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APEC Survey Report on Feasible Solutions for Food Loss and Waste Reduction

APEC Agricultural Technical Cooperation Working Group

APEC Policy Partnership on Food Security

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ACRONYMS

Acronym	Definition
APEC	Asia-Pacific Economic Cooperation
APEC MEs	APEC Member Economies
ATCWG	Agricultural Technical Cooperation Working Group
FLW	Food Loss and Waste
FSC	Food Supply Chain
MFM	Mass Flow Model
PPP	Public – Private Partnership
PPFS	Policy Partnership on Food Security

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1. INTRODUCTION

1.1. Background

According to the Food and Agriculture Organization (FAO), the world population is expected to grow by nearly 30%, to 9.1 billion people by 2050 and it will require a 70% increase in food production and a 50% rise in investment in agriculture to feed the demands of these extra 2 billion people. Based on the UN's research, roughly one-third of the edible parts of food produced for human consumption gets lost or wasted globally (FAO, 2011), which is about 1.3 billion tons per year. For fruit and vegetables, post-harvest losses can be as high as 50% or more. Therefore, it is of vital importance to strengthen partnerships among public and private sectors of APEC member economies (MEs) in developing policy recommendations and solutions on reducing post-harvest loss and waste, as well as enhancing food quality and safety, to contribute to food security in the Asia-Pacific region.

Asia-Pacific Economic Cooperation (APEC) accounts for 39% of the world population, 54% of the world GDP, 53% of the global cereal production, and 70% of the fish production. The region is facing multiple food security challenges from population growth, rapid urbanization, income growth, diet change, natural resources constraints and climate change. In the APEC Food Security Roadmap Towards 2020, the long-term goal of the Policy Partnership on Food Security (PPFS) is the attainment of a food system structure by 2020. In alignment with this goal, APEC proposed its food loss and waste (FLW) 10% reduction goal, in which APEC MEs will strive to reduce FLW by 10% compared with the 2011 – 2012 levels by 2020.

Since the APEC Multi-Year Project (MYP) entitled "Strengthening Public-Private Partnership to Reduce Food Losses in the Supply Chain" is reaching its final phase, it is useful to take stock of activities and progress. Following the progress report during the 2017 APEC Capacity Building Workshop on Food Losses and Waste Reduction for a Sustainable APEC Food System in Can Tho City on August 19, 2017, the project overseer of the MYP conducted a survey entitled: "APEC Feasible Solutions on Food Loss and Waste Reduction Survey" with the main purpose to identify the current situation of reducing FLW in APEC MEs, discover the costs and benefits of feasible solutions in public and private sectors and explore public-private partnership on FLW reduction in APEC region.

This survey is part of the Multi-Year Project (MYP) entitled "Strengthening Public-Private Partnership to Reduce Food Losses in the Supply Chain".

1.2. Objectives

The survey addresses the following objectives:

- To stock-take the targets, policies and strategies for FLW reduction in APEC MEs at economy level;
- To gather information of FLW quantification and verify FLW quantity in APEC MEs;
- To identify the diversion potential, costs, and benefits of the reduced FLW by implementing the feasible solutions;
- To investigate current situation of Public-Private partnership (PPP) in the economies and explore MEs' recommendations.

The survey outputs help us evaluate the previous progress of each APEC economy and further study the feasibility of an APEC FLW data reporting standard as well as to design capacity building initiatives for the developing MEs. We expect the results of the survey will help us identify future directions for implementing policy and action plans for FLW reduction.

1.3. Methodology

To obtain a clear and comprehensive picture of APEC MEs, the survey questionnaire[1] was designed to gather information at an economy-level, with both quantitative and open-ended questions. The former helps us collect data for quantitative analysis and the latter helps us collect different opinions. This survey was circulated to the Policy Partnership on Food Security (PPFS) and Agricultural Technical Cooperation Working Group (ATCWG) representatives of APEC MEs in mid-May of 2018. All of respondents of the questionnaire have been involved in either FLW data collecting or reduction programs in their economies.

According to the mapping of the questions shown in Table 1, this questionnaire is divided into four main sections: (1) MEs policies and strategies for FLW, (2) quantification of FLW, (3) FLW diversion potentials and cost in implementation, and (4) public-private partnership (PPP) on FLW reduction.

[1] The comprehensive questionnaire is in Appendix A.

Table 1 - Mapping of questions

Q1: Economy's targets, policies and strategies for FLW
1.1 Are you involved in FLW reduction programs/projects/activities in your economy? 1.2 Does your economy have a FLW reduction target? 1.3 Does your economy have FLW reduction policy/plans at economy-wide level? 1.4 Is FLW reduction policy/plans mainstreamed into agricultural development plans in your economy? 1.5 Are there challenges hampering the mainstreaming of FLW policy/plans in your economy? 1.6 Are there challenges hampering the development of FLW policy/plans in your economy?
Q2: Quantification of FLW
2.1 Does your economy have a definition of FLW? 2.2 Does your economy adopt the Mass Flow Method[2] suggested by FAO (2011) to quantify FLW? 2.3 Please provide the amount of FLW by stage in your economy if available. 2.4 Are you involved in data collecting/information sharing/education on FLW?
Q3: FLW diversion potentials and cost in implementation
3.1 How many solutions listed above that have been implemented in your economy by government/ public sector? 3.2 Is there any solution that is not listed in the Table above but has been implemented in your economy by government/ public sector? 3.3 Are there challenges hampering their implementation in your economy? 3.4 Please provide the estimated reduction potentials and associated costs in your economy below.
Q4: Public-Private Partnership on FLW Reduction
4.1 Has your economy/institution had a type of PPP project on FLW reduction? 4.2 What areas of FLW reduction should PPP project focus on? 4.3 What type of PPPs has been applied in your economy? 4.4 Do you think PPP is a better and much effective method for FLW reduction? 4.5 What reasons will make you opt for PPP? 4.6 What do you think are the key indicators of a successful PPP project on the areas of FLW reduction? 4.7 Does your economy have practical guidelines on PPP implementation? 4.8 What are the strength of applying PPP on reducing FLW? 4.9 What are the disadvantages of PPP on reducing FLW? 4.10 What improvements should be taken to support PPP on FLW? 4.11 What should legislations/ policies/ regulation be designed to support PPP?

[2] The "Mass Flow Method" allows for a measurement of waste levels through the change in the weight and quantity of products as they move through the food chain. In particular, after an initial assessment process in which the losses accrued at each stage of production are measured, it becomes relatively simple to mathematically estimate subsequent waste levels.

2. RESULTS OF THE SURVEY

2.1. Sample Characteristics

In total, 15 MEs participated in the survey, accounting for 71.4% of all APEC MEs. The geographic location of the respondent economies included Oceania (Australia; New Zealand; and Papua New Guinea), Asia (People's Republic of China; Hong Kong, China; Japan; Malaysia; the Philippines; Singapore; Chinese Taipei; and Viet Nam) and the Americas (Canada; Chile; Peru; and the United States) as shown in Figure 1.

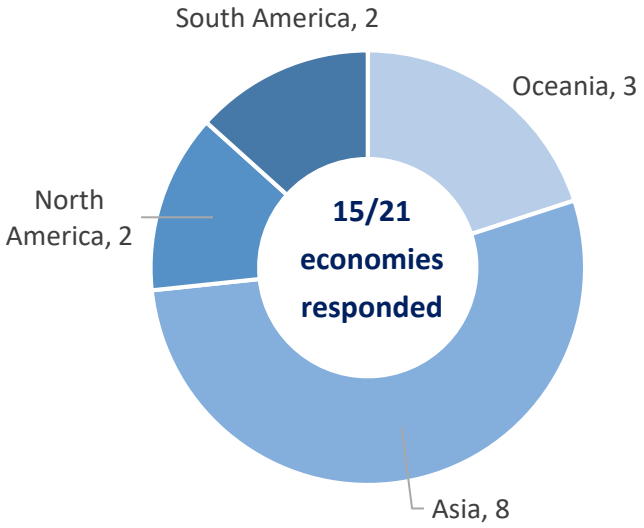


Figure 1 – Geographic location of respondents

Respondents include both advanced and emerging market and developing MEs (hereafter denoted by "developing MEs"), based on the International Monetary Fund's classification (IMF, 2016). The respondents are listed in Table 2, with 8 MEs classified as advanced MEs, and 7 MEs classified as developing MEs.

Table 2 - List of respondents based on IMF's classification

Advanced Economies (8 MEs)	Developing Economies (7 MEs)
Australia; Canada; Hong Kong China; Japan; New Zealand; Singapore; Chinese Taipei; USA.	Chile; People's Republic of China; Malaysia; Papua New Guinea; Peru; Philippines; Viet Nam.

2.2. Responses from APEC MEs

In this section, we report the survey results from each of the four survey sections in turn: (1) policy targets and strategies for FLW reduction, (2) quantification of FLW, (3) FLW diversion potentials and cost in implementation, and (4) public-private partnership on FLW reduction.

2.2.1. Policy Targets and Strategies for FLW Reduction

In alignment with UN SDG 12.3 to halve per capita of food waste and reduce food loss along the supply chain by 2030, we aimed to ask APEC MEs for their targets, policies and strategies for FLW reduction in APEC MEs at economy level.

Q: Does your economy have an FLW reduction policy/plans at economy-wide level?

Q: Does your economy have an FLW reduction target?

There were 13 (87%) MEs, i.e., Australia; Chile; People's Republic of China; Hong Kong, China; Japan; Malaysia; New Zealand; Peru; the Philippines; Singapore; Chinese Taipei; the USA; and Viet Nam, that answered they had either policy or strategic plans at economy level on reducing FLW. Targets have been set along with the plans in 10 MEs (Figure 2). The other 3 MEs (New Zealand; Peru; and Chinese Taipei) currently have numerous policies for reducing FLW but they do not have a specific target at economy level.

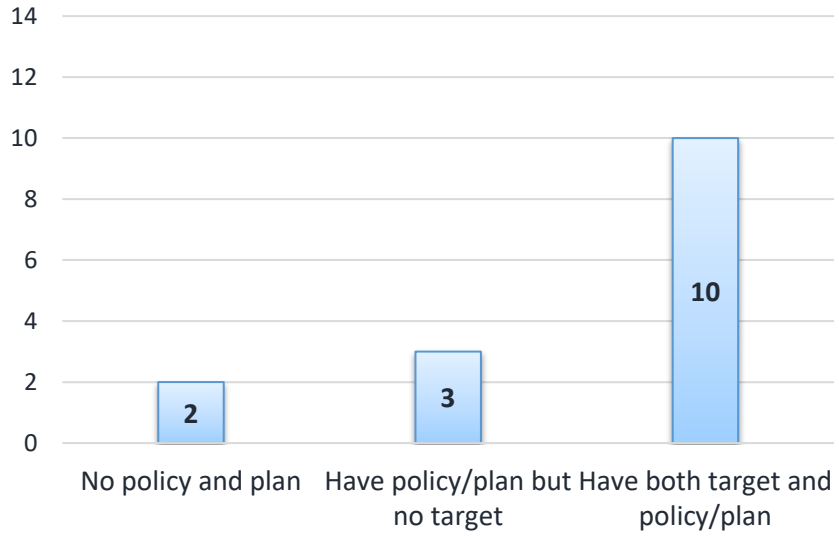


Figure 2 – Target, policy and plan to FLW reduction in APEC MEs

Table 3 shows information of FLW reduction policy targets and strategic plans for reducing FLW at economy-wide level in APEC region.

Table 3 - Information on FLW reduction targets, policies/plans and relevant Links

No	Economy	FLW reduction targets	FLW reduction plans	Relevant link
1	Australia	To halve food waste by 2030. The goal is aligned with the UN SDG 12.3.	The Australian Government's Food Waste Strategy was launched by the Minister for the Environment and Energy at the Food Waste Summit at Economy Level on November 20, 2017.	https://www.environment.gov.au/protection/national-waste-policy/food-waste
2	Canada	Under UN Sustainable Development goals, North American Leaders' Statement joint action plan in June 2016, Canada committed to work towards reducing global food waste by 50% by 2030. However, no specific target has been identified for reducing Canada's FLW.	Several provinces and municipalities have initiated programs intending to reduce FLW. However, these do not currently extend to the economy-wide level.	
3	Chile	To reduce FLW by 17% in 2022, which is aligned with SDG 12.3. The goal was stated in the Chilean Program of Sustainable Consumption and Production.	The Committee or FLW of Chile has developed the first draft of a plan at the economy-wide level, with the objective to prevent and reduce FLW.	
4	People's Republic of China	To reduce FLW by 40% by 2020 and to reduce FLW by 13mt in the post-harvest stages per year.	Chapter Nine of the 13th Five-Year Plan for Grain Industry Development titled "Promote FLW reduction". The plan was launched in October 2016.	
5	Hong Kong, China	To cut down the amount of food waste that goes to landfills by at least 40% by 2022.	A Food Waste & Yard Waste Plan for Hong Kong 2014-2022 was launched by the Environment Bureau of Hong Kong Special Administrative Region Government.	

No	Economy	FLW reduction targets	FLW reduction plans	Relevant link
6	Japan	The recycling rate targets set by government in 2015 are manufacturers (95%), wholesalers (70%), retailers (55%), and restaurants (50%).	Food Recycling Law which was launched by Ministry of Agriculture, Forestry and Fisheries, and Ministry of the Environmental in 2001.	http://www.maff.go.jp/e/policies/env/attach/pdf/index-5.pdf
7	Malaysia	To reduce half of FLW by 2030. It was set to follow the target of FAO. It was set by the MYSaveFood Network Secretariat when it was established in 2016.	• Reduction of postharvest losses in rice is in 3rd Agricultural Policy and 11th Malaysian Plan • The reduction of the FLW Policy is part of the 3rd Action Plan for Nutrition in Malaysia (NPANM) 2016-2025 and Nutrition Research Priorities in Malaysia for 11th Malaysian Plan, 2016-2020.	
8	New Zealand	No target at economy level.	• New Zealand – Food Act 2014 352 Immunity of food donors, which encourages food waste donation. • Love Food Hate Waste consumer campaign, funded by government (Ministry for Environment) and run through a non-government organization Waste Management Institute New Zealand Incorporated (WasteMINZ). • Bioresource Processing Alliance, funded by government to help industry create economic value by creating value from co-products & waste streams.	http://www.legislation.govt.nz/act/public/2014/0032/latest/DLM5431609.html https://lovefoodhatewaste.co.nz/ https://bioresourceprocessing.co.nz/
9	Papua New Guinea	No target at economy level.	No policy at economy level.	

No	Economy	FLW reduction targets	FLW reduction plans	Relevant link
10	Peru	No target at economy level	• Law No. 30498 to promote food donation and facilitate the transport of donations; however, only in situations of natural disasters. • The Plan on Food and Nutritional Security 2015-2021 action line to promote mechanisms for the reduction of post-harvest losses hydro-biological products.	http://busquedas.elperuano.pe/normaslegales/ley-que-promueve-la-donacion-de-alimentos-y-facilita-el-tran-ley-n-30498-1412960-1/ http://www.minagri.gob.pe/portal/download/pdf/seguridad-alimentaria/plan-acional-seguridad-2015-2021.pdf
11	Philippines	Rice and corn: target is a 2% post-harvest loss reduction in 2017 for the next five years. Fisheries: target is 10% reduction of fisheries postharvest losses by 2020.	• Senate Bill 357 or the Zero Food Waste Act, targeting zero food waste; • "Be RICEsponsible" Program is an economy-wide advocacy to manage rice consumption by reducing wastage and promoting better health through rice which is the staple food. • 10-Point Agenda of the Department of Agriculture which includes the establishment of strategic post-harvest facilities across crops.	http://www.bericeponsible.com/
12	Singapore	Overall recycling rate of 70% by 2030.	• Singapore adopts a food waste management approach, beginning with preventing and reducing food wastage at source, followed by promoting the redistribution of unsold/excess food and lastly, recycling/treating food waste. • Singapore also plans to collect and co-digest 400 tons of source segregated food waste with used water sludge per day at the Integrated Waste Management Facility when it is completed in 2024.	https://www.mewr.gov.sg/ssb http://www.nea.gov.sg/energy-waste/3rs/food-waste-management

No	Economy	FLW reduction targets	FLW reduction plans	Relevant link
13	Chinese Taipei	No target at economy level	• Establishment of public assistance and food banks at the local level. • Investment in drying and low temperature storage facilities is being promoted among rice farmers' associations.	
14	USA	To Reduce FLW in the United States by 50% by 2030. The goal was jointly launched by the US Department of Agriculture and the US Environment Protection Agency.	• Two primary laws support the donation of wholesome otherwise wasted food to food banks and people in need: - Tax benefits for food donations. Congress made permanent the enhanced charitable deduction for contributions of food inventory, extending and expanding the charitable tax deductions for food donations. - Liability protection for food donors. Food donors are protected from liability under the Bill Emerson Good Samaritan Food Donation Act (42 U.S.C. §1791) • Comprehensive food waste and recovery legislation has been introduced in both the House (H.R. 4184) and Senate (S. 3108). These bills would expand the mission and funding for several existing federal programs to cover a range of food waste efforts including: - Funding for loans and grants to expand use of composting and energy projects - Additional bill focusing on standardizing food date labeling. • At the federal level, USDA and the U.S. Environmental Protection Agency work together to support economy-wide policy initiatives to reduce FLW. Most recently, these agencies have worked together to spearhead the U.S. FLW 2030 Champions[3].	

