years, including **three responses with 5–10 years of experience** and **two responses with more than 10 years**. This suggests that circular agriculture is no longer merely an emerging concept in many economies, but has gradually evolved into a more established policy and implementation area. Only **one economy** reported that its efforts were still at an early stage, with less than one year of implementation experience. While economies are at different stages of development, the overall trend points toward increasing maturity.

A3. Annual Budget Allocation

In terms of financial commitment, most economies reported annual budgets in the range of **USD 1 million to USD 10 million**, while several reported budgets below USD 1 million, and one economy indicated that no budget had yet been allocated. Overall, the level of investment remains relatively modest, suggesting considerable room for scaling up funding support in the future.

A4. Development Level of Different Types of Circular Agriculture

Among the different categories of circular agriculture, **livestock waste reuse (4.25)** and **biomass reuse (4.0)** received the highest development scores, indicating that manure recycling and biomass valorization are currently the most advanced areas of implementation. The reuse of food and agricultural by-products, water resources, and general agricultural waste showed **moderate levels of development (3.25–3.5)**,

reflecting a diverse and multi-dimensional pattern of circular agriculture development across the region.

A5. Policy Tools Most Commonly Used

With regard to policy instruments, economies reported the most frequent use of **economy-wide strategies (4.0)**, **regulatory frameworks (3.75)**, and **R&D demonstration projects and public–private partnership models (both 3.38)**. Education and outreach, as well as financial subsidies, were also regarded as important measures. These findings suggest that economies are strengthening circular agriculture through a combination of institutional measures, innovation support, and capacity-building efforts.

A6. Main Challenges in Implementation

The most significant challenges identified were **insufficient funding and resources (4.12)**, **knowledge and technology gaps (3.62)**, and **unstable supply chains (3.62)**. These findings indicate that resource mobilization, technical capability, and value-chain coordination remain key bottlenecks. **Insufficient infrastructure and limited human capital (3.38)** were also frequently mentioned, suggesting that foundational capacities still need to be strengthened.

A7. Perceived Benefits of Circular Agriculture

Among the expected benefits of circular agriculture, **environmental benefits (3.5)** received the highest recognition, followed by **technological innovation** and **education/awareness raising** (both **3.25**). **Energy-related benefits (3.14)** and **economic benefits (3.12)** were also acknowledged to some extent. However, **market expansion** and **carbon reduction visibility** received relatively lower scores (both **2.75**), suggesting that most economies still regard circular agriculture primarily as a means of improving resource use efficiency and environmental sustainability, while stronger links to market mechanisms and clearer emission reduction impacts remain underdeveloped.

Part B: Linkages between Circular Agriculture and Net-Zero Goals

B1. Economy-wide Net-Zero Targets

A large majority of responding economies—**8 out of 10**—reported that they had established **economy-wide net-zero targets**, indicating a high level of alignment between circular agriculture and broader climate policy priorities.

B2. Agricultural Sector Net-Zero Targets

Responses were less consistent with respect to the agricultural sector. **Five respondents answered "yes," two answered "no," and three indicated "uncertain."** This suggests that only about half of the responding economies have set explicit net-zero targets for the agricultural sector, and that sectoral integration into economy-wide climate strategies remains incomplete.

B3. Strategic Positioning of Circular Agriculture

Most respondents (**7 responses**) indicated that circular agriculture contributes **less than 50 percent** to achieving net-zero goals. This suggests that circular agriculture is

generally regarded as a **supporting strategy**, rather than the primary pathway or dominant solution for achieving net-zero emissions.

B4. Greenhouse Gas Measurement and Monitoring Methods

Among the methods used to measure or monitor greenhouse gas mitigation outcomes, the most commonly used were **emission factor approaches (4.0)** and **MRV systems (3.75)**. More advanced approaches such as **life-cycle assessment (LCA) (3.12)** and **soil carbon/carbon credit mechanisms (2.75)** were less frequently applied, while **integrated assessment indicators (2.12)** were the least commonly used. These findings suggest that there is still room for improvement in technical infrastructure, data systems, and more comprehensive monitoring methodologies.

Part C: Private-Sector Participation and Best Practices

C1. Level of Private-Sector Participation

Private-sector participation was generally assessed as **moderate** or **limited**. Four responses indicated a moderate level of engagement, while three reported limited participation. Only one economy reported extensive private-sector involvement. This suggests that, overall, private-sector participation remains at a relatively modest level and still requires stronger enabling conditions.

C2. Government Support for Private-Sector Investment

Government co-financing support for private-sector investment was generally reported to be below 50 percent. **Four responses** indicated support levels below 30 percent, while **three responses** reported support ranging from 30 to 50 percent. These results suggest that stronger incentives or clearer policy frameworks may be needed to encourage greater private-sector investment in circular agriculture.