[3] Champions are businesses and organizations that have made a public commitment to reduce FLW in their own operations in the United States by 50 percent by the year 2030.

No	Economy	FLW reduction targets	FLW reduction plans	Relevant link
15	Viet Nam	• Government set the target of reducing post-harvest loss rate: (1) rice, from 11-13% to 5-6%, maize from 13-15% to 8-9%, and aquaculture from 20% to 10% in 2020 in the resolution 48/2009/ NQ-CP • Decision 1003/QD-BNN-CB dated 13/5/2014 by the Ministry of Agriculture and Rural development: By 2020, the added value of agro-forestry and fishery products increase an average of 20%; and post-harvest losses of agricultural and fishery products reduce by 50% compared to the current ratio.	• Government enacted a policy to give financial incentives for businesses, farmer cooperatives, and farmers for investment in agricultural facilities to reduce post-harvest loss. • Government have several policies to attract private sector: - to invest in technological innovation, increase the proportion of in-depth processed products, ensuring food safety, competitive prices, markets requirements. - to invest in advanced technology of high value-added products manufacturing from agricultural waste.	Viet Namese version available at: https://thuvienphapluat.vn/van-ban/Dau-tu/Nghi-quyet-48-NQ-CP-co-che-chinh-sach-giam-ton-that-sau-thu-hoach-nong-san-thuy-san-95190.aspx https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Quyet-dinh-1003-QD-BNN-CB-2014-Nang-cao-gia-tri-gia-tang-hang-nong-lam-thuy-san-giam-ton-that-232184.aspx

Although FLW reduction targets have been set and policies/plans enacted to support the goal in various MEs, the plans and policies face different challenges. Table 4 illustrates the existing challenges to FLW reduction policies and plans by the respondents.

Table 4 – Challenges to the mainstreaming/development of FLW policies and strategic plans

	Economy	Challenges
1	Australia	• A lack of comprehensive, reliable and robust data providing the evidence base to inform the development and implementation of policy. • Australia's food supply and consumption chain can be fragmented, non-linear and geographically dispersed, making cross-sector collaboration difficult. • The three-tiered approach (i.e. state and territory, local governments, and Australia's international obligations) to government can create challenges in developing and delivering consistent policies and plans and monitoring performances of FLW policy at an economy level.
2	Canada	The lack of overall communication between organizations and governments engaged in work to reduce FLW.
3	Chile	The main challenges are to quantify the FLW in each food supply chain (FSC), data that will need to be gathered from multiple sources, and to raise awareness of the problem of FLW, at all levels.
4	People's Republic of China	Famers and businesses lack capital.
5	Hong Kong, China	Various challenges such as the lack of legislative framework, public and stakeholders' resistances to set up the legislative framework, space constraint, etc.
6	Japan	Raising awareness for reduction of food loss throughout the economy
7	Malaysia	Implementing FLW policies in Malaysia will involve multiple Ministries. Coordinating actions from different Ministries are difficult as priorities are different.
8	New Zealand	Have an overall waste policy at economy level, but do not have a specific policy/plan on FLW at current time.
9	Papua New Guinea	No policy/plan on FLW at economy level at current time.
10	Peru	Planning and implementing FLW policies in Peru will involve multiple actors, from public and private sectors: the lack of coordination and common goals among them is the main challenge.
11	Philippines	The economy faces various challenges listed below • Internal governance issues; • Budgetary constraints to construct new facilities; • Financial limitation of farmers; • Education/ training for stakeholders/port clients; • A slow procurement process; • A lack of standards for data monitoring and reliable data and data systems; • Resistance to change and a lack of interest and awareness of general public and some public officials; • A lack of "push" to get FLW issues in the agenda of policy makers; • Limited capacity of stakeholders to implement loss reduction techniques; • Market imperfection
12	Singapore	• Lack of data from various food waste source and awareness on food wastage reduction;

		• Challenges in food waste segregation; • Limited demand for food waste derived compost.
13	Chinese Taipei	A lack of interest from consumers & lack of data or standards.
14	USA	There is still a lack of awareness about the size and impact of FLW
15	Viet Nam	• Small and fragmented land. • Lack of financial access and high interest rate. The credit priority policy is not clear for private sector investing in post-harvest facility. • Inadequate farmer knowledge and skills in post -harvest loss reduction. • Limited technology and research capacity. • Unpredictable impact of environment and climate change. • Limited Infrastructure and Market system • Weak value chain governance and cooperative of small farm. • No formal definition on food loss and waste, no measurement formula, no criteria on FLW. • No monitoring system to regular monitor the FLW. • State budget constraints while private investment is limited.

Making policy or plan on reducing FLW at economy level faces the problem that FLW is monitored by multiple ministries and organizations. Thus, it is difficult to consolidate due to the different priorities of ministries and authorities. Overall, we find that FLW is a multifaceted problem, which means that many agencies at the federal- and state-level must work together to achieve the designated reduction goal.

2.2.2. Quantification of FLW in APEC MEs

This section addresses the objective 2 that is to gather information of FLW quantification and verify FLW quantities in APEC MEs.

Our project previously applied the Mass Flow Method (see footnote 3), developed by the UN Food and Agriculture Organization, to calculate the quantity of FLW for 19 APEC MEs. We anticipate that different methods might result in various data. Therefore, we expect to have the most appropriate numbers by considering various sources.

To quantify FLW, an entity initially chooses the scope and extent of FLW through its definition, followed by choosing an appropriate quantifying methodology. Therefore, we firstly investigated how FLW is defined in the MEs. Secondly, we asked what method is currently used in the MEs. Thirdly, respondents were asked to provide the quantity of FLW that has been statistically quantified in their economy or estimated by previous studies. This question is to verify our previous results of FLW quantification based on Mass Flow Method.

1. Definition of FLW

To begin with, the survey asked the respondents if they have a definition of FLW at the economy-wide level.

Q: Does your economy have a definition of FLW?

As shown in Figure 3, 10 MEs answered they had a definition of FLW at economy level. Among these 10 MEs, only 3 (Chile; Malaysia; and Viet Nam) are currently aligned with the definition proposed by FAO as below. The other 7 MEs including Australia; Hong Kong, China; Japan; the Philippines; Singapore; Chinese Taipei; and the USA have FLW defined by their own MEs. Canada and New Zealand do not have a FLW definition at economy level but rather have a range of diverse definitions that are used by individual organizations.

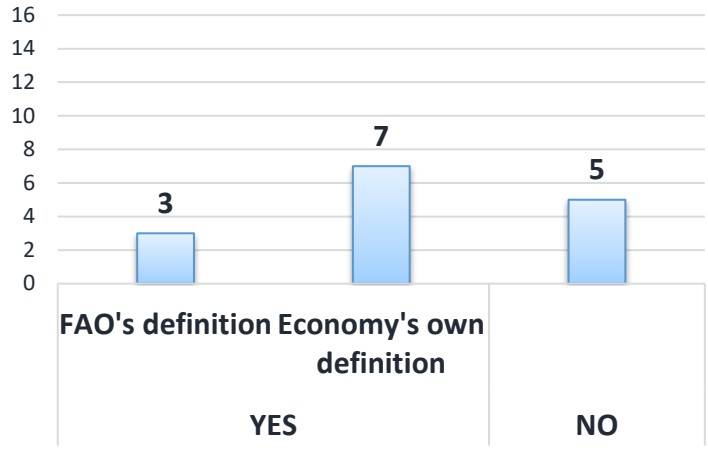


Figure 3 – FLW definition status of respondents

FLW is defined differently by scope and terminology in the 7 MEs that have defined it. In comparison the definition of FLW between MEs, we raise three questions (1) What terminology does the economy use for FLW (i.e. food waste, food loss, food wastage)? (2) What does FLW contain? (3) Which stages of FSC do FLW incur?

FAO (2011) and FAO (2014) defined FLW as below:

- **Food loss (FL)** *refers to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption*.
- **Food waste (FW)** *refers to the removal from the FSC of food which is fit for consumption, by choice, or which has been left to spoil or expire as a result of negligence by the actor – predominantly, but not exclusively the final consumer at household level*.
- **Food loss and waste (FLW)** *takes place at all stages of the FSC from agricultural production to consumption*.
- **FLW** *also includes food that is redirected to animal feed, compost or other non-food uses*.

Box 1. FAO's definition of FLW

Table 5 – Various definitions of FLW in APEC MEs

No	Economy	Terminology	Scope (edible/inedible food)	Stage of the FSC	Detail Descriptions
1	Australia	Food waste	Edible and inedible food Imported food that is disposed of in the economy	Across the entire supply chain	Australia's Food Waste Strategy adopts a broad and inclusive definition of food waste that covers: • solid or liquid food that is intended for human consumption and is generated across the entire supply and consumption chain • food that does not reach the consumer or reaches the consumer but is thrown away. This includes edible food, the parts of food that can be consumed but are disposed of, and inedible food, the parts of food that are not consumed because they are either unable to be consumed or are considered undesirable (such as seeds, bones, coffee grounds, skins, or peels) • food that is imported into, and disposed of, in Australia • food that is produced or manufactured for export but does not leave Australia. [Australia's Food Waste Strategy – page 8]
2	Chile	FAO's Definition	Edible food	The entire FSC	Refer to box 1
3	Hong Kong, China	Food waste (include food waste disposal and food waste recovery)	Food waste disposal: food is disposed of at landfill Food waste recovery: food waste that is recovered by industrial operators and government facilities.	N/A	Food waste disposal and recovery are monitored in the Municipal Solid Waste report. Food that is disposed of at landfills is measured as food waste disposal, whereas food waste that is recovered by industrial operators and Government facilities is measured as food waste recovery
4	Japan	• Food loss • Food waste from industries	Food loss: edible food. Food waste from industries: food that are not used and byproducts	Food processing, distribution and consumption	The definition of the word "food loss" and "food waste" in Japan is different from that in FAO's definition. In Japan, "food loss" means wasted food that is still edible. The meaning of "food waste from industries" is food that are not utilized and byproducts from manufacturing, processing and cooking, which cannot be eaten. Both do not include

No	Economy	Terminology	Scope (edible/inedible food)	Stage of the FSC	Detail Descriptions
					agricultural production stage and post-harvest stage.
5	Malaysia	FAO's Definition	Edible food	The entire FSC	Refer to box 1
6	Philippines	Food waste	N/A	Retail and consumption	Food waste refers to discarded in the retail and consumption stages determined to be unfit for consumption.
7	Singapore	• Food loss, Food wastage, Food waste • Food waste = Food loss + Food wastage + inedible food	Apply for edible and inedible food	The entire FSC	• Food loss refer to the decrease in edible food mass along the FSC, in the process of producing food for human consumption. Food loss takes place at production, post-harvest and processing stages in the FSC. • Food wastage refers to food waste occurring at the end of the FSC (that is, at the retail and final consumption stages), resulting from retailers' and consumers' behavior • Food waste = Food loss + Food wastage + inedible food.
8	Chinese Taipei	• Food loss and food waste • Food waste is an important part of food loss	N/A	The entire FSC	• Food loss is mainly caused by the functioning of the food production. • Food waste is mainly caused by economic behavior, poor stock management or neglect.
9	USA	• Food loss and waste • Wasted, surplus or excess food: use in donation	Edible amount of food that is available for human consumption but is not consumed in any reason.	The entire FSC	USDA has adopted the convention of defining FLW as the edible amount of food, postharvest, that is available for human consumption but is not consumed for any reason. It includes cooking loss and natural shrinkage (for example, moisture loss); loss from mold, pests, or inadequate climate control; and food waste. FLW therefore describes reductions in edible food mass anywhere along the food chain. In some U.S. statistics such as those on organic waste in landfills, however, the term "food waste" is stretched to include non-edible (by humans) parts of food such as banana peels, bones, and egg shells.
10	Viet Nam	FAO's Definition	Edible food	The entire FSC	Refer to box 1

To summarize, definitions of FLW are diverse in the terminology used, the scope of edibility/non-edibility included and the stage of the FSC (FSC) covered as shown in Figure 4.

Regards of terminology, different economies call FLW in different ways. We find that 3 MEs (Australia; Hong Kong, China; the Philippines) refer to Food waste; meanwhile 7 MEs (Chile; Japan; Malaysia; Singapore; Chinese Taipei; the US; and Viet Nam) refer to it as FAO's definition "Food loss and Food waste".

As for the definitional scope of FLW, 4 MEs (Chile; Malaysia; the US; and Viet Nam) include only edible food, 3 MEs (Australia; Japan; and Singapore) count both edible and inedible part of food and the rest of MEs do not describe the edibility clearly in the scope in their definitions.

Obviously, FLW occurs at all stages of the FSC; thus, most MEs' definitions are clear that it includes the loss and waste across the entire FSC.

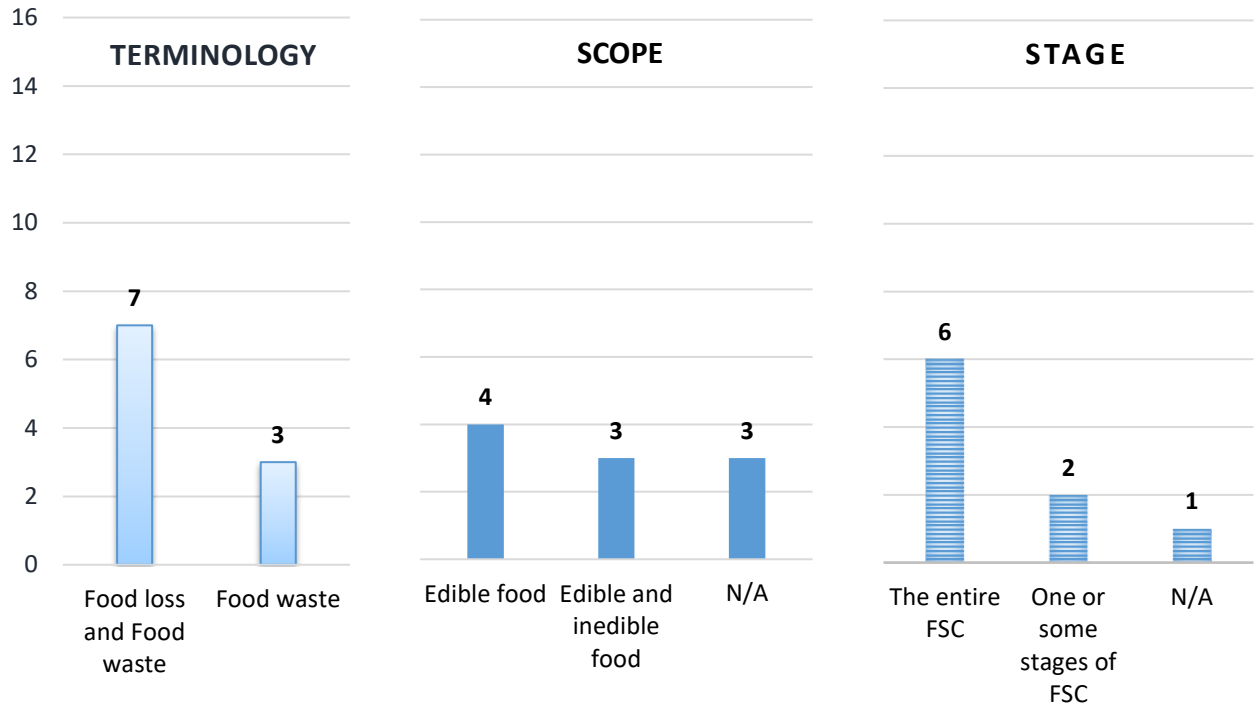


Figure 4 – The diversion of FLW definitions in APEC MEs

2. Quantifying method

Ten methods are used to quantify FLW and these can be classified into three main groups (1) weighing–based, (2) approximation-based, and (3) inference-based (FLW

Protocol, 2013; FUSION, 2016), as shown in Figure 5. FAO developed Mass Flow Method and estimated global FLW (first developed in 2011). The Mass Flow Method belongs to the inference-based group. Because the 2011 report is by far the most cited reference for FLW quantification, we therefore asked MEs if they have adopted this method in quantifying FLW in the economy level.

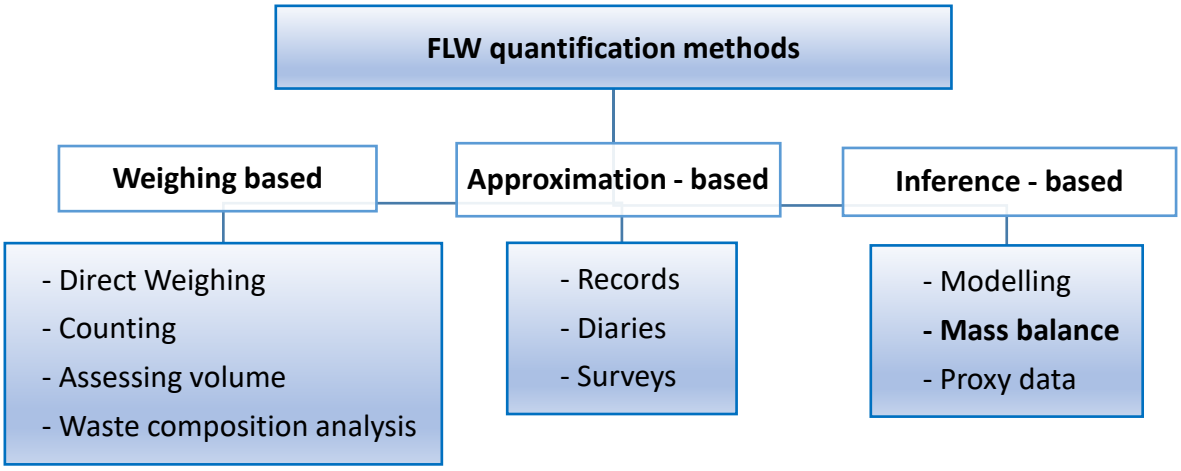


Figure 5 – FLW quantification methods and grouping

Q: Does your economy adopt the Mass Flow Method suggested by FAO (2011) to quantify FLW?

- ***If "Yes", does your economy use FAO's loss ratios to quantify FLW or use your own estimates?***
- ***If "No", please specify the quantifying method in your economy.***

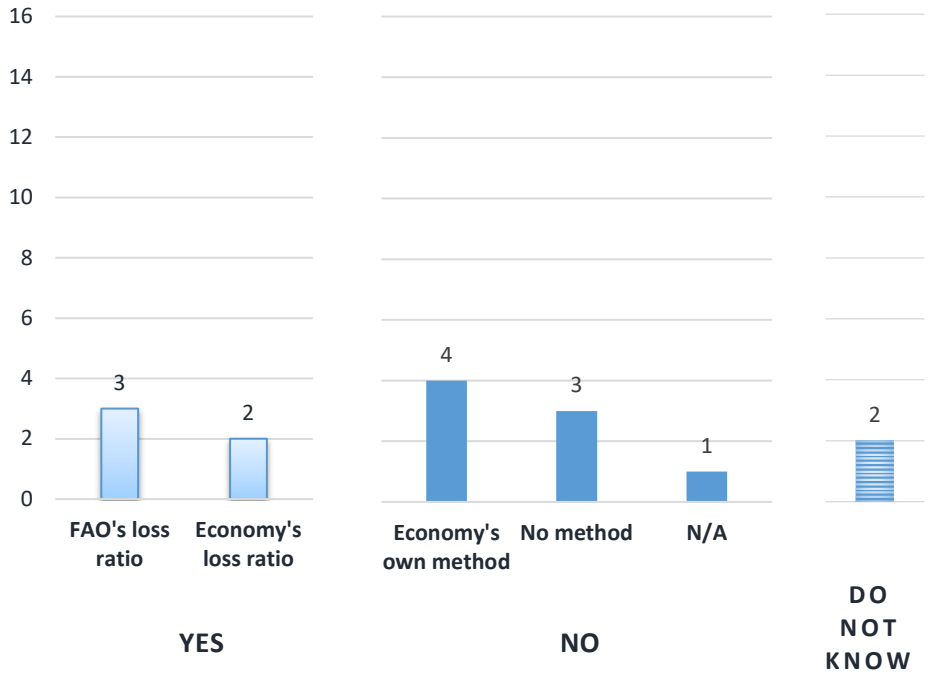


Figure 6 – Adopting mass flow method of FAO

At a glance from Figure 6, 5 MEs (Canada; the Philippines; Chinese Taipei; the US; and Viet Nam) adopt FAO's Mass Flow Method for estimating FLW, 3 MEs (the Philippines; Chinese Taipei; and Viet Nam) also adopt FAO's loss ratio, meanwhile, Canada and the US use their own loss ratio. There are 4 MEs (Australia; Japan; Peru; Singapore) that use their own method to estimate FLW. No method is applied in Chile; New Zealand; Papua New Guinea at economy level.

Table 6 reveals the details of the quantification method to measure FLW in APEC MEs.

Table 6 – Quantification method of respondents

No	Economy	Detailed description
1	Australia	As part of the implementation phase of the Food Waste Strategy to reduce food waste by half by 2030, the Australian Government is developing a Food Waste Baseline for Australia at economy level. The baseline will be determined to measure, monitor and evaluate reductions in food waste against across the entire supply and consumption chain over time.
2	Canada	The existing Statistics Canada table Supply and Disposition of Food in Canada presents, by commodity, the quantity of food that is produced, processed, imported, exported and sold for consumption (termed "domestic disappearance"). A waste factor is also applied to quantify the amount lost during processing or in storage at the processing/industrial level. Information on this table can be accessed here: http://www23.statcan.gc.ca/imdb-bmdi/document/3475_D1_T9_V3-eng.html.

		The currently available economy-wide data on FLW is at the retail and consumer level. The Loss Adjusted Food Availability tables created by Statistics Canada each year identify these quantities on an annual basis here: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3475. Canada is in the process of developing a framework to measure FLW. The framework will identify Canadian-specific loss factors for commodity-specific FLW at each stage of the FSC (i.e. production, manufacture/processing, wholesale/distribution, retail, restaurant/food service, household/consumer).
3	Chile	The various goals, objectives, and the availability of human and financial resources lead to various method of measuring FLW. The quantifying methods have been used including direct weighing counting, assessing volume records, surveys, mass balance, and modelling.
4	Japan	I In Japan, there is a mandatory regular reporting system which started in 2007, in accordance with Food Recycling Law.
5	Peru	Peru has different projects focusing on quantifying different agricultural products; thus, different methods have been used to fit the products at best. •Post-harvest losses in potato has been identified by International Potato Center (a CGAR Research Center collected) •Post-harvest losses in the agro-productive chain of hard yellow maize-agroindustry (case study in Barrance) was quantified by Inter-American Institute for Cooperation on Agriculture. •FAO has one project on determining the loss in post-harvest in the agro-food chain of bean, case study in Huanuco and Huacho.
5	USA	The US Department of Agriculture's Economic Research Service (ERS) estimates of food loss are based mainly on inference. ERS develops supply and use balance sheets for over 200 individual commodities. In the Loss-Adjusted Food Availability (LAFA) data series, ERS takes the balance sheets for individual commodities, removes the inedible share (such as peach pits and asparagus stalks), and applies food loss assumptions at the retail and consumer levels to estimate food consumption and loss in the United States.
6	Singapore	Singapore conducts waste characterization study to determine the total amount of food waste disposed at the waste-energy incineration plants. Food waste surveys are conducted to determine the amount of food waste treated or recycled. Singapore also conducts waste audit for different premises, including domestic, commercial and industrial premises to determine the amount of food waste disposed of.

3. Validation of the FLW Quantity

There are 10 MEs that provided us with their statistics for FLW, although none of them could provide a complete estimate from the first stage of FSC to the end user-consumer stage. The reason for the lack of complete information is that there has not been a systematic method to estimate FLW at the whole FSC level. Table 7 displays the data that is currently available and their sources.

On the information about the quantity of FLW came from Canada, Japan, New Zealand, and the USA. All of them belong to the advanced economy group.

Table 7 – Data available on FLW in APEC MEs

No	Economy	Our estimate using MFM (1,000 ton/ in 2013)	FLW (1,000 ton/year)	Source
1	Canada	Year 2013: - Distribution: 1,168 - Consumption: 5,141	Year 2010: - Distribution: 1,340 - Consumption: 2,814	http://www.agr.gc.ca/eng/about-us/publications/economic-publications/an-overview-of-the-canadian-agriculture-and-agri-food-system-2015/?id=1428439111783
2	Hong Kong China	Total: 1,108 (2013)	Total: 1,318 (2016)	Monitoring of Solid Waste in Hong Kong - Waste Statistics for 2016.
3	Japan	Year 2013: - Processing and Packing: 841 - Distribution: 2,316 - Consumption: 10,977	Year 2015: - Manufacturer: 16,533 - Wholesalers: 2,940 - Retailer: 12,750 - Restaurant: 19,950 - Household: 8,320 - Total: 28420	Mandatory regular reporting system in accordance with the Food Recycling Law.
4	Malaysia	Year 2013: - Rice loss: 315	Year 2016: - Rice loss: 205	The Malaysian Agricultural Research and Development Institute.
5	New Zealand	Year 2013: - Total: 2,375	Year 2015: - Total: 123 (estimated that NZ$872,000,000 worth of food is wasted at the household level).	WasteMINZ.
6	Peru		Year 2017: - Potato: 16% producers, 1% marketers, 6.1% transformers Year 2016: - Yellow maize: 26.27% in Huanuco - Bean: 17.05% in Huacho-Barrance	- Identifying post-harvest losses in potato - by International Potato Center (a CGIAR Center). - Post-harvest losses in the agro-productive chain of hard yellow maize - agroindustry (case study in Barrance- by Inter-American Institute for Cooperation on Agriculture (IICA). - Study to determine the lost in post-harvest in the agro-food chain of bean (case study in Huanuco and Huacho) – FAO.

7	Philippines		- Harvesting loss (% total production): Paddy: 2.03% Corn: 1.08% - Threshing/shelling loss: Paddy (threshing): 0.08 % Corn (shelling): 0.52% - Handling and storage loss: Paddy: 0.8% Corn: 0.56% - Processing: Fisheries: 25-30% -Distribution loss: Fisheries: 20-25% -Consumption loss (year 2013): Rice: 689,704 tons	Food and Nutrition Research Institute survey.
8	Singapore	No information of Singapore's food balance sheets	Year 2017: - Total: 809.8 tons Year 2016-2017: - Households: 336 tons	Annual waste characterization study NEA Household Waste Study 2016/2017.
9	USA	Year 2013: - Distribution: 10,404 - Consumption: 47,593	Year 2010 - EPA: Generated: 38,400 Disposed: 36,460 - USDA: The estimated total value of food loss at the retail and consumer levels was $161.6 billion.	- Buzby, Jean C., Hodan F. Wells, and Jeffrey Hyman. The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States, EIB-121, U.S. Department of Agriculture, Economic Research Service, February 2014. - EPA's Advancing Sustainable Materials Management: Facts and Figures Report.

10	Viet Nam	Year 2013: - Agricultural production: 13.3% - Handling & Storage: 6.8% - Distribution: 21.5% - Consumption: 3.7% - Total: 47.1%	Year 2018 for Fruit and Vegetables: - Agricultural production loss: 13% total production - Post-harvest handling and storage loss: 7% - Processing loss: 8.6% - Distribution loss: 3.0% - Total: 32% equivalent to 7 million tons	CEL Consulting

2.2.3. Feasible Solutions, Diversion Potentials and Cost of Implementation

This section aims at identifying two key points:

(1) update the programs on reducing FLW that have been implemented in APEC MEs following the first survey and challenges hampering their implementation and;

(2) explore the estimated reduction potentials and associated costs with the above programs in APEC MEs.

First, we have synthesized the reduction solutions from our first survey circulated in May, 2017 into 14 categories. In addition, we asked MEs to update their existing programs.

Q: How many solutions listed on the table have been implemented in your economy?

Q: Is there any solution that is not listed but has been implemented in your economy?

Q: Are there challenges hampering their implementation in your economy?

The survey results show that all of 15 respondent MEs have been implementing several solutions to reduce FLW. Beside the original 14 solutions, the respondent provided 7 extra options and they are:

15. Produce Specification (Imperfect produce): The solution has been widely implemented in various places in Canada.
16. Waste Tracking & Analytics:
    - In Canada, Provision Coalition developed and launched an online FLW Reduction Toolkit in 2016 for use by food processing companies to better understand quantities, causes and reduction opportunities for FLW at the facility level and compare performance with peers.
    - In Singapore, waste characterization studies and waste audits are conducted to obtain quantitative data on food waste generation. The data obtained from the waste audits will help establish the potential for reducing the amount of food waste disposed of and develop FLW reduction programmes.
    - In the U.S., the Foundation to End Senior Hunger's "What a Waste" program partnered with LeanPath to implement waste tracking for senior nutrition programs.

New Zealand; Chinese Taipei; and the USA have additional solutions as below:

17. Packaging Adjustments & Spoilage Prevention Packaging.
18. Smaller Plates & Trayless Dining.
19. Improved Inventory Management.

20. Manufacturing Line Optimization.
21. Value-Added Processing.

As solution 1 and 2 (Consumer Education Campaigns, Education Campaign on FLW at School) are sharing mostly similar features, we consolidate those two into solution 1 – Education campaign. Therefore, we finalize the 20 feasible solutions for reducing FLW in APEC region.

The updated information on 20 feasible solutions are listed in Table 8. It can be seen that “Education campaign” and “capacity building” are the most commonly adopted solutions (12 MEs) followed by “Pre-harvest Technical Support”, “Harvesting Technical Aid”, “Postharvest Facility Support”, “Improved Handling and Transportation”, “Food Donation Support”, “Food Waste Recycling” (11 MEs), and “Animal Feed” (9 MEs). The detailed descriptions can be found in Appendix B.

Table 8 – Surveyed solutions on reducing FLW in APEC MEs

No	Economy	1. Education Campaigns	2. Waste Tracking &Analytics	3. Standardized Date Labeling	4. Produce Specifications	5.Adjustments & Spoilage Prevention Packaging	6. Smaller Plates & Trayless Dining	7. Improved Inventory Management	8. Manufacturing Line Optimization	9. Pre-harvest Technical Support	10. Harvesting Technical Aid
1	Australia	•		•						•	•
2	Canada	•	•	•	•					•	•
3	Chile	•								•	•
4	People's Republic of China	•								•	•
5	Hong Kong, China	•									
6	Japan	•		•							
7	Malaysia	•		•						•	•
8	New Zealand	•	•	•	•	•	•	•	•	•	•
9	Papua New Guinea									•	
10	Peru									•	•
11	Philippines	•		•						•	•
12	Singapore	•	•								
13	Chinese Taipei	•		•		•			•	•	•
14	USA	•	•	•	•	•	•	•	•	•	•
15	Viet Nam										•
	Total No of MEs	**12**	**4**	**8**	**3**	**3**	**2**	**2**	**3**	**11**	**11**

No	Solution	11.Postharvest Facility Support	12 Improved Handling and Transportation	13. Cold Chain Management	14. Financial/Tax Incentives	15. Economy-Wide Legislation	16. Capacity Building	17. Food Donation Support	18. Value-Added Processing	19. Food Waste Recycling	20. Animal Feed
1	Australia	•	•				•	•		•	
2	Canada	•	•		•		•	•		•	•
3	Chile	•	•	•		•	•	•		•	
4	People's Republic of China	•	•		•	•	•				
5	Hong Kong, China							•		•	•
6	Japan					•				•	•
7	Malaysia		•				•	•		•	•
8	New Zealand	•	•	•			•	•	•	•	•
9	Papua New Guinea	•	•								
10	Peru	•					•	•			
11	Philippines	•	•	•	•	•	•			•	•
12	Singapore			•	•		•	•	•	•	•
13	Chinese Taipei	•	•	•			•	•		•	•
14	USA	•	•	•	•	•	•	•	•	•	•

15	Viet Nam	•	•	•	•		•	•			
	Total No of MEs	**11**	**11**	**7**	**6**	**5**	**12**	**11**	**3**	**11**	**9**

As for the challenge to implement the above solutions, they are listed as follows:

1. Economic factors such as:
    - It is cheaper to landfill food waste rather than to donate (edible), compost (inedible), or recover and redirect uneaten food to another use.
    - Food firms will adopt a loss-reducing practice if it is economically justifiable, that is, if the benefits outweigh the costs.
    - Expense of delivering food to a new destination such as food bank.
2. Technological factors such as:
    - Lack of R&D funding, human resources, and infrastructure.
    - Implementation on technologies.
    - Application standards, enforcement and legislation.
    - Food safety issue in food donation.
3. Food waste handling/disposition factors such as:
    - Lack of incentives to support changes to reduce waste generation or to divert waste from landfill.
    - Limited demand for the end products of composting.
    - Logistics of getting wholesome food distributed timely.
    - Lack of interest from consumers.