C3. Best Practice Highlights

Respondents shared a number of noteworthy examples of circular agriculture practices:

- **Straw valorization:** Farmers have replaced open-field burning of straw with alternative uses such as mushroom production, animal feed, and biofuel, thereby reducing emissions while creating new income opportunities.
- **Circular agriculture roadmaps:** One economy developed an integrated roadmap based on precise data and scientific analysis, providing highly targeted and problem-solving policy solutions.
- **Integrated manure systems:** Smallholder cooperatives established manure collection systems for the production of organic fertilizer and biogas, demonstrating that circular solutions can improve sustainability even under limited financial conditions.
- **Conversion of household food waste into feed:** A community-based initiative converted household food waste into black soldier fly larvae for use as poultry feed, thereby promoting local circular economy development and strengthening food security.

Part D and Part E: International Cooperation and Workshop Expectations

D1. Current Participation in International Cooperation

Only about **one-third of respondents (3 responses)** reported active participation in international cooperation related to circular agriculture or net-zero initiatives. This suggests that international collaboration in this area remains limited or, in some cases, still insufficiently developed.

D2. APEC Cooperation Priorities

Respondents identified **technology transfer (4.38)** and **capacity building (4.25)** as the top priority areas for APEC cooperation. Other important areas included **financing and investment**, **joint research and pilot projects**, and **market cooperation** (all **4.25**), followed by **policy experience sharing (4.12)**. These results indicate that economies expect APEC to play a practical role in facilitating both technical and institutional support.

D3. Expected Workshop Topics

The topic most frequently selected by respondents for the workshop was **innovative technologies and solutions for circular agriculture** (**7 responses**). This was followed by **successful cases and best practices from APEC economies**, **policy frameworks and regulatory support**, and **methods for measuring and verifying decarbonization outcomes in agriculture** (each with **4 responses**). These preferences show that member economies are seeking both policy-relevant insights and practical technical knowledge.

D4. Willingness to Contribute to Session 3

Most respondents indicated their willingness to share circular agriculture practices during **Session 3** of the workshop, demonstrating a strong spirit of cooperation and a clear willingness to exchange experiences and lessons learned.

D5. Relevance to ATCWG Strategic Priorities (Optional Background Section)

The survey findings also align closely with the emerging direction of the **ATCWG Strategic Priorities for 2026–2030**, which identify seven major areas for future agricultural cooperation in APEC. These priorities reflect shared regional needs and challenges in the context of climate change, food system transformation, and technological innovation.

These priority areas include:

1. **Strengthening regional food security and food safety**, including reducing food loss and waste, improving agricultural productivity and quality, promoting sustainable land management, and facilitating agricultural trade and investment.

2. **Promoting the conservation and use of animal and plant genetic resources**, including the development of climate-resilient crop and livestock varieties and enhanced cooperation in genetic resource conservation and utilization.

3. **Advancing smart agriculture research and application**, including the use of IoT, sensors, AI, drones, and agricultural robotics to improve productivity and reduce environmental pressure.

4. **Building agricultural value chains and marketing channels**, including post-harvest technologies, cold chain development, traceability systems, e-certification, digital trade tools, and support for smallholders and MSMEs.

5. **Establishing innovative agricultural systems to improve efficiency and reduce environmental risks**, including early warning systems, climate information services, disaster risk management, and decision-support tools.

6. **Fostering sustainable agricultural systems**, with an emphasis on circular agriculture, resource efficiency, soil and water management, sustainable materials management, biodiversity conservation, and farmer safety.

7. **Strengthening cooperation on plant and animal disease and pest control**, including SPS issues, integrated pest management, biosecurity, invasive alien species, and antimicrobial resistance.

Taken together, these priorities reflect APEC's increasingly comprehensive approach to agricultural cooperation—from food security and technological innovation to value chain upgrading, climate resilience, biosecurity, and sustainable transformation. They also provide an important policy context for interpreting the survey findings and for positioning circular agriculture within broader regional cooperation efforts.

E. Policy Implications

Based on the survey results, several policy implications can be drawn.

First, while circular agriculture is already widely recognized and has been adopted by many economies, **investment levels remain relatively modest**, indicating the need for greater financial support and more effective resource mobilization.

Second, the survey shows that circular agriculture is generally treated as a **supporting strategy** within broader net-zero pathways. To strengthen its contribution, economies may need to improve policy integration between agricultural development and climate mitigation frameworks, especially at the sectoral level.

Third, **private-sector participation remains limited to moderate** in most economies. This suggests that stronger incentives, more stable regulatory frameworks, and better co-financing mechanisms will be necessary to encourage larger-scale private investment.

Fourth, economies clearly expect APEC to provide support in **technology transfer, capacity building, financing facilitation, and collaborative pilot efforts**. This indicates that APEC has a valuable role to play not only as a platform for policy dialogue, but also as a catalyst for practical cooperation.

Finally, the workshop expectations expressed by respondents suggest a strong demand for **action-oriented knowledge exchange**, especially in the areas of

innovative technologies, successful implementation models, and methods for measuring and verifying agricultural decarbonization outcomes.