Table 9 shows us the information on diversion potential associated costs for conducting the reduction solutions. Most MEs replied that the FLW can be potentially reduced by implementing the above solutions. However, because most of the respondents are mainly working in the public sector, the cost estimate mostly came from the budget spent by government in a few MEs. Only 1 economy provides some estimates from the business sector.

Table 9 – Diversion potential and implemented cost associated with surveyed solutions

Solution	Economy	Potential diversion	Budget spending USD/year	Private sector cost	ReFED cost estimates for implementation in the United States (USD/year)
Education campaign	Chile		Total: $21.000/year - $14.000/year spent in printing - $USD 7.000 spent in human resources		$26 million/year for various media campaigns
	New Zealand		$267,000/year		
	Hong Kong, China	131,400 tons/year			
	Chinese Taipei	100 tons/year	$400,000/year		
• **Pre-harvest technical support** • **Harvesting technical aid** • **Postharvest facility support**	Chile		Total: $ 1.400.000 (Estimated budget spent in 2017, based only on available information)		N/A
Cold chain management	Chile		$ 120.000 (Estimated budget spent in 2017)		$4.2M per year from use of more expensive transport vendors with additional cold chain technology investments
	Chinese Taipei	The percent of grain lost in cold storage facility is about 1/3 of the storage loss at normal temperature warehouse	$3.56 million/year for assist farmers' association in building up rice cold storage facility	$5.53 million/year	
	Chinese Taipei	100 tons/ year		$20 million /year for electric power consumption	

Solution	Economy	Potential diversion	Budget spending USD/year	Private sector cost	ReFED cost estimates for implementation in the United States (USD/year)
Capacity building for FLW (conference/workshop/training course)	Chile		- $7,000 spent on the 1st Seminar Zero Waste in the Agro-industry at economy level - $5,000 spent on the 1st Seminar of the Committee for the FLW Reduction		N/A
• **Animal feed** • **Food waste recycling (composting)**	Hong Kong, China	About 900 ton per day or 25% of food waste per year			
	Singapore	133,000 tons/year or 16% of food waste per year			
Manufacturing Line Optimization	Chinese Taipei	100,000 tons/ year	$1 million/year		$3.9M/ year
• **Packaging adjustment** • **Spoilage prevention packaging** • **Cold chain management**	Chinese Taipei	- Vegetables: Reduce 101 thousand tons/year Grains: Reduce 3,800 tons/year	- Vegetables: $3 million subsidies on automated facilities - Grains: 6.7 millions		
Packaging adjustments	Chinese Taipei	1000 tons/ year		$60 millions /year for Production fee of new package	$275M/year from increased costs of food packaging

2.2.4. Public-Private Partnership (PPP) on FLW Reduction

This section provides information on PPP in APEC MEs including the current implementation of PPP on FLW reduction by type and area, the indicators of a successful PPP project, as well as the strengths, weaknesses and improvements needed.

Generally speaking, PPP can be defined as agreed upon, cooperative ventures that involve at least one public and one private sector institution as partners (Carroll et al., 2000). In this survey, we consider a PPP on FLW as any PPP project or program that connect at least one public organization and one private company to conduct activities aim at reducing FLW from five areas (i.e. food waste recycling, food donation, cold chain system, agricultural facility enhancement, and campaign).

First, we find that most APEC MEs have engaged in more than one forms of PPP in reducing FLW. Figure 7 shows the difference between the 8 advanced MEs and 7 developing MEs in PPP application.

Based on Figure 7, public financial support is the most popular type of PPP. Ten out of 15 MEs have this type of PPP applied (4 advanced and 6 developing MEs), which means these governments spend money in a form of loan, insurance, or grant to business or non-profit organization to conduct activities related to reducing FLW. Relatively, joint ventures have been implemented in only 7 MEs, followed by consultative PPP (6 MEs), multi-functional PPP (5 MEs) and contractual PPP (5 MEs).

Q1: What types of PPP have been applied in your economy?

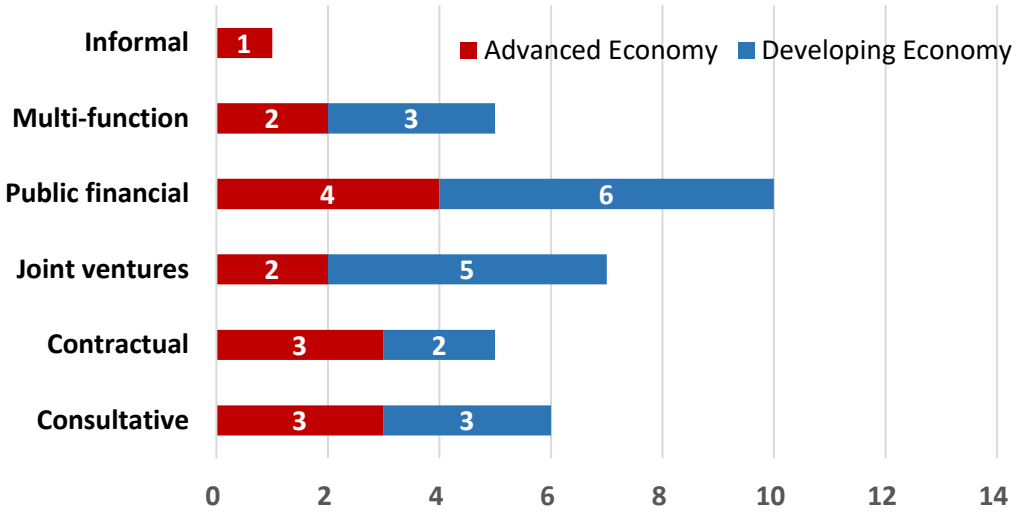


Figure 7 – Types of PPP being applied in APEC region

Joint ventures PPP is more prevalent in developing MEs than the advanced (5 developing vs. 2 advanced MEs). The U.S reported that they only have PPP in the type of informal, voluntary agreements.

Q2: What areas of reducing FLW that PPPs have been applied in your economy?

As for areas, Figure 8 shows that among the five areas of reducing FLW, PPP has covered the most in food waste recycling with 12 APEC MEs. Food donation has also been reported to implement in 10 MEs [4] under certain types of PPPs, followed by agricultural facility enhancement (9 MEs), FLW campaigns (8 MEs) and cold chain system (6 MEs).

Most advanced MEs have a PPP in which 7 out of 8 MEs have PPP in food waste recycling, 6 MEs reported engaging PPP in food donation. PPP in cold chain system, however, is not widely applied in the advanced MEs. Relatively, developing MEs have PPPs across all areas evenly, with agricultural enhancement and food waste recycling slightly above the other areas.

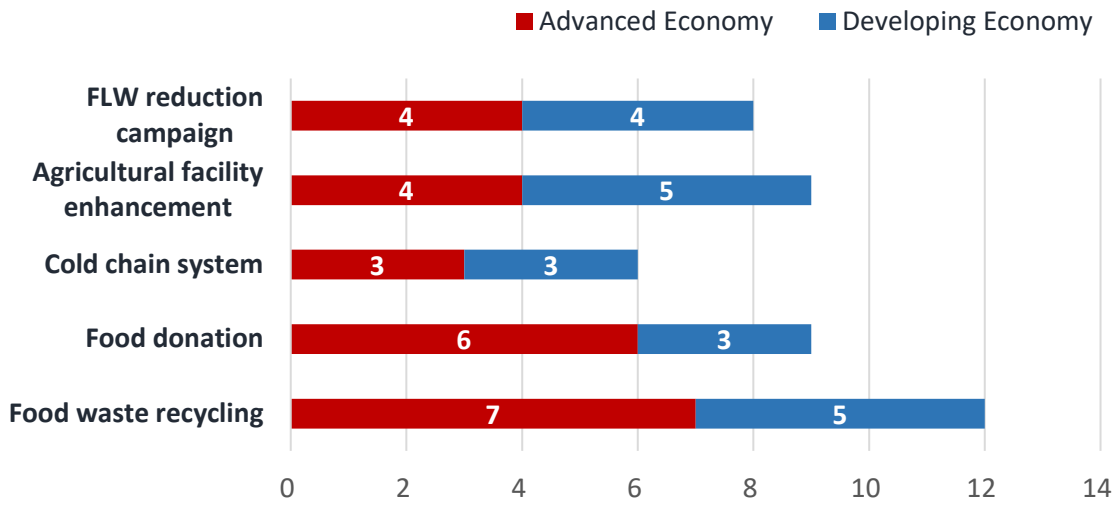
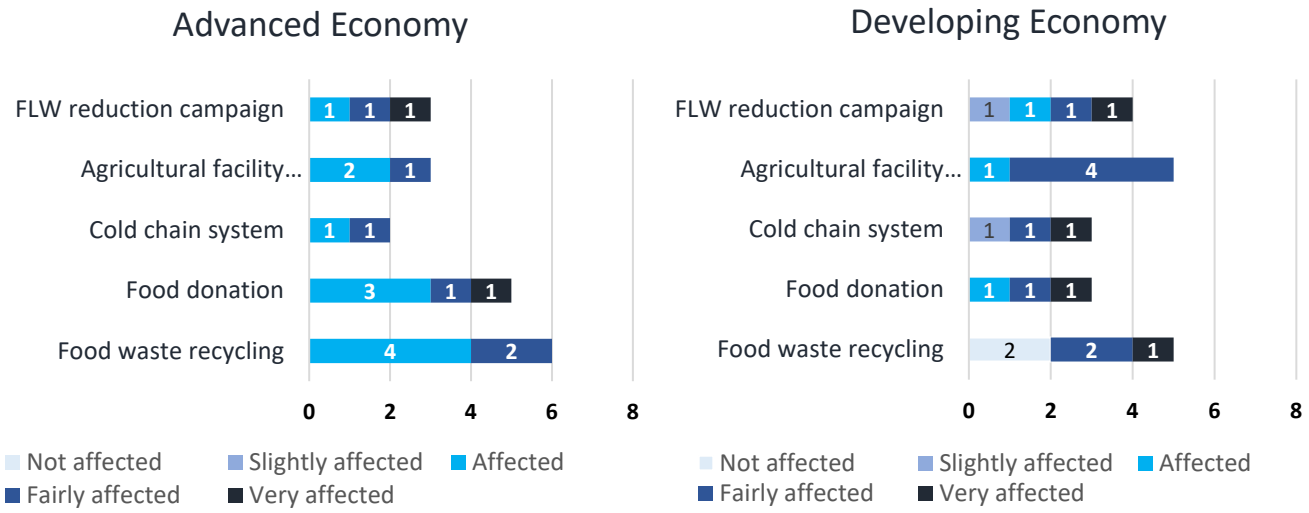


Figure 8 – PPP in APEC region by areas of FLW reduction

Q3: Of the areas listed in figure 7, what areas have been affected by the current PPP? (Rating from 1-5 in each area, with 1 as the least affected and 5 as the most affected one)

[4] Note that Peru reported they had the Law No. 30498 to promote food donation and facilitate the transport of donations; however, only in situations of natural disasters. In this case only, companies that donate food in cases of emergency will have tax benefits. Any natural or legal person can donate, the goal of this rule is that most can donate, but basically businesses. Public or private non-profit organization qualified as a donor entity according to the norms that regulate the income tax. They can donate food in good condition, delivered before its expiration date and can be reused. They can donate up to 10% of the company's net income and if it is a company with losses only up to 3%.

Figure 9 depicts to what extent PPP affects five areas of FLW reduction in advanced and developing MEs. The advanced MEs' rating tell us the fact that PPP influences various areas due to their grade from affected level up to very affected. Food donation and food recycling are seen as the two areas mostly affected by PPP. FLW campaign and food donation got the "very affected" from 2 MEs. In the developing group, in contrast to the advanced group, food waste recycling did not have a significant effect (scored 2.8 points) but agricultural facility enhancement fairly effect all the 5 MEs applied this PPP (3.8 points).



	Food waste recycling	Food donation	Cold chain system	Agricultural facility enhancement	FLW reduction campaign
Average score	**3.0**	**3.8**	**3.6**	**3.6**	**3.8**
Advanced	3.3	3.6	3.5	3.3	**4.0**
Developing	2.8	**4.0**	3.7	**3.8**	**3.5**

Figure 9 – Effectiveness of PPP on FLW reduction by areas

Q4: What areas of FLW reduction should PPP focus on?

Reckoning the effect of PPP on the five areas, Figure 10 displays the areas to be focused on to reduce FLW by the 15 APEC respondents. Both advanced and developing MEs agreed that reduction campaign and food waste recycling should be conducted with dominant advocates. The difference of suggestions mainly come from the areas of agricultural facility and cold chain improvement. While advanced MEs did not focus on these two areas, the developing MEs strongly recommend these two areas for further PPP applications.

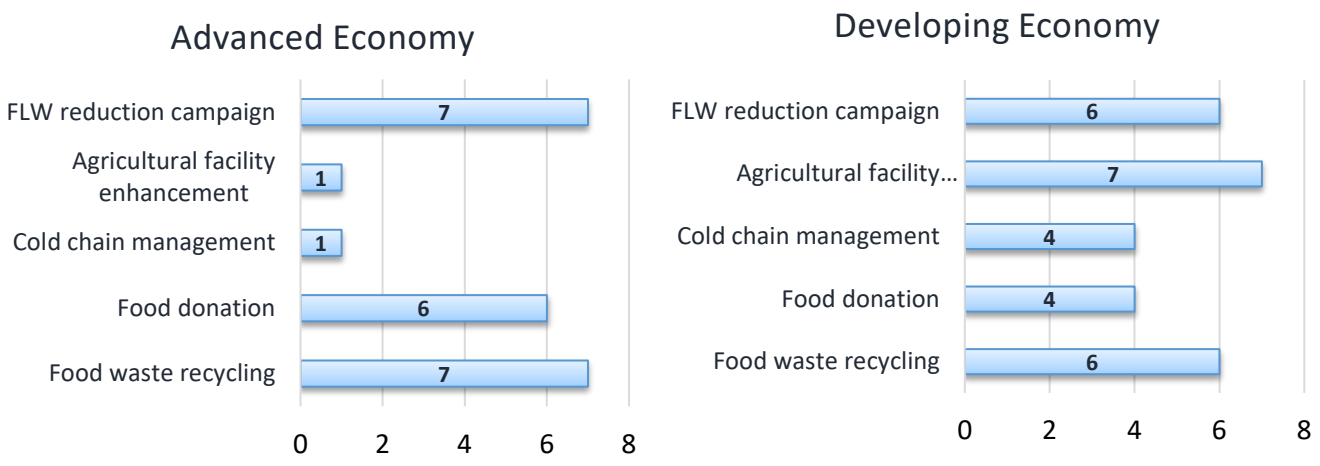
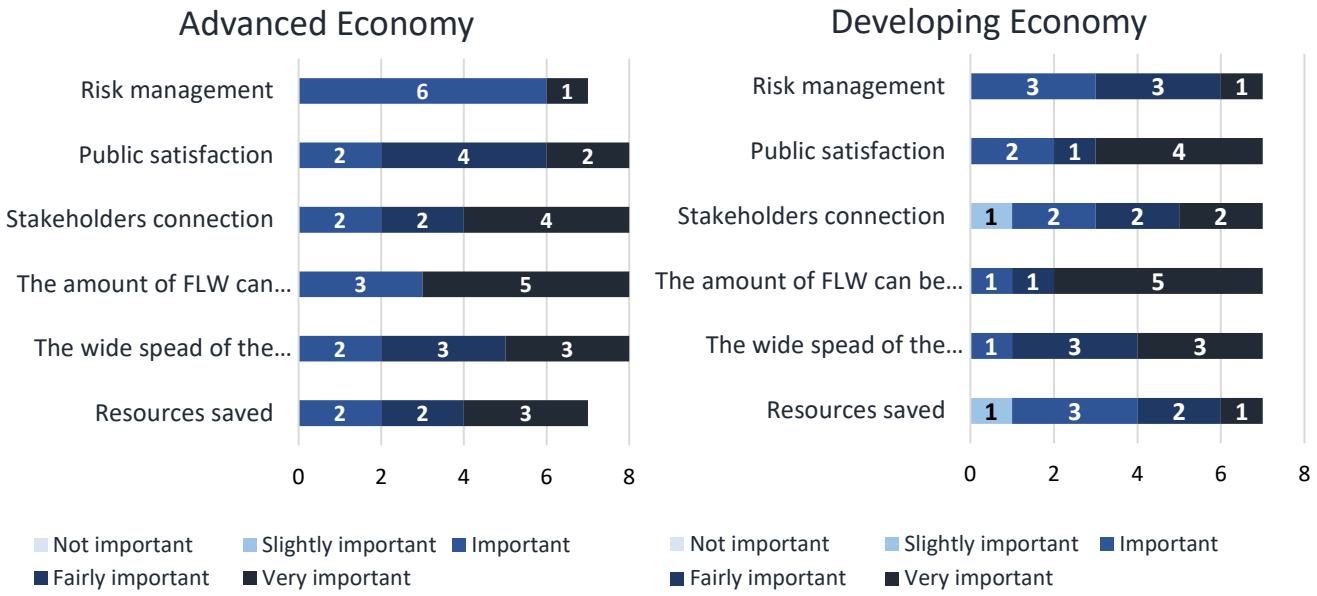


Figure 10 – The areas of FLW reduction that PPP should be focusing

Q5: What do you think are the key indicators of a successful PPP project on the areas of FLW reduction? (Rate from 1-5 in each indicator, with 1 as the least important and 5 as the most important)



	Resources saved	Widespread of the project	Amount of FLW can be reduced	Stakeholders connection	Public satisfaction	Risk management
Average score	3.8	4.2	**4.4**	4.0	4.1	3.5
Advanced	**4.1**	4.1	**4.3**	**4.3**	4.0	3.3
Developing	3.4	**4.3**	**4.6**	3.7	**4.3**	3.7

Figure 11 – The key indicators of a successful PPP on FLW reduction

As shown in Figure 11, the most important indicator leading to a successful PPP project on reducing FLW is "The amount of FLW can be reduced" by the activities within the project. All respondents scored this indicator as the most important problem, average score is 4.6/5. Both groups of MEs share the common opinion on "The importance of the widespread of the project", marking this indicator as the second most important criterion leading to an excellent PPP.

Beside "The amount of FLW can be reduced", the advanced MEs highly appreciate "Stakeholder connection" (4.3 points) and "The resources saved" (4.1 points) in a PPP, while these two indicators are not the key issues in developing MEs. Preferably, developing MEs emphasize "Public satisfaction" and "Importance of widespread of the project" as the important indicator for an efficient PPP with the rating average score are 4.3 in both criteria.

Q6: What are the strengths of applying PPP on reducing FLW?

Figure 12 shows APEC MEs' opinion on the strength of PPP on reducing FLW. According to the 15 responding MEs, the most important advantage of PPP is that it improves the performance of policy, knowledge-sharing, and project enforcement. Many MEs consider that PPP can also improve data quality on quantifying the amount of FLW since it can link many stakeholders along the FSC. For the public sector, PPP also provide better infrastructure, ensure budget efficiency, speed up project completion, and transfer risk to the private sector.

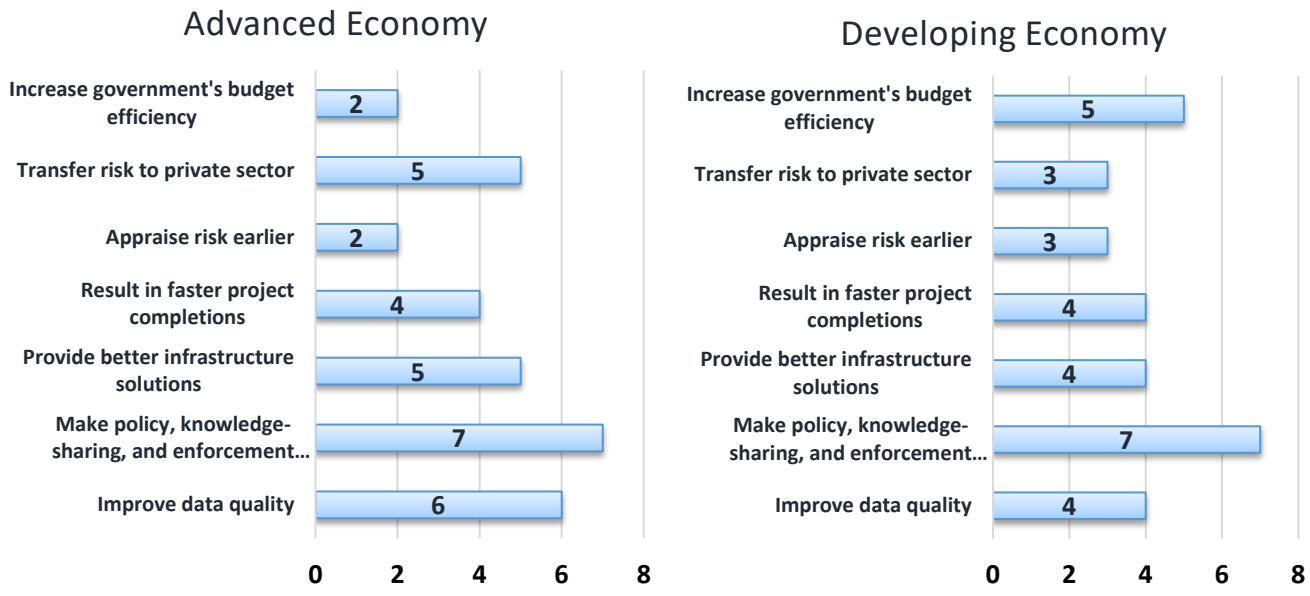


Figure 12 – The strengths of applying PPP on reducing FLW

Comparing advance MEs with the developing MEs, the advantages of PPP are very similar

between the two groups of MEs. The only exception is that "PPP increase government's budget efficiency". Only 2 out of 7 advanced MEs mark this as the strength of PPP, while 5 out of 7 developing MEs believe that PPP can improve government's budget spending efficiency.

Q7: What are the disadvantages of applying PPP on reducing FLW?

Figure 13 demonstrates the major challenges or weaknesses of PPP in management and monitoring. The majority of responding MEs face the conflict between business' gain and the environmental impact (5 advanced and 7 developing MEs). Majority of advanced MEs are likely to apply PPP as PPP's strength can outweigh weakness. However, only two MEs reported that they think PPP had no disadvantage. Four advanced MEs were concerned that private sector would just do what they are paid to.

The developing MEs, in contrast, listed numerous weaknesses of PPP. All 7 developing MEs regard the conflict of environment consideration and business profit as the biggest weakness of PPP. Two-thirds of the developing MEs also share the same concern about balancing the self-interest of private sector with public interest and emphasize the lack of contract management skills of government personnel and the requirement of a performance monitoring system.

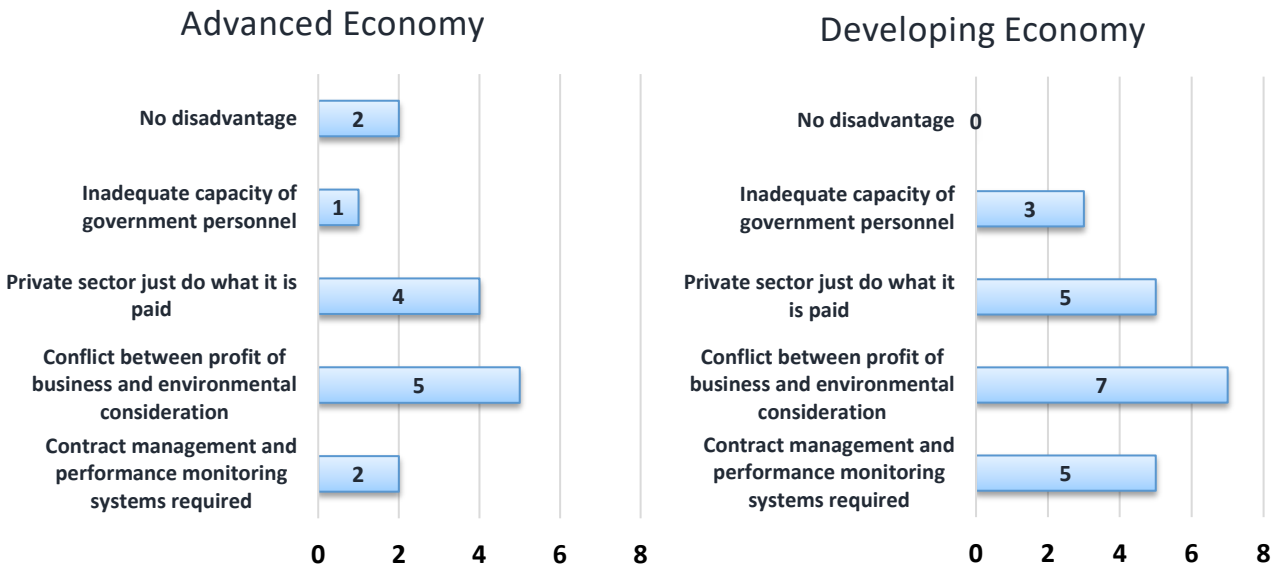


Figure 13 – The weaknesses of PPP on FLW reduction

Considering the strengths and weaknesses of PPP in the field of reducing FLW, 9 MEs think that PPP is a better and much effectiveness method. Some are not sure if PPP is a better method compared to purely public or purely private operating mechanism and they believe

that it is highly dependent upon actual situations.

Q8: What reasons will make you opt for PPP?

Figure 14 reveals the reasons that might encourage an economy to choose PPP instead of other partnerships. It is obvious that both groups of MEs listed that the expertise of other partners in the partnerships is the major reason for them to apply PPP (opted by 14 MEs). Furthermore, many MEs believe that private sectors would work more efficiently in a PPP arrangement (chosen by 11 MEs). Most developing MEs would choose PPP only if governments have legal enforcement regulations (6 MEs). Meanwhile, only 2 advanced MEs choose to adopt PPP under government regulations.

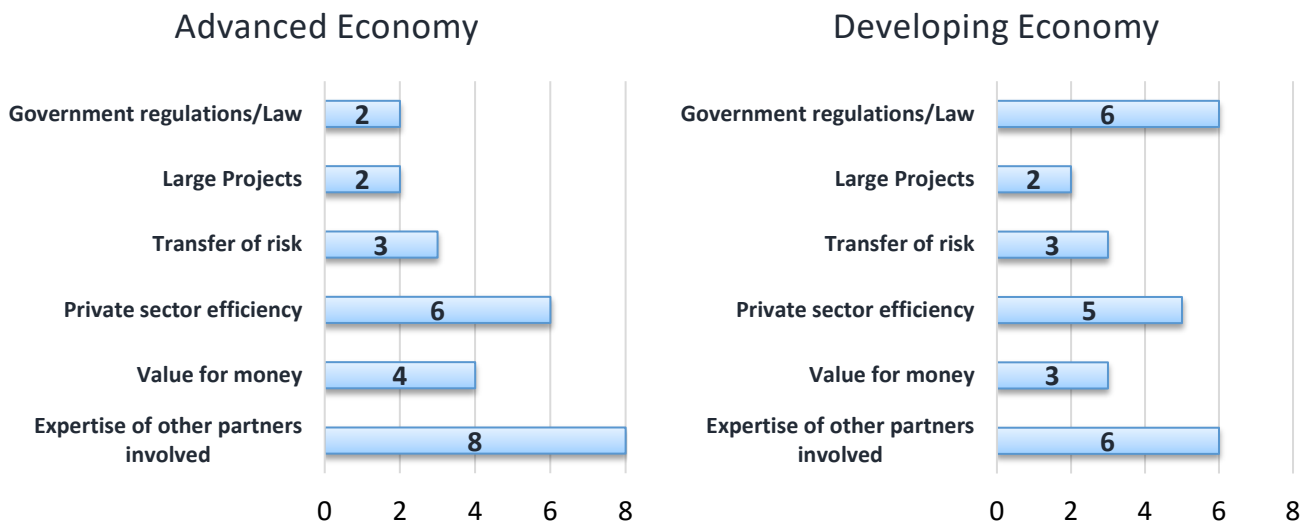


Figure 14 – The reasons make APEC MEs choose PPP

To understand what kind of support is needed by the MEs for facilitating PPP on FLW reduction, we asked the question below:

Q9: What should legislations/policies/regulation be designed to support PPP?

Fourteen MEs answered that a clear guideline of PPP on FLW is needed for business and organization to reckon the benefits, rules and responsibilities of each partner in the relationship. Alternatively, 11 respondents expressed that a FLW center can be established to provide knowledge and information with respect to PPP projects on FLW and connects public and private sectors in the APEC region. Both advanced and developing APEC MEs share the similar level of agreement on designing a supporting mechanism for PPP on reducing FLW in the APEC region.

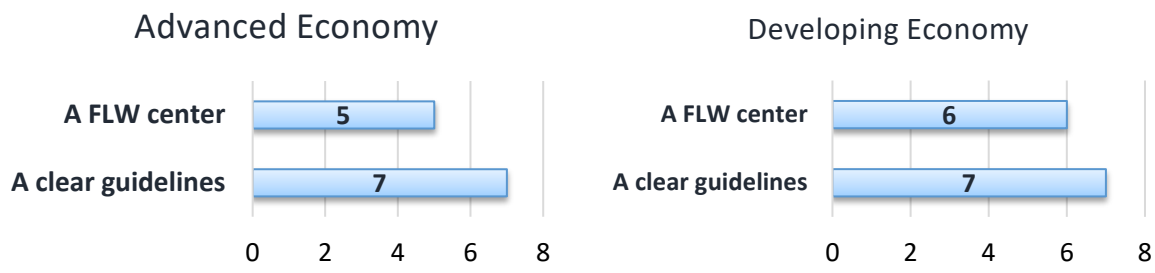


Figure 15 – The need of guidelines and FLW center to support PPP on FLW

Note that in the US, the US Department of Agriculture (USDA), Environmental Protection Agency (EPA), and a partnership of private businesses and organizations launched a new virtue FLW Center "Further With Food: Center for Food Loss and Waste Solutions", which is an online hub for the exchange of information and solutions targeting FLW in the United States. This site lists a vast number of solutions on FLW reduction. The details can be found in: https://furtherwithfood.org/

To summarize, PPP have been supporting FLW reduction in different areas, in which food waste recycling, agricultural facility improvement, FLW education campaign, and food donation have all been applied by most APEC MEs. PPP has an important role in these areas, but its effectiveness and weakness are different between advanced and developing MEs. Our survey results inform us that the enhancement of agricultural equipment greatly affect developing MEs while it had a minor effect on the advanced ones. Therefore, most developing MEs recommend a PPP on agricultural facility enhancement.

Regarding the criteria leading to a good PPP, MEs strongly believe that the amount of FLW can be reduced by the project and the satisfaction of the public should be prioritized. The strengths of PPP are it supports policy, knowledge-sharing, and enforcement in APEC region. It also improves data quality as the stakeholder connections are included in its nature, and it results in a faster completion of a project. Notably, PPP can help increase government's budget in developing MEs.

However, PPP might confront the conflict between business's revenue and environmental issues. This is considered as PPP's weakness by most APEC MEs. Despite a few disadvantages of PPP, advanced MEs are optimistic about PPP practice. Developing MEs, in contrast, are primarily concerned about the management and operating issues and they are not confident in the management skills of public sector.

Finally, other partners' capacity in a partnership will make APEC MEs opt for PPP. The developing MEs might choose PPP if government support it in form of regulation or law. APEC

MEs strongly support the establishment of a guideline or mechanism which acts as a bridge between public and private sectors, sharing initiatives, and facilitate stakeholders on management issue.

3. KEY FINDINGS AND CONCLUDING REMARKS

The survey has gathered information about FLW from 15 APEC MEs. The information includes FLW reduction targets and policy/plan, quantification method of FLW, feasible solutions for reducing FLW, and partnerships between public entities and businesses. Through the 15 ME's responses, we draw our key findings and conclusions as follows:

Overview of policy target and measurement:

- Reduction targets have been set and policies/plans have been enacted in 13 MEs. The others, however, might have targets and FLW reduction programs at states/ provincial levels or implemented by an organization or institute.
- Promoting FLW reduction at economy-wide level confronts various challenges, such as:
  - FLW is managed by different ministries and organizations thus, it is not easy to collaborate up to economy level due to different priorities and purposes of different entities.
  - A lack of robust data on FLW lead to less policy advocates from the public. MEs keep repeating the lack of awareness of FLW. The public do not acknowledge that a huge amount of FLW is disposed of every year because there is no reliable source of information.
  - FLW information and data are limited because of the complicated properties of FSC and FLW. It takes a lot of effort to gather information from multiple stakeholders.
- FLW definitions are varied in terminology, scope, and quantification methods between MEs. Most advanced MEs either have a quantification method or have been in a process of designing a quantification system for FLW.
- Without a specific target or plan for reducing FLW, MEs are less likely to have a quantifying system and self-improved monitoring is difficult.

Overview of feasible solutions and challenges:

- Most APEC MEs have been conducting feasible solutions on reducing FLW in both governmental entities and businesses. MEs of the advanced group generally have a broad spectrum of solutions covering the entire FSC. Meanwhile, developing MEs

mainly focus on post-harvest loss innovation solutions.

- Education campaigns, harvesting technical aid, postharvest facility support, improved handling and transportation, capacity building, and food recycling are the most adopted solutions among the 20 APEC surveyed solutions.

- The implementation of 20 APEC surveyed solutions faces three main challenges:

    1. Economic challenges:
        - It is often cheaper to landfill food waste rather than to donate (edible), compost (inedible), or recover and redirect uneaten food to another use.
        - Food firms will adopt a loss-reducing practice if it is economically justifiable, that is, if the benefits outweigh the costs.
    2. Technological challenges:
        - Lack of R&D funding, human resources, and infrastructure.
        - Implementation of technologies.
        - Application standards, enforcement and legislation.
        - Food safety issues in food donation.
    3. Food waste handling/disposition challenges:
        - Lack of incentives to support changes to reduce waste generation or to divert waste from landfill.
        - Limited demand for the end products of composting.
        - Logistics of getting wholesome food distributed in a timely manner.
        - Lack of interest from consumers.

Overview of PPP on reducing FLW:

- The most popular form of PPP currently conducting in APEC members is public financial support.

- PPP remarkably affect FLW reduction campaign in most MEs. Agricultural facility enhancement has a great influence in developing MEs. In advanced group, food waste recycling and food donation are two main areas affected.

- Most advanced MEs suggest that PPP should focus on FLW reduction campaign and food waste recycling. The majority of developing group recommend FLW reduction campaign and agricultural facility enhancement.

- The larger the amount of FLW a PPP project can reduce would lead to a better PPP in FLW reduction. In addition, a successful PPP should be spread-out or scaled up widely.

- Both advanced and developing MEs point out the importance of resource saving and

stakeholders connection in a PPP and they would choose PPP in condition that each partner could optimize their capacity. In addition, the developing MEs would like to have more incentives of applying PPP under government regulation or law.

- The weakest characteristics of PPP is that the private sector's profit goal could harm the environmental condition and jeopardize the performance of FLW reducing activities.

Concluding Remarks

Food insecurity is and will remain a critical issue for the APEC region. Increasing frequency and intensity of extreme weather events due to climate change have been also negatively affecting agricultural production and food security in the APEC region. The collaboration and co-ordination of regional initiatives on food loss and waste reduction is essential.

Based on the survey, we found that APEC MEs have developed a number of solutions to implement the APEC Action Plan for Reducing Food Loss and Waste. The solutions collected through the survey, however, are not exhaustive of all the solutions being implemented. We also found that PPPs encompass a variety of project delivery options as a potential way of bringing new financial resources with varying degree of private sector participation. Therefore, we encourage all MEs to strengthen PPPs on awareness raising, capacity building, infrastructure investment, and consider further collaboration on relevant APEC action plans.

To achieve the major goals prescribed in the APEC Food Security Roadmap, we continuously recognize the importance of improving assessment methodology, data collection, FLW quantification, education campaigns, harvesting technical aid, postharvest facility support, improved handling and transportation, capacity building, and food recycling, as well as capacity-building and networking with other relevant APEC sub-fora and international organizations.

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Appendix A: Questionnaire

APEC Feasible Solutions on Food Loss and Waste Reduction Survey

(APEC Multi-Year Project: M SCE 02 2013A)

APEC Economy	
Respondent's Information	**Name:**
	Position:
	Agency:
	Email (if available):

Q1. Economy's Targets, Policies and Strategies for Food Loss and Waste (FLW) Reduction

1.1 Are you involved in FLW reduction programs/projects/activities in your economy?

☐ Yes ☐ No

If "Yes", please specify

……
……
……

1.2 Does your economy have a FLW reduction target?

☐ Yes ☐ No

If "Yes", please describe what this is, when it was set, and by whom.

……
……
……

1.3 Does your economy have FLW reduction policy/plans at economy-wide level?

☐ Yes → go to **1.4** ☐ No → go to **Q2**

If "Yes", please specify the name of the policies/plans and the official link if available

……
……
……

1.4 Is FLW reduction policy/plans mainstreamed into agricultural development plans in your economy?

☐ Yes ☐ No

If "Yes", please gives some details on the tools/approaches used for mainstreaming and implementation

……
……
……

1.5 Are there challenges hampering the mainstreaming of FLW policy/plans in your economy?

☐ Yes ☐ No

If "Yes", please specify

……
……
……

1.6 Are there challenges hampering the development of FLW policy/plans in your economy?

☐ Yes ☐ No

If "Yes", please specify

……
……
……

Q2. Quantification of Food Loss and Waste (FLW)

2.1 Does your economy have a definition of FLW?

☐ Yes ☐ No

If "Yes", please specify

……
……
……

FAO (2011) and FAO (2014) defined FLW as below

- **Food loss (FL)** *refers to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption.*
- **Food waste (FW)** … *refers to the removal from the FSC of food which is fit for consumption, by choice, or which has been left to spoil or expire as a result of negligence by the actor – predominantly, but not exclusively the final consumer at household level.*
- **FLW** *takes place at all stages of the FSC from agricultural production to consumption.*
- **FLW** *also includes food that is redirected to animal feed, compost or other non-food uses.*

2.2 Does your economy adopt the Mass Flow Method[5] suggested by FAO (2011) to quantify FLW?

☐ Yes ☐ No

If "Yes", does your economy use FAO's loss ratios to quantify FLW or use your own estimates?

☐ FAO (2011) ☐ Your economy's own estimates

[5] A Mass Flow model allows for a measurement of waste levels through the change in the weigh and quantity of products as they move through the food chain. In particular, after an initial assessment process in which the losses accrued at each stage of production are measured, it becomes relatively simple to mathematically estimate subsequent waste levels.

If "No", please specify the quantifying method in your economy (use additional sheet if necessary)

……
……
……

2.3 Please provide the amount of FLW by stage in your economy if available

Stage	Description	Quantity (1,000 ton/ yr)	Year collected	Sources
Agricultural Production	losses due to mechanical damage and spillage during harvest operation, e.g. threshing, fruit picking, sorted out, etc.			
Post-harvest handling and storage	losses due to storage and transportation between farm and distribution, and spillage and degradation during handling.			
Processing	losses during industrial or domestic processing and packaging.			
Distribution	losses and waste in the market system, including wholesale markets, supermarkets, retailers, and wet markets.			
Consumption	all losses and waste at household level (including consumer-facing businesses (e.g. restaurants, schools, institutions) and residential waste)			
Total				

2.4 Are you involved in data collecting/information sharing/education on FLW?

☐ Yes ☐ No

If "Yes", please specify

……
……
……

Q3. FLW diversion potentials and cost in implementation

The table below contains the existing programs on FLW reduction provided by 16 APEC MEs in our 1st survey (2017). Please read the table and answer question **Q3.1**

	Type	Description	Program	Economy
1	**Consumer Education Campaigns**	Conducting large-scale consumer advocacy campaigns to raise awareness of food waste and educate consumers about ways to save money and reduce wasted food	My save food initiative	Malaysia
			Crusade Against Hunger (Promoting community participation objective)	Mexico
			Love Food Hate Waste New Zealand	New Zealand
			Be Ricesponsible by PhilRice; Save Food Asia by FAO and Asian Institute of Technology	Philippines
			Save food campaign (by FAO and Ministry of Agriculture and Cooperatives)	Thailand
			Food wastage reduction outreach programme	Singapore
			U.S FLW 2030 Champions; U.S Food Waste Challenge	USA
2	**Education Campaign on FLW at School**	Promote food education focusing on FLW in school; knowledge transfer to reduce Plate scraping behavior of children	Save food campaign (by FAO and Ministry of Education	Thailand
			Rice education at school	Chinese Taipei
			Love Your Food @School project	Singapore
3	**Standardized Date Labeling**	Standardizing food label dates and instructions, develop tools to help customer on checking the expiration dates of products	FoodKeeper App is to provide consumers with a tool to access clear, scientific information on food storage, proper storage temperatures, food product dating, and expiration dates	USA
4	**Pre-harvest technical support**	Provide technical advice on selecting the best high yielding varieties, use the best culture practices relating to crop management, irrigation, and fertilizer use and pest control; support farmer cultivating equipment (tractors, attached farm implements, drum seeder)	Rice Mechanization Program	Philippines
5	**Harvesting technical aid**	Suggest the best time for harvesting of crops; train the farmers/operators on mechanized harvesting as relevant as the losses are minimal; provide farmer training on handling of produce. Support/provide farmer harvesting facilities (i.e. rice combine harvester, thresher)	Provide farmer training on mechanical drying of paddy rice; Provide better training to the farmers on handling of produce	Philippines
			Adhere to the best time for harvesting of crops and handle produce with care; Train the farmers/operators on mechanized harvesting as relevant as the losses are minimal	Viet Nam
6	**Postharvest Facility Support**	Provide/ support postharvest facilities on various crops such as air blast freezers, fish stalls, chest freezers, ice plant and cold storage in fisheries, mechanical dryer in rice cultivation.	Provision of Fisheries Postharvest Facilities; Distribution of IEC materials on proper fish handling and seafood safety awareness	Philippines
			Postharvest processing of vegetables and grains	Chinese Taipei
7	**Improved Handling and Transportation System to Reduce Postharvest Losses from Farm to Retail**	Implementing the best postharvest technology to reduce losses of grain, fruit and vegetable	Handling of paddy postharvest losses to support enhancement of Rice Production; Revitalization model of small rice milling unit, corn and soybeans postharvest handling to reduce losses	Indonesia
			Crusade Against Hunger (Food production objective to cut down food losses after harvesting, in storage, transportation, distribution, and commercialization)	Mexico
8	**Cold Chain Management**	Reducing products loss during shipment to retail distribution centers by using direct shipments and cold chain certified carriers	Provision of cold storage for slaughterhouses	Philippines
			Cold Chain Standard Development;	Singapore
			Refrigeration equipment of rice	Chinese Taipei

9	**Economy-wide legislation on FLW reduction**	Promote FLW reduction program in official law at economy-wide level	Zero waste of raw material in the Food Industry, Program of Sustainable Production and Consumption: Sustainable Food System	Chile
			Basic policy for Food Recycling Law; the Third Basic Plan for Promotion of Food Education; Basic Plan for promoting usage of biomass; Basic Plan for Establishing a Sound Material	Japan
			State program of Agriculture development and regulation of agricultural markets till 2020	Russia
			Goal to Reduce FLW in the United States by 50% by 2030	USA
			The Scheme on improving added value in the processing of agro-forestry and fishery products and reducing postharvest losses; Agricultural restructuring towards raising added values and sustainable development	Viet Nam
10	**Capacity building for FLW (conference/ workshop/ training course)**	Hold capacity building (conference, workshop, or training course) to discuss on FLW related issue and discover strategy, policy or suggest legislation to government.	Project "Measurement and management of fruit and vegetable losses in the production stage at the economy-wide level"	Chile
			Roundtable of FLW Reduction (attached to the Multi-Sectoral Commission on Food and Nutritional Security)	Peru
			Anti Food Waste Campaign; Assessment of Fisheries Postharvest Losses; Capacity Building on Fish processing and Seafood Safety Programs; Technology Demonstrations on proper fish handling and utilization	Philippines
			The initiative Save Food with FAO	Russia
			Project on Cold Chain Management for Seafood; Training courses on vegetable and seafood cold chain management	Singapore
			Capacity building to reduce postharvest losses on chili and mango; Store product away from insect, pest, and control by fumigation; Aflatoxin reduction during grain storage; Good handling in the collecting and packing house	Thailand
			Pilot Postharvest Losses Viet Nam and Identifying solutions to reduce food waste in the value chain	Viet Nam
11	**Financial/ Tax incentives**	Support in terms of interest rates of long-term, mid-term, and short-term commercial loans to organization/ farmer association/ company/ individual for buying machinery and equipment serving FLW reduction program. Give financial/ tax benefit to entity which attempt to reduce FLW.	Providing support policies to reduce losses in agriculture, and implement respective measures for each commodity value chain (Viet Nam)	Viet Nam
12	**Food Donation Support**	All the supports (transportation, financial incentives, policy, etc) to the distribution activities of safe and nutritious food for human consumption with or without payment, food (processed, semi-processed or raw) which would otherwise be discarded or wasted from the agricultural, livestock, forestry and fisheries supply chains of the food system.	Food Recovery Challenge by EPA	USA
			A food waste and yard waste plan for Hong Kong 2014-2020 (Activities to donate surplus food for human consumption)	Hong Kong, China
13	**Animal Feed**	Feeding food waste to animals after it is heat-treated and dehydrated and either mixed with dry feed or directly fed.	Collected food waste from garbage truck will be delivered to the pig farms to feed the pigs after treated	Chinese Taipei
			Food waste collected from companies' cafeterias, restaurant, and foodservices is heated and feed to animal (mainly to pigs)	Viet Nam

14	**Food Waste Recycling for Energy and Digester**	Recycle food waste to convert to energy or compost through anaerobic and aerobic digestions	Recycling campaign (3R)	Thailand
			A food waste and yard waste plan for Hong Kong 2014-2020 (Activities aim at recycling FLW to recover energy and nutrients)	Hong Kong, China
			Food waste treatment pilots, 3R Fund	Singapore

3.1. How many solutions listed above have been implemented in your economy by government/ public sector? ……..

Please specify the solution number (from 1 to 14): …….....

3.2. Is there any solution that is not listed in the Table above but has been implemented in your economy by government/ public sector?

☐ Yes ☐ No

If "Yes", please specify

……
……

3.3. Are there challenges hampering their implementation in your economy?

☐ Yes ☐ No

If "Yes", please specify

……
……

3.4 Please provide the estimated reduction potentials and associated costs in your economy below.

(*Please use the U.S.'s costs of the solutions in the **appendix 1** as your reference).*

Note: The first row is the example for filling the information. If you are not able to fill the absolute amount of reduction potentials, please write down the proportion in the **"proportion"** column and the denominator of the proportion (e.g. In Solution 1- **Standardized Date Labeling,** if your economy can **reduce 5% of residential waste annually**, please write **"5% residential waste"**)

Solution	Name	Estimated reduction potential		Estimated cost (USD/ year)		
		(1,000 tons/ year)	Proportion (% of X waste/ year)	Government (budget spending)	Business (total investment)	Consumer (involving payment)
e.g. 1	**Standardized Date Labeling**		**1.5 % of residential waste**	**10 million for educating consumers**	**0**	**0**

(Add additional rows if necessary)

Q 4. Public-Private Partnership on FLW Reduction

Please read the comparison of five PPP models and examples below before answering **Q 4.1-4.9**:

Type	Types of PPP	Examples on FLW Reduction
1	**Consultative**, Policy Development and Planning Partnerships.	Nashville Food Saver (U.S) with the cooperation of city authority, restaurants and the NRDC focuses on changing behavior through a spirit of competition between restaurants. FSC called on restaurants to reuse what they could, donate leftover food, and send their scraps to be composted.
2	**Contractual** relationships involving procurement, operations and management.	The Orange County Health Department in Orange County, California, created a coalition called "Waste Not Orange County." The vision of the coalition is to mitigate hunger in Orange County by educating the community about food donations, identifying food-insecure individuals, and connecting those individuals to sources of food.
3	**Joint ventures** involving both public and private equity.	Materials recovery facility (MRF) and transfer station in the Philippines. A private firm provides all the services while the City Government provided the land for the MRF, assists the firm in marketing their compost fertilizer to farmer.
4	**Public financial** support for private organizations, both business and not for profit, e.g. loans, insurance, grants.	The Philippine Cold Chain Project is a four-year agriculture development project funded by the United States Department of Agriculture and implemented by Winrock International Institute of Agriculture Development. PCCP works to create and strengthen producers' groups to increase agricultural production that meets international food safety requirements through provision of improved technologies, developing cold chain related markets, and strengthening intermediate organizations.
5	**Multi-function** partnerships involving two or more of the above	FAO collaborates with Unilever Argentina to launch joint initiatives to reduce FLW through awareness-raising campaigns, involving governments, civil society and the private sector.

4.1 Has your economy/institution had a type of PPP project on FLW reduction?

☐ Yes ☐ No ☐ Don't know

If yes, what area of reducing FLW that PPPs has been applied in your economy? Select all that apply:

☐ 1. Food waste recycling ☐ 2. Food donation (Food Bank) ☐ 3. Cold chain system

☐ 4. Agricultural facility enhancement ☐ 5. FLW reduction campaign ☐ 6. None

☐ 7. Other (please specify): ……

Of the areas listed above, what area have been affected by the current PPPs?
(Rate from 1-5 in each area, with 1 as the least affected and 5 as most affected one)

Area	Least		Affected		Most
1. Food waste recycling	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. Food donation (Food Bank)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. Cold chain system	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. Agricultural facility enhancement	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. FLW reduction campaign	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
6. Other (please specify): ……	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

4.2 What areas of FLW reduction should PPP project focus on?

☐ 1. Food waste recycling ☐ 2. Food donation (Food Bank) ☐ 3. Cold chain system

☐ 4. Agricultural facility enhancement ☐ 5. FLW reduction campaign ☐ 6. None

☐ 7. Other (please specify): ……

4.3 What type of PPPs has been applied in your economy? Select all that apply:

☐ 1. Consultative ☐ 2. Contractual. ☐ 3. Joint ventures

☐ 4. Public financial. ☐ 5. Multi-function ☐ 6. None

☐ 7. Other (please specify): ……

4.4 Do you think PPP is a better and much effective method for FLW reduction?

☐ Yes ☐ No ☐ Not sure

4.5 What reasons will make you opt for PPP?

☐ 1. Expertise of other partners involved
☐ 2. Value for money
☐ 3. Private sector efficiency
☐ 4. Transfer of risk
☐ 5. Large Projects
☐ 6. Government regulations/Law

4.6 What do you think are the key indicators of a successful PPP project on the areas of FLW reduction?

(Rate from 1-5 in each indicator, with 1 as the least important and 5 as most important one)

Area	Least Important Most				
1. Resources saved	☐1	☐2	☐3	☐4	☐5
2. The wide spread of the project	☐1	☐2	☐3	☐4	☐5
3. The amount of FLW can be reduced	☐1	☐2	☐3	☐4	☐5
4. Stakeholders connection	☐1	☐2	☐3	☐4	☐5
5. Public satisfaction	☐1	☐2	☐3	☐4	☐5
6. Risk management	☐1	☐2	☐3	☐4	☐5
6. Other (please specify): ……	☐1	☐2	☐3	☐4	☐5

4.7 Does your economy have practical guidelines on PPP implementation?

☐ Yes ☐ No ☐ Don't know

4.8 What are the strength of applying PPP on reducing FLW?

☐ 1. PPP greatly improve data quality because PPP connects many key stakeholders.
☐ 2. PPP makes policy, knowledge-sharing, and enforcement/compliance more effective.
☐ 3. PPP provides better infrastructure solutions than an initiative that is wholly public or wholly private.
☐ 4. PPP results in faster project completions.
☐ 5. Risk are fully appraised early on to determine project feasibility. In this sense, the private partner can offer a break on unrealistic government promises or expectations.
☐ 6. The operational and project execution risks are transferred from the government to the private participant, which usually has more experience in cost containment.
☐ 7. Increase government's budget efficiency.

4.9 What are the disadvantages of PPP on reducing FLW?

☐ 1. Contract management and performance monitoring systems required
☐ 2. There might be a conflict between profit of businesses and environmental consideration
☐ 3. Private sector will do what it is paid to do and no more than that – therefore incentives and performance requirement need to be clearly set out in the contract.
☐ 4. Government personnel have inadequate capacity to conduct monitoring and evaluation of PPP projects.
☐ 5. None
☐ 6. Other (please specify): ……

4.10 What improvements should be taken to support PPP on FLW?

……
……
……

4.11 What should legislations/ policies/ regulation be designed to support PPP?

☐1. A clear guidelines of PPP on FLW is needed for business and organization to reckon the benefits, rules and responsibilities of each P in the relationship
☐ 2. A FLW center which provides knowledge and information with respect to PPP projects on FLW and connects public and private sectors is in need.
☐ 3. Other (please specify): ……

Thank you for your cooperation!

Appendix 1. FLW reduction potential and cost estimates for the United States of 27 solutions provided by ReFED (2016)

	FOOD WASTE PREVENTION SOLUTION						
	Name	Description	Stakeholders adopted (SA)	Diversion potential in the United States (%diversion amount/FLW generated by SA)	Estimated Cost for the United States (investment cost ($M)	Cost (operating costs) ($M/year)	Total costs in the US ($M/yr)
1	Standardized Date Labeling	Standardizing food label dates and instructions, including eliminating "sell by" dates, to reduce consumer confusion	Residential	1.5%		$10M per year for educating consumers	8
2	Packaging Adjustments	Optimizing food packaging size and design to ensure complete consumption by consumers and avoid residual container waste	Residential	0.8%		$275M per year ($0.05/lb average cost of food packaging modifications)	234
3	Spoilage Prevention Packaging	Using active intelligent packaging to prolong product freshness and slow down spoilage of perishable fruit and meat	Retail, residential	0.2%		$170M per year ($0.04 per unit spoilage prevention packaging cost)	145
4	Produce Specifications (Imperfect Produce)	Accepting and integrating the sale of off-grade produce (short shelf life different size/ shape/ color), also known as "ugly" produce, for use in foodservice and restaurant preparation and for retail sale	On-farm losses	1.6%		$80M per year at restaurant/foodservice and $53M per year at retail based on $0.25/lb average purchase price for cosmetically imperfect (CI) produce	112
5	Smaller Plates	Providing consumers with smaller plates in self-serve, all-you-can-eat dining setting to reduce consumer waste	Restaurant and institutional waste	2.2%	$250M for replacement of smaller plate sizes (replace in 20,000 restaurants and 4,640 institutions)	Minimal	25
6	Trayless Dining	Eliminating tray dining in all-you-can-eat dining establishments to reduce consumer waste	Restaurant and institutional waste	1.0%	$30M for retrofit of tray return system in institutions (in 1,830 institutions)	Minimal	3
7	Waste Tracking & Analytics	Providing restaurants and prepared-food providers with data on wasteful practices to inform behavior and operational changes	Restaurant and institutional waste	4.7%		$90M for both institutions and restaurants Institutional foodservice cost: $36M based on 25,000 facilities*80% adoption rate*$1800/ year Restaurant cost: $53, based on 500,000 facilities*15% adoption rate*$700/year	75
8	Cold Chain	Reducing product loss during shipment to retail	Retail waste	0.6%		$4.2M per year from use of more	4

	Management	distribution centers by using direct shipments and cold chain certified carriers				expensive transport vendors with additional cold chain technology investments	
9	Improved Inventory Management	Improvements in the ability of retail inventory management systems to track an average product's remaining shelf-life (time left to sell and item) and inform efforts to reduce days on hand (how long an item has gone unsold)	Retail waste	1.5%	$100M one-time to upgrade retailer inventory software systems	$40M to conduct inventory analyses	44
10	Secondary Resellers	Businesses that purchase processed foods and produce directly from manufacturers and distributors for discounted retail sale to consumers	Retailers	15.5%	$900M to open 300 additional stores ($3M per store)	$1.12B per year based on 90% of annual revenue	1229
11	Manufacturing Line Optimization	Identifying opportunities to reduce food waste from manufacturing / processing operations and product line changeovers	Consumers/ Consumer-Facing Businesses	5.8%		$3.9M per year based on average costs of $0.10 per wholesale dollar value of reclaimed food	3
12	Consumer Education Campaigns	Conducting large-scale consumer advocacy campaigns to raise awareness of food waste and educate consumers about ways to save money and reduce wasted food	Residential	2.2%		$260M for various media campaigns	22
	FOOD WASTE RECOVERY SOLUTIONS						
13	Donation Matching Software	Using a technology platform to connect individual food donors with recipient organizations and reach smaller scale food donations	Restaurant/ Foodservice	1%	$5M for development of software platform, employee/staff training and education	$0.5M for system maintenance and ongoing training and support	1
			Retail	0.75%			
14	Donation Storage & Handling	Expanding temperature-controlled food distribution infrastructure (e.g. refrigeration, warehouses) and labor availability to handle (e.g. process, package) additional donation volumes	Restaurant/Foodservice	0.4%	$100M one-time for physical facility construction	$500 per ton of food stored/handled=$105M per year	53
			Retail	1.25%			
15	Donation Transportation	Providing small-scale transportation infrastructure for local recovery as well as long-haul transport capabilities	Farm	0.2%		$700 per ton of food picked up = $46M per year	65
			Restaurant/ Foodservice	0.4%			
			Retail	1%			
16	Value-Added Processing	Extending the usable life of donated foods through processing methods such as making soups, sauces, or other value-added products	Farm	0.7%	$75M upfront for capital investment and machinery	$4M based on preparation, maintenance , and other costs estimated at 5% of initial investment cost	10
			Restaurant/ Foodservice	0.1%			
			Retail	0.3%			
17	Donation Liability Education	Educating potential food donors on donation liability laws	Farm	0.3%		$5M for a mix of ongoing policy advocacy and lobbying, employee education and training, and awareness campaign costs	
			Restaurant/ Foodservice	0.1%			
			Retail	0.3%			
18	Standardized	Standardizing local and state health department	Farm	1.1%		$5M for a mix of ongoing policy	4

	Donation Regulation	regulations for safe handling and donation of food through federal policy	Restaurant/ Foodservice	0.5%		advocacy and lobbying costs for legislators	
			Retail	0.6%			
19	Donation tax Incentives	Expanding federal tax benefits for food donations to all corporation improving ease of donation reporting processes for tax deductions	Farm	3.1%		$5M for a mix of ongoing policy advocacy and lobbying and subsequent employee awareness and training efforts	633
			Restaurant/ Foodservice	0.5%			
FOOD WASTE RECYCLING SOLUTIONS							
20	Centralized Anaearobic Digestion (AD)	A series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen resulting in two end products: biogas and digestate. There are many different AD technologies, including wet and dry versions, the latter being generally better suited for food waste mixed with yard waste	Commercial (24.3)/ industrial FLW (1.1)	7.5%	$848M=$83M annual payments	$109M across 9 metro areas $145M in collection costs	308
21	Water Resource Recovery Facility (WRRF) with AD	Delivering waste by truck or through existing sink disposal pipes to municipal WRRF, where it is treated with anaerobic digestion; the biosolids can be applied to land for beneficial reuse	Residential waste	6.0%	$736M across 50 metro areas=$61M annual payments	$97M across 50 metro areas	151
22	In-Vessel Composting	Composting at small scale at institutions or businesses with heat and mechanical power to compost relatively quickly (less than a month versus more than two months for windrow composting)	Commercial (24.3)	0.0%	7.7	0.262 ($22 per ton)	2
23	Commercial greywater	An on-site treatment technology, greywater AD use combinations of nutrients or enzymes and bacteria to break food organics down until soluble where it is flushed into the sewage system	Commercial waste	2.4%	83	5.4 ($9 per ton)	38
24	Community composting	Transporting food from homes by truck, car, or bicycle to small, community, or neighborhood-level compost facilities that process 2,500 tons per year on average	Residential waste	0.6%	63.7	8.6 ($52 per ton)	19
25	Centralized Composting	Transporting waste to a centralized facility where it decomposes into compost	Commercial/ industrial	19.7%	$878 across 20 metro areas=$123M per year	$91M across 10 metro areas $319M in collection costs	502
26	Animal Feed	Feeding food waste to animal after it is heat-treated and dehydrated and either mixed with dry feed or directly fed	Retail//industrial waste	0.5%	5.8 ($16 per ton)	0.859 ($18 per ton) $3.6M in collection costs ($74 per ton)	4
27	Home Composting	Keeping a small bin or pile for on-site waste at residential buildings to be managed locally; also known as “backyard composting”.	Residential waste	0.4%	$486K across all areas ($5 per ton)	$3.5M ($36 per ton)	3

Source: ReFED, 2016. *A Roadmap to Reduce U.S. Food Waste by 20 Percent*, https://www.refed.com/downloads/ReFED_Report_2016.pdf.

Appendix B: Surveyed solutions implemented in APEC MEs

	Type	Description	Program	Economy
1	Education Campaigns (Consumer Education Campaigns & Education Campaign on FLW at School)	Conducting large-scale consumer advocacy campaigns to raise awareness of food waste and educate consumers about ways to save money and reduce wasted food. Promote food education focusing on FLW in school; knowledge transfer to reduce Plate scraping behavior of children	Metro Vancouver's Love Food Hate Waste Campaign; online educational campaign; York Region with Good Food Program aim at encouraging meal planning, healthy eating and reducing food waste going to the green bin; Sustain Ontario launched a toolkit in 2016: 'Reducing Household Food Waste: A Municipal Regional Toolkit'; British Columbia Ministry of Environment is working with the USEPA on the Food: too Good to Waste challenge to promote food waste reduction.	Canada
			The stakeholders involved in the Committee to Prevent and Avoid Food Losses and Waste of Chile, together with the organization "5 a Day", developed a booklet with information about FLW to promote education campaign on FLW at schools and to the public.	Chile
			MYSaveFood' campaign.	Malaysia
			Crusade Against Hunger (Promoting community participation objective).	Mexico
			Love Food Hate Waste New Zealand.	New Zealand
			Be Ricesponsible by PhilRice; Save Food Asia by FAO and Asian Institute of Technology.	Philippines
			Food wastage reduction outreach programme. Love Your Food @School project.	Singapore
			U.S FLW 2030 Champions; U.S Food Waste Challenge.	USA
			Schools and environmental organizations develop tools and learning materials for teachers and youth from kindergarten and university.	Canada
			Rice education at school.	Chinese Taipei
			Save food campaign (by FAO and Ministry of Education.	Thailand
2	Standardized Date Labeling	Standardizing food label dates and instructions, develop tools to help customer on checking the expiration dates of products	Canadian Food Inspection Agency is exploring opportunities to standardize date labeling under the Food Labeling Modernization Initiative.	Canada
			FoodKeeper App is to provide consumers with a tool to access clear, scientific information on food storage, proper storage temperatures, food product dating, and expiration dates.	USA
3	Pre-harvest technical support	Provide technical advice on selecting the best high yielding varieties, use the best culture practices relating to crop	Government funding (e.g. Growing Forward 2) has been made available to support harvest efficiencies in Canada's agricultural sector. (funding not technical aid).	Canada

		management, irrigation, and fertilizer use and pest control; support farmer cultivating equipment (tractors, attached farm implements, drum seeder)	Public institutions had provided technical advice on selecting the best high yielding varieties, use the best culture practices relating to crop management, irrigation, and fertilizer use and pest control; and support farmer cultivating equipment.	Chile
			Rice Mechanization Program.	Philippines
4	Harvesting technical aid	Suggest the best time for harvesting of crops; train the farmers/operators on mechanized harvesting as relevant as the losses are minimal; provide farmer training on handling of produce. Support/provide farmer harvesting facilities (i.e. rice combine harvester, thresher)	Public institutions had provided technical advice on selecting the best high yielding varieties, use the best culture practices relating to crop management, irrigation, and fertilizer use and pest control; and support farmer cultivating equipment.	Chile
			Provide farmer training on mechanical drying of paddy rice Provide better training to the farmers on handling of produce.	Philippines
			Adhere to the best time for harvesting of crops and handle produce with care; Train the farmers/operators on mechanized harvesting as relevant as the losses are minimal.	Viet Nam
5	Postharvest Facility Support	Provide/ support postharvest facilities on various crops such as air blast freezers, fish stalls, chest freezers, ice plant and cold storage in fisheries, mechanical dryer in rice cultivation.	Public and private institution had developed post-harvest research to prevent food losses/waste specially in fruit and vegetables for export and had provided training to the farmers to improve the handling of produce; adhere to the best time for harvesting of crops and handle produce with care; train the farmers/operators on mechanized harvesting; training on postharvest processing of fruits, vegetables and grains.	Chile
			Provision of Fisheries Postharvest Facilities; Distribution of IEC materials on proper fish handling and seafood safety awareness.	Philippines
			Establish a post-harvest center for reducing FLW in off-farm storage.	People's Republic of China
			Postharvest processing of vegetables and grains.	Chinese Taipei
6	Improved Handling and Transportation System	Implementing the best postharvest technology to reduce losses of grain, fruit and vegetable	Sobeys optimized the distribution and logistics of their inventory management system from direct operations in distribution centers and retail stores. Metro is also planning to modernize and automate its network by building a new fresh distribution facility and a new frozen distribution center in Toronto (ON) between 2018 and 2030.	Canada
			Public and private institutions had been implementing the best postharvest technology to reduce losses of fruit, vegetable and grains.	Chile
			Handling of paddy postharvest losses to support enhancement of Rice Production; Revitalization model of small rice milling unit, corn and soybeans postharvest handling to reduce losses.	Indonesia
			Crusade Against Hunger (Food production objective to cut down food losses after	Mexico

			harvesting, in storage, transportation, distribution, and commercialization).	
7	Cold Chain Management	Reducing products loss during shipment to retail distribution centers by using direct shipments and cold chain certified carriers	Provision of cold storage and refrigeration equipment for fruits and vegetables from public and private institutions.	Chile
			Provision of cold storage for slaughterhouses.	Philippines
			Cold Chain Standard Development.	Singapore
			Refrigeration equipment of rice.	Chinese Taipei
8	Economy-wide legislation on FLW reduction	Promote FLW reduction program in official law at economy-wide level	Zero waste of raw material in the Food Industry, Program of Sustainable Production and Consumption: Sustainable Food System. The Law 20.920 (launched 06.2016 by the Ministry of Environment) of Waste Management and Producer Enlarged Responsibility forces the producers of some foods to organize, and manage the waste arising from the production chain.	Chile
			Basic policy for Food Recycling Law; the Third Basic Plan for Promotion of Food Education; Basic Plan for promoting usage of biomass; Basic Plan for Establishing a Sound Material.	Japan
			State program of Agriculture development and regulation of agricultural markets till 2020.	Russia
			Goal to Reduce FLW in the United States by 50% by 2030.	USA
			The Scheme on improving added value in the processing of agro-forestry and fishery products and reducing postharvest losses; Agricultural restructuring towards raising added values and sustainable development.	Viet Nam
9	Capacity building for FLW (conference/ workshop/ training course)	Hold capacity building (conference, workshop, or training course) to discuss on FLW related issue and discover strategy, policy or suggest legislation to government.	A number of events have been delivered in Canada to discuss opportunities to prevent, reduce and/or recycle food. The Zero Waste Council incorporates discussion on FLW in their annual conference. Provision Coalition offers workshops for food sector businesses to learn about opportunities and approaches to reduce food losses in their operations. A FLW Forum was hosted by Provision Coalition in 2017.	Canada
			Project “Measurement and management of fruit and vegetable losses in the production stage at the economy-wide level”. Two workshops on FLW was organized in 2017, which are 1st Seminar Zero Waste in the Agro-industry and 1st Seminar of Committee for the FLW Reduction at economy-wide level.	Chile
			In Malaysia, agencies dealing with R&D, extension and marketing under Ministry of Agriculture and Agro-Based Industry, provide training for each player throughout supply chain (farmers, wholesaler, exporters, retailers), covering aspects from farm to table in order to equip them with knowledge and skills in maximizing yield and minimizing losses of fruits and vegetables. A few workshops have been conducted to bring together experts to discuss and solve the issues	Malaysia

			associated with postharvest losses of fruits and vegetables. In addition to that, R&D agencies and universities have developed an array of technologies to overcome the postharvest losses issues. Promotion of the technologies to the potential users, sponsors and policy makers have been done through exhibitions and conferences. Among conferences conducted in Malaysia which are directly related to postharvest losses are International Postharvest Symposium (2012) and Postharvest Losses and Food Waste Conference (2013). Workshop on maintenance of postharvest quality of vegetables in ASEAN (PH-AARNET 2017) has been carried out last year in collaboration between ASEAN Economies, WorldVeg and JAIF.	
			Roundtable of FLW Reduction (attached to the Multi-Sectoral Commission on Food and Nutritional Security).	Peru
			Anti Food Waste Campaign; Assessment of Fisheries Postharvest Losses; Capacity Building on Fish processing and Seafood Safety Programs; Technology Demonstrations on proper fish handling and utilization.	Philippines
			The initiative Save Food with FAO.	Russia
			Project on Cold Chain Management for Seafood; Training courses on vegetable and seafood cold chain management	Singapore
			Capacity building to reduce postharvest losses on chili and mango; Store product away from insect, pest, and control by fumigation; Aflatoxin reduction during grain storage; Good handling in the collecting and packing house	Thailand
			Pilot Postharvest Losses Viet Nam and Identifying solutions to reduce food waste in the value chain	Viet Nam
10	Financial/ Tax incentives	Support in terms of interest rates of long-term, mid-term, and short-term commercial loans to organization/ farmer association/ company/ individual for buying machinery and equipment serving FLW reduction program. Give financial/ tax benefit to entity which attempt to reduce FLW.	A portion of federal government funding (e.g. Growing Forward 2) has been made available to support food waste reduction activities in Canada's food manufacture and processing sector. Some provinces provide food donation tax credits to farmers that donate surplus food to food banks or student nutrition programs (e.g. British Columbia, Ontario).	Canada
			Providing support policies to reduce losses in agriculture, and implement respective measures for each commodity value chain (Viet Nam)	Viet Nam
			Providing funding support for the implementation of food waste minimisation project under the 3R Fund	Singapore
11	Food Donation Support	All the supports (transportation, financial incentives, policy, etc) to the distribution activities of safe and nutritious food for human consumption with or without payment, food	Food Banks Canada supports a network of provincial associations, affiliate food banks, and food agencies to pick up food from farmers, manufacturers and local retailers. Second Harvest (Toronto), the largest food rescue organization in Canada, collects	Canada

		(processed, semi-processed or raw) which would otherwise be discarded or wasted from the agricultural, livestock, forestry and fisheries supply chains of the food system.	and delivers perishable foods (e.g., fruits, vegetables, dairy, breads, meats). Moisson Montreal collects perishable foods in Montreal and re-distributes them to over 250 agencies throughout Quebec that provide meals to people in need. They have launched a Food Exchange online platform to streamline the food donation process for donors.	
			There are special tax benefits for business that make donations to food rescue organizations (food bank).	Chile
			A food waste and yard waste plan for Hong Kong 2014-2020 (Activities to donate surplus food for human consumption)	Hong Kong, China
			Food Recovery Challenge by EPA	USA
			To promote excess food distribution to food distribution organisations, a list of food distribution organisations is listed on the NEA's food waste management webpage to raise awareness of the avenues for food donation.	Singapore
12	Animal Feed	Feeding food waste to animals after it is heat-treated and dehydrated and either mixed with dry feed or directly fed.	In Canada, there is a well-established system and infrastructure for farms, processors, and rendering facilities to use surplus food for animal feed. Some food manufacturing/processing facilities and retailers divert food waste to animal feed operations (but it must conform to requirements under Canada's animal feed regulations) The Canadian aquaculture feed sector is a global leader in the replacement of fishmeal and fish oil with alternative feed sources, and the sector is researching the further development of alternative feeds from animal, vegetable, microbial and algal sources. Project Protein is being piloted in Alberta to encourage cattle and hog farmers to donate animals to their local food bank for a charitable tax receipt equivalent to the fair market value of the animal (NZWC 2015). Enterra (British Columbia) is using pre-consumer surplus food (fruits and vegetables) to produce poultry and fish feed with black soldier fly larvae. West Coast Reduction (British Columbia), Rothsay (Ontario) and Sanimax (Quebec) are examples of well-established rendering facilities that create a variety of animal feed products.	Canada
			Collection of homogenous food waste from food manufacturers for processing into animal feed.	Singapore
			Collected food waste from garbage truck will be delivered to the pig farms to feed the pigs after treated.	Chinese Taipei

			Food waste collected from companies' cafeterias, restaurant, and foodservices is heated and feed to animal (mainly to pigs)	Viet Nam
13	Food Waste Recycling for Energy and Digester (composting)	Recycle food waste to convert to energy or compost through anaerobic and aerobic digestions.	Several Canadian municipalities direct food waste to anaerobic digestion facilities (e.g. Saint Hyacinthe, QC; Toronto, ON).	Canada
			Solid waste from the agri-food industries is collected from the private companies and converted to compost, energy production, incorporated to the soil or go to animal feed.	Chile
			A food waste and yard waste plan for Hong Kong 2014-2020 (Activities aim at recycling FLW to recover energy and nutrients).	Hong Kong, China
			Food waste treatment pilots, 3R Fund.	Singapore
			Recycling campaign (3R).	Thailand
14	Produce Specifications (Imperfect produce)	Accepting and integrating the sale of off-grade produce (short shelf life, different size/shape/color), also known as "ugly" produce for use in food service and restaurant preparation and for retail sale.	Retailers and processors in British Columbia, Alberta, Saskatchewan, Ontario, and Quebec have started to relax food grading standards and create new markets for ''ugly'' fruits and vegetables products that might otherwise not be harvested. Example: IGA and Metro have used ''ugly'' products or produce soon to be wasted to prepare the ready-made meals sold in stores. Loblaws has introduced a "no name® Naturally Imperfect™ line"; The Misfits (RedHat Co-operative, Alberta) is a farmer co-operative led campaign for second grade produce by selling to wholesalers and retailers at a discounted price; Rebel Food (Discovery Organics, British Columbia) is a produce line developed by a distributor to sell discounted second grade organic produce to retailers; Second Life (Quebec) is a company that offers online ordering of second grade produce baskets for customers to pick up at various locations.	Canada
15	Waste Tracking & Analytics	Providing restaurants and prepared-food providers with data on wasteful practice to inform behavior and operational changes.	Provision Coalition developed and launched an on-line FLW Reduction Toolkit in 2016 for use by food processing companies to better understand quantities, causes and reduction opportunities for FLW at the facility level and compare performance with peers	Canada
			The Foundation to End Senior Hunger's "What a Waste" program partnered with LeanPath to implement waste tracking for senior nutrition programs. Stony Brook University adopted a food waste reduction program called Trim Trax, developed by foodservice contractor Compass Group to help businesses track and measure food waste costs. StopWaste, a public agency in Alameda, Califonia, launched the "Smart Kitchen Initivate" with LeanPath to subsidize the adoption of waste tracking and analytics tools among businesses that perceive too much risk to implement on their own.	USA
			Singapore conducts waste characterisation studies and waste audits to obtain quantitative data on food waste generation. The data obtained from the waste audits will help establish the potential for reducing the amount of food waste disposed of and develop FLW reduction programmes.	Singapore

16	Packaging Adjustments & Spoilage Prevention Packaging	Optimizing food packaging size, design and using active intelligent packaging (i.e. ethylene absorbing packaging inserts) to ensure complete consumption by consumers, avoid residual container waste and slow down the spoilage of perishable fruits and meat.	Government subsidizes to a project of post-harvest process of vegetables and grains, in which investing in changing the packaging of fruit and grain products.	Chinese Taipei
			BluWrap uses a controlled atmosphere technology solution to reduce oxygen in protein packages during transit to extend shelf life.	USA
17	Smaller Plates & Trayless Dining	Eliminating tray dining in all-you-can-eat dining establishments to reduce consumer waste	Eliminating tray dining has been applying vastly in all-you-can-eat dining establishments.	New Zealand
			University of Massachusetts Amherst dining halls removed trays from all dining halls in 2009 and reduced post-consumer food waste by 30%	USA
18	Improved Inventory Management	Improvements in the ability of retail inventory management systems to track an average product's remaining shelf-life (time left to sell and item) and inform efforts to reduce days on hand (how long an item has gone unsold)	Applied Data Corporation uses enhanced analytics to manage the stages of fresh food items for grocery and supermarkets throughout their life cycle, from ingredients ordering to display management and decision-making.	USA
19	Manufacturing Line Optimization	Optimizing equipment operating conditions, addressing production line design flaws, modifying production schedules to minimize changeovers, and identifying a new way to repurpose discarded food for sale.	Identifying opportunities to reduce food waste from manufacturing/processing operations and product line changovers.	New Zealand
			Extend the retention period by processing technologies	Chinese Taipei
			ConAgra changed the way it transitioned between pudding flavors to create blended flavors that could be sold at a lower value	USA
20	Value-Added Processing	Extending the usable life of donated foods through processing methods such as making soups, sauces, or other value-added products	Several social enterprises have emerged recently to sell value-added products from food waste at a profit. These include Barnana (banana snack bites from rejected products), Misfit Juicery (repurposing waste food into juice), and MM Local Foods (value-added products from farmers).	USA
			Singapore promotes test-bedding and adoption of innovative technology for food waste reduction/recycling (including conversion of food waste into other edible products).	Singapore

Appendix C: Responses of MEs to PPP application on FLW

No	Economy	Advanced/ developing	Area of PPP					Areas PPP should focus on				
			Food waste recycling	Food donation	Cold chain system	Agricultural facility enhancement	FLW reduction campaign	Food waste recycling	Food donation	Cold chain system	Agricultural facility enhancement	FLW reduction campaign
1	Australia	Adv	•	•	•	•	•					
2	Canada	Adv	•			•		•				•
3	Chile	Dep	•	•	•	•		•		•	•	•
4	People's Republic of China	Dep	•			•	•	•			•	•
5	Hong Kong, China	Adv	•	•			•	•	•			•
6	Japan	Adv	•	•			•	•	•			•
7	Malaysia	Dep	•	•			•	•	•		•	•
8	New Zealand	Adv	•	•	•	•		•	•	•	•	•
9	PNG	Dep			•	•	•		•	•	•	•
10	Peru	Dep		•				•	•		•	•
11	Philippines	Dep	•		•	•		•	•	•	•	•
12	Singapore	Adv						•	•			•
13	Chinese Taipei	Adv	•	•	•	•		•	•			•
14	USA	Adv	•	•			•	•	•			•
15	Viet Nam	Dep	•			•	•	•		•	•	
	Advanced MEs		7	6	3	4	4	7	6	1	1	7
	Developing MEs		5	3	3	5	4	6	4	4	7	6
	Total		12	9	6	9	8	13	10	5	8	13

No	Economy	Advanced/ developing	Type of PPP						Key indicator of a successful PPP					
			Consultative	Contractual	Joint ventures	Public financial	Multi-function	Informal	Resources saved	The wide spread of the project	The amount of FLW can be reduced	Stakeholders connection	Public satisfaction	Risk management
1	Australia	Adv							3	4	5	5	4	3
2	Canada	Adv				•			5	5	5	5	4	3
3	Chile	Dep			•	•	•		2	5	5	3	3	3
4	People's Republic of China	Dep			•	•			4	5	5	2	5	4
5	Hong Kong, China	Adv	•	•	•	•			3	3	3	3	3	3
6	Japan	Adv							5	3	5	3	3	3
7	Malaysia	Dep			•		•		5	4	5	5	5	3
8	New Zealand	Adv	•	•	•	•	•		5	5	5	5	5	5
9	PNG	Dep	•			•			4	3	3	3	3	3
10	Peru	Dep	•			•			3	4	5	5	5	4
11	Philippines	Dep	•	•	•	•	•		3	4	4	4	5	5
12	Singapore	Adv		•					4	4	3	4	4	3
13	Chinese Taipei	Adv	•			•	•			5	5	5	5	
14	USA	Adv						•	3	3	3	3	3	3
15	Viet Nam	Dep		•	•	•			3	5	5	4	4	4
	Advanced MEs		3	3	2	4	2	1	4.0	4.0	4.3	4.1	3.9	3.3
	Developing MEs		3	2	5	6	3	0	3.4	4.3	4.6	3.7	4.3	3.7
	Total		6	5	7	10	5	1	3.7	4.1	4.4	3.9	4.1	3.5

No	Economy	Advanced/ developing	Strength of PPP							Weakness of PPP				
			Improve data quality	Make policy, knowledge-sharing, and enforcement more effective	Provide better infrastructure solutions	Result in faster project completions	Appraise risk earlier	Transfer risk to private sector	Increase government's budget efficiency	Contract management and performance monitoring systems required	Conflict between profit of business and environmental consideration	Private sector just do what it is paid	Inadequate capacity of government personnel	No disadvantage
1	Australia	Adv	•	•	•						•	•		
2	Canada	Adv		•				•	•	•	•			
3	Chile	Dep	•			•		•	•			•		
4	People's Republic of China	Dep	•	•						•	•	•		
5	Hong Kong, China	Adv		•	•	•			•	•	•	•		
6	Japan	Adv		•	•	•		•		•	•	•		
7	Malaysia	Dep		•										•
8	New Zealand	Adv	•	•		•					•		•	
9	PNG	Dep	•	•	•	•	•	•	•					•
10	Peru	Dep	•	•	•	•	•	•	•		•	•	•	
11	Philippines	Dep	•	•	•	•	•	•	•	•	•	•	•	
12	Singapore	Adv	•	•	•		•	•		•	•	•		
13	Chinese Taipei	Adv	•	•				•			•		•	
14	USA	Adv	•	•	•	•					•			
15	Viet Nam	Dep		•	•		•		•	•	•	•		
	Advanced MEs		6	7	5	4	2	5	2	2	5	4	1	2
	Developing MEs		4	7	4	4	3	3	5	5	7	5	3	0
	Total		10	14	9	8	5	8	7	7	12	9	4	2

No	Economy	Advanced/ developing	Reasons will make MEs opt for PPP						Support needed for PPP	
			Expertise of other partners involved	Value for money	Private sector efficiency	Transfer of risk	Large Projects	Government regulations/Law	A clear guidelines	A FLW center
1	Australia	Adv	•			•			•	•
2	Canada	Adv	•		•			•	•	
3	Chile	Dep	•	•	•				•	
4	People's Republic of China	Dep	•				•	•	•	•
5	Hong Kong, China	Adv			•	•		•	•	•
6	Japan	Adv	•		•	•			•	•
7	Malaysia	Dep	•							
8	New Zealand	Adv	•	•				•	•	•
9	PNG	Dep	•	•	•	•	•	•	•	•
10	Peru	Dep	•	•	•			•	•	•
11	Philippines	Dep	•	•	•	•	•	•	•	•
12	Singapore	Adv	•	•	•				•	
13	Chinese Taipei	Adv	•		•				•	•
14	USA	Adv	•	•	•		•	•	•	•
15	Viet Nam	Dep	•		•	•			•	•
	Advanced MEs		8	4	6	3	2	2	7	5
	Developing MEs		6	3	5	3	2	6	7	6
	Total		14	7	11	6	4	8	14	